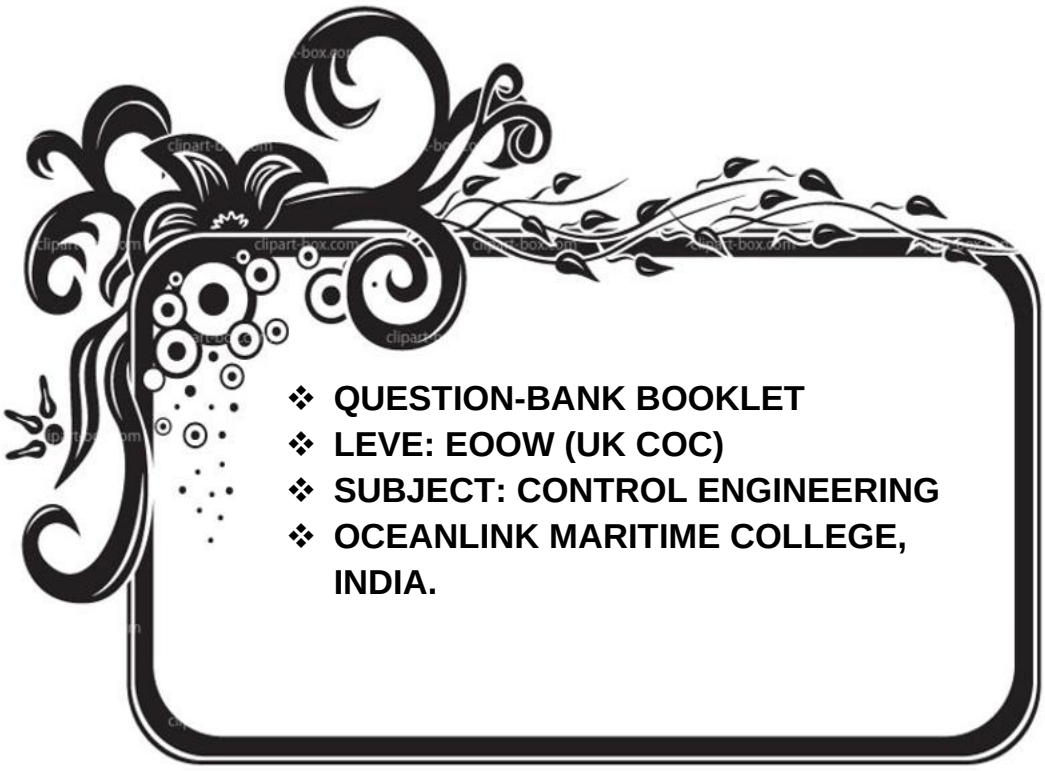

- **QUESTION-BANK BOOKLET**
- **LEVE: EOOW (UK COC)**
- **SUBJECT: CONTROL ENGINEERING**
- **OCEANLINK MARITIME COLLEGE, INDIA.**

STUDENT NAME: ……

BATCH: ……

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We, the team of Chief Engineers (with U.K. CoC) and Academic Professionals together formed an Institute, "**Oceanlink MariTime College (OMTC), India,"** situated at Bhubaneswar, Odisha, India. We have been coaching Management level (III/2) and E.O.O.W (III/1) courses for U.K. CoC since 2012 in India. At Oceanlink MariTime College, we are dedicated to delivering an excellent education that enables our students to become responsible leaders and enthusiastic sailors.

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CONTROL ENGINEERING SYLLABUS

TOPIC 1: INSTRUMENTS

QUE.1

a.	Sketch and describe Two different remote indicating temperature sensors suitable for use in a control system.	(10)
b.	Explain why the same type of temperature sensor is not used for all applications throughout a ship's control system.	(6)
c.	List two applications for EACH of the sensors described in (a)	(4)

QUE.2

a.	Sketch and describe a remote indicating temperature sensor suitable for use in a control system;	(14)
b.	Explain why the same type of temperature sensor is not used for all applications throughout a ship's control system.	(6)

QUE.3

	With reference to a Pt100 temperature sensor:	
a.	Explain the significance of the term Pt100.	(4)
b.	Describe, with the aid of a sketch, the construction, including how allowance is made for the wires connecting to the sensing element.	(16)

QUE.4

a.	Describe, with the aid of a sketch, how a differential pressure sensor could be used to measure the depth of liquid in a tank with a pressurized ullage space.	(14)
b.	Explain the adjustments necessary to the sensor output signal required to obtain the correct depth of liquid.	(6)

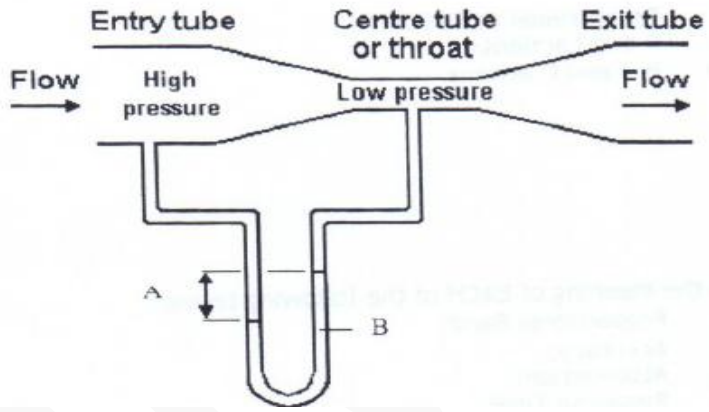
QUE.5

	With reference to piezo-electric pressure sensors,	
a.	Explain, with the aid of a sketch, how the sensor produces an output;	(10)
b.	Explain how the sensor can be utilized to measure pressure;	(6)
c.	State TWO different practical applications of these sensors onboard a vessel.	(4)

QUE.6

	Describe, with the aid of a sketch, the construction and operation of a flow sensor that uses differential pressure.	(20)

QUE.7

	With reference to the measuring instrument shown in Fig Q1;	
a.	State the name of the instrument;	(2)
b.	Explain its purpose;	(2)
c.	Describe how the reading at point A is achieved;	(6)
d.	State TWO types of liquid normally used for B;	(2)
e.	State the units normally used at A;	(2)
f.	List THREE advantages of this Device	(3)
g.	List THREE disadvantages of this Device 	(3)

QUE.8

a.	Describe, with the aid of a sketch, one method of accurately measuring movement that is suitable for remote measurement.	(16)
b.	State one use for remotely measuring movement in a ship's machinery plant.	(4)

