

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEI	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Instrumentation (EX 504)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.



1. a) Define measurement system. Explain it with the help of a block diagram. [4]
- b) List out the applications of a data logger. [2]
2. Explain the static and dynamic parameters in measurement. What are causes of errors in measurement? [2+6]
3. Classify the transducer on the different basis used. An LVDT is used for measuring the deflection of a bellows. The sensitivity of LVDT is 40 V/mm. The bellows is deflected by 0.125 mm by a pressure of $0.8 \times 10^6 N/m^2$. Determine the sensitivity of LVDT in V per N/m^2 and pressure when output of LVDT is 3.5 V. [4+4]
4. What are the different PC interfacing techniques? Explain. [4+4]
5. The base address of a 8255 PPI card is 60H.
 - a) Identify the port addresses and address of control register. [2]
 - b) Identify the Mode 0 control word to configure port A as an input port and port B as an output port. [2]
 - c) Write a subroutine program to read the DIP switches connected at port A and display the reading at port B. Also, draw the interfacing diagram for this arrangement. [4]
6. How can you transmit data over telephone line? Explain with suitable diagram and handshaking signals. Also differentiate between asynchronous and synchronous serial data transmission. [5+3]
7. Explain the operation of successive approximation type ADC. Now calculate the digital output for analog input of 5.5V to the successive approximation type ADC with reference voltage 8V and resolution of 4-bit. [3+2]
8. What is ESD? What are methods you can use to prevent the dangers from Electric Static Discharge? [1+4]
9. Explain how can you convert the requirements into design. Define the reliability of the circuit design. [3+2]
10. Introduce PCB. What are the factors to be considered while routing tracks in PCB? [1+4]
11. Why software designing metrics are important in software development? Explain the different types of metrics that quantify software development. [2+3]
12. What is the purpose of Energy meter? Describe the working principle of dynamometer type Wattmeter. [5]
13. Explain your industrial visit carried out on your case study in terms of existing system circumstances, problem identification and analysis, recommendation plan, requirement and feasibility analysis of recommended plan with suitable block diagram. [8]

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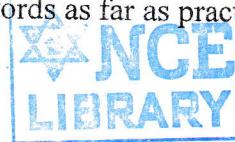
1. What is an instrumentation system? Explain various components of a measurement system with the help of a block diagram. [1+3]
2. When are Maxwell's bridge and Hay's Bridge used? Which AC bridge is used for the measurement of capacitance? Also, derive its balanced condition. [6]
3. Differentiate between sensors and actuators. A strain gauge is bonded to a beam that is 16 cm long and has a cross-sectional area of 4 cm^2 . The unstrained resistance of the strain gauge is 300Ω and the gauge factor is 2. There is a change in resistance of 0.015Ω on the application of load. If the modulus of elasticity for steel is 207 GN/m^2 , calculate the amount of force applied on the beam and the change in length the steel beam. [2+4]
4. Differentiate between open loop system and closed loop system with examples. [4]
5. What is the control word format for MODE2 programming? Explain the input and output operation in MODE 1 with proper timing diagram and control signals. [2+6]
6. How is USB different than OTG? Justify the statement, "USB offers great expandability" with proper examples and diagrams. [2+6]
7. Explain the errors associated with ADC and DAC. [5]
8. Is data storage, data backup and data archiving the same thing? Explain with examples. [4]
9. What is electrostatic discharge? What guidelines can be adopted for protection against ESD? [2+6]
10. What is fault tolerance? What are the approaches to fault tolerance? [5]
11. What is a decoupling capacitor and a bypass capacitor? If you are designing a low frequency circuit, what kind of grounding method will you prefer and why? [2+2]
12. What is a good programming practice? Explain in brief. [5]
13. Explain the working of frequency meter. [5]
14. In your case study, what are the problems you identified in the current plant/process. Give recommendations/suggestions from your side and draw the block diagram of the proposed system. [8]

