2502/305
POWER PRODUCTION SYSTEMS
Oct./Nov. 2022
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN MECHANICAL ENGINEERING (PLANT OPTION)

MODULE III

POWER PRODUCTION SYSTEMS

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
Answer booklet;
Drawing instruments;
Non programmable scientific calculator;
Tables of Thermodynamic and Transport Properties of Fluids by Rodgers and Mayhew.
*Answer **FIVE** of the following **SEVEN** questions in the answer booklet provided.*
Maximum marks for each part of a question are as indicated.
Candidates should answer the questions in English.

This paper consists of 4 printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

1. (a) Outline the procedure of carrying out hydrostatic test in a boiler. (4 marks)

(b) With the aid of a diagram, describe the operation of a water tube boiler. (6 marks)

(c) Outline **four** benefits of an economiser in a boiler. (4 marks)

(d) With the aid of a diagram, describe a dead weight safety valve used in boilers. (6 marks)

2. (a) Explain the use of the following in a steam plant:

(i) condensate lift pump;

(ii) hot well. (2 marks)

(b) Highlight **four** advantages of a condenser in a steam plant. (4 marks)

(c) With the aid of a diagram, describe the operation of a parallel flow jet condenser. (5 marks)

(d) (i) Define the following terms:

(I) dryness fraction;

(II) thermal efficiency;

(III) equivalent evaporation.

(ii) A boiler generates 2500 kg of dry saturated steam per hour at a pressure of 11 bar. The grate area is 4 m^2 and 110 kg of coal is burnt per m^2 of grate area per hour. If calorific value of coal is 32180 kJ/kg and the temperature of feed water is 17.5°. Determine:

(I) actual evaporation per kg of coal;

(II) equivalent evaporation 'from and at 100° C';

(III) efficiency of the boiler. (9 marks)

3. (a) (i) Outline **three** classifications of fuel stating **two** advantages for each.

(ii) Highlight **four** functions of fuel burners. (8 marks)

(b) (i) State **six** service requirements of a mechanical stoker.

(ii) List **six** maintenance checks carried out on an oil burning equipment. (6 marks)

(c) With the aid of diagrams, explain the operation of a four-stroke cycle petrol engine. (6 marks)

4. (a) (i) Describe the following elements of a nuclear power plant:

(I) nuclear reactor;

(II) heat exchanger.

(ii) Outline **three** types of a nuclear reactor. (5 marks)

(b) With the aid of a diagram, describe the operation of a nuclear power plant. (7 marks)

(c) With the aid of a diagram, describe the circuits of a steam power plant. (8 marks)

5. (a) Outline **three** types of steam plants. (3 marks)

(b) (i) State **three** sources of air into a steam condenser.

(ii) Highlight **three** effects of air leakage into a steam condenser. (6 marks)

(c) With the aid of a diagram, describe the operation of an air extraction pump. (6 marks)

(d) List **five** maintenance checks and **five** maintenance tasks of an electrostatic precipitator. (5 marks)

6. (a) (i) List **six** requirements of a steam distribution system.

(ii) With the aid of a diagram, describe a baffle type steam separator. (8 marks)

(b) List **three** causes for each of the following problems in a thermostatic steam trap:

(i) not enough steam heat;

(ii) condensate won't drain. (3 marks)

(c) (i) Explain the following methods of boiler storage:

(I) wet;

(II) dry.

(ii) Outline the procedure for preparing a boiler for inspection.

(9 marks)

7. (a) Outline **four** requirements of a flash steam recovery system. (4 marks)

(b) With the aid of a diagram, explain the operation of a flash steam vessel. (5 marks)

(c) (i) Highlight **four** maintenance checks carried out on a steam pipeline.

(ii) State **two** causes and **two** remedies for each of the following problems in a steam system:

(I) water hammer;

(II) steam foaming.

(6 marks)

(d) With the aid of a diagram, describe a pelton wheel water turbine. (5 marks)

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