



KIBABII UNIVERSITY

**UNIVERSITY EXAMINATIONS
2020/2021 ACADEMIC YEAR**

**THIRD YEAR FIRST SEMESTER
SUPPLEMENTARY EXAMINATIONS**

**FOR THE DEGREE OF B.SC (RENEWABLE ENERGY AND BIOFUELS
TECHNOLOGY)**

COURSE CODE: REN 312

COURSE TITLE: FLUID MACHINERY

DATE: 12/1/2022

TIME: 11-1PM

INSTRUCTIONS TO CANDIDATES

TIME: 2 Hours

Answer question ONE and any TWO of the remaining

KIBU observes ZERO tolerance to examination cheating

Question One (Compulsory)

- a) Describe briefly the following terms as used in fluid machinery. (2 marks)
- i) Positive displacement machine (2 marks)
 - ii) Turbomachine (2 marks)
 - iii) Fluid energy machine (2 marks)
- a) Distinguish between driving machine and driven machine. (2 marks)
- b) What are the primary differences between fans, blowers, and compressors? Discuss in terms of pressure rise and volume flow rate. (3 marks)
- c) List THREE main categories of dynamic pumps. (3 marks)
- d) Describe the principle of operation of reciprocating pumps. (4 marks)
- e) Describe the following heads as used in centrifugal pumps. (2 marks)
- i) Delivery head (2 marks)
 - ii) Eulers head (2 marks)
- f) Name and briefly describe the differences between the two basic types of dynamic turbine. (4 marks)
- g) List the main parts of a centrifugal pump. (4 marks)

Question Two

- a) Define the following terms as used in reciprocating compressors. (8 marks)
- i) Effective pressure
 - ii) Indicated power
 - iii) Volumetric efficiency
 - iv) Pressure ratio
- b) A single acting single cylinder reciprocating air compressor has a cylinder diameter 200mm and a stroke of 300mm. Air enters the cylinder at 1bar, 27°C. It is then compressed polytropically to 8bar according to the law $PV^{1.3} = \text{constant}$. If the speed of the compressor is 250rpm, calculate. (12 marks)
- i) The mass of the air compressed per minute

- ii) The power required in kW for driving the compressor, if $\eta_{mech} = 80\%$ and neglecting the clearance volume.

Question Three

- a) State the main parts of a reciprocating pump. (6 marks)
- b) A single acting reciprocating pump running at 50 r. p. m delivers $0.01\text{m}^3/\text{s}$ of water. The diameter of piston is 200mm and stroke length 400mm. calculate; (14 marks)
- theoretical discharge.
 - coefficient of discharge.
 - slip and percentage of slip.

Question Four

- a) A centrifugal pump discharge $0.118\text{m}^3/\text{s}$ at a speed of 1450 r. p. m against a head of 25m, with impeller outer diameter of 250mm. Its width at the outlet is 50mm and manometer efficiency of 75%. Determine the vane angle at outer periphery of the impeller. (12 marks)
- b) Describe the losses experienced in centrifugal pumps. (8 marks)

Question Five

- a) A Kaplan turbine develops 24647.6kW power at an average head of 39m. Assuming a speed ratio of 2 and flow ratio = 0.6; diameter of the boss = 0.35 times the diameter of runner and an $\eta_o = 90\%$. Calculate the diameter, speed and specific speed of the turbine. (12 marks)
- b) A centrifugal compressor running at 1500 r. p. m has internal and external diameters of the impeller as 250mm and 500mm respectively. The blades angles at inlet and outlet are 18° and 40° respectively. The air enters the impeller radially. Determine the work done by the compressor per kg of air and degree of reaction. (8 marks)