

## G158 HV Machine Testing

1.1+1.2 OHS

See G006 Exercises

1.5 Winding data (G158 Page 67 to 74)

Q1-Sketch the winding connection diagram for three phase 4 poles 36 slots induction motor

1.7 Materials

Q2-List tools and materials required for motor winding

1.8 Tools & test (G158 Page 81 to 91)

Q3-Write the procedures for pole polarity test and growler test.

2.1 OHS Risk (G158 Page 58)+2.2 OHS

Q4-Write safety requirement to do the motor test.

1.3 External effect

Intro of G158 + G158 Page 1 to 26

Q5-Sketch the block and line diagram of marine power system

Q6-Explain the attachment of HV machineries

Q7-Describe electrical propulsion system

Q8-Describe the attachment of HV motors

2.3+2.4 HV Test

Page 1 to 26 of G158

Q9-Explain partial discharge test

Q10-Explain dielectric response analysis

Q11-Explain partial discharge monitoring

## 2.4 Status

G158 Page 27 to 40

Q12-How to perform the followings

- Power frequency voltage and current testing
- Impulse generator
- Finding  $\tan \delta$
- Non destructive testing.

T1-Testing devices

G158 Page 47 to 57

Q13-Explain HV testing devices

T2-Connection of test equipment

G158 Page 81+82+86

Q14-Sketch the connection diagram for testing motor poles and growler.

T3-Reading

Q15-Express typical shaft voltage reading

T4-Storage

Q16-Explain the procedures to store the test equipment.

## 2.5 preparation / Solution

G158 Page 41 to 67

Q17-Explain shaft voltage measuring methods

## 2.6 Quality check + 2.7 Completion

Q18-Sketch the block diagram of ship electrical system and identify the high voltage equipment

Q19-Explain the followings

- Residual dielectric strength
- Ultrasonic detection

- Online partial discharge measurement

Q20.Explain di-electric response analysis.

Q21.Sketch the followings

- Single stage impulse generator
- Basic schering bridge circuit to test  $\tan \delta$

3.Machine document

Q22.Why shaft voltage testing is performed.

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### POP428A Develop High Voltage switching System

1.1 Requirement

428(1)

Q1.Write the list of primary essential services of a ship that a duty engineer needs to take care of.

428(2)

Q2.Write the list of secondary essential service that the duty engineer needs to take care of.

1.2 Area planned outage

428 (3)

Q3.From the typical ship electrical system if the outage happens at the main switch board, write how the emergency generator can supply the power to essential areas.

1.1

428(4)

Q4.What are the factors that influences the design of ship electrical network.

1.3 Planned works

428 (5/6)

Q5.From the basic power management system, outline the points that need to be focused on outage resolution.

## 2.1 Implication

428 (7/8/10)

Q6. List the standard types of ac distribution system for a ship for the following aspects.

- (a) Generation
- (b) Primary distribution
- (c) Secondary distribution
- (d) Radial distribution
- (e) Sketch busbar types & distribution
- (f) Sketch the cross linked type distribution

## 2.2 Types and function of switch gear

428(12)

Q7. Identify the switch gears on the given diagram (Typical ship electrical distribution system)

## 2.3 System loading & implication

428(14)

Q8. When turbine generator is required?

Q9. When two generators are required?

## 2.6 Switching performed

428 (15)

Q10. List the control switching system of ship.

428 (19/20)

Q11. Describe emergency electrical system of a ship.

428(21)

Q12. How does the stored energy for starting the emergency generator set maintain?

428 (23)

Q13. List the basic indicators on emergency switchboard.

2.7 HV/LV Control circuit

428(26)

Q14.Explain the given basic emergency power supply system.

3.3 Program plan/ 3.4 Check

428 (29/30/31)

Q15.Sketch and explain the emergency generator and routine testing.

Q16.outline the starting procedures and stopping procedures.

3.4 Switching program check

428 (34)

Q17.From shore supply arrangement diagram, highlight the importance of indicators.

3.5 Documentation

428 (40)

Q18.Write the performance requirement of generator and automatic voltage regulators.

2.8 Enterprise procedure

428 (182)

Q19.From the enterprise procedures, write the list of records to be kept.

428 (42/43/45)

Q20.Explain the followings

- (a) Self excitation system
- (b) Permanent magnet generator
- (c) Voltage comparison circuit
- (d) Thyristor controlled static excitation system

2.5 Shortest possible route for switching

428(12)

Q27. In the given circuit diagram, to replace the motor for maintenance, indicate which switches need to be off.

3.1/3.2 Formal draft

428 (12)

Q28. Write down the switching program in the following format

Tasks to be performed	List of switches to be off	Affected areas.

