Dr. MAHALINGAM
COLLEGE OF ENGINEERING AND TECHNOLOGY
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Dr. MAHALINGAM
COLLEGE OF ENGINEERING AND TECHNOLOGY
Affiliated to Anna University, Chennai; Approved by AICTE ; Accredited by NAAC with Grade 'A++'
Accredited by NBA - Tier1 (Mech, Auto, Civil, EEE, ECE, EIE and CSE)
Udumalai Road, Pollachi - 642 003. Tel: 04259-236030/40/50 Fax: 04259-236070 www.mcet.in

Question Bank

Virtual Instrumentation

DEPARTMENT OF

ELECTRONICS AND INSTRUMENTATION

ENGINEERING

UNIT I - GRAPHICAL SYSTEM DESIGN

Graphical System Design Model – Virtual Instrumentation – Virtual Instrument and Traditional Instrument – Hardware and software in virtual instrumentation – Virtual instrumentation for test, control and Design – Conventional and Graphical programming

Two Marks:

1. **Define Virtual Instrumentation.**
   Virtual instrumentation is defined as combination of **hardware and software** with industry-standard computer technologies to create **user-defined, Re-configurable instrument**s. Here software will be the end instrument.
2. **What is Graphical System Design model? Mention its three phases.**
   Ref notes
3. **Draw the VI and GSD model.**
   Ref notes
4. **Draw the architecture of VI and indicate the parts.**
   Ref notes
5. **Distinguish between Virtual Instrument and Traditional Instrument.**
   Ref the table in notes
6. **Mention the role of hardware's in VI**
   I/O modules: Modular and scalable hardware with adaptability to new concepts
   Computer
   Communication interfaces with USB, PCI, ETHERNET, etc
7. **Mention the role of software's in VI**
   Creating user interfaces
   Creating data acquisition systems
   Manipulating and storing data
   Making instrument with intelligent and decision making
8. **Name the different layers of VI software.**
   Application software
   Test and Data management s/w
   Measurement and control software
9. **Mention the different challenges in Test.**
   Increasing customer expectation
   New validation, Verification and manufacturing requirements
   Innovation
   Adaptable to new design
10. **What is G programming?**
    G or Graphical programming is a visually oriented approach to programming
    Ex: LabVIEW
11. **Compare Graphical programming with Textual programming.**
    Ref notes or VI using LabVIEW by JOVITHA JEROME page no 18
12. **Mention the characteristics and advantages of VI.**
    Characteristics and Advantage:
    - User – friendly
    - High performance
    - Cost effective

- High flexible
- Customizability

Descriptive Questions:

1. **Draw and explain the graphical and VI models with design flow.**
   - VI model diagram and intro
   - GSD model using VI model
   - Design with example
   - Prototype with example
   - Deployment with example
   - Design flow

2. Explain the essential need for Virtual Instrumentation and compare it with the traditional instruments.

Ref book VI using LabVIEW by JOVITHA JEROME page no 6 to 9
(Topics 1.4 and 1,5) OR Topic 1.5 and Difference table given in notes

3. Explain the role of different hardware's and software's in VI.

Role of Hardware
Explanation about
I/O modules: Modular and scalable hardware with adaptability to new concepts
Computer
Communication interfaces with USB, PCI, ETHERNET, etc
Three layers and Software Layer Diagram
Application software
Test and Data management s/w
Measurement and control software
Role of software
Creating user interfaces
Creating data acquisition systems
Manipulating and storing data
Making instrument with intelligent and decision making
Ref book VI using LabVIEW by JOVITHA JEROME page no 10 and 11

4. Explain how VI can be used in test, Control and Design process.

Ref book VI using LabVIEW by JOVITHA JEROME page no 12 to 15

5.Compare Graphical programming with traditional programming

Ref book VI using LabVIEW by JOVITHA JEROME pages no 17 and 18 or difference table given in class notes

Unit II - LabVIEW Basics –I

Front Panel and Block Diagram – Tools, Controls and Functions palette. Modular programming – SubVI. Structures – FOR, WHILE Loops, Case, Sequence, event structures, Formula node

Two Marks:

