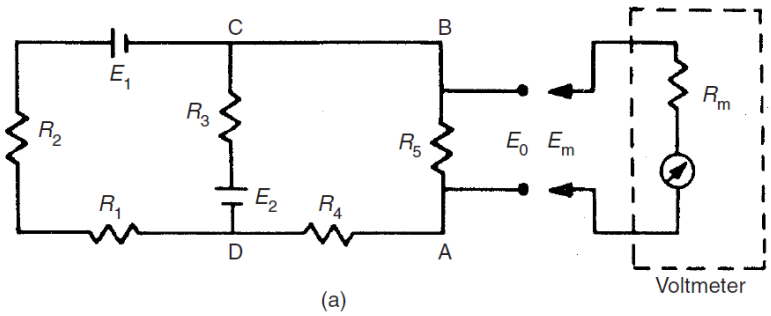
FEDERAL UNIVERSITY OF TECHNOLOGY OWERRI,
SESET, EEE DEPARTMENT.
COURSE CODE: ECE 508. COURSE TITLE: DIGITAL INSTRUMENTATION.
RAIN SEMESTER EXAMINATION 2020/2021 SESSION. TIME: 2 HRS
INSTRUCTION: ANSWER 4 QUESTIONS, 2 FROM EACH SECTION

SECTION A QUESTION 1

(a) State five advantages of Digital instruments over Analog instruments? [5 marks]
(b) Draw the basic block diagram of Digital Time measurement and how does it measure frequency? [5 marks]
(c) Explain with the help of a block diagram the operation of a Digital Frequency Meter? [10 marks]

QUESTION 2

(a) List and explain the four (4) types of measurement errors? [8 marks]
(b)



(a)

From the diagram above, R1= 400Ω, R2= 600Ω, R3= 1500Ω, R4= 400Ω, R5= 400Ω. The voltage across AB is measured by a voltmeter whose internal resistance is 7000. What is the measurement error caused by the resistance of the measuring instrument? [5 marks]

(c) (i) The current I flowing in a resistor R is measured by a 0–5A ammeter which gives an indication of 3.8A. The voltage V across the resistor is measured by a 0–30V voltmeter, which gives an indication of 18.5V. Determine the resistance of the resistor, and its accuracy of measurement if both instruments have a limit of error of 2% of f.s.d. Neglect any loading effects of the instruments. [5 marks]

(ii) A voltmeter measurement gave a systematic error of 4% and random error of 3%. Statistically what is the combined effect of the systematic error and random error? [2 mks]

QUESTION 3

(a) i) Define the following terms: Precision, accuracy, repeatability, reproducibility. [4 marks]

ii) Explain the 3 major sources of noise in a measurement system? [6 marks]

(b) i) With the aid of a diagram describe the working principle of a Digital Phase Meter. [7 marks]

ii) With an example differentiate between Systematic and Random Errors. [3 marks]

SECTION B QUESTION 4

(a) State the application of the following Test Instruments: (i) Manufacturing Defect Analyzer (ii) JTAG Boundary Scan Tester (iii) Functional Automatic Test equipment (iv) Rack and Stack Test equipment and (v) Functional Testing equipment [10 marks]
(b) Give five advantages of Automatic Optic Inspection over manual inspection [5 marks]
(c) Briefly describe an AOI [5 marks]

QUESTION 5

(a) Show with a block diagram only how temperature can be measured using a microprocessor based electrical monitoring system [5 marks]
(b) State five limitations of FFT Spectrum Analyzer [5 marks]
(c) An FFT Spectrum Analyzer was set to sample a 40KHz signal at rate of 6sec and using a 10-bit converter. Determine the (i) resolution (ii) frequency displayed on the screen (iii) DR [5 marks]
(d) Show how an op-amp can be configured to perform a mathematical operation of Integration [5marks]

QUESTION 6

(a) List five basic components of DAS and their functions [10 marks]
(b) What are the main task of a signal conditioning system [5marks]
(c) List two main purposes of amplification in signal conditioning process [2 marks]
(d) What are the different processes for isolation of field instrument from DAQ system? [3 marks]

