



JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

**UNIVERSITY EXAMINATIONS FOR THE DEGREE OF SCIENCE IN RENEWABLE
ENERGY TECHNOLOGY AND MANAGEMENT**

THIRD YEAR FIRST SEMESTER 2015/2016 ACADEMIC YEAR

CENTRE: MAIN CAMPUS

COURSE CODE: TET 3315

COURSE TITLE: STEAM PLANT ENGINE TECHNOLOGIES

EXAM VENUE: CR

STREAM: BSc RE TECH & MGT

DATE: 27/04/16

EXAM SESSION: 2.00 – 4.00 PM

TIME: 2 HOURS

Instructions to candidates

The paper contains FIVE questions.

Answer question ONE and any other TWO questions

Candidates must hand in their answer booklets to the invigilator while in the examination room.

QUESTION ONE (COMPULSORY)

- a) Briefly describe the following types of power cycles.
 - i. Rankine cycle,
 - ii. Regenerative cycle,
 - iii. Reheat cycle,
 - iv. Binary vapour cycle
 - v. reheat regenerative cycle(10 Marks)
- b) Briefly state different types of systems and components used in steam power plant.(10 Marks)
- c) Steam at a pressure of 15 kg/cm^2 (abs) and temperature of 250°C . is expanded through a turbine to a pressure of 5 kg/cm^2 (abs.). It is then reheated at constant pressure to a temperature of 200°C after which it completes its expansion through the turbine to an exhaust pressure of 0.1 kg/cm^2 (abs). Calculate theoretical efficiency.
 - i. Taking reheating into account
 - ii. If the steam was expanded direct to exhaust pressure without reheating.(10 Marks)

QUESTION TWO

- a) Give the differences between the Impulse turbine and reaction turbine. (5 Marks)
- b) Briefly describe the following types of steam condensers;
 - i. Surface condenser
 - ii. Jet condenser (6 Marks)
- c) A steam power plant, operating with one regenerative feed water heating is run at the initial steam conditions of 35.0bar and 440°C with exhaust pressure of 0.040bar. Steam is bled from the turbine for feed water heating at a pressure of 1.226bar. Determine;
 - i. Specific heat consumption
 - ii. Thermal efficiency of the cycle
 - iii. Economy percentage compared with the cycle of a simple condensing power plant.(9 Marks)

QUESTION THREE

- a) Briefly describe the differences in the following methods used in solid fuel firing into the furnace.
 - i. Hand firing
 - ii. Mechanical firing (4 Marks)
- b) Explain the principle of fire tube and water tube boilers.(5 Marks)
- c) What are the advantages of using pulverized coal in steam power plants furnaces?(3 Marks)

- d) State eight (8) requirements a steam generator (boiler) should fulfill. (8 Marks)

QUESTION FOUR

- a) List five (5) criteria used in classification of steam turbines (5 Marks)
- b) In an impulse steam turbine, steam is accelerated through nozzle from rest. It enters the nozzle at 9.8 bar dry and saturated. The height of the blade is 10 cm and the nozzle angle is 15° . Mean blade velocity is 144 m/s. The blade velocity ratio is 0.48 and blade velocity coefficient is 0.97. Find:
- Isentropic heat drop.
 - Energy lost in the nozzles and in moving blades due to friction.
 - Energy lost due to finite velocity of steam leaving the stage.
 - Mass flow rate.
 - Power developed per stage.
 - Diagram and stage efficiency. Take: Nozzle efficiency = 92%, Blade angles at inlet = Blade angles at out let Speed = 3000 rev/min(15 Marks)

QUESTION FIVE

- a) What are the desirable characteristics of a steam power plant?(5 Marks)
- b) State six (6) advantages of steam turbine over steam engine. (6 Marks)
- c) Determine the thermal efficiency of the basic cycle of a steam power plant (Rankine Cycle), the specific and hourly steam consumption for a 50 mW steam turbine operating at inlet conditions: pressure 90 bar and temperature 500°C . The condenser pressure is 0.40 bar.(9 Marks)