UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2022/2023

COURSE NAME	:	GENERATOR SYSTEM MAINTENANCE
COURSE CODE	:	BBJ 20905
PROGRAMME CODE	:	BBJ
TEST DATE	:	FEBRUARY 2023
DURATION	:	2.5 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS. 2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**. 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

Q1. (a) Identify **four (4)** most critical locations where diesel generator is used as backup power system to the locations.

(4 marks)

(b) Explain the factors of diesel generator output voltage becomes abnormal.

(3 marks)

(c) Describe with a sketch the operation principle of Automatic Voltage Regulator (AVR) of a generator.

(7 marks)

(d) Suggest **two (2)** types of protection relay that can be used to protect generator system.

(2 marks)

Manufacturer: Volva Penta Marine Genset
Model: D7AT
Four stroke cycle, Direct Inject, Turbocharger,
In line 6 Cylinder Diesel Engine
Rated output: 1500RPM, 50Hz
Capacity: 108kW
Fuel Consumption: 219 gram/kWh

Figure Q1(e)

(e) **Figure Q1(e)** presents the specifications of a generator. Calculate

(i) fuel consumption in litre/hour. Assume diesel fuel density is 850 kg/m^3.

(2 marks)

(ii) minimum size of the fuel tank.

(4 marks)

(iii) minimum runtime of the generator.

(3 marks)

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Q2. (a) State the equipments that can be used to monitor or measure the synchronization conditions between two generators.

(4 marks)

(b) Explain **four (4)** conditions that need to be met in order to synchronize the two generators properly.

(4 marks)

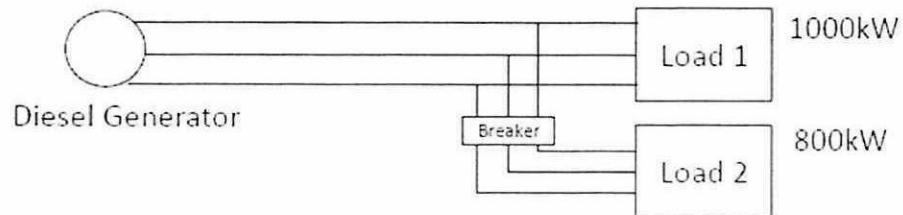(c) Describe the chronology of steps procedure for load sharing after synchronization.

(8 marks)

Figure Q2(d)

(d) **Figure Q2(d)** shows a generator supplying two loads where Load 2 is to be connected in parallel with Load 1. The generator has a no- load frequency of 51 Hz and a slope, *sp* of 1 MW/Hz. Load 1 consumes a real power of 1000 kW at 0.9 power factor lagging, while Load 2 consumes a real power of 800 kW at 0.8 power factor lagging.

   (i) Calculate the operating frequency of the system before the switch is closed.

(3 marks)

   (ii) Calculate the operating frequency of the system after Load 2 is connected.

(3 marks)

   (iii) After Load 2 is connected, suggest actions that an operator could take in order to restore the system frequency to 50 Hz?

(3 marks)

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Q3. (a) Outages and technical incidents in industry yield to missed deadlines, late payments, project delay etc to a company. This becomes crucial for a company to quantify and track metrics around uptime, downtime, and how quickly and effectively teams are resolving issues, among which the terms MTTR, MTBF and MTTF become their measure.

       (i) State what do MTTR, MTBF and MTTF stand for.

(3 marks)

       (ii) Explain briefly the definition of MTTR, MTBF and MTTF.

(3 marks)

       (iii) State **three (3)** things that will be covered during the period of MTTR?

(3 marks)

(b) A pump has failed **three (3)** times per months. The first repair lasted for 70 minutes, while the second repair took 120 minutes and the last repair took 60 minutes. Calculate the MTTR of the motor.

(3 marks)

(c) A pump was running about 1440 hours before its engine failed to run. After repair, the pump has been operating about 3600 hours before it broke down. The pump was maintained and repaired, and thereafter was able to run for 4320 hours. Calculate the MTBF of the motor. Justify your answer.

(4 marks)

(d) Root Cause Analysis (RCA) is defined as the approaches, tools and techniques used to uncover causes of problems. Demonstrate with sketch three (3) analysis tools that are used in industry as the elements of this problem solving method.

(9 marks)

Q4. (a) State **five (5)** example of techniques under predictive maintenance (PdM) that can be taken on generator system.

(5 marks)

(b) Explain **four (4)** types maintenance strategies.

(8 marks)

(c) Figure out the possible factors of a generator for these conditions;
  (i) Difficult or fail to start.

(4 marks)

  (ii) Has excessive smoke during loading.

(4 marks)

(d) Predict what type of fault that could occur on an exciter of a generator system and what is the identification of the fault that can be observed.

(4 marks)

-END OF QUESTIONS –

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