1. Name the three parts of LabVIEW.

Front panel→ Contains Controls and Indicators

Block diagram→Graphical Code based control program

Icon/Connector pane → for making subVI

2. Mention the different debugging process in LabVIEW.

Setting probes and break points, highlight execution and single stepping

3. Mention any four merits of LabVIEW,

Page no 21,22 - JOVITHA JEROME

4. What is icon/connector pane?

Page no 25 - JOVITHA JEROME

5. Name the three palette of LabVIEW.

Control palette→ front panel(contains controls and indicators)

Functions palette→block diagram(contains subVI,functions and constants)

Tools palette→ available in front panel and block diagram(tools for creating editing)

6. What is module or Sub VI?

A VI within another VI is called a module or subVI. A subVI corresponds to a subroutine in text-based programming languages. A subVI node corresponds to a subroutine call in text based programming languages. The node is not the subVI itself, just as a subroutine call statement in a program is not the subroutine itself.

7. Write the syntax for two types of WHILE loop.

Pre Test Mode

Syntax: WHILE<CONDITION=TRUE>
:
:
DO

Post Test Mode

Syntax: DO
:
:
WHILE<CONDITION=TRUE>

8. List out the various functions available in structure

For and while loops

Case structure

Sequence structures (flat and stacked)

Event structures

9. Mention the two ways used to access data previous iteration outputs of a loop.

1. Shift register

2.Feedback node

10. What is shift register and stacked shift register?

Shift register is created on border of FOR and WHILE loops and is used to access data from previous iterations.

Stacked shift register

Stacked shift register collects and remembers values from multiple previous iterations and remembers to the next iterations. It can be created by left click on left terminal of shift register and selecting Add element.

11. What is the role of tunnel in a loop?

Data can be passed out of or into a loop through a tunnel. Tunnel feed data into and out of structures.

12. Define Local & Global variables.

Local variables:

Local variables are used to access front panel objects from more than one location in a single VI and pass data between block diagram structures that cannot be connect with a wire. With a local variable, read or write function can be done from a control or indicator on the front panel.

Global variables:

Global variables are used to access and pass data among several VIs that run simultaneously. Global variables are built-in LabVIEW objects. While creating a global variable, LabVIEW automatically creates a special global VI, which has a front panel but no block diagram.

13. What is Sequence Local?

- Sequence Local is a terminal to pass data between the frames of a Sequence Structure.
- Created on the border of the Sequence frame.
- Data wired to a sequence local is available only in subsequent frames. It is not availablein previous frames.

14. Define Property Node.

Property Node is used to get and set various properties on an application or VI. Property Node is used to read or write multiple properties using a single node. The Property node executes from top to bottom. The Property Node does not execute if an error occurs before it executes.

15. What is Formula Node?

The Formula Node is a convenient text-based node used to perform mathematical operations on the block diagram. Formula Node can accept text-based versions of if statements, while loops, for loops, and do loops, which are familiar to C programmers. Formula Nodes are useful for equations that have many variables or are otherwise complicated and for using existing text-based code.

Descriptive Questions:

1. **Explain the three parts of LabVIEW with three floating palette.**

   Three parts of LabVIEW

   Detailed explanation of Front panel, block diagram, and Icon and Connector pane with diagrams

   Three floating palettes

   Detailed explanation of tools palette, functions palette, and control palette with diagrams.

   For answer refer Jovitha Jerome book pages 23 to 30

2. **List out the various advantages of LabVIEW.**

   For answer refer Jovitha Jerome book pages 21 to 23

3. **Explain the modular programming concept in LabVIEW using sub VI with procedure and example.**

   Concept of data flow programming and modular program
   Definition and concept of /subVI
   Procedure
   Example
   Page 48 to 53

4. **Discuss in detail about While and For Loops with Examples.**

   While loop –definition, syntax, explanation and example

   FOR loop–definition, syntax, explanation and example

   Concept of Tunnel and shift registers

   For answer refer Jovitha Jerome book pages **65 to 74**

5. **Discuss in detail about different structures with examples.**

   Case structure– definition, syntax, explanation and example

   Sequence structure (flat and stacked) - Case structure– definition, syntax, explanation and example

   Event structure – explanation

6. **Explain the following in detail with suitable examples.**

   - Shift registers
   - Local variables and Global variables
   - Feedback node
   - Formula node

7. **Simple programs in the pages given below of jovitha Jerome book**

   For answer refer Jovitha Jerome book pages 39 to 44, 59 to 63, 83 to 89

UNIT III - LabVIEW Basics –II

Arrays, Clusters, Strings, File I/O, Time and Dialog controls, Waveform chart, Graph, XY Graph and operations. Report generation, Web Publishing tool

Two marks:

1. **What is array in LabVIEW and subscript?**

   A group of homogeneous elements of same data types is known as array. Individual elements of array are accessed by their positions. The position is given by an index, which is also called as subscript.