QUE.9

	State a type of transducer or measuring device suitable for measuring EACH of the following parameters.	
(i)	Accurate remote reading of a diesel engine exhaust temperature.	(1)
(ii)	Accurate remote reading of the twist of a propeller shaft.	(1)
(iii)	Accurate and remote position of a diesel engine governor or fuel rack.	(1)
(iv)	The speed of a ship's main propeller shaft in RPM.	(1)
(v)	Remote reading of a ship intermediate shaft bearing temperature.	(1)
(vi)	The presence of a flame in an oil-fueled boiler.	(1)
(vii)	Remote reading of lubricating oil pressure in a diesel engine.	(1)
(viii)	Flow rate of a water maker.	(1)
(ix)	The salt or chloride content of the water maker.	(1)
(x)	Simple local pressure reading of ships fire main	(1)
(xi)	The position of the steering gear or rudder	(1)
(xii)	Local reading of jacket cooling water temperature	(1)
(xiii)	Explain, with the aid of a sketch, the principle and operation of a thermocouple.	(8)

QUE.10

	With reference to a fuel viscosity control system,	
a.	Describe, with the aid of a sketch, how a viscosity sensor works.	(14)
b.	State why the viscosity of fuel oil is controlled.	(6)

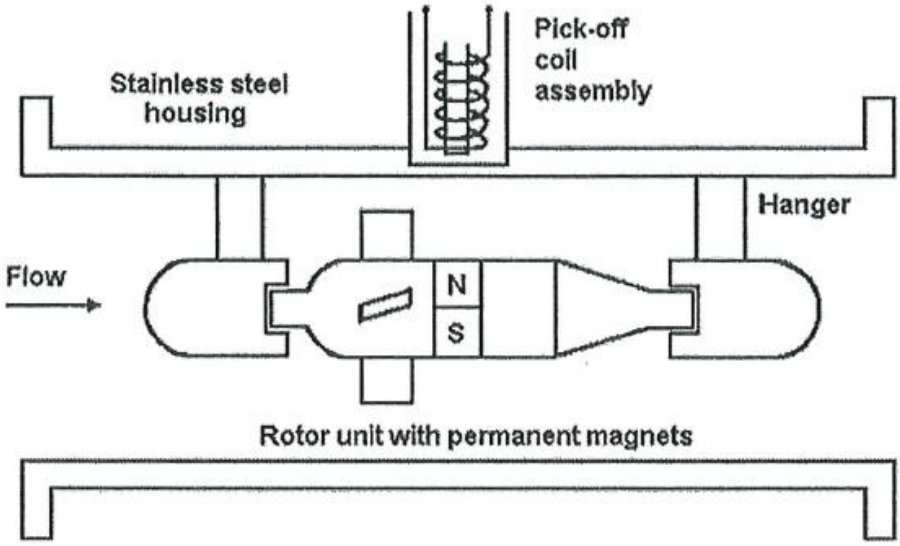
QUE.11

	State a suitable type of device or transducer to measure EACH of the following parameters:	
a.	Diesel engine fuel rack position indicator;	(2)
b.	Remote temperature fuel rack position indicator;	(2)
c.	Remote rudder angle indication;	(2)
d.	Fresh water generation plant made water flow.	(2)

QUE.12

a.	Explain, with the aid of a sketch, a method of remote measurement of boiler water level.	(20)

QUE.13

	With reference to the device shown	
a.	Describe the principle of operation, explain how the output signal is converted to give a reading of flow.	(16)
b.	Describe the principle of operation, explain how the output signal is converted to give a reading of flow	(4)
		

QUE.14

Q1	With reference to a tapered tube type rotameter:	
a)	Describe with the aid of a sketch how the flow of a liquid can be measured	(12)
b)	State TWO advantages and TWO disadvantages.	(4)
c)	State TWO typical applications in ship's systems.	(4)

QUE.15

a.	Explain, with the aid of a sketch, the term hysteresis applied to a measuring instrument in a control system.	(10)
b.	Explain the meaning of EACH of the following control Terms:	
i)	Threshold;	(2)
ii)	Resolution;	(2)
iii)	Span;	(2)
iv)	Range;	(2)
v)	Sensitivity	(2)

QUE.16

	Explain the meaning of EACH of the following control terms:	
a.	Threshold;	(4)
b.	Resolution;	(4)
c.	Span;	(4)
d.	Range;	(4)

e.	Sensitivity	(4)

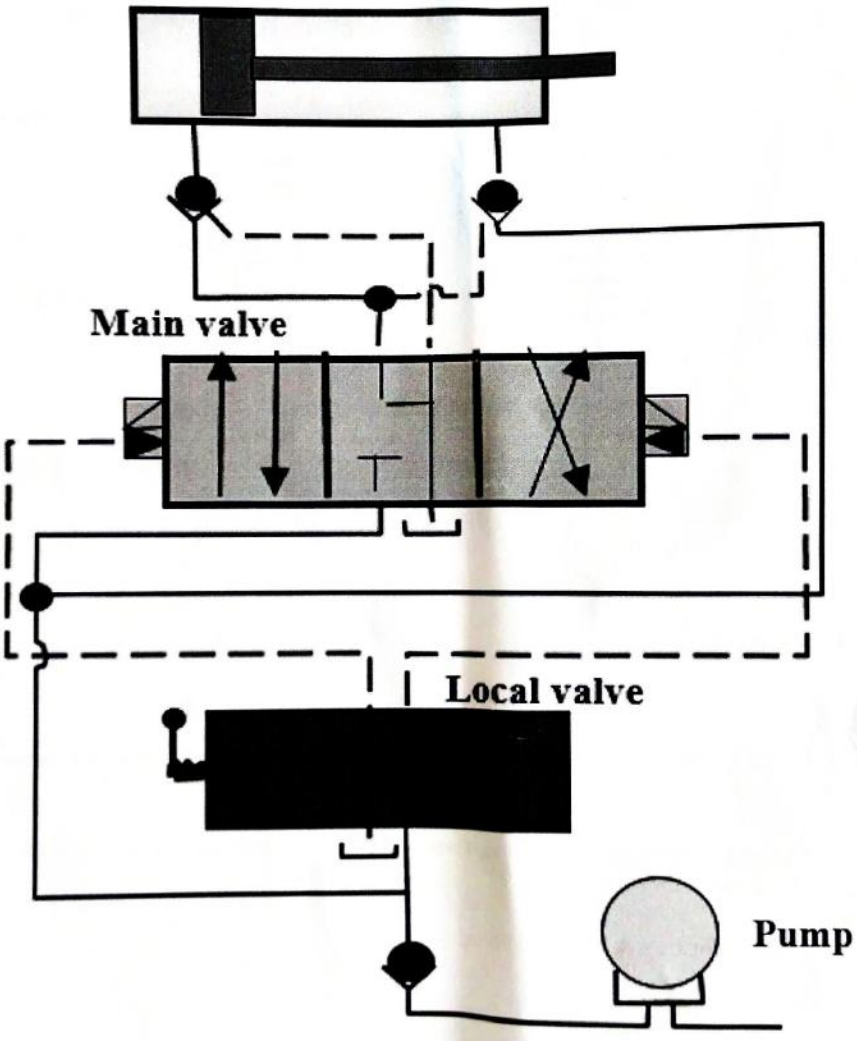
QUE.17

	With reference to instruments measuring parameters in a ship engine room, explain EACH of the following terms:	
a.	Range	(4)
b.	Accuracy	(4)
c.	Repeatability;	(4)
d.	Resolution;	(4)
e.	Hysteresis	(4)

