96/97 Final Examination for Ship Technology 44545
Post-experience Diploma in Ship Command Course 4456
Suggested Solutions and Marking Scheme for the questions of Control Systems

Q A3 (a) Describe the three main disadvantages when using controllable pitch propellers.

(b) Describe, with the aid of an appropriate diagram, the remote control system for a controllable pitch propeller.

ANSWER :

(a) (i) It is impossible to adjust the pitch angle of a controllable pitch propeller to the exact neutral position without any sign of creeping ahead or astern.

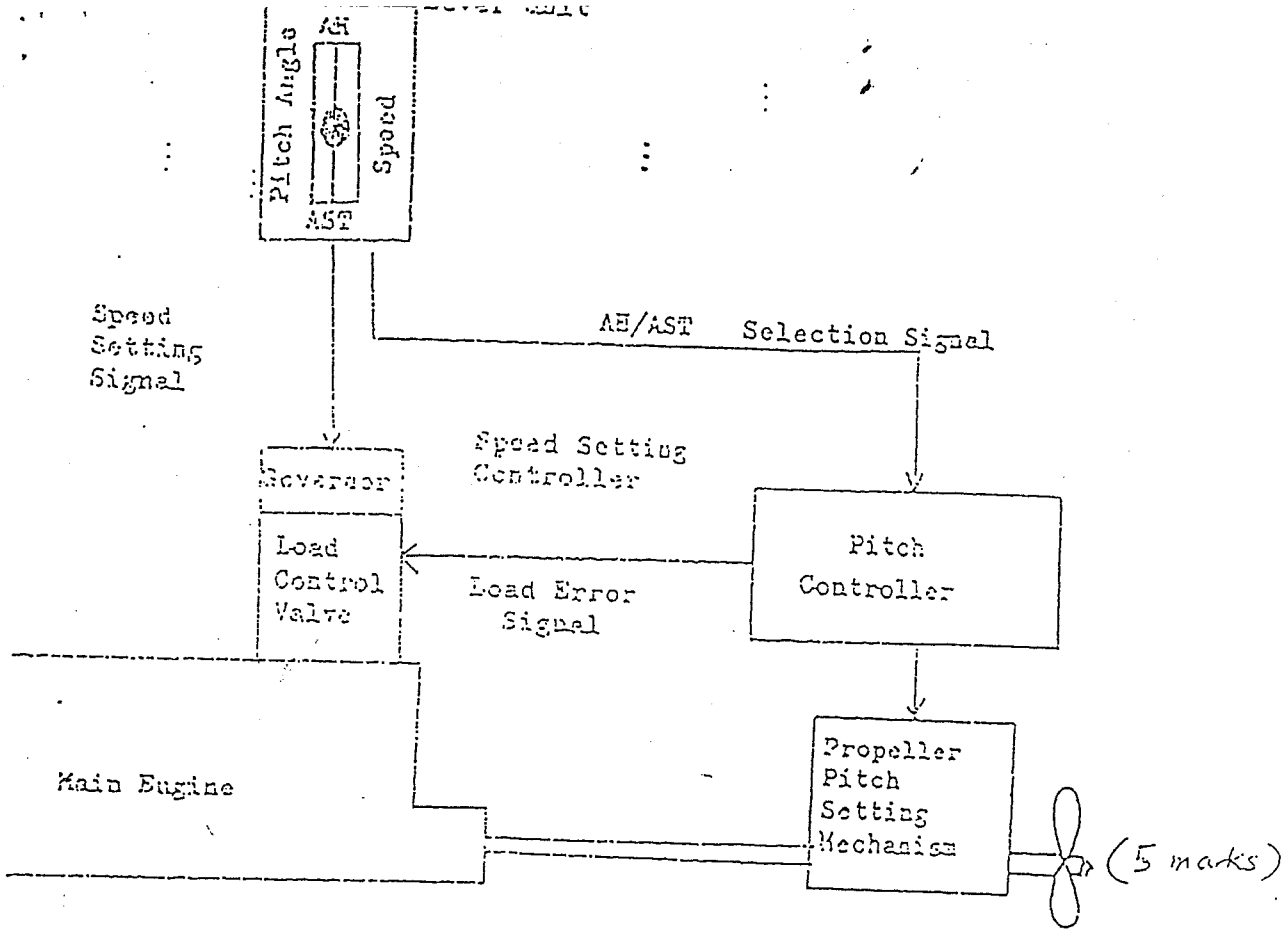
(ii) While a vessel is berthing, a mooring boat is required to bring the mooring ropes to the berth. Simultaneously the controllable pitch propeller of the vessel is still running continuously at some pitch angles. It may endanger the mooring boat when the boat is close to the stern of the vessel or when a mooring rope is caught by the revolving propeller, especially if the ship is in "lightship" condition.

(iii) If the system of the controllable pitch propeller fails, the system is automatically locked at the fail-safe position which corresponds to either full ahead or stop. It may cause damage to the berth, the vessel itself or another vessel if failure suddenly happens and the "full ahead" position is adopted whilst the vessel is maneuvering.

