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KIBABII UNIVERSITY

**UNIVERSITY EXAMINATIONS
2020/2021 ACADEMIC YEAR**

**THIRD YEAR FIRST SEMESTER
MAIN EXAMINATIONS**

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

COURSE CODE: REN 312

COURSE TITLE: FLUID MACHINERY

DATE: 16/07/2021

TIME: 2:00-4:00PM

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) What is meant by the term “fluid machinery”? (2 marks)
- b) Define the following terms as used in compressors. (4 marks)
- i) Free air Delivered (FAD)
 - ii) Clearance volume
- c) State two types of dynamic action type air compressors. (2 marks)
- d) Define pump. (1 marks)
- e) Explain three types of impellers used in pumps. (3 marks)
- f) List any four main parts of a reciprocating pump. (4 marks)
- g) State any three reasons for the occurrence of negative slip. (3 marks)
- h) Explain the following efficiencies in turbines. (3 marks)
- i) Hydraulic efficiency
 - ii) Mechanical efficiency
 - iii) Overall efficiency
- i) Differentiate between gross head and net head as used in turbines. (4 marks)
- j) Define specific speed and state its significance in turbines. (4 marks)

Question Two

- a) List five types of heads in a centrifugal pump. (8 marks)
- b) The impeller of a centrifugal pump has external and internal diameters of 500mm and 250mm respectively. Width of outlet 50 mm and running of 1200 rpm. It works against a head of 48 m. The velocity of flow through the impeller is constant and equal to 3 m /sec. The vanes are set back at an angle of 40° at outlet. Determine (12 marks)
- i) Inlet vane angle,
 - ii) Work done by the impeller on water per second and
 - iii) Manometric efficiency.
- c) Name three losses in centrifugal pumps. (3 marks)

Question Three

- 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)

Question Four

- a) A pelton wheel has a mean bucket speed of 10 metres per second with a jet of water flowing at the rate of 700 litres/sec under a head of 30 metres. The buckets deflect the jet through an angle of 160° . Calculate the power given by water to the runner and the hydraulic efficiency of the turbine. Assume co-efficient of velocity as 0.98. (8 marks)
- b) A double acting reciprocating pump running at 40 rpm is discharging 1m^3 of water per minute. The pump has a stroke of 400mm, diameter of piston is 200mm and the delivery and suction head are 20m and 5m respectively. Find the slip of the pump and power required to drive the pump. (12 marks)

Question Four

- a) Distinguish between fans, blowers and compressors in terms of pressure rise and volume flow rate. (6 marks)
- b) A single stage double acting compressor has a free air delivery of $15\text{m}^3/\text{min}$ measured at 1.013bar and 15°C . The pressure and temperature in the cylinder during suction are 0.95 bar and 32°C . the delivery pressure is 7 bar and index of compression, $n = 1.3$. The clearance volume is 5% of swept volume. Calculate indicated power required and volumetric efficiency. (10 marks)
- c) Explain four features to be considered while selecting fans. (4 marks)