4. Validation

Q29. If particular switch is off, validate the following consequences

- Will it impact on black out of the whole system?
- Will it cause overload on the remaining system?
- Will it disturb the frequency, speed and load sharing of the system?
- Will it cause any electrical and mechanical damages?

KNOWLEDGE

AC Distribution system

428(7)

Q30. Sketch three phase four wires system.

428(13)

Q31. List the suitable types of generation and distribution systems of a ship.

## EMERGENCY POWER &amp; SHORE SUPPLY

428(21)

Q32. Write switching arrangement for emergency generator set.

428(22)

Q33. Explain the given shore supply arrangement diagram

## AUTOMATIC VOLTAGE REGULATOR

428(47)

Q34. Explain thyristor controlled excitation system.

428(51)electrical

Q35. Explain the alternative thyristor based AVR circuit.

## PANEL INSTRUMENTATION

428(72)

Q36. List the types of sequence indicators.

428(73)

Q37. Sketch dc tachometer.

428(79)

Q38. Sketch the diagram of electrical multi-meter consisting of 2 VTs and 2 CTs

## PARALLELING ALTERNATORS

428(80)

Q39. Write down the essential conditions for paralleling alternators.

428(84)

Q40. Explain the procedure for manual mode of sharing and synchronizing alternators.'

428(92)

Q41. Sketch the arrangement of synchronizing lamps

428(96)

Q42. How does loss of excitation impact?

#### STARTERS FOR MOTORS

428(104/105)

Q43. Sketch the DOL starter circuit.

428(14/15)

Q4. Sketch Star/ Delta starter circuit and control.

#### FAULT PROTECTION DEVICES

428(211)

Q45. Explain the protection discrimination

428(212)

Q46. Explain electronic over current relay for motor.

#### PROPULSION SYSTEM

428(117)

Q47. Explain

- (a) Propulsion system
- (b) Steering system

428(18/119)

Q48. Sketch machinery arrangement of

- (a) Convectional propeller
- (b) Thruster propulsion system



428(123)

Q49.Describe electrical propulsion

428(127/128)

Q50.Describe turbo electric propulsion

428(131)

Q51.What is thrust controller?

#### STEERING & STABILIZER SYSTEM/ELECTRONIC SIGNAL

Q52.Describe dynamic positioning system.

#### DECK MACHINERY

428(150)

Q53.Describe the operation of horizontal electro-hydraulic windlass.

428(151)

Q54.Describe the operation of vertical windlass.

#### CONTROL OF AIR COMPRESSOR

428(161)

Q55.Describe basic high pressure non oil free compressor system.

428(165)

Q56.Write the methods of unloading compressor.

#### HV EQUIPMENTS/ SUBSTATION EQUIPMENT

G037+38+39 Power System Control Equipment

Slide 1

Q57(1) Sketch power supply busbar

Slide 4

Q58(2) Describe substation equipment and substation operation.

Slide 8

Q59(3) Explain the types of protection system in substation.

Slide 9

Q60(4) What is wide area monitoring and control system.

#### GENERATOR CONTROL & LOAD FLOW

G037+38+39 (16) Generator control & Load flow

Q61(5) Write the equation that relates to angular acceleration and transfer of power and load power change.

Q62(6) Describe digital excitation system.

#### COMPUTER CONTROL

Q63. Sketch governor control system.

#### VOLTAGE SURGE CONTROL

Q64(7) Sketch the diagram of harmonic filter

Q65(8) Sketch the diagram to design to minimize the harmonics in power transformer.

#### MODERN POWER SYSTEM

G037+38+39 (16) Generator control & Load flow

Q66(9) Write the methods of voltage control.

#### ELECTRONIC SIGNAL

428(147)

Q67(10) See Q52.

E011/017

Q67.What are the hazards of electricity?

Q68.Describe risk assessment process.

428 (190/191/181/183)

Q69.Describe the steps in maintenance program.

Q70.Explain the risk reduction in maintenance.

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POP 456 Perform switching to a switching program

1.2 OHS

Q67 of 428

1.4 Risk

Q68 of 428

1.5 Documentation

Q28 of 428

1.1 Extent of work

Q29 of 428

1.6 Team Responsibility

Q1.Differentiate disintegration and integration of a team.

Q2.Describe the process of management leadership

2.1 Risk control in switching

456(19)

Q3.Describe hazardous areas on board ship.

456(20)

Q4.What are the safety types of electrical equipment on board ship.

### 2.3 Plant drawing

456(2/3)

Q5. Describe the over view of ship electrical systems and single line diagram.