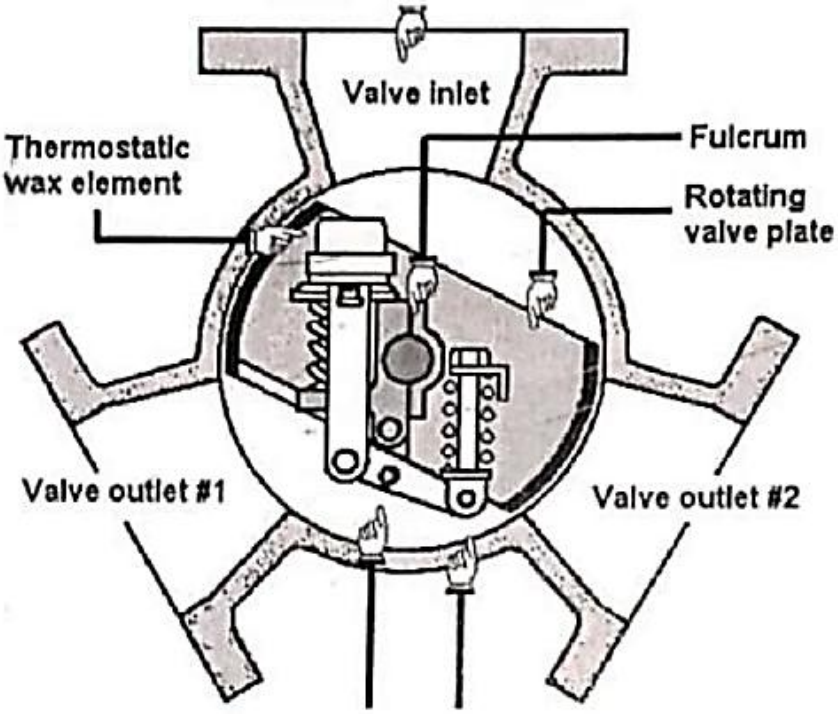
TOPIC 2: REGULATORS

(ACTUATORS)

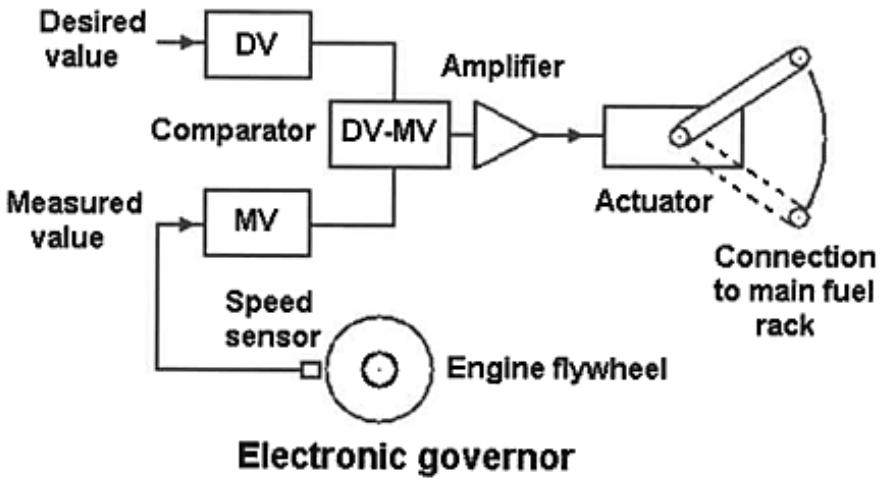
QUE.1

	Describe the operation of the hydraulic watertight door circuit drawing below for EACH of the following conditions:	
a.	Using the local valve to extend the cylinder to close the door.	(10)
b.	Using the local valve to retract the cylinder to open the door.	(10)
		

QUE.2

Q35	With reference to the device shown in, figure below	
a)	Describe the principle of operation;	()
b)	State an application for use on-board a vessel	()
c)	Describe the procedure to test this device if was suspected of being faulty.	()
		

QUE.3

Q3	With reference to the governor diagram for a generator shown in figure Q3 below, explain Each of the following:	
a)	The purpose of a generator governor	(6)
b)	How speed controls achieved	(8)
c)	The meaning of the term isochronous	(2)
d)	Four possible causes of hunting	(4)
	 Figure Q3	

QUE.4

Q4		
a)	Describe with the aid of a graph, VALVE hysteresis showing the relationship between pressure and valve position.	(8)
b)	Explain the need for air pressure boosters and valve positioners.	(6)
c)	State THREE advantages and THREE disadvantages of using air as a control medium.	(6)

QUE.5

	With reference to a diaphragm-operated pneumatic control valve with a double-seated valve plug.	
a.	Describe, with the aid of a sketch, how the diaphragm motor transduces a varying air pressure signal to a mechanical moment.	(8)
b.	Describe with the aid of a sketch how the process fluid pressure acting with the valve body is balanced in order to reduce the load on the diaphragm motor.	(8)
c.	State why a pneumatically operated control valve may be preferred to an electrically operated control valve.	(4)

QUE.6

	With reference to pneumatically operated control valves	
a.	Describe the operation of a diaphragm actuator with the aid of a sketch.	(12)
b.	Explain the term fail-safe.	(4)
c.	State two methods that could be used in the design to change the fail-safe.	(4)

QUE.7

a.	Explain the term Fail safe in a control system and give TWO examples where this term is applied.	(8)
b.	Explain the term Fail set in a control system and give TWO examples where this term is applied.	(8)
c.	State what is meant by 4:3 control valve.	(4)

QUE.8

a.	Explain the meaning of the term fail-safe.	(5)
b.	For each of the following fail-safe options, State a Marine system that must include an actuator that has the fail-safe option, explaining why the fail-safe option is required: I. fail safe open II. fail-safe closed III. fail-safe set	(5) (5) (5)

QUE.9

a.	State why some applications are best suited for using pneumatically controlled valves as others are best suited for electrically operated valves.	(12)
b.	State one advantage and one disadvantage of a pneumatically operated valve.	(4)
c.	State one advantage and one disadvantage of an electrically operated valve.	(4)