2. **Mention any four operations carried on an array.**

   Initialize array, Array indexing, Array subset replacement, array size, Insert into arrayetc

3. **What is mean by polymorphic VI?**

   All Lab VIEW arithmetic functions are polymorphic. This means that the inputs to these functions can be different data structures such as scalar values and arrays. By definition Polymorphism is said to be the ability of a numeric function to adjust to input data of different data structures.

4. **What is auto indexing?**

   For and While loops can index and accumulate arrays at their boundaries. This is known as Auto indexing. If any array is wired to a FOR or WHILE Loops input tunnel, it can read and process every element in that array by enabling auto indexing. When the auto index is done on array output tunnel, the output array receives a new element from every iteration of the loop.

5. **State the default auto index of FOR and WHILE Loops.**

   FOR loop-Auto indexing for While Loop is **enabled** by default

   WHILE Loop- Auto indexing for While Loop is **disabled** by default

6. **Define cluster.**

   Cluster group of data elements of mixed type. It is similar to record or struct in text based language. Elements of clusters must be all controls or all indicators or constants.

7. **Name the different operations of cluster.**

   1. Bundle(assembling individual elements)
   2. Unbundle (assembling individual elements by name)
   3. Bundle by name (Extracting individual elements)
   4. Unbundle by name (Extracting individual elements by name)

8. What is the difference between bundle and bundle by name?

The **bundle**function assembles a cluster from individual elements and also allows one to replace elements in an existing order.

The **Bundle by name**assembles one or two individual elements are referenced by names rather than position.

9. What is the difference between Unbundle and Unbundle by name?

The **Unbundle** splits cluster into its individual components. The components are arranged top to bottom in the same order that they have in the cluster.

Unbundle by names function returns the cluster elements whose names are specified.

10. Define strings and mention any uses of strings.

A string is a group of displayable or non-displayable ASCII characters.

Uses:

1. Creating text messages
2. Passing numeric data as character strings to instruments
3. Storing numeric data to disk
4. Instructing or prompting the user with dialog boxes.

11. **Mention few string functions.**

1. String length
2. Concatenate string
3. String subset
4. Match pattern
5. Match regular expression
6. Array to spreadsheet string.,etc

12. Mention the four types of string display.

1. Normal display
2. Backlslash display
3. Password display
4. Hex display

13. What is File I/O?

File I/O records or reads data in a file.the common operations performed by File I/O VI are

Opening and Closing data files

Reading and writing

Spread sheet file reading and writing.,etc

14. **List out the different file formats available in LabVIEW.**
    - Binary file
    - ASCII
    - LVM
    - TDM
15. **What is disk streaming and relative path?**

    Disk streaming is a technique for keeping files open while you perform multiple write operations.

    Relative path describes the location of a file or directory relative to arbitrary location in the file system. It is also called as symbolic paths.

    Absolute path describes the location of a file or directory starting from the top level of the file system.
16. **List out the types of charts and graphs.**
    - Wave form graph and charts→ constant rate
    - XY graph → Nonconstant rate
    - Intensity graphs and charts→ Display 3D on 2D
    - 3D graphs
17. **Mention the three types of 3D graph.**
    - 3D surface graph
    - 3D parametric surface graph
    - 3D curve graph
18. **State the three different update modes waveform chart.**
    - Strip chart
    - Scope chart
    - Sweep chart
19. **How multiple plots can be displayed on a graph?**

    By using 1. Build array and 2. Bundle function of cluster

Descriptive Questions:

1. **Explain array and its function in detail.**

    Definition for array

    Short intro about array parts and dimension

    Array generation using for loop

    Different array functions

2. **Explain clusters and its function in detail.**
    - Definition and introduction
    - Cluster control, indicators and constants
    - Assembling and disassembling functions
        - Bundle, Unbundle, bundle by name, and Unbundle by name
3. **Describe in detail about various file types and File I/O functions**.
    - Uses of file I/O
    - Types with explanation
    - Various File I/O functions
    - Path and relative path
4. **What is string? Explain various string functions and formatting functions.**
    - Definition and uses
    - String control, constant, and indicators
    - String functions
    - Formatting strings
5. **Describe in detail about various types of waveform chart and graphs. How can single and multiple multiple traces be obtained on a graph?**
    - Types and definitions
    - Explanation of
        - Waveform chart and graph
        - XY graph
        - Intensity chart and graph - brief explanation
        - Digital waveform graphs - brief explanation
        - 3D graphs - brief explanation
        - Drawing single plot and multiple plot
6. **Explain the detailed procedure for**
    - 1. Report generation
    - 2.Web publishing tool
7. **Simple programs in the pages given below of jovitha Jerome book**
    - 106 to 113, 124 to 129, 153 to 158, 209 to 215

UNIT IV - DATA ACQUISITION SYSTEM

Instrument control: GPIB – VISA – Instrument drivers – Serial Port communication. Data Acquisition: Review of Transducers and signal conditioning, DAQ hardware – AI, AO, DIO. DAQ Assistant and configuration.

Two marks:

1. **Define data acquisition systems.**

   The system used for data processing, data conversion, data transmission and data storage is called Data Acquisition System.

   Data Acquisition Systems are used to measure and record analog signals basically in two different ways.
   - Signal which originate from direct measurement of electrical quantities. These signal may be dc (or) ac voltages, frequency or resistance etc..
   - Signals which originate from use of transducers.

2. **What is Instrument I/O assistant?**

   The Instrument I/O assistant is a Lab VIEW Express VI which can be used to communicate with message based instruments and converts the response from raw data ti ASCII representation.

3. **Mention some example for Parallel and serial interfaces.**
   - Parallelinterfaces – GPIB or IEEE488
   - Serialinterfaces - RS232, RS422, and RS485

4. **What is VISA? Mention the various types of instruments can be controlled by VISA.**

   VISA or Virtual Instrumentation Software architecture is the lower level of functions in the LabVIEW instrument driver Vis that communicates with the driver software of interfaces.

   It can control 1. Serial
   2. GPIB
   3. VXI (VME (Versa Module Europa) extensions for instrumentation)
   4. PXI (Extended PCI (peripheral Component interface)

5. **List out the three different commands used for configuring Instrument assistant.**

   Query and Parse—Combines the Write and Read and Parse commands

   Write—Sends a command to the instrument

   Read and Parse—Reads and parses data from the instrument

6. **Mention the various methods to terminate communication in GPIB.**
   - Assert the End Or Identify (EOI) hardware line with the last data byte - this is the preferred method

- Place a specific end-of-string (EOS) character at the end of the data string itself
- The listener counts the bytes transferred by handshaking and stops reading when the listener reaches a byte count limit

7. Mention different programming terminology used with VISA.

- **Resource**—Instrument, Serial Port, or Parallel Port
- **Session**—Connection to a Resource
- **Instrument Descriptor**—Resource location
  - Format: Interface Type::Address::INSTR

8. Mention few Instrument driver VI functions.

Initialize
Configure
Action/Status
Data
Utility
Close

9. Compare RS232, RS422 and RS485.

- RS-232—this is a single-ended communication method where only one device can be connected per port. Two connector types, 8- or 25-pin. Two configurations, DCE or DTE.
- RS-422—this is a differential communication method. Connector has 8 pins.
- RS-485—this is a differential communication method with multiple master/slave with less noise immunity.

10. What is mark and Space?

Mark- Off sate or Logic level low
Space- ON sate or Logic level high

11. What is MAX?

MAX or Measurement and Automation Explorer is a VI and is used to detect, configure and test the GPIB interface and instruments.

12. List the primary characteristics of Analog signal and Digital signal.

Analog: Level, Shape, and Frequency
Digital: Level, State, and rate

13. List out the various functions of Signal conditioning.

Amplification, Isolation, Multiplexing, Filtering, Transducers excitation, Linearization.