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1. a) With block diagram, describe characteristics of data logger. [4]
- b) Differentiate analog and digital system. [2]
2. a) Explain the measurement of inductance using Maxwell's Bridge. [5]
- b) A voltmeter whose accuracy is 2% of the full-scale reading is used on its 0-50V scale. It is used to measure a voltage of 15V and 42V. Calculate the possible error of both readings and comment on your answer. [3]
3. What is inverse transducer? Explain the working principle of Linear Variable Differential Transformer (LVDT) with neat diagram. [7]
4. Explain different PC interfacing techniques. [4]
5. The 8255A PPI is mapped with 8085 microprocessors in mode 0. The address captured by the 8255A card is 4004H to 4007H. Input is taken from switches from part A and port C upper and displayed at port B and Port C lower. Find the port address of each port. Draw an interfacing circuit. Write a program for the given operation. [1+3+3+2]
6. What are the different errors in serial transmission? Explain in brief. Explain how data communication can exist between two computers using RS 232. [3+5]
7. Explain the working of R-2R ladder type DAC with example. [5]
8. What are the different noise coupling mechanism? Explain how they affect the circuit and what are the remedial approach. [5]
9. Write an importance of decoupling, ground bounce, cross talk and impedance matching in designing circuit. [5]
10. List the general rules for component placement. Explain how can you eliminate the crosstalk effect in the circuit. [5]
11. What is software reliability? Compare waterfall and prototyping model. [2+3]
12. Explain the working principle of energy meter and show that number of revolutions is directly proportional to energy consumption. [5]
13. Describe the different processing plants that you have studied in your case study. With neat and clean diagram, explain how the further improvement of these plants can improve the performance of the overall system. [8]

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1. a) Define Measurement and Measurement System. [3]
- b) What are the characteristics of Bluetooth communication? [3]
2. a) A voltmeter whose accuracy is 2% of the full-scale reading is used on its 0-50V scale. It is used to measure a voltage of 15 V and 42V. Calculate the possible error of both readings. Comment on your answer. [3]
- b) Describe the measurement of inductance using Maxwell Bridge. [3]
3. What is the loading effect of the potentiometer? Show that the error will be maximum when the potentiometer slider is at potentiometer's midpoint. [5]
4. Draw and explain the block diagram of the closed-loop microprocessor-based instrumentation system. [8]
5. Assume that your group has decided to make microprocessor based instrumentation system for a cookies factory using an 8255 PPI card at base address 6000H in memory mapped I/Q mode for controlling purpose. You need to measure 3 temperature points and 1 pressure point. [4]
 - a) List out collected documents and components. [1]
 - b) List out different signals you need to drive and or can be directly connected to your interfacing circuit. [1]
 - c) Draw minimum mapping circuit for above system. [1]
 - d) What are addresses captured by your card? Generate the control word for the system. [1]
 - e) Write a program module for measuring temperature and control if the temperature is not in the range. Assume suitable data if necessary. [1]
6. What do you understand by bit rate and baud rate? How can we exchange data between two Data terminal equipment using Rs232 serial interface? [2+6]
7. Describe the successive approximation method of analog to digital (A/D) conversion, taking an example of a 4-bit converter with a full range of 5V and input of 3.225V. [5]
8. What are the different noise coupling mechanism? How can you reduce the conductive noise coupling? [2+3]
9. Explain how we can avoid many failures that may occur on the circuit by using careful design, testable function and redundant architecture. [5]
10. What is trace density? How can you reduce crosstalk while routing signal traces in a PCB? [5]
11. A software company is planning to build new software useful for educational institutes to improve online teaching and learning activities. Which software development model do you suggest for them? Explain the procedure, advantages and limitations of the recommended software development model. [5]
12. Explain in details about ferrodynamic type frequency meter. [5]
13. Explain the existing instrumentation system of the industry involved in your case study. What was your recommendation for further improvement of the system? What are the advantages and limitations of the recommended system? [8]