QUE.10

a.	With reference to using a pneumatic medium;	
	i) State FOUR advantages;	(4)
	ii) State, with reasons, THREE disadvantages	(6)
b.	With reference to pneumatic control valves, state EACH of the following.	
	i) FIVE advantages;	(5)
	ii) FIVE disadvantages;	(5)

TOPIC 3: CONTROLLERS

QUE.1

Q2	With Reference to Control and Instrumentation:	
a)	Define the term Measured Variable.	(3)
b)	List FOUR examples of a Measured Variable.	(8)
c)	Define EACH of the following elements of a measuring instrument:	
	(i) Detecting Element. (ii) Measuring Element. (iii) Display Element.	(3) (3) (3)

QUE.2

	Explain the meaning of EACH of the following control terms:	
a.	Gain	(4)
b.	Stability	(4)
c.	Error Signal	(4)
d.	EPROM	(4)
e.	NAND Gate	(4)

QUE.3

	Explain the meaning of EACH of the following terms:	
a.	Proportional Band;	(4)
b.	Offset;	(4)
c.	Gain;	(4)
d.	Damping;	(4)
e.	Stability	(4)

QUE.4

	Explain the meaning of EACH of the following control terms:	
a.	Dead Zone	(4)
b.	Proportional Band	(4)
c.	Settling time;	(4)
d.	Analogue;	(4)
e.	Cascade Control	(4)

QUE.5

	Explain the meaning of EACH of the following terms:	
a.	Proportional Band;	(4)
b.	Accuracy;	(4)
c.	Attenuation;	(4)
d.	Response Time;	(4)
e.	3 Term Controller	(4)

QUE.6

	With reference to the transmission of control signals:	
a)	Define EACH of the following terms:	
i)	Analogue	(4)
ii)	Digital	(4)
b)	State the advantages and disadvantages of analogue.	(4)
c)	Explain the advantages of using 4-20 mA	(8)

QUE.7

	Draw labelled response graphs EACH of the following types of control systems:	
	(i) Under damped;	(3)
	(ii) Over damped	(3)
	(iii) Critically damped	(4)

QUE.8

a)	Describe a practical method for setting up (tuning) a PID control system.	
b)	Explain the meaning of each of the following control item.	
i)	Stability	
ii)	Gain	
iii)	Overshoot	
iv)	Sensitivity	

QUE.9

a)	With reference to the control room block diagram shown below describe the function of each of the following:	
i)	Measurement sensor	(4)
ii)	PID controller.	(4)
iii)	Manual control	(4)
b)	Describe a practical PID tuning process	(8)

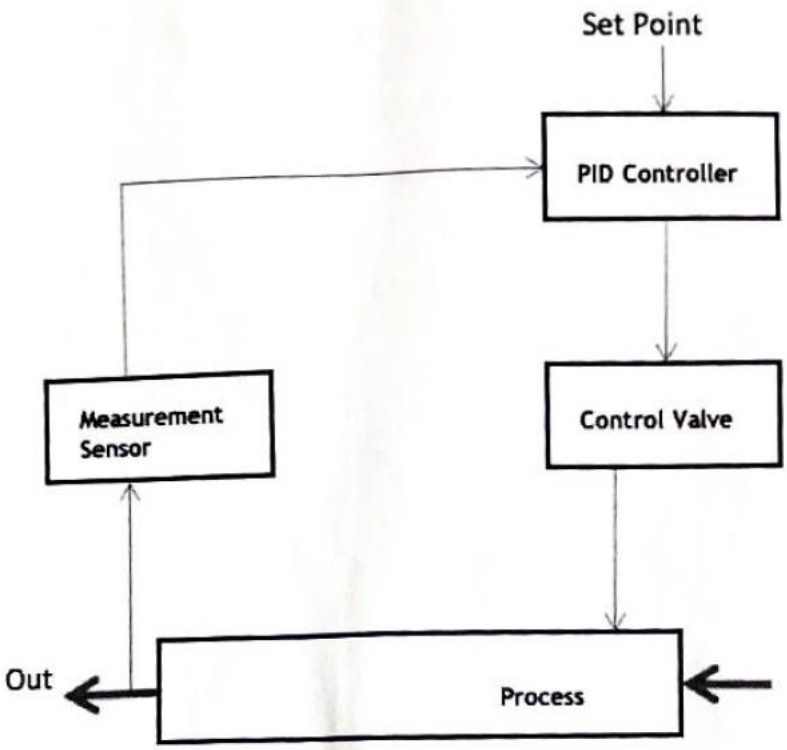


Figure Q3

QUE.10

Q5	With reference to a closed loop control system:	
a)	Define the term Proportional Action	
b)	Explain the purpose of integrating the error signal (I action).	
c)	Describe a possible effect of adding too much I action.	
d)	Explain the purpose of Differentiating the error signal (D action)	
e)	Describe the effect of adding too much “D” action may have on the output	

QUE.11

a)	Sketch and label a system for automatic controlling the viscosity of fuel oil for the main engine operating on high viscosity fuel oil.	(6)
b)	Describe the operation of the system is kept in 3a.	(6)
c)	State the control actions required for the controller explaining why they are needed.	(8)

QUE.12

	Describe with the aid of the sketch and how to step control of the air pressure within an air reservoir can be achieved.	(20)

QUE.13

a)	Describe with the aid of a diagram showing time against measured variable and actuator position, a two-step or on off control system response controlling a heater.	(10)
b)	Explain the meaning of EACH of the following terms.	
	(i) Offset;	(2)
	(ii) Stability;	(2)
	(iii) Hysteresis;	(2)
	(iv) Dead band;	(2)
	(v) Bandwidth	(2)

QUE.14

	Describe with aid of a sketch the typical response of the control system output after a step change in demand for each of the following controller setting:	
a)	Proportional action only	
b)	P and I actions	
c)	PI and d actions.	