(3 marks each)

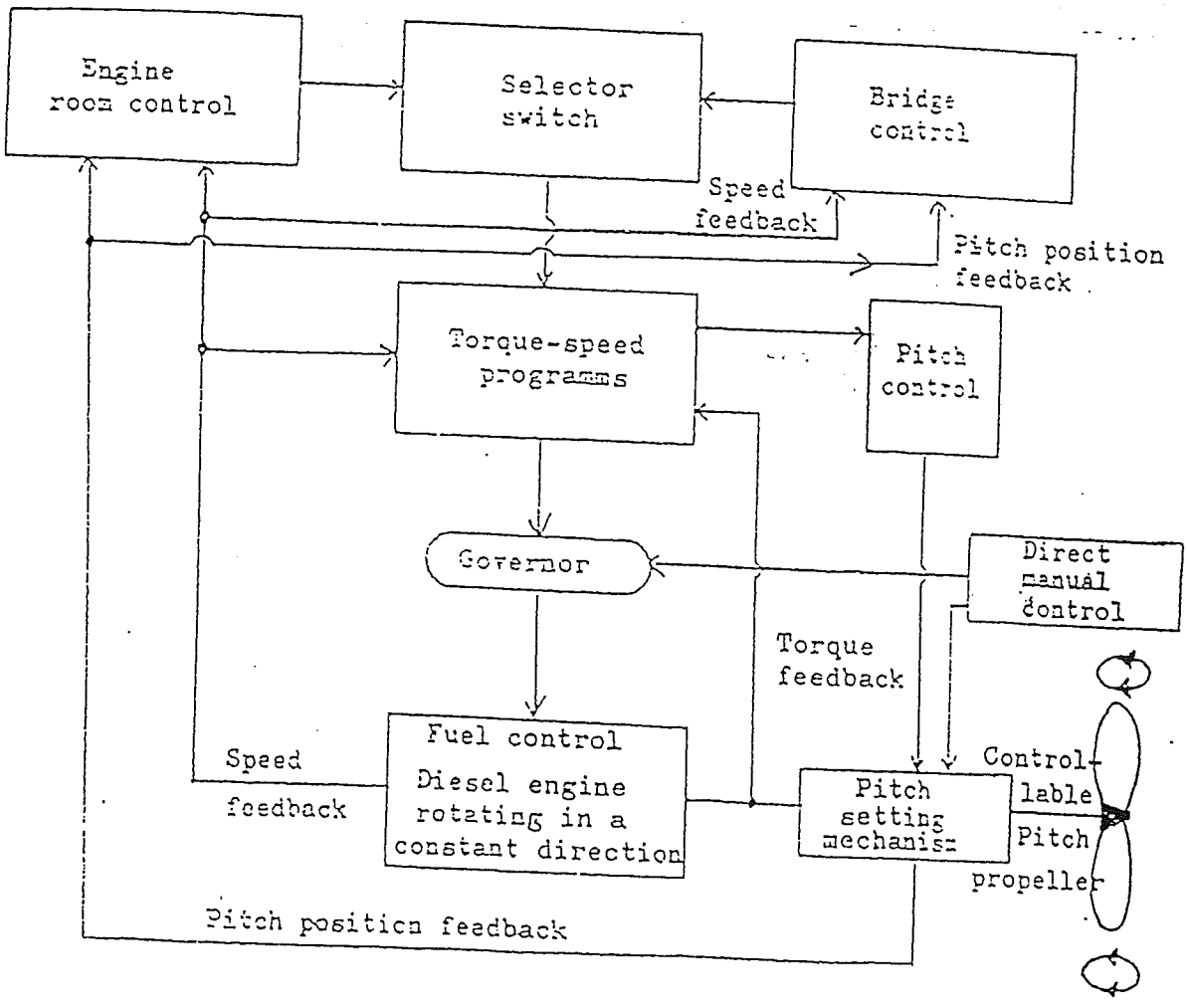
(b) The remote control system is used to control the propeller pitch, the speed and torque of a diesel engine according to the control signal selected from either the bridge or the engine room. The system shown in Fig. 1 is in the form of a closed control-loop in which the propeller pitch is set to a value to maintain the load (power) on the engine to a predetermined value at any selected speed setting. The control-loop consists of the propeller, its pitch setting mechanism, the engine, the engine governor and the pitch controller. The engine governor adjusts the fuel supply to maintain the engine running at the required speed in accordance with the speed setting signal. On the other hand, the pitch setting signal adjusts the propeller pitch through the pitch controller and its pitch setting mechanism. The system maintains a balance between power absorbed by the propeller and preset power level. The pitch is actuated automatically by error signal in this balance such that, under steady state conditions the shaft torque remains constant for any unique speed setting.