FEDERAL UNIVERSITY OF TECHNOLOGY, OWERRI.
SCHOOL OF ELECTRICAL SYSTEMS ENGINEERING AND TECHNOLOGY.
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING.
RAIN SEMESTER EXAMINATION 2021/2022 SESSION.
ECE 508. DIGITAL INSTRUMENTATION
INSTRUCTION: ANSWER SECTION A AND 2 FROM SECTIONS B AND C . TIME: 3 HRS

***Do not solve or write anything on this question paper please

SECTION A

1. The function of data acquisition system includes sending signal to the real world [A] True [B] False
2. Identify the element which is not part of a data acquisition system [A] DAC [B] Filter [C] Display [D] Timer
3. Which ADC has highest conversion time? [A] Flash type [B] Dual slope integrating [C] Successive approximation [D] Ramp/Counting
4. The function of notch filter is to pass a particular band of signal [A] True [B] False
5. If a signal has a bandwidth of 20 Hz to 20 KHz, what will be the minimum sampling frequency to acquire the signal so that the signal can be reproduced properly? [A] 20KHz [B] > $20KHz$ *but* < $20KHz$ [C] < $20KHz$ [D] > $20KHz$
6. Which may not be the feature of a data acquisition application software? [A] manage the data stored in computer memory [B] Plot acquire data [C] Report relevant information such as the number of samples acquired [D] Acquire data from real world
7. The main function of a DAQ hardware is to convert analog signal to digital signal and vice versa [A] True [B] False
8. Sensor signals are often not compatible with DAQ hardware. [A] True [B] False
9. In nature, what is the main characteristics of physical variables?
10. One instrument used to characterize the dynamics of a DUT is called …….
11. The circuit generally used in digital instruments to convert sine waves into rectangular pulses is_____
12. What is the minimum value of the sample frequency to the maximum frequency component of the analogue signal?
13. Analogue signals are digitized by_____
14. For phase difference measurement input signals must have _____ frequencies?
15. ..... supplies the reference frequency signal?
16. For higher accuracy of clock oscillators the are kept in what condition?
17. What is the function of a time base selector??
18. Which type of error is taken care of by repeating the measurement a number of times?
19. Errors that occur due to wrong use of instruments is called??
20. Output of a digital meter is _____?

SECRION B

QUESTION 1

a. What does the transfer function of a system describe for the system? [2 marks]
b. What is the use of a Transfer Function and what is the transfer function of an electronic filter? [3 marks]
c. What is a Frequency Response Analyzer? [5 marks]
d. List the different signal condition units of a DAQ [5 marks]
e. Explain how a DAQ is excited [5marks]

QUESTION 2

a. Briefly describe the following: [i] an Automatic Test Equipment and [ii] Automatic Optical Inspection [10 marks]
b. A ramp ADC system uses a 10MHz clock generator and a ramp voltage that increases from 0V to 1.25V in a time of 125 ms. Determine the number of clock pulses counted into the register when V= 0.9V and when it is 0.75V [10 marks]

QUESTION 3

a. What is the different processes for isolation of a field instrument from DAQ hardware? [3 marks]
b. State five functions of a driver software [5 marks]
c. State the rule of Nyquist Criterion [2 marks]
d. With sketches describe the functions of band pass and band stop filters [5 marks]
e. An 8-bit ADC is converting a temperature signal which has a measuring range of 0 to 800 degrees Celsius. Calculate the resolution of the temperature measuring instrument [5 marks]