### OPERATE PLANT EQUIPMENT

456(27)

Q6. Explain air compressor and system.

456(36/38)

Q7. Describe control system of air.

456(39/45)

Q8. Sketch and explain oil refinery process

456(54)

Q9. Explain fuel heating system.

456(68/69)

Q11. What is oily water separator?

456(80)

Q12. List the components of fresh water system.

### 2.4 Switch gear types and characteristics

456(9)

Q13. In given switchboard diagram, outline the functions of protective gears.

456(10)

Q14. What are the components of distribution system?

456(11)

Q15. Why insulated neutral system is used for ship?

456(12)

Q16. Describe the types of fuses.

Q17. Write the protection system of outgoing circuits.

456(12/13)

Q18. Describe (a) Open circuit fault (b) Earth fault

### Operate AC Generator & Transformer

Session 5+6 Alternators

#### (11) Synchronous machine

Slide 2

Q19. Write the basic principle of synchronous machine.

Slide 4

Q20. Sketch the construction diagram of synchronous machine.

#### (12) Synchronous generator

Q21. Sketch the vector diagram of synchronous generator.

#### (13) Effect of field excitation

Slide 1

Q22. Describe the effect of field excitation on power factor of synchronous motor

#### (15) Generator control

Slide 1 to 5

Q23. Describe the followings

- (a) Exciter (b) Voltage regulator (c) Prime mover governor with sketches.

Session 7+8 Transformer

1. Transformer construction

Slide 1

Q24. Explain the construction and operation of transformer

4. Transformer testing

Slide 2

Q25. Describe the polarity testing of transformer.

6. Parallel operation

Slide 9

Q26. Describe the polarity testing for transformer parallel operation.

Slide 10

Q27. Write transformer load sharing equation for parallel operation.

7. Three phase transformer connection

Slide 2

Q28. Sketch (a) Dd0 (b) Yy6

9. Harmonics

Slide 1/2/3

Q29. Explain the harmonics in transformer

Slide 4

Q30. How does harmonics effect on the following connections

(a) Delta (b) Star with earthed (c) Star without earthed.

Slide 5

Q31. Describe harmonics reduction method in power transformer core design.

Risk Management Leadership

Q68 of 428

## 2.7 Enterprise Recording

Q32. Write down the logbook entries aspects for

- (a) Generator (Temperature/ RPM/Voltage/ Frequency)
- (b) Pumps ( Start/ Stop time/ Vibration/RPM/Pressure)
- (c) Valves (Inlet and outlet pressure)

2.5 System operation/ 2.6 Abnormal operation/ 2.7 Corrective action

456(27)

Q33. What has caused air start valve and other parts are blown away without explosion . How to correct it?

456(39)

Q34. What are the dangers that can be caused by very abrasive silica-alumina catalytic fires on engine and how to prevent it?

456(50)

Q35. What is revolution needed of homogenizer to breakdown the sludges and water?

456(61)

Q36. Which system fault has caused oil contaminated in exhaust bilge water (oily water separator)

## 2.2 Leadership

Q2 of 456

## 2.7 Recording

456(22/23)

Q37. List the documents of vessel

## 3.1 Risk Control

456 (24/25)

Q38. To control the electrical fault risk factors, outline the procedure to determine the right protective device.

Maintenance work activities

428 (181 to 204)

428 (181)

Q39.What are the methods of test and inspection?

428(186)

Q40.Sketch the basic concept of maintenance

Q41.What is the planed preventive maintenance

Documentation

428(184)

Q42.Express the check list of principal maintenance system management control

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Knowledge

Panel Instrumentation

T1

456(1)

Q43(1)T1- What kinds of electrical equipment are required in shipboard electrical plants?

456(3)

Q44(2)T1-Describe the voltage levels of ship electrical equipment.

Alternator

456(4)

Q45(15)T1-Write the operation of marine generators and describe (a) Revolving armature  
(b)Revolving field

456(6)

Q46(16)T1-Describe the construction of alternator



Fault protection devices

456(7)

Q47(3)T1-Describe the equipment on main switch board.

456(8)

Q48(4)T1-What are the important aspects of protection equipment?

Q49(4a)T1-Explain the emergency generator and switch board.

Transformer

17+18 T1 Q9+Q10+Q11+Q12

Risk Management

19+20 T1—Q23

Electrical Energy Supply

456(3)

Q50 (16) T2-Sketch one line diagram of ship electrical supply system.

456(9)

Q51 (17) T2-Sketch electrical distribution diagram of ship.

456(11)

Q52(18)T2-Sketch neutral earthing and insulated neutral.