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1. a) Explain different working environment of an instruments. [3]
- b) Sketch the block diagram of data acquisition system. [3]
2. a) Explain the measurement of capacitance using Schering Bridge. [4]
- b) A moving coil ammeter has a uniform scale with 50 divisions and gives full scale reading of 5A. The instrument can read upto one-fourth of the full scale division with a fair degree of certainty. Determine the resolution of instrument in mA. [4]
3. Describe loading effect in a potentiometer and discuss the methods to reduce loading effect in a potentiometer. Also prove that linearity and sensitivity are two conflicting requirements in a potentiometer. [8]
4. What are the benefits of microprocessor based system? [4]
5. The address captured by 8255 PPI are C0C0H to C0C3H. Sketch the interfacing circuit with 8085 microprocessor in memory mapped I/O for same. What will be the control words for following configurations of 8255 PPI? [2+2+2+1+1]
 - a) Port A: Mode 0 output
Port B: Mode 0 input
Port C: Mode 0 output
 - b) Port A: Mode 1 output
Port B: Mode 1 input
PC_{4,5}: Output
 - c) Port A: Bidirectional
Port B: Mode 1 output
 - d) Set PC₅ in BSR mode
6. a) Describe the functions of RS232C signals used in handshaking. [4]
- b) What is Enumeration in USB protocol? Describe different types of packets used in USB Protocol. [4]
7. Explain how do you interface a 10-bit DAC with 8085 in detail. [5]
8. Explain the different types of filtering mechanism used to reduce conductive noise coupling based on frequency. [5]
9. Explain reliability and fault tolerance in the context of circuit design. [5]
10. Explain the general rules to follow while doing the component placement. List out the factors that should be considered in routing the signal traces on printed circuit board (PCB). [3+2]
11. Explain about spiral model of software development life cycle in detail. [5]
12. Explain the construction and working principle of dynamometer type single phase power factor meter. [5]
13. Draw the complete block diagram of the industrial process control involved in your case study. What are the critical factors affecting the production you have noticed in the visited industry and what are the measures can you suggest for the same? Also mention advantages and disadvantages of suggested system. [8]

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1. a) Define analog and digital signals. Differentiate between analog and digital systems. [1+3]
b) What is a data logger? What are its applications? [2]
2. a) Distinguish between static and dynamic characteristics of a measurement system. Describe various parameters used to study these characteristics. [4]
b) Explain quality factor in Maxwell's bridge? Why is it not suitable to use a Maxwell bridge for measuring the inductance of a large quality factor ($Q > 10$)? [4]
3. a) Explain the working principle of LVDT for the measurement of displacement.
b) A capacitive transducer is made up of two concentric cylindrical electrodes. The outer diameter of inner electrode is 5 mm and the dielectric medium is air. The inner diameter of outer electrode is 5.1 mm. Calculate the dielectric stress when a voltage of 120V is applied across the electrode. Is it within the safe limit? The length of electrode is 20mm. Calculate the change in capacitance if electrode is moved through a distance of 2 mm. The breakdown strength of air is 4 kV/mm. [4]
4. Design an interface arrangement for 8085 microprocessor to map output ports in address space 85 H and input ports in address space 89 H. [4]
5. A dairy factory uses an 8255 PPI card at base address 5000 H.
 - a) Explain how port address is changed with the change in address lines of 8085 connected with 8255. [2]
 - b) How do you initialize a control word for 8255? [2]
 - c) Write a program to read data from port B and display at port A and also, data from port C_U to C_L. [4]
6. a) Describe the various error detection techniques used in data communication.
b) Discuss the types of data packets used in USB protocol. [4]
7. How can you interface 10 bit DAC with 8085? Explain. [5]
8. What is the general principle of grounding? Explain the capacitive noise coupling mechanisms in electronic circuits. [1+4]
9. During circuit design process, what are some general technical dilemmas faced by engineers? Explain how an engineer can arrive at an optimal solution given the requirements of a customer. [5]
10. Define impedance matching and ground bounce? What are the different ways of reducing crosstalk when routing signal traces on a PCB? [2+3]
11. Explain spiral software development model with its advantages and disadvantages. [5]
12. Explain the constructional detail and working principle of electrical resonance type frequency meter. [5]
13. Discuss the current control system and methodology of the instrumentation system involved in your case study with necessary block diagram. What are the suggestions and recommendations you would provide to enhance the current system. Explain with necessary reasons why your recommendations should be implemented. [8]

