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**DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA**  
**MINISTRY OF PORTS AND SHIPPING**  
**DIRECTOR GENERAL'S OFFICE OF MERCHANT SHIPPING**  
Merchant Shipping Secretariat

**PREPARATORY COURSE FOR CHIEF ENGINEER OFFICER ON SHIPS OF 3000KW PROPULSION POWER OR MORE**

*FINAL EXAMINATION QUESTION PAPER*

*Automation & Controls*

- Answer **TWO** questions from **PART A**, **TWO** questions from **PART B** and **TWO** questions from **PART C**
- Time allocated: 03 Hrs
- Pass mark 50%
- Date:

**Part A**

1. With regards to the sensors and transducers,
  - a. Describe the functions of Transducer and Transmitter. (06 Marks)
  - b. Describes the operation of the DP cell in boilers water level detection system. (06 Marks)
  - c. In modern control systems, most of conventional pneumatic, hydraulic and mechanical control lines are replaced by electrical lines using electrically controlled sensors, controllers and actuators. Describe the advantages of using electrical control systems for marine applications. (04 Marks)
  
2. With regards to the control systems,
  - a. Explain the individual operation of following control systems,
    - i. ON/OFF control with hysteresis (03 Marks)
    - ii. Proportional Control (03 Marks)
    - iii. Integral Control (03 Marks)
    - iv. Derivative control (03 Marks)
  - b. Describe the difference between Digital and Analog controllers. (04 Marks)

3. With regards to the PLC systems,

- a. What are the advantages of using PLC based control systems over conventional hard-wired control panels. (06 Marks)
- b. Briefly describe about the maintenance if PLC systems in onboard ships. (06 Marks)
- c. Briefly describe about the programming methods available for PLCs. (04 Marks)

### **Part B**

4.

- i) Sketch and describe a cascade control system that could be adopted for boiler water level and feed water control. (10 Marks)
- ii) Explain how it would be different from a multi element control system principles. (03 Marks)
- iii) Explain how the system will be more efficient than a system without cascade control. (03 Marks)

5.

State the factors with reasons, that you would consider when deciding on the number of "terms" you would incorporate in a controller for the following control conditions.

- a) Boiler pressure control. (04 Marks)
- b) Cooling water temperature control of the main engine. (04 Marks)
- c) Fuel oil heater for purifier. (04 Marks)
- d) Viscosity control of fuel oil for the main engine. (04 Marks)

6. With regard to governors used on ships,

- a) State the requirements of governors used for a multi engine single propeller shaft arrangement. (04 Marks)
- b) State where in marine propulsion systems can Iso Chronos governors are used. (04 Marks)
- c) State the two parameters that could be used for the governors to maintain set value of the prime mover speed. (04 Marks)
- d) What is meant by the "dead band" of a governor. (04 Marks)

**Part C**

7.

- a) Draw and explain a shaft torque measurement device. (10 Marks)
- b) Explain an electronic tachometer with sketches. (06 Marks)

8.

- a) What are the types of errors in a control system? (06 marks)
- b) How to detect above errors and rectify? (10 marks)

9.

- a) Draw and name Each elements of 4 to 20 mA current loop in controls system (04 Marks)
- b) Explain the function of the above control loop and why it is used onboard systems (04 Marks)
- c) What are the advantages and disadvantages of 4 to 20 mA Current loop control system (04 Marks)
- d) Explain application of smart sensors and HART in modern control system. (04 Marks)