456(14)

Q53(19)T2-Explain shore based power and circuit arrangement.

Q54(20)T2-What are the contents in shore connection box?

Electrical Principle

1. Electrical components, energy and power

Q55.(5)T1-Define the followings

- (a) Resistor (b) Capacitor (c) Inductor (d) Semi conductor (e) Work (f) Energy (g) Power

2. Energy conversion/ AC Principle

Q56(6)T1-Sketch wave form diagram for (a) Pure resistor (b) Pure inductor (c) Resistor+ Inductor

- (d) Resistor + Capacitor

G03+63+107 Wk 6

Q57(6)T1-Sketch typical arrangement of earthing system

Write the operation principle of RCD.

Ship Systems

456(16)

Q58(7)T1-Sketch the electric propulsion options of a ship.

456(17)

Q59(8)T1-Explain propulsion electric motor.

456(18)

Q60(9)T1-Explain the features of HV power system of a ship.

456(19)

Q61(10)T1-What motors need to be supplied with HV from main switchboard CB?

456(21)

Q62(11)T1-List the dangerous zones or spaces on ship

456(22)

Q63(12)T1-Describe ship air compressor and system.

Electrical Control Switch Gear & Motor

G033+63+107 Wk 7—Page 2

Q64(11)T2-What is the meaning of circuit protection?

Page 3

Q65(12)T2-Write down the equation for protection co-ordination.

Page 4

Q66(13)T2-Write the formula for protection against short circuit current.

Q67(14)T2-Sketch typical protection block diagram.

Q68(15)T2-Express the clauses of AS3000 related to positions of protective devices.

General Marine Engineering

456(30)

Q69(1)T2-Sketch the compressor indicator diagram

456(34)

Q70(2)T2-Explain the automatic operation of air compressor.

456(39)

Q71(3)T2-Explain oil refinery process.

456(46)

Q72(4)T2-Write the equation of Centrifugal force produced by centrifuge.

456(55)

Q73(5)T2-Explain viscosity controller

456(55)

Q74(6)T2-Explain homogenizer

456(58)

Q75(7)T2-Explain automatic combustion system.

456(60)

Q76(8)T2-Explain fuel blender for auxiliary engines.

456(69)

Q77(9)T2-Explain bilge/ ballast and fuel main diagram.

What is oil water separator?

456(86)

Q78(10)T2-Explain electrical supply to domestic fresh and sanitary water system.

456(96)

Explain sewerage plant

PLC Practice

Fault finding

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POP 349 Operate local HV switch gear

Follow IS68+74 for lessons and assessment mapping

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POP430 Control permit to work operation

1.1 Environment/ OHS

430(38)

Q1(CW1)-Express safe distance in HV system

Q2(CW1)-Describe component quality (or) Reliability level

Q3(CW1)-Explain the organized system of maintenance

3.1 Documentation

430(41)

Q4(CW11/12)T-What are the required aspects of personnel protection?

430(42/43/44)

Q5(CW11+12)-Write the documentation for

(a) Safety of supply

- (b) Main generator/ Prime mover
- (c) Power transformer
- (d) Cable installation
- (e) Circuit protection

### 3.2 Approved documentation

430(26/27)

Q7(Proj) For your ship, prepare the maintenance process manual for one selected machine. Your manual should contain

- Use of equipment/ Fault finding/ Planned maintenance
- Working personnel-Competency/ confident/familiarity
- Equipment specification instruction-Maker
- Regulation/ Work standard

### 3.3 Work completed with enterprise requirement

Q8. Write down the work completion recommendation procedures for your ship.

### 1.4 Plant identification

430(1)

Q9. Write electric power distribution system of a ship.

430(2)

Q10. Explain grounding system of a ship.

430(3)

Q11. Compare solid / insulated and high resistance grounding systems

Q12. Describe earth fault.

430(4/5)

Q13. Describe (a) Open circuit fault (b) Significance of earth fault (c) Electric power system reliability

## 1.2 Information Documentation

Q14.Perform the internet research work on (a) IEC 60002 Electrical Installation on ship

## 1.3 OHS Standard Procedures

430(17)

Q15(CW1)-Write down the points for HV safety system on board ship.

## 1.5 Key stake holders

Q16(CW1)-You are required to replace a sea water pump motor for servicing , write the procedure on how to notify and consult with the relevant personnel.

## 1.6 Individual rules and responsibility

Q17(CW1)-Provide the structure of servicemen working in naval ships and outline their duties and responsibilities.

Centrifugal force produced by centrifuge

### 2.1 obtain the permit

430(36)

Q18(CW1+2)-To issue the electrical work permit. Highlight the important facts to be concerned for ship electrical system.