QUE.15

Q3	Using the P, I and D type control system output response graphs shown in Figure Q3:	
a)	State the type of control action shown at response: i. W ii. X iii. Y iv. Z	 (2) (2) (2) (2)
b)	Explain why P&D actions are rarely used on their own.	(2)
c)	Identify the part of the response indicated at point A	(3)
d)	Identify the part of the response indicated at point B.	(3)
e)	Explain why 'I' action may be added to controllers	(2)
f)	Explain why 'D', action added to controllers	(2)

QUE.16

	With reference to signal transmission:	
a)	State the desired air quality requirements for a control air system after compression.	(8)
b)	State the function of each of the following signal conditioning devices and provide one example of where they may be used:	(2)
	(i) Square Root Extractor	(4)
	(ii) I to P converter	(4)
	(iii) A/D Converter	(4)

QUE.17

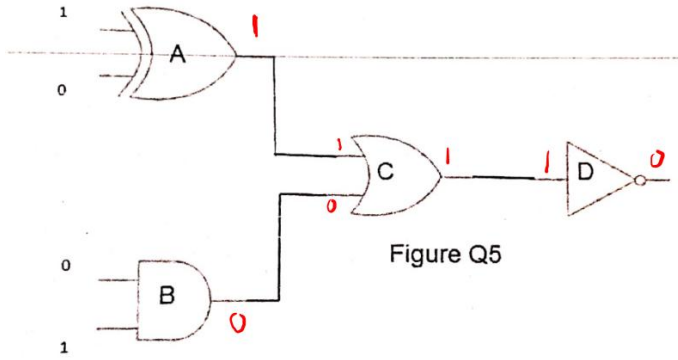
	Explain with the order of the block diagram the meaning of each of the following term give one advantage.	
a)	Open loop control, close loop control.	
b)	For each of the terms in, state two examples of use in systems on board a ship.	

QUE.18

	Describe with aid of sketch how diesel engine jacket water cooling system temperature is maintained at a constant level using a closed loop control system.	(20)

LOGIC GATES

QUE.1

	With reference to the logic gate circuit shown in figure Q5 below:	
a)	State the type of each of the gates (A-D);	(8)
b)	List the output of each of the gates (A-D) for the inputs shown;	(8)
c)	Sketch the symbol for an EXCLUSIVE NOR gate.	(4)
	 Figure Q5	

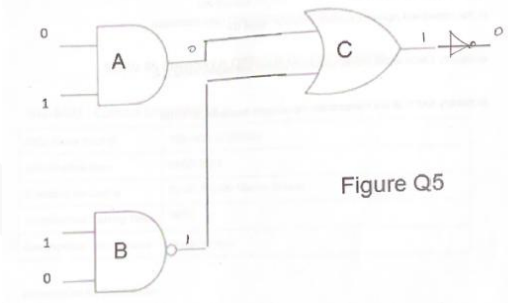
QUE.2

a.	With reference to logic gates, complete a truth table for each of the following:	
i)	AND gate;	(6)
ii)	OR gate;	(6)
iii)	NOR gate;	(6)
b)	Sketch the symbol used for an exclusive NOR gate.	(2)

QUE.3

a.	With reference to logic gates, complete a truth table for each of the following:	
i)	NOR gate;	(4)
ii)	Exclusive OR gate;	(6)
iii)	NAND gate;	(4)
b.	Sketch the symbol used for:	
i)	An Inverter or NOT gate;	(3)
ii)	An Exclusive NOR gate.	(3)

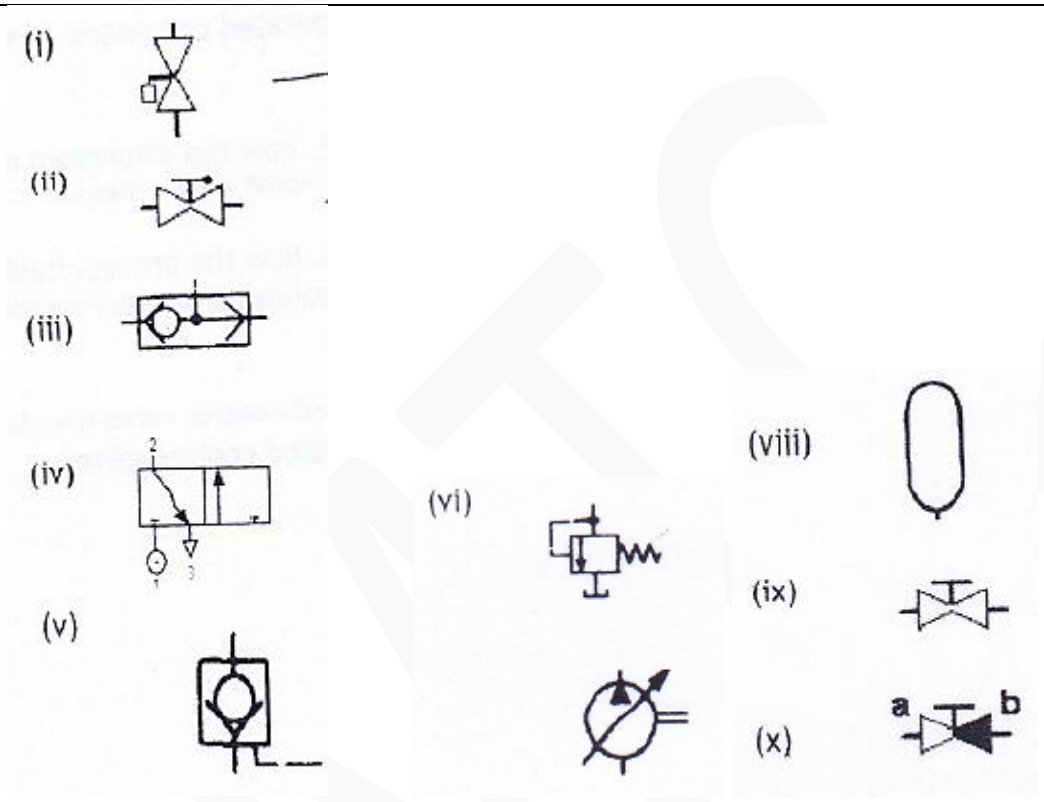
QUE.4

	With reference to the logic gate circuit shown in figure Q5 below:	
a)	State the type of each of the gates (A-D):	(8)
b)	List the output of each of the gates (A-D) for the inputs shown;	(8)
c)	Sketch the symbol for an EXCLUSIVE OR gate.	(4)
	 Figure Q5	

