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LEVEL 4

STUDENT NAME:

SEMESTER 2

MODULE CODE: M4X00386
Engineering Science 2

ASSESSMENT TYPE: COURSEWORK

ASSESSMENT/COMPONENT: 2 / 2

COMPONENT WEIGHTING: 30 %

MODULE TUTOR: Dr R Kadhim + Dr A Marotin

Attempt all questions

SUBMISSION DETAILS:

Date set: 24th April 2020

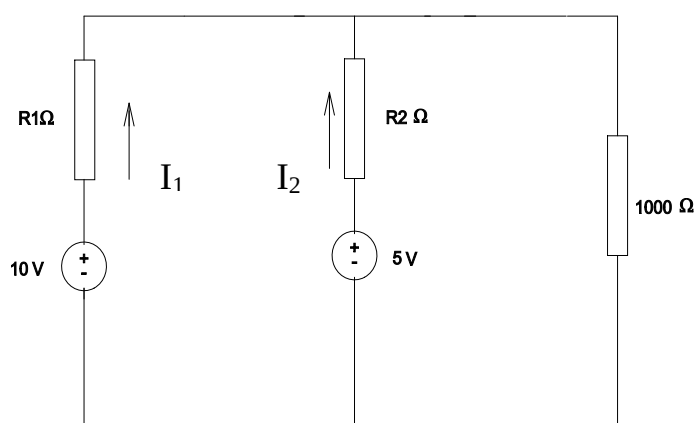
Date to submit: 1st June 2020 at 9am through Turnitin

QUESTION ONE (20 marks):

For the circuit below, use **Superposition Theory** to determine the current flowing through the 1000Ω , then use **Kirchhoff's laws** to verify your calculations.

(The table below shows individual component values to be used by each student).

Student	1	2	3	4	5	6	7	8
R1 (Ω)	200	250	300	200	250	300	200	250
R2 (Ω)	15	20	25	30	15	20	25	30

**QUESTION TWO (15 marks):**

- a) A coil having a resistance of 100Ω and an inductance of 0.05H is connected in series with a capacitor of $C_1\mu\text{F}$ to a 100V , 50Hz supply. Determine:
- The supply current (magnitude and phase angle)
 - The voltage across the capacitor
 - The voltage across the coil

Student	1	2	3	4	5	6	7	8
C1 (μF)	100	120	140	160	100	120	140	160

- b) A series R-L-C circuit consists of a resistance 12Ω , inductance 0.012H and capacitance $C_2\text{nF}$ is connected to a 50mV a.c supply. Determine:
- The resonant frequency
 - The potential difference across the inductor and capacitor at resonance

Student	1	2	3	4	5	6	7	8
C2 (nF)	15	16	18	10	11	12	15	16

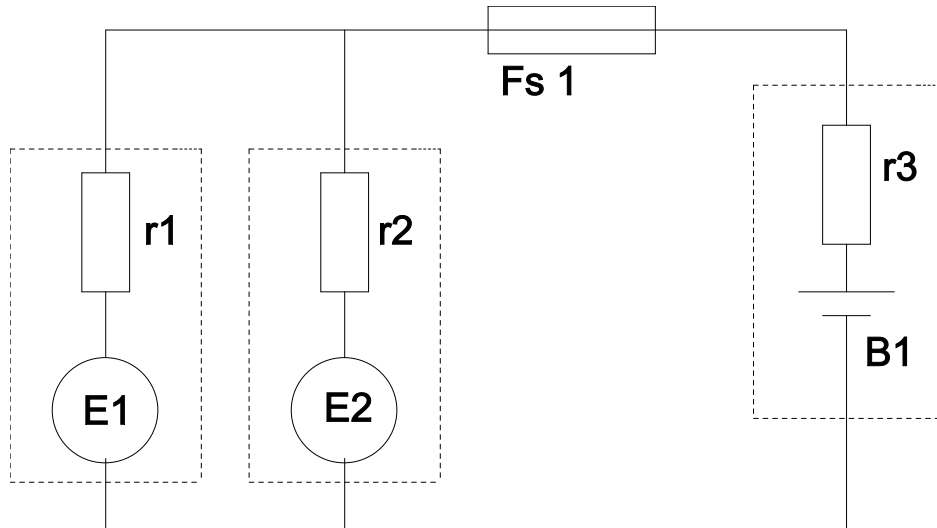
QUESTION THREE (15 marks):

A charging circuit for a critical system on board an aircraft has been designed such that two chargers are connected in parallel to provide resilience in case of a single failure. The chargers each provide a charging voltage of 14V. The resistances r_1 and r_2 represent the total internal resistance of the individual charger along with the resistance of the connecting cable. The battery to be charged has an internal resistance r_3 along with a terminal voltage B_1 . A fully discharged battery may have a terminal voltage of 11V

In order to protect the charger circuit, a fast acting fuse Fs_1 has been placed in series with the battery. The rating of the fuse is provided below.

Apply relevant circuit theory in order to evaluate whether the rating of the fuse is appropriate.