Descriptive Questions:

1. **Explain in detail about GPIB or IEEE488 with block diagram, various signals. Also explain the procedure for acquiring data from GPIB using MAX.**

   Refer notes and jovitha Jerome book pages:223 to 228

2. **Explain the following in detail.**

   a. Instrument I/O assistant (3)

   b. VISA (3)

   c. Instrument drivers (4)

   Refer notes and jovitha Jerome book pages: 228 to 235

3. **Explain serial port communication in Lab VIEW. Compare RS232, RS422 and RS485.**

   Refer notes and jovitha Jerome book pages: 236 to 239

4. **Explain the different functions of Signal conditioning system. How the Signal conditioning system is chosen to a transducer.**

   Refer notes and jovitha Jerome book pages: 256 to 260

5. **Explain about DAQ hardware's and its configuration**

   Refer notes and jovitha Jerome book pages: 260 to 265

6. **Discuss in detail about Analog Inputs, Analog outputs, Digital I/O.**

   Refer notes and jovitha Jerome book pages: 265 to 269

7. **Explain how DAQ Assistant is used to acquire and generate signals with procedure for creating, configuring, Test and generate Lab VIEW code using DAQ Assistant.**

   Refer notes and jovitha Jerome book pages: 270 to 275

UNIT V - LabVIEW APPLICATIONS

LabVIEW RT, Process control applications, Physical applications, Speed control, Data visualization, Imaging and Sound. Level, flow, temperature process, Bio Medical application - Pulse rate..

1. **What is the difference between LabVIEW and LabCVI?**

   LabWindows/CVI (CVI is short for C for Virtual Instrumentation) is an ANSI C programming environment for test and measurement developed by National Instruments.

   LabWindows/CVI uses the same libraries and data acquisition modules as the better known National Instrument product LabVIEW, and is thus highly compatible with it.

   LabVIEW is targeted more at domain experts and scientists and CVI more towards software engineers that are more comfortable with text-based linear languages such as C.

2. **Mention a few biomedical applications in which LabVIEW is used?**

   Biomedical Signal Analysis

   Heart rate variability Analyzer -Pulse rate measurement

   Blood Pressure Analyzer

   ECG feature extractor

   Biomedical image Analysis

3. **Which tool is used for Image Analysis?**

   Tool used for Image Analysis is IMAQ Vision. This s/w includes NI-IMAQ driver s/w,vision development module, vision builder for automated inspection and vision assistant.Use MAX to configure your IMAQ device and acquire your first images.

4. **LabVIEW applications in process control.**

   Flow measurement

   Temperature measurement

   Pressure measurement

5. **List the types of interfacing bus**

   Serial (RS232,RS485)

   Parallel

   PCI/PXI

   VXI

6. **List the Applications of LabVIEW.**

   Areas includes

   Image Processing

   Signal Processing-recording and reproducing sound signals

   LabVIEW for instrument control

   LabVIEW for Automating Test and Validation Systems

   LabVIEW for Designing Embedded Control and Monitoring Systems

7. **DefineIVI**

   Interchangeable Virtual Instruments, or IVI, is a revolutionary standard for instrument driver software technology. IVI builds on the VXI plug & play specifications and incorporates new features that address issues such as system performance, development flexibility, and instrument interchangeability. IVI drivers also take advantage of the power of the VISA I/O library defined by VXI plug & play to seamlessly communicate with instruments across different I/O buses such as GPIB, VXI, PXI, Serial, Ethernet, and USB.

8. **How does the motion controller acts as the brain of the motion control system?**

   Refer Material

9. **Components of Speed control/motion control system.**

   Refer Material

10. **What are the NI-IMAQ and IMAQ vision functions used to acquire and display images?**

    Utility functions

    Single buffer acquisition functions

    Multiple buffer acquisition functions

    Display Control

    Trigger Functions

11. **What are the image processing tools and functions in IMAQ vision used in developing an application?**

    Colour processing

    Frequencyprocessing

    Filtering,

    morphology(form and structure of image)

12. **Applications of machine vision in industries**

    Manufacturing industries -Inspection of printed circuit boards

Electronics-resistor placement verification and inspection of liquid crystal display

Biomedical-tracking eye movement in response to stimuli

Pharmaceuticals- blister pack inspection and foreign tablet inspection

13. What is LabVIEW RT?

LabVIEW RT means LabVIEW Real Timeand it can be used to develop embedded applicationbased on graphical system design and deploy to embedded target works under a commercial RTOS.

14. List out the issues crop up by LabVIEW RT.

1. Task timing
2. Task scheduling
3, Task priority assignment

15. What is mean by Determinism and Latency?

Determinism is prediction of time taken by a program or section of program to execute.

Latency or worst case response time: How late or early the code is accurately running with respect to the desired time is known as latency or worst case response time.