### 2.5 Permit condition/ Monitoring

430(40/41)

Q19(CW3+4) Describe the component quality or reliability that needs to be monitored during the operation.

### 2.3 Permit requirement conveyed

430(46/47)

Q20(CW3+4) You are required to install the electrical wire on ship. You need to follow the fundamental requirements for safe installation of equipment to comply with the permit requirement, outline them

2.4 Sign on permit

Q21.To commence the work, who needs to authorize you in your ship?

2.2 Isolation/ Barrier

430(47/48)

Q22(CW9+10)-What should be done and what should not be done while working with electrical equipment?

430(50)

Q23(CW9+10)-What are the danger signals to be aware of?

Q24(CW9+10)-Write the facts or pre-cautions for preventing an electric shock.

KNOWLEDGE

Marine Equipment

430(7)

Q25(1)T-Write notes on (a) Generator/ Motor used on ship

(2)T-Starting devices

Maintenance Procedure

430-9

Q26(3)T-What is cathodic protection?

430(10/11)

Q26 (4)T-Write cathodic protection with relevant diagrams.

Safe system

430(14)

Q27(5)T-Sketch ship anodes and impressed current control system.

430(18/19)

Q28(6)T-Define the followings

- (a) Authorized person (b) Danger notice (c) High voltage (d) Isolated (e) Apparatus

Hazardous System

430-21

Q28(7)T-What is classified as HV on board ship?

Q29(8)T-List HV equipment.

Confine space

430(54)

Q30(9)T-Sketch the confined spaces on ship

Q31(10)T-Sketch the diagram that shows hazardous areas and normal safe areas of a ship.

Document Control

Q32(11)T-Who is responsible for controlling the marine engine room logbook?

Q33(12)T-Who is responsible for auxiliary engines?

430(59)

Q34-Explain the function of gas analyser.

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POP525 Co-ordinate / Direct the switching program

1.1 OHS

Q67 of 428

1.2 Risk control

Q68 of 428

1.3 Contingency plan

525(1)



Q1 (CW3/4/5/6/7)-Write down the emergency steering plan in the case of failure of electric steering system.

1.5 Documentation

Q28 of 428

1.6 Team

Q1+2 of 456

1.4 Permit Access

Q18 of 430

2.1 OHS Risk

Q19/20 of 456

2.5 Work Group Co-ordination

Q2-Describe main engine starting procedure and duties and responsibilities of work group members

Q3. When the blackout happens. Describe the emergency procedures to follow.

2.3 System Operation

525-1

Q4-Explain ship steering system

525(4/5)

Q5-Explain remote control of propulsion machineries

525(8)

Q6-Explain components of steering control equipment.

525(9)

Q7-Describe ruder control system operation

525(10)

Q8. What is electro-hydraulic control?

2.7 Abnormal plant/ System operation

525(15)

Q9.Explain the failure sequence with one pump running and both pump running

525(16/17)

Q10.Sketch electronic steering control with manual mode and highlight the typical failure aspects.

2.2 Safe working procedure

Q22 of 430

2.4 Access to plant

Q23 of 456

2.6 Permit

Q18 of 430

3.1 Switching program steps

525(14)

Q19-Write the procedure to put steering gear into operation

525(18)

Q20.Write the procedure for change over from normal to emergency mode of operation of steering.

3.2 Steps are logged

Q21 Write down the recording procedures for normal mode of operation of steering

3.3 System condition/ Stability

525(29)

Q22.Explain the limit switches and relay and follow up potentiometer

### 3.4 Alternative program steps

525(18/19)

Q23-Write the procedure for change over from normal to emergency mode operation of steering system.

### 4.1 OHS / Work Completion

525(21)

Q24. Write down the salient features of mono steer for safety

### Starters for AC Motor

Q25 (1+2)T Sketch DOL starter & Star/delta starter ( Q43+4 of 428)

### Cable Insulation / Ingress protection

525(50/51)

Q26 (3+4)T-Explain the distribution cables.

Write down the termination and joining of cables

### Propulsion System

525(7)

Q27(5+6)T-Explain steering control

525(11)

What are the advantages of electro-hydraulic control system.

525(17)

Q28(7+8)T. What are the factors affecting control of rudder?

525(19)

Write the basic actions between navigation bridge and steering flat.

### Deck machineries

525(36)

Q29(9+10)T. Explain anchor windlass

Explain horizontal windlass

Control of air compressor

456 (32+3)

Q30(11+12)T. Explain the operation and maintenance of air compressor

456(33)

Sketch the diagram for compressed air torque.