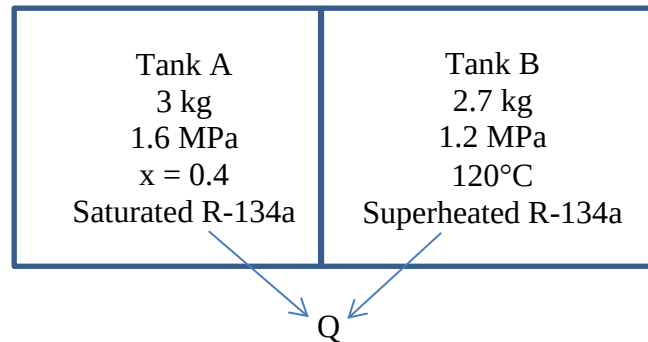
Student	1	2	3	4	5	6	7	8
$r_1 (\Omega)$	0.21	0.22	0.23	0.24	0.25	0.26	0.27	0.28
$r_2 (\Omega)$	0.31	0.22	0.23	0.24	0.25	0.26	0.27	0.28
$r_3 (\Omega)$	0.041	0.042	0.043	0.044	0.045	0.046	0.047	0.048
$Fs_1 (A)$	18.05138	19.73684	18.98734	18.29268	17.64706	17.04545	16.48352	15.95745



QUESTION FOUR (25 marks): Closed System

Two tanks (Tank A and Tank B) are separated by a partition. Initially, Tank A contains 3 kg of saturated liquid-vapour mixture refrigerant R-134a at 1.6 MPa and a quality value of 0.4. Tank B contains 2.7 kg of refrigerant R-134a in the superheated state at 1.2 MPa and 120°C. Now the partition is removed and the two sides are allowed to mix until the mechanical and thermal equilibrium are established. If the pressure at the final state is 900 kPa, determine,

- The quality of the refrigerant at the final state.
- The amount of heat lost from the tanks.

Schematic:**Assumptions:**

- Kinetic and potential energy changes are negligible.
- There are no work interactions.
- Tables A-12, and A-13 are required.
- In a saturated liquid-vapour mixture, the mass fraction of vapour is called the *quality* and is expressed as:

$$x = \frac{m_{vapour}}{m_{total}}$$

Quality may have values between 0 (saturated liquid) and 1 (saturated vapour). It has no meaning in the compressed liquid or superheated vapour regions. In the saturated mixture region, the average value of any intensive property y is determined from:

$$y = y_f + x \cdot y_{fg}$$

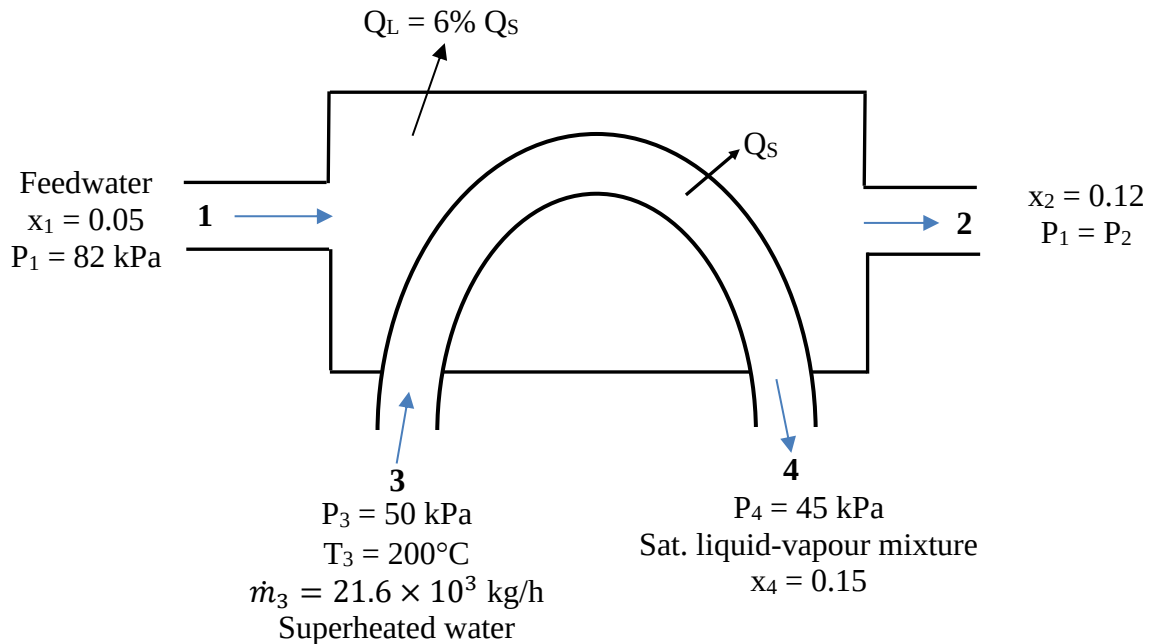
where f stands for saturated liquid, g for saturated vapour and y stands for v , u or h .

- For specific volume, $v_{fg} = v_g - v_f$

QUESTION FIVE (25 marks): Steady-Flow Open System

In large steam power plants, the feedwater is frequently heated in closed feedwater heaters, which are basically heat exchangers, by steam extracted from the turbine at some stage. Steam enters the feedwater heater as superheated water at 50 kPa, 200°C and a mass flow rate of 21.6×10^3 kg/hr, and leaves as saturated liquid-vapour mixture at 45 kPa and a quality of 15 percent. Feedwater enters the heater with a quality of 5 percent at 82 kPa and leaves with a quality of 12 percent at the same pressure. If the heat losses from the outer surfaces of the heater are 6% of the heat given up by the steam, determine,

- The heat transfer rate from the steam to the feedwater.
- The mass flow rate of the feedwater $\dot{m}_w$.

Schematic:**Assumptions:**

- Steady-flow process.
- Kinetic and potential energy changes are negligible.
- There are no work interactions.
- The properties of saturated and superheated water can be found in Tables A-5 and A-6.
- In a saturated liquid-vapour mixture, the mass fraction of vapour is called the *quality* and is expressed as:

$$x = \frac{m_{\text{vapour}}}{m_{\text{total}}}$$

Quality may have values between 0 (saturated liquid) and 1 (saturated vapour). It has no meaning in the compressed liquid or superheated vapour regions. In the saturated mixture region, the average value of any intensive property y is determined from:

$$y = y_f + x \cdot y_{fg}$$

where f stands for saturated liquid, g for saturated vapour and y stands for v , u or h .