SECRION C

QUESTION 4

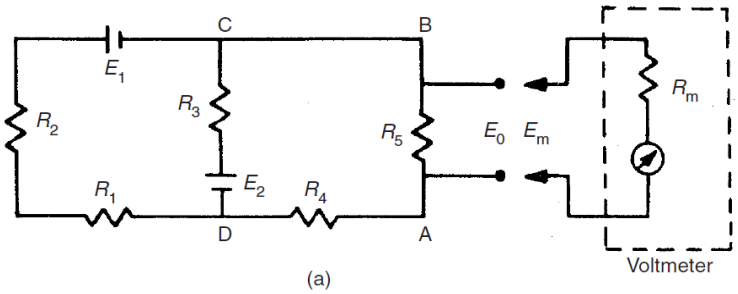
a. Explain the following terms associated with digital measurement; calibration, accuracy, precision, resolution and range. [5 marks]
b. State five (5) advantages of Digital instruments over Analog instruments? [5 marks]
c. Explain with the help of a block diagram the operation of a digital frequency meter. [10 marks]

QUESTION 5

a. Differentiate between application error and random error; give examples of each type and state ways to overcome the effects of these types of errors. [5 marks]
b. Draw the block diagram of a Digital period measurement and how does it measure frequency? [5 marks]
d. Draw the block diagram of a digital phase meter and describe the various functional parts. [10 marks]

QUESTION 6

a. The current flowing through a resistor of 8kΩ±0.2% is measured at 4mA with an accuracy of measurement ±0.4%. Determine the nominal value of the voltage across the resistor and its accuracy. [4 marks]
b. The current I flowing in a resistor R is measured by a 0–5A ammeter which gives an indication of 3.6A. The voltage V across the resistor is measured by a 0–25V voltmeter, which gives an indication of 17V. Determine the resistance of the resistor and its accuracy of measurement if both instruments have a limit of error of 2% of f.s.d. Neglect any loading effects of the instruments. [5 marks]
c. A voltmeter measurement gave a systematic error of 4% and random error of 3%. Statistically what is the combined effect of the systematic error and random error? [3 marks]
d.



(a)

From the diagram above, R1= 500Ω, R2= 400Ω, R3= 1400Ω, R4= 500Ω, R5= 600Ω. The voltage across AB is measured by a voltmeter whose internal resistance is 7000. What is the measurement error caused by the resistance of the measuring instrument? [8 marks]

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FEDERAL UNIVERSITY OF TECHNOLOGY, OWERRI,
SCHOOL OF ELECTRICAL SYSYEMS ENGINEERING TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING
ECE 508: Digital Instrumentation, 2022/2024 Rain Semester Examination: Units: 3
Instructions: Answer Section A and 2 Each from Sections B and C, Date: 08/04/2024: Time Allowed: 3HRS

Avoid exam malpractice(s): Please, do not solve or write anything on this question paper

SECTION A

(1) One of the functions of data acquisition system (DAS) is sending signals to the real world [A] True [B] False
(2) Identify the element which is not part of a DAS [A] DAC [B] Filter [C] Display [D] Timer
(3) Which ADC has highest conversion time? [A] Flash type [B] Dual Shape Integrator [C] Successive Approximation [D] Ramp/Counting
(4) It is appropriate to have signal conditioning before analog-to-digital conversion [A] True [B] False
(5) Sensor signals are often not compatible with data acquisition hardware [A]True [B] False
(6) AI subsystem is another name for analog-input subsystem [A] True [B] False
(7) The function of a Notch filter is [A] pass high frequency signals [B] pass low frequencies [C] pass a particular band of frequencies [D] None of the above
(8) One of the main functions of Application Software is to allow access multiple data acquisition boards [A] True [B] False
(9) Which of these is the function of a Data Logger? [A] Inline analysis [B]User defined functionality [C] Real-time visualization [D] All of the above [E] None of the above
(10) The FFT Spectrum Analyzer does not perform true continuous transform. Why? ----------
(11) For a digital frequency meter what device generates the known frequency signal?_____
(12) What is the minimum value of the sample frequency to the maximum frequency component of the analogue signal?
(13) What device converts sine waves to pulse trains?
(14) For phase difference measurement input signals must have _____ frequencies?
(15) For repeatability and reproducibility of a measurement instrument what factor does not change?
(16) Clock oscillators are kept in what condition to ensure accurate output?
(17) What does the time base selector do in a digital frequency meter?
(18) Which type of error is taken care of by repeating the measurement a number of times?
(19) Errors that occur due to wrong use of instruments is called??
(20) Output of a digital meter is _____?

