JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

UNIVERSITY EXAMINATIONS FOR THE DEGREE IN SCIENCE IN RENEWABLE ENERGY TECHNOLOGY AND MANAGENT

3RD YEAR 1ST SEMESTER 2017/2018 ACADEMIC YEAR

CENTRE: MAIN CAMPUS

COURSE CODE: TET 3314

COURSE TITLE: STEAM POWER PLANT ENGINE TECHNOLOGY

EXAM VENUE: WS **STREAM: BSc REN ENERGY TECH & MGT**

DATE: 12/12/2017 **EXAM SESSION: 9.00 – 11.00 AM**

DURATION: 2 HOURS

Instructions

1. **Answer question 1 (Compulsory) and ANY other two questions**
2. **Candidates are advised not to write on question paper**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room**

QUESTION ONE (30 marks) (COMPULSARY)

a) Briefly describe the following types of power cycles. (2 marks each)
   i. Rankine cycle,
   ii. Regenerative cycle,
   iii. Reheat cycle,
   iv. Binary vapour cycle
   v. reheat regenerative cycle

b) State eight requirements a steam generator (boiler) should fulfill. (8 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 bars and temperature 500°C. The condenser pressure is 0.40 bars. (8 Marks)

a) Briefly describe the differences in the following methods used in solid fuel firing into the furnace. (2 marks each)
   i. Hand firing
   ii. Mechanical firing

QUESTION TWO

a) State six (6) advantages of steam turbine over steam engine (6 Marks)

a) In a Rankine cycle, steam at 6.89Mpa, 516^{o}C enters the turbine with an initial velocity of 30.48m/s and leaves at 20.68kPa with a velocity of 91.44m/sec. If the mass flow rate of the steam is 136.078kg/hr, compute the thermal efficiency of the cycle and the net power produced in W or MW. (14 Marks)

QUESTION THREE

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:
   i. Isentropic heat drop.
   ii. Energy lost in the nozzles and in moving blades due to friction.
   iii. Energy lost due to finite velocity of steam leaving the stage.
   iv. Mass flow rate.
   v. Power developed per stage.

vi. Diagram and stage efficiency. Take: Nozzle efficiency = 92%, Blade angles at inlet = Blade angles at out let Speed = 3000 rev/min (15 Marks)

QUESTION FOUR

a) Explain factors that determines the furnace shape and size (5 Marks)
b) State the characteristics desirable for a steam power plant (5 Marks)
c) What conditions should a furnace fulfill to burn the fuel completely? (6 Marks)
d) Describe the following types of steam condensers; (2 marks each)
   iii. Surface condenser
   iv. Jet condenser

QUESTION FIVE

a) A steam power station design requires wide experience. Therefore design of a satisfactory system requires systematic steps. As a steam power plant engineer, outline how you will go about setting up a steam power plant. (6 Marks)
b) Steam at 3Mpa, 300^{o}C leaves the boiler and enters the high pressure turbine (in a reheat cycle) and is expanded to 300kPa. The steam is then reheated to 300^{o}C and expanded in the second stage turbine to 10kPa. What is the efficiency of the cycle if it is assumed to be internally reversible? (14 Marks)