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ICT Centre of Excellence

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND COMMUNICATION ENGINEERING
SECOND SEMESTER 2014/2015 EXAMINATIONS

THIRD YEAR FIRST SEMESTER EXAMINATION DEGREE OF BACHELOR OF SCIENCE IN TELECOMMUNICATION AND INFORMATION ENGINEERING

ETI 2303: INSTRUMENTATION AND MEASUREMENTS

DAY/ DATE: MONDAY 17.12. 14   TIME: 8.30-10.30AM   VEN: LR4

Instructions:

- This paper consists of **Five** questions.
- Answer question **One** and any other **TWO**
- Phones and any unauthorized materials not allowed in exam room

QUESTION ONE.

$emf = R_m + R_e + R_s$

(a).   A thermocouple circuit uses a Chromel-Alumel thermocouple which gives an e.m.f. of 35.4mV when measuring a temperature of 800^0C, with reference temperature 0^0C. The resistance of the meter coil R_m is 50Ω and a current of 0.1mA gives full scale deflection. The resistance of junction and leads, R_e *is* 12Ω. Calculate:

   (i)   Resistance of the series resistance if a temperature of 800^0C is to give full scale deflection. *[2 marks]*

   (ii)   The approximate error due to rise of 1.25Ω *in* R_e *[3 marks]*

   (iii)   The approximate error due to rise of 10^0C in the copper coil of the meter. The resistance temperature co-efficient of coil is $0.0045/^0C$ *[3 marks]*

(b).   Define the following primary standards SI units of measurements. *[6 marks]*

   (i).   Meter

   (ii).   Mole

   (iii).   Kilogram

(c).   Highlight *four* advantages of an intelligent medical instrumentation system to a Medical Cardiologist Surgeon. *[8 marks]*

1

(d). A resistance having a true value of $1k\Omega$ is measured using a voltmeter of resistance $10k\Omega$ and an ammeter of resistance 10Ω. If the supply used has an e.m.f of $6\,V$, calculate the percentage error in the measured value using the two possible instrument connections. *[8 marks]*

QUESTION TWO.

(a). Give *two* main differences and *two* main similarities between tachogenerators and Linear Variable Differential Transformers (LVDT) transducers. *[4 marks]*

(b). An analogue electrical indicating instrument has a moving coil of 4Ω resistance and gives full-scale deflection when carrying a current of $75mA$. Explain, with the aid of sketches, how the instrument may be used to indicate at full-scale deflection of (i) a current of 10A and (ii) a p.d. of 100V. *[6 marks]*

(c). Differentiate *clearly* the following terms as used in instrumentation systems. *[10 marks]*

    (i). Analogue recorder from digital recorder

    (ii). Signal conditioning from signal processing

    (iii). Active transducer from passive transducer

    (iv). Resolution from threshold of an instrument.

    (v). *Reference Standard* from *Working Standard* with reference to meteorological standards

QUESTION THREE

(a). It is difficult if not impossible to carry out space research (exploration) without data telemetry. Discuss this school of thought. *[5 marks]*

(b). In a balanced bridge network, AB is a resistance of 500Ω in series with an inductance of $0.18H$; BC and DA are non-inductive resistances of 1000Ω; and CD consists of a resistance R in series with a capacitance C. A potential difference of 5 volts at a frequency of $5000/2\pi\,Hz$ is established between the points A and C. ~~Draw to *scale* a phasor diagram showing the currents and potential difference in the bridge and from it~~ determine the values of R and C. *Check* the result algebraically. *[15 marks]*

QUESTION FOUR.

(a). Explain the significance of using bridges in electrical measurements. *[5 marks]*

(b). An aircraft is a complicated vessel used for air transport. To enable safe flight a lot of measurement must be made through complicated instrumentation systems in and out of the aircraft. You have been employed as a fresh Engineer in-charge of the aircraft instrumentation systems in Kenya Airways K LTD (KQ). Explain systematically as an intelligent fresh Engineer how and what you should study to fit your job within the shortest time possible. *[10 marks]*

(c).   A strain gauge is bonded to a beam 0.1m long and has a cross sectional area 4 square cm, Young Modulus for steel is $207\,GN/m^2$. The strain gauge has an unstrained resistance of 240 Ohms and a gauge factor of 2.2. When a load is applied the resistance of gauge changes by 0.013Ω. Calculate the change in length of the steel beam and the amount of force applied to the beam. *[5 marks]*

QUESTION FIVE X

(a).   Highlight *three* main problems encountered in Telemetry systems used in Telemedicine applications. *[6 marks]*

(b).   Define what is a *dead zone* in an instrument. Hence elaborate any *two* causes of dead zones and discuss suitable ways used to reduce these problems. *[6 marks]*

(c).   (i).   State three main application of instrumentation systems. *[3 marks]*

        (ii).   Using a block diagram name and explain the basic elements of a generalized telemetering instrumentation system. *[5 marks]*