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KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2019/2020 ACADEMIC YEAR

THIRTY YEAR SECOND SEMESTER
SPECIAL/SUPPLIMENTARY EXAMINATIONS

FOR THE DEGREE OF BSC (RENEWABLE ENERGY AND BIOFUEL SYSTEMS)

COURSE CODE: *IPT 327*

COURSE TITLE: *HEAT AND MASS TRANSFER*

DURATION: 2 HOURS

DATE: ~~2020~~ TIME: ~~9-11AM~~ 4/02/21 8-10Am

INSTRUCTIONS TO CANDIDATES

- Answer **QUESTION ONE** (Compulsory) and any other two (2) Questions.
- Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page.

This paper consists of **3** printed pages. Please Turn Over

1, A. Derive the one dimensional heat diffusion equation. (5mks)

B. Describe the following as applied to heat and mass transfer

i. Heat flux 4mks
ii. Thermal conductivity 3mks
iii. Steady – state conditions 3mks

C. Briefly, explain the following;

i. Forced induction 5mks
ii. Free – natural convection 5mks
iii. Combined (mixed) 5mks

2a) A thermocouple bead is largely solder, 1mm diameter. It is initially at room temperature and is suddenly placed in a 200°c gas flow. The heat transfer coefficient is 250w/m2k and the effective values of K, P, C are 45w/m.k, 9300kg/m^3 and c=0.18 kj/kg.k, respectively. Evaluate the response of the thermocouple. (10mks)

b) Ablack thermocouple measures the temperature in a chamber with blackwalls. If the air around the thermocouple is at 20°c, the walls are at 100°c and the heat coefficient between the thermocouple and air is 15w/m^2k. What temperature will thermocouple read? (10mks)

3) a)An uninsulated steam pipe passes through a room in which air and walls are at 25°c. the outside diameter of the pipe is 70mm and its surface temperature and emissivity are 200°c and 0.8, respectively. What are the surface emissive power and irradiation? If the coefficient associated with free convection heat transfer from the surface to the air is 15w/m^2.k, what is the rate of heat loss from the surface per length of pipe? (10mks)

b)The front of a slab of load k=35w/m.k is kept at 110°c and the back is kept at 50°c. If the area of the slab is 0.4m^2 and it is 0.03m thick. Compute the heat flux and heat transfere rate.(10mks)

4) a)A copper slab k=372 w/m.k is 3mm thick. If it is protected from corrosion by a 2mm thick. If is protected from corrosion by 2mm thick layers of stainless steel k=17w/m.k on both sides. The temperature is 400°c on one side of this composite wall and 100°c on the other. Find the temperature distribution in the copper slab and heat conduction through the wall. (10mks)

b)The heat flux is 6000w/m^2 at the surface of an electrical heater. The heater temperature is 120°c when it is cooled by air at 70°c. What is the average convective heat transfer coefficient? What will the heater temperature be if the power is reduced so that is 2000w/m^2? (10mks)