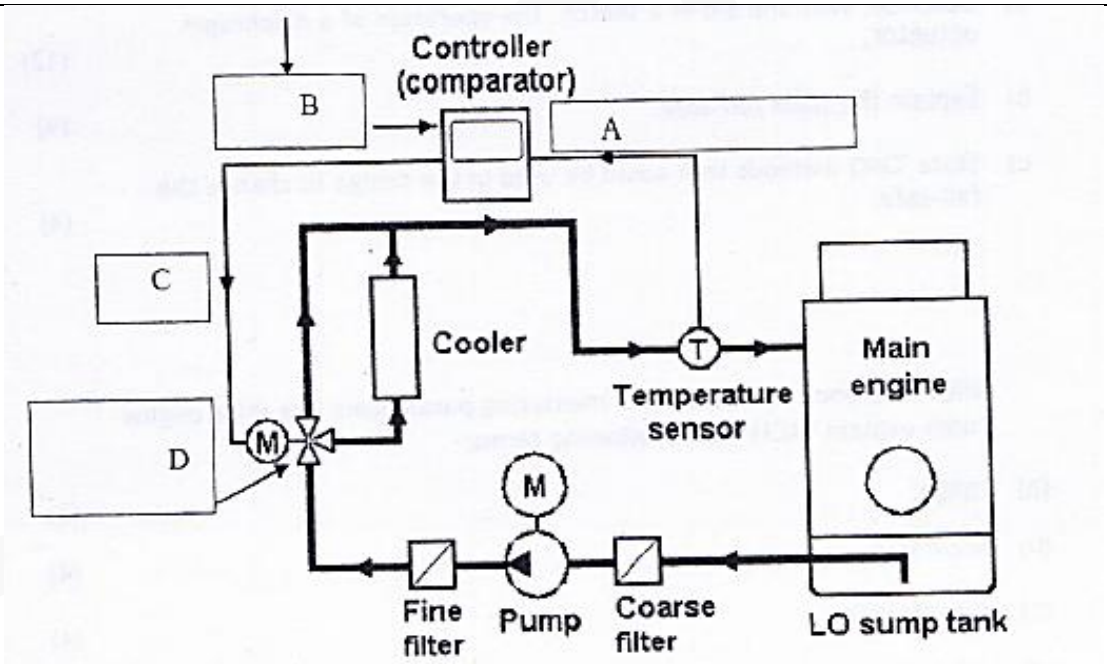
TOPIC 4: SYSTEM DIAGRAMS

(Identify and explain the purpose of symbols highlighted in a typical pipe and instrument diagram.)