(6 marks)


Pitch Angle
AH
Speed
AST
Speed Setting Signal
AE/AST Selection Signal
Governor
Speed Setting Controller
Load Control Valve
Load Error Signal
Pitch Controller
Main Engine
Propeller Pitch Setting Mechanism

(5 marks)

OR


Engine room control
Selector switch
Bridge control
Speed feedback
Pitch position feedback
Torque-speed programms
Pitch control
Governor
Direct manual control
Torque feedback
Fuel control
Diesel engine rotating in a constant direction
Speed feedback
Pitch setting mechanism
Controllable Pitch propeller
Pitch position feedback

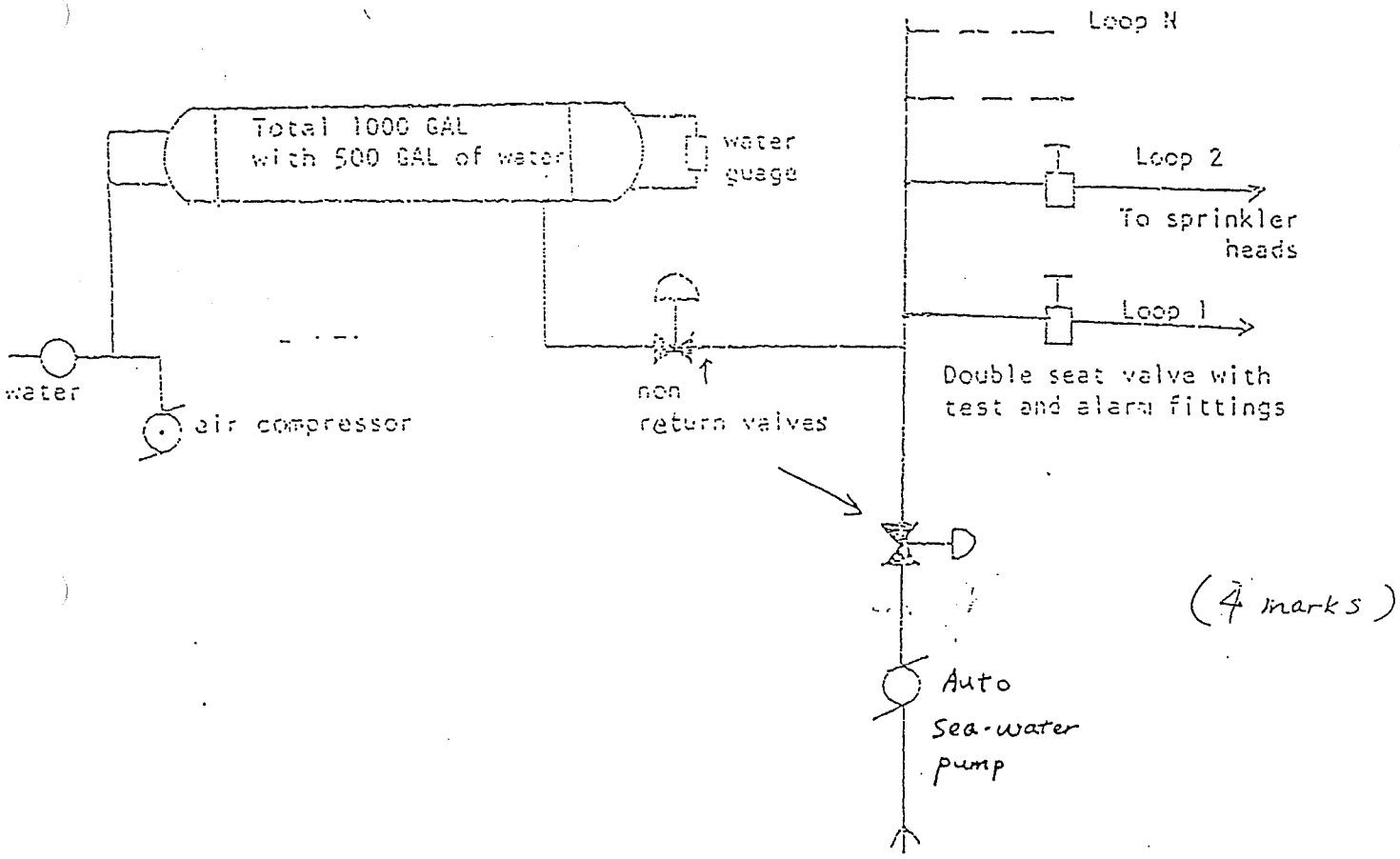
Q B6. Describe an automatic sprinkler system of a merchant ship with the aid of an appropriate diagram.

(10 marks)

Answer:

The sprinkler system consists of a pressurized tank filled with fresh water and compressed air. The tank is fitted with a relief valve to set the upper pressure limit for safety purpose. An air pump supplies air to maintain the water under pressure in the tank. The tank is connected by suitable piping and stop valves to the trunk mains. The ship is divided into a number of sections, each section will have a number of sprinkler heads. Each head consists of a coloured quartzoid bulb filled with a highly expansible liquid. The colour indicates the temperature at which a bulb breaks to allow water to flow out from a sprinkler head. A sea-water pump is started by a pressure relay in the tank if the pressure falls due to the outbreak of fire. This pump delivers into the trunk mains and will therefore continue to supply water to the seat of fire. When the sprinkler head breaks, water flows through the alarm valve to actuate the alarm circuit. The alarm gives warning of the outbreak of fire in a particular section. Thus the sprinkler system is an automatic fire detecting, alarm and extinguishing system.

(6 marks)



(4 marks)

Automatic Sprinkler System