SECTION B

QUESTION 1

(a) List the multiple subsystems that make up Multifunction Board of a DAS [4 marks]
(b) What are the functions of a signal conditioning system of a DAS [5marks]
(c) Show using a circuit diagram only the implementation of an active low pass filter [1 mark]
(d) A Ramp-type ADC system uses a 10 MHz clock generator and Ramp voltage that increases from 0V to 1.25 V in a time of 125ms. Determine the number of clock pulses counted in the Register when the voltage is (i) 0.9V and (ii) 0.75V [10 marks]

QUESTION 2

(a) Explain the term Quantization as applicable in DAS and list the primary types of ADCs found in the System [6 marks]
(b) An 8-bit converter has V_{ref}= 5V and $-V_{ref}$= 0V (ref voltage). What is the output voltage when B_{in} = 10110100*?* Find also the V_{LSB} [4 marks]

(c) With the aid of a schematic diagram of an Op-amp, show that the open loop gain at the output is obtained by $V_{out} = AV_d$. If the openloop gain is 100,000 and the supply voltage is 15V, what will be the value of V_d to avoid overload of the Op-amp? [10marks]

QUESTION 3

(a) The temperature of a cubicle is to be monitored by energy-conversion method. Design using a block diagram only, a Thermocouple-based Microprocessor measuring instrument capable for use as temperature measuring device. [5marks]

(b) Briefly describe the functions of any five units used. [5marks]

(c) List the limitations of a Fourier Transform Spectrum Analyzer [5marks]

(d) Find the resolution, frequency, pulse rate and the Dynamic Range for an input signal sampled for 5s at a rate of 40KHz and an 8-bit conversion. [5marks]

SECTION C

QUESTION 4

(a) Explain the five modes of operation for a decade counter. [5 marks]

(b) State five (5) advantages of Digital instruments over Analog instruments? [5marks]

(c) Explain with the help of a block diagram the operation of a digital frequency meter. [10 marks]

QUESTION 5

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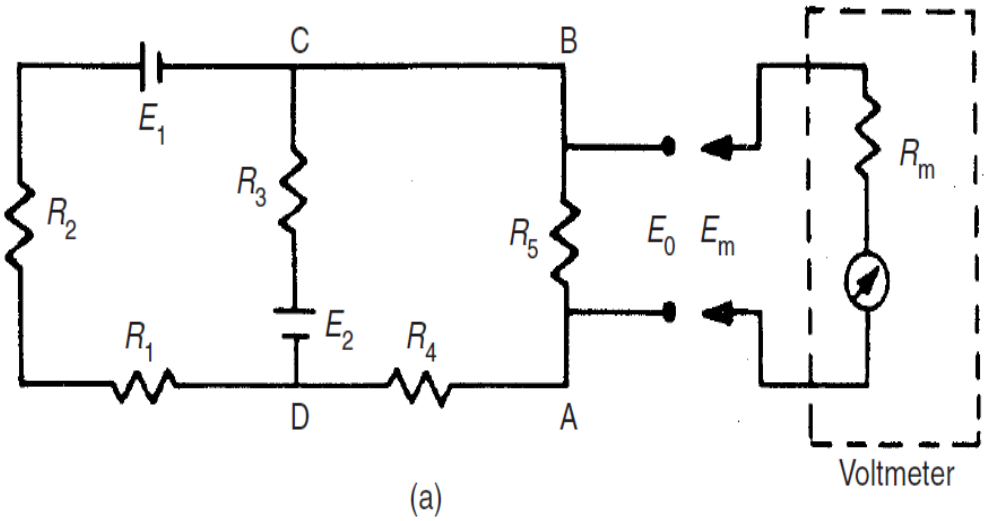

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