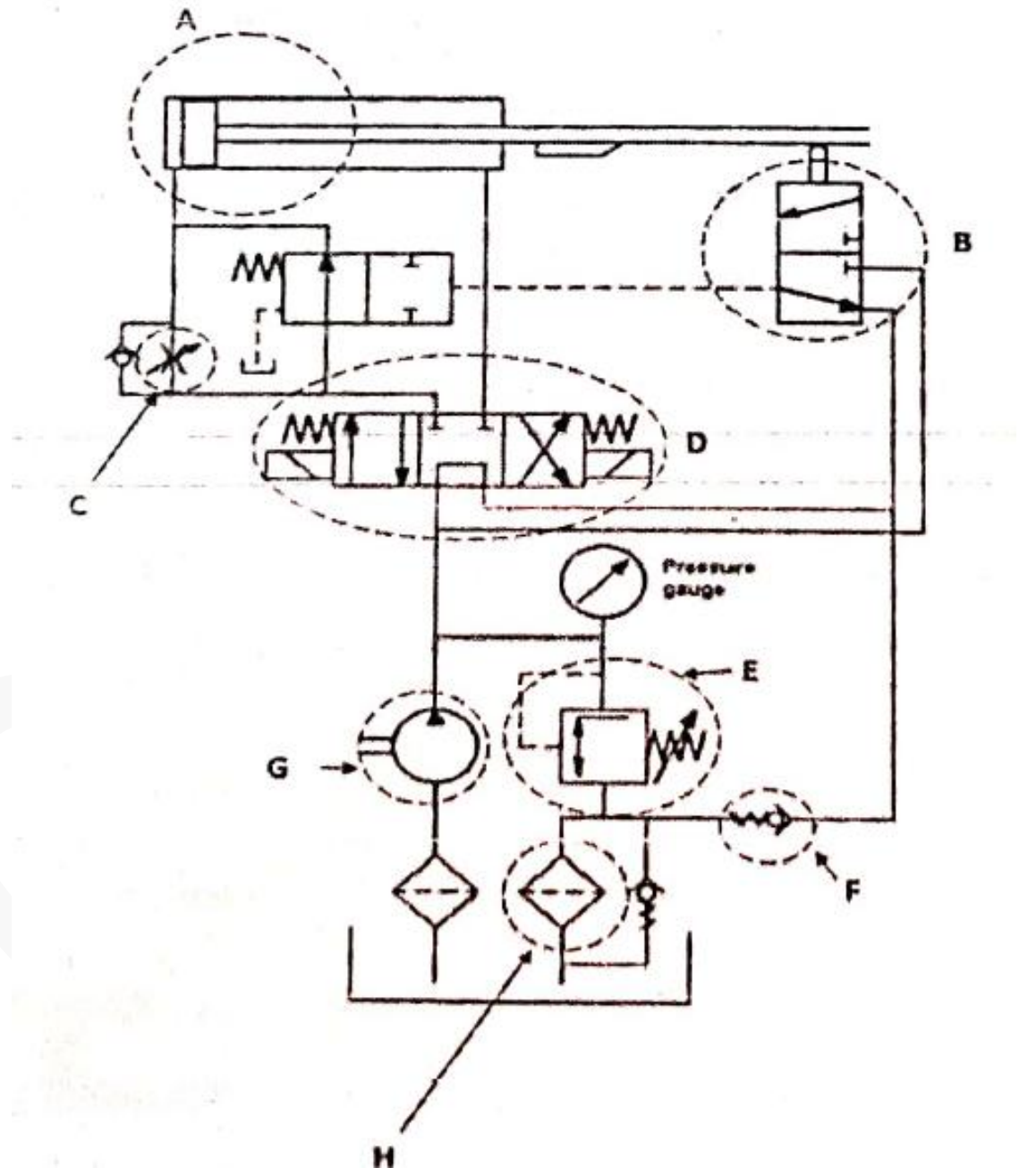
QUE.1

	Identify EACH of the symbol shown	
		

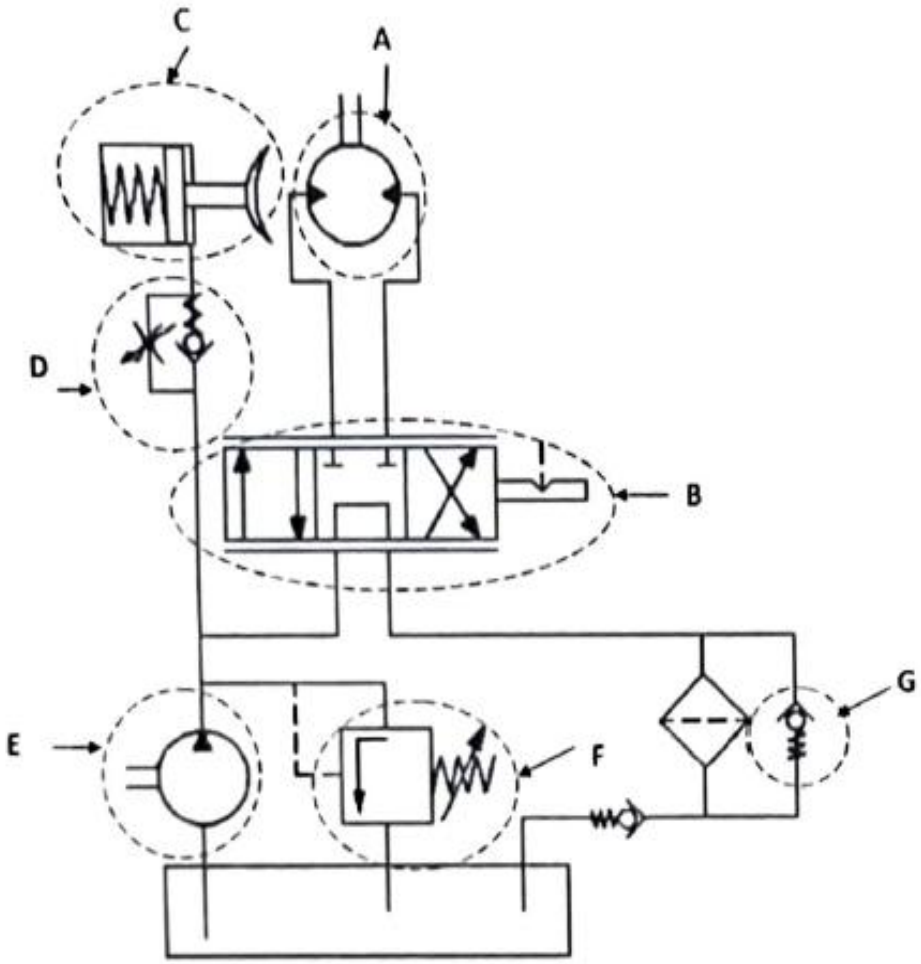
QUE.2

	For the closed loop Engine cooling control system in Figure Q5 below:	
a)	Identify the signal paths A, B, and C;	(6)
b)	Describe the function of the Comparator:	(5)
c)	Name and describe the function of component D;	(5)
d)	State a suitable device capable of producing a varying signal at T;	(2)
e)	Define the term FEEDBACK and explain why it is necessary in this system.	(2)
	 Main engine LO temperature control system Figure Q5	

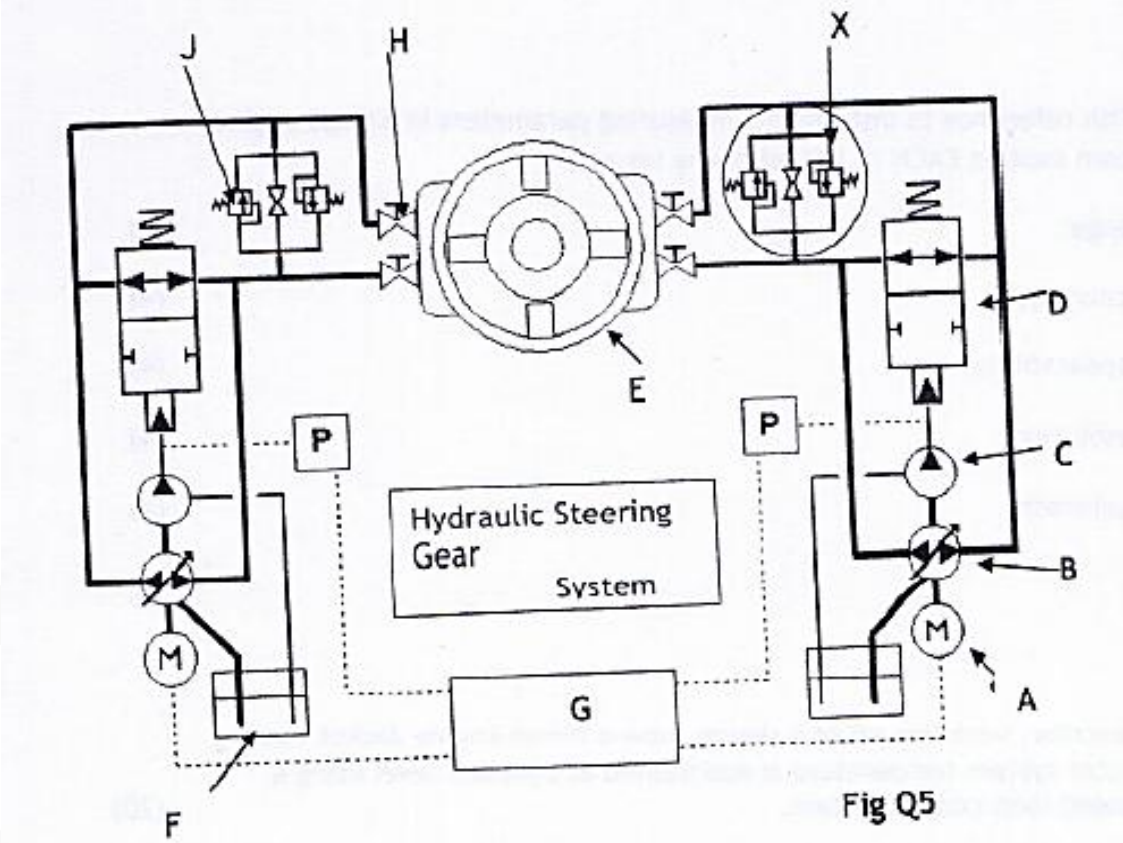
QUE.3

a)	Identify EACH of the components circled in dotted lines, annotated A-H, in figure Q5.	(16)
b)	Explain the difference between a STRAINER and a FILTER in a hydraulic circuit.	(4)
		