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1. Sketch the block diagram of generalized measurement system. [3]
2. a) If Voltmeter having accuracy of 1% and full scale range of 100v is used to measure (i) 80 v and (ii) 12 v. How accurate will the reading be? Comment your answer. [4]
 - b) Explain the method used to measure inductance of coil with circuit diagram. [4]
3. Explain in detail about Optical Pyrometer with its advantages and limitations. [8]
4. Draw and explain the block diagram of microprocessor based instrumentation system. [4]
5. The addresses captured by 8255A PPI are D0D0H to D0D3H. What are the addresses captured by the card? Sketch the interfacing circuit with 8085 microprocessor in memory mapped I/O. Write the control word for following configuration. [1+2+2+1+2]
 - a) Port A: Mode 1 input
 - Port B: Mode 1 input
 - Port C_{6, 7}: output
 - b) Set PC2 in BSR mode
 - c) Port A: Bidirectional Port
 - Port B: Mode 1 I/P
6. What are errors in serial data transmission? Explain error detection techniques in serial transmission. Explain USB-OTG in brief. [3+3+2]
7. Explain the operation of Flash type ADC with suitable example. [5]
8. Explain the Bluetooth network topology. [3]
9. Explain the various corrective strategies for different energy coupling mechanisms. [5]
10. What are the factors that describe reliability of an electronic system? Describe the working principle of decoupling capacitors in short. [3+2]
11. Write about the factors we should consider while doing component placement. How do you reduce crosstalk when routing signal traces on PCB? [3+2]
12. Explain the process of software development using Spiral model. [5]
13. Explain in detail about Induction type single-phase Energy meter. [5]
14. Explain the existing system involved in your case study with necessary block diagram. Recommend the changes that you deem necessary in the visited industry during your case study. [8]

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1. a) What are the essential components of Data Acquisition System? Explain it with the help of a block diagram. [4]
- b) What are the reasons to prefer pneumatic systems over hydraulic and electrical system? [2]
2. Obtain the balanced equation of an ac bridge and explain with diagram how Schering bridge can be used to measure unknown capacitance. [8]
3. What do you mean by piezoelectric effect? What are the different types of piezoelectric materials? Explain piezoelectric sensors in detail. [8]
4. Explain the types of microprocessor –based instrumentation system. [4]
5. Interface a printer and a keyboard in mode 1. Port A is designed as output for printer with status check I/O and port B is designed as input for keyboard with interrupt I/O.
 - a) Draw the mapping circuit in I/O mapped I/O. [2]
 - b) What are the port addresses captured by the PPI card. [2]
 - c) Generate required control words. [1]
 - d) Write initializing instructions and subroutines to read characters from keyboard and to send them to the printer. [3]
6. What are the errors in data communication? Compare and contrast Rs 232, Rs 422, and Rs 423 interfaces. [3+5]
7. Explain the working principle of successive approximation type of ADC. [5]
8. What do you understand by decoupling capacitor? Explain the capacitive shielding mechanism. [2+3]
9. What is fault tolerant system? Explain how careful design, testable functions and redundant architecture can avoid many failures in electronic circuits. [1+4]
10. Poor circuit layout and signal propagating principle may cause many problems in the circuit operation, manufacturing ease and probability of design errors. What factors will you consider while routing the signal traces on PCB. [5]
11. How does prototyping model overcomes the short comings of waterfall model? Explain. [5]
12. What is wattmeter? Explain the working principle of induction wattmeter with diagram. [5]
13. Explain the existing system involved in your case study with the necessary block diagram. What was your recommendation over the existing system in terms of cost, manpower and plant automation? [8]