16. Differentiate hard and soft real time systems.

Soft Real Time System : A RTS is referred as Soft Real Time System when it allows deadline deviations, I,e., the missing of dead lines does not make the system complete failure.

Hard Real Time System: A system is called as Hard RTS when it has tasks, that have to be run on time else the system will fail.

17. Mention some examples for LabVIEW RT.

DAQ7041

DAQ6040E

18. Mention the real time requirements for software design.

1. Deterministic behavior
2. Timing requirement

19. List out the possible performance systems used to asses performance of LabVIEW RT.

1. RDTSC Timing Library→ for assessing software performance
2. Oscilloscope

3,Logic analyzer

20. What are the problem arises due to shared resources in LabVIEW RT? How they are rectified?

- Priority inversion and Deadlock situation
- It can be prevented by using MUTEX(Mutually Exclusion) and Priority boosting.

21. Mention the Four different priority levels assigned to enabled tasks by RT.

- Time Critical or Highest
- High
- Above normal
- Normal

22. How to obtain high performance in LabVIEW RT?

For obtaining high performance in LabVIEW RT, there should be only one time critical thread at same time. It can be obtained by creating temporary sleeping functions by using Hardware timing or Software timing (wait ms or wait until next ms).

23. Name the tool kit used for process control applications in LabVIEW.

DSC(Dataloging and SupervisoryControl)

24. What is P&I Diagram? Mention the abbreviation meaning for letters used in P&ID tag name.

Piping and Instrument Diagram is a important diagram of a plant which shows the interconnection of vessels, pipes,valves, pumps, transducers, transmitters and control loops.

Usually the Tagnames are used to identify the particular component and it comprises of two or three letters.

1st letter→ Measured or initiating variable

2nd letter→Readout or output function

3rd letter→Succeeding letters (if required)

25. Draw few P&I Diagram symbols.

Page 441 garyjhonson

26. Mention the methods used to measure High voltage.

Resistance voltage dividers or High voltage probes

Resistance probes with frequency compensation for pulsed high voltage

Any one from above with Isolation Amplifier for floating measurements

27. Mention the methods used to measure High current.

Current Transformer

Hall effect devices

Current shunts or current viewing resistors.

28. Mention the methods used to measure High frequency.

Transient digitizers or Digitizing oscilloscope

Time to digital converter

Boxcar average or Gated integrater

29. What is CAMAC?

CAMAC stands for Computer automated Measurement and control and is reliable standard for data acquisition systems used in physics research.

30. How the data are classified?

Cartesian data

Bivariate data

Multivariate data

31. How data's can be visualized. Mention the different possibilities to visualize multiple numbers of data.

data's can be visualized:

Graphs and charts

possibilities to visualize multiple number of datas:

combining Array and cluster

build cluster array

BUILD ARRAY

32. What is IMAQ? Mention is functional areas.

Ref garyjhonson pages 573

33. List out the different image file formats.

Ref notes or jovitha Jerome book

34. Different functions carried by IMAQ.

IMAQ init(initialization)

IMAQ create(memory allocation)

IMAQ snap(acquire frame)

IMAQ windraw(edits the image)

Pattern matching→ matches with template

Threshold→converts gray scale image to bitmap image

IMAQ multi threshold→converts gray scale image to binary

Morphology→ cleaning a image

Spatial filtering→edge detection

IMAQ complex particle→ complex report which is a set of statistics of particle location

35. Mention the techniques used in image filtering.

Erosion→ eliminating isolated background

Dilation→ opposite to erosion (fills tiny holes)

Opening→erosion followed by dilation

Closing→dilation followed by erosion

Descriptive Questions:

1. **Discuss in detail about LabVIEW RT**

   Refer Material
2. **Describe in detail about Process control applications of LabVIEW**

   Refer Material
3. **Explain how LabVIEW based data acquisition systems are more efficient in physical application. Explain in detail about physics applications of LabVIEW.**

   Refer Material
4. **Explain the different data visualization techniques available in LabVIEW.**

   Refer Material
5. **Explain in detail about Image processing using IMAQ.**

   Refer Material
6. **Explain motion and speed control using Lab VIEW.**

   Refer Material
7. **List out the functional areas of Image processing. Explain the parts, functions, and various functions carried out by IMAQ with a example.**

   Refer Material
8. **Explain in detail about pulse rate measurement using LabVIEW.**

   Refer Material