QUE.4

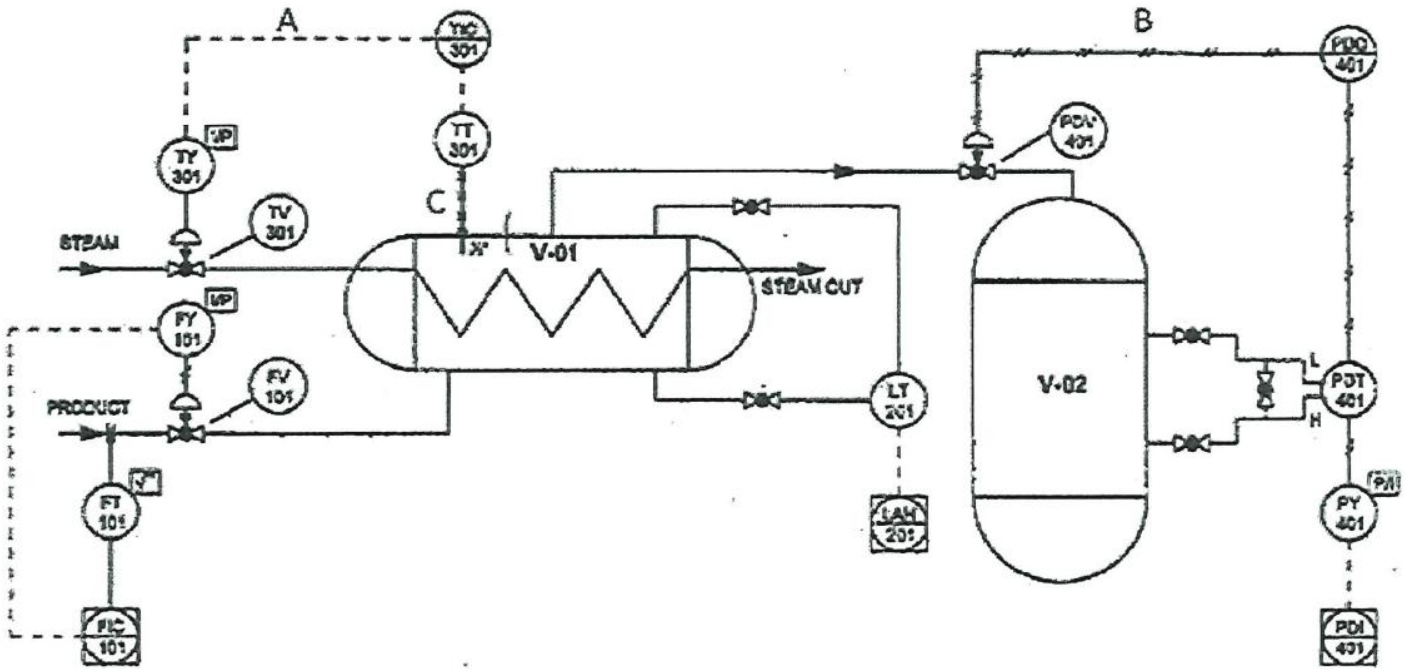
a)	Identify the components circled and labelled A-G in the hydraulic circuit shown in figure.	(14)
b)	Explain the purpose of component G.	(6)
		

QUE.5

Q5.	In the Hydraulic Control System shown in Fig Q5 below:	(8)
a)	identify EACH of the components labelled A to J from their Symbols	
b)	Describe is the function of the group of components labelled X	(4)
c)	In stop and directional control valve, explain the meaning of 2/2 and 3/2	(4)
d)	State a suitable device that could be used to feedback the Position of the actuator.	(4)
	 Fig Q5	

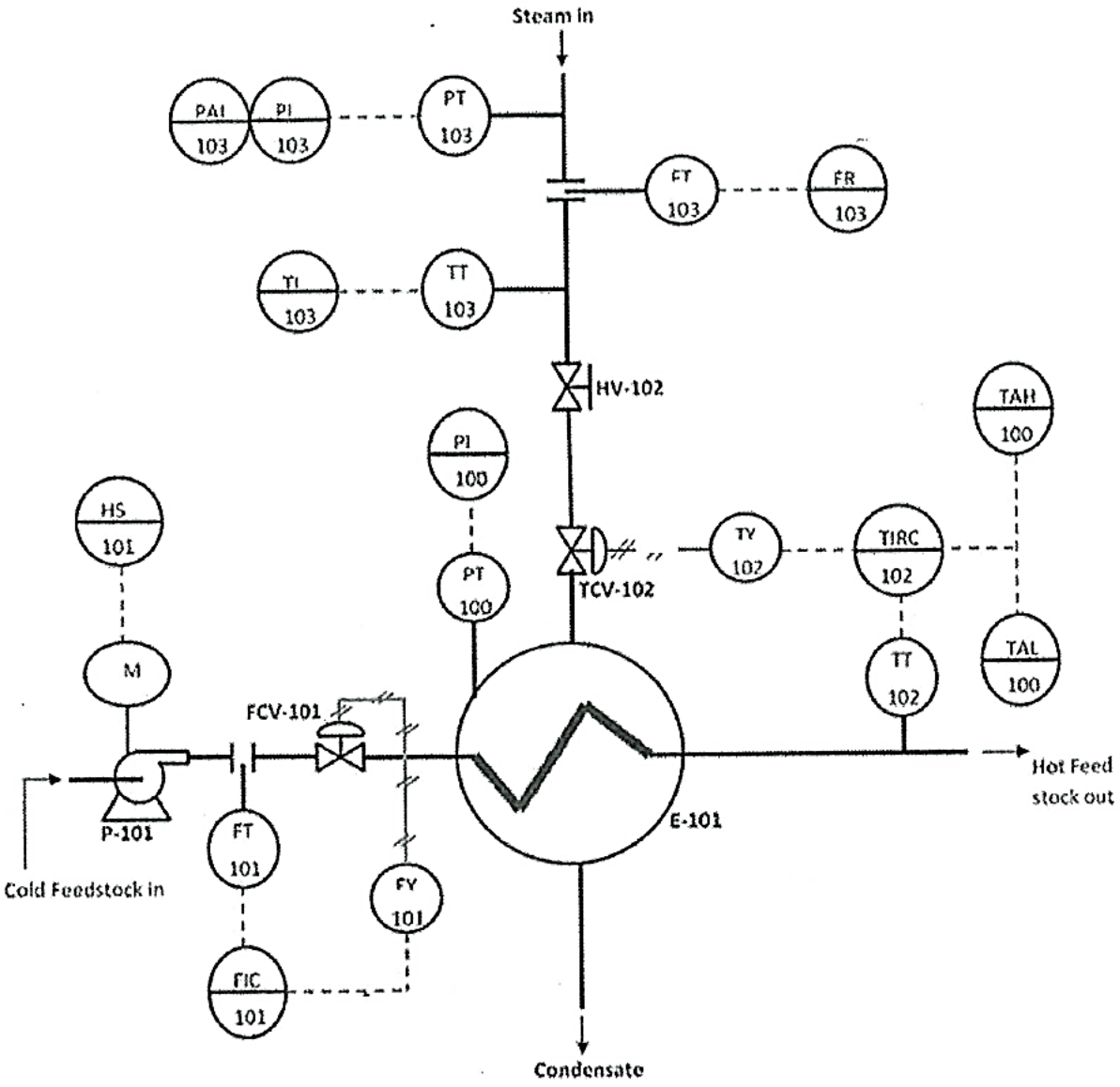
QUE.6

	In the control and pipework system shown in Figure Q5:	
a)	Identify EACH of the instrumentation, control and display items	(14)
b)	Identify EACH of the transmission signal types labelled A, B, C.	(6)



QUE.7

a)	A With reference to Figure Q5, identify EACH of the instrumentation, control and display devices.	(20)



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