

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

Course Code: ME407
Course Name: MECHATRONICS

Max. Marks: 100

Duration: 3 Hours

PART A

Answer any three full questions, each carries 10 marks.

Marks

- | | | |
|---|--|-----|
| 1 | a) Explain the working principle of thermocouples. | (2) |
| | b) What is a thermos pile? What is the principle used to increase the sensitivity of thermopile? | (4) |
| | c) Explain the working of any one non-contact temperature measurement system. | (4) |
| 2 | a) Illustrate the working of a strain gauged load cell. | (8) |
| | b) List four examples of temperature sensors. | (2) |
| 3 | a) Explain any two situations when pneumatic actuators are preferred over hydraulic ones. | (2) |
| | b) Explain the configuration of a pneumatic actuation system with a block diagram | (4) |
| | c) Explain the schematic of a 5/2 way pilot operated valve. | (4) |
| 4 | a) Distinguish between pilot operated and direct operated DCVs | (2) |
| | b) Design a pneumatic circuit to operate a clamping cylinder using a pilot operated 5/2way valve and two push button operated 3/2way valves. | (8) |

PART B

Answer any three full questions, each carries 10 marks.

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| 5 | a) Explain the sputtering process with a neat sketch. | (6) |
| | b) Differentiate between electroplating and electro-less plating associated with chemical deposition methods. | (4) |
| 6 | Illustrate the working of capacitance based accelerometer. | (10) |
| 7 | a) Explain the working of recirculating ball screws with a neat sketch | (6) |
| | b) Explain the two preloading techniques for ball screws with diagrams | (4) |
| 8 | a) Draw the ladder diagram for the following logic functions. | (4) |
| | (i) XOR | |
| | (ii) NAND | |
| | (iii) NOR | |
| | (iv) AND | |

- b) Illustrate the significance of Internal Relays in PLC program. (2)
- c) Explain 'latching' in PLC logic with an example. (4)

PART C

Answer any four full questions, each carries 10 marks.

- 9 a) Illustrate the working of Harmonic Drives with neat sketches (8)
- b) What are the advantages of harmonic drive over gear drives (2)
- 10 a) Bring out the working principles of Triangulation method and elapsed time method used in range finders. (6)
- b) Explain different methods adopted in light based range finders. (4)
- 11 a) Sketch and explain working of an AC servomotor. (5)
- b) Using neat diagram, explain working of a tactile sensor. (3)
- c) List any *two* requirements of an ideal range finder. (2)
- 12 a) Using sketches and block diagrams, discuss the working of mechatronics system-based automobile engine management system. (6)
- b) List any *two* image data reduction techniques for image processing and analysis. (2)
- c) With a schematic diagram, discuss how a template match technique is implemented in image processing. (2)
- 13 a) Define the terms 'gray image' and 'threshold' in connection with Digital images. Explain the role of histogram in achieving a binary image. (7)
- b) Bring out any 3 difference between CCD and CID camera. (3)
- 14 Design PLC based automated car parking barrier system with suitable sensors and actuators. Design the ladder logic for PLC so that the system collects coins for parking cars and the barrier prevents the entry of more than one vehicle for a single coin collection and also prevents entry of cars when a max number has reached. (10)

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION(S), MAY 2019

Course Code: ME407
Course Name: MECHATRONICS

Max. Marks: 100

Duration: 3 Hours

PART A

Answer any three full questions, each carries 10 marks.

Marks

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|---|--|-----|
| 1 | a) Compare the working of resolver and synchro. | (6) |
| | b) Suggest two applications of Hall effect sensor in mechatronic systems. | (2) |
| | c) Describe the terms hysteresis error and non-linearity error. | (2) |
| 2 | a) Differentiate between absolute and incremental encoders | (2) |
| | b) Explain the working of an optical absolute encoder. How the number of tracks and sectors of absolute encoder is related to the resolution of the encoder? | (5) |
| | c) Draw the encoder wheel layout of a grey coded absolute encoder with 45degree resolution | (3) |
| 3 | a) Explain the working of a double acting hydraulic actuator | (4) |
| | b) Why cushioning is necessary for pneumatic actuators | (2) |
| | c) Explain how cushioning is achieved in pneumatic actuators with a sketch. | (4) |
| 4 | a) What is a 4/3 way valve? When is it used in place of 4/2 way valves | (4) |
| | b) Design a hydraulic circuit to operate a winch fitted with a hydraulic motor. The motor should be run clockwise, counter clockwise and stopped. Use a manually operated valve. | (6) |

PART B

Answer any three full questions, each carries 10 marks.

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| 5 | a) List any 2 controlling factors in wet etching. | (2) |
| | b) Differentiate between immersion etching and spray etching. | (2) |
| | c) Describe the dry etching process in MEMS micromachining | (6) |
| 6 | Explain the LIGA process in MEMS fabrication with neat sketches. | (10) |
| 7 | a) Mention any 2 functions of guide ways in machine tools. | (2) |
| | b) Comment on the stick-slip phenomenon associated with friction guide ways. | (2) |
| | c) Explain the working of LM guide ways | (6) |
| 8 | Develop a PLC ladder program for the following sequence: Start a motor with push switch, and then after a delay of 90s, start a pump. When the motor is | (10) |

switched off, the pump will get switched off after a delay of 5s. Mention the logic used for each rung in the program to substantiate your answer.

PART C

Answer any four full questions, each carries 10 marks.

- 9 a) Draw a schematic of a magneto-resistive tactile sensor and list any *three* features of the sensor. (5)
- b) List any four techniques to measure an unknown force. (2)
- c) Draw the sketch of the basic configuration of a laser-based triangulation range finder. (3)
- 10 a) With a block diagram, illustrate the elements of a control system. (3)
- b) List three types of models and give an example each. (3)
- c) Draw a block diagram of a feedback control system. (4)
- 11 a) Draw a flowchart and discuss the steps in frequency domain analysis. (5)
- b) Draw the response curve for an under-damped system. (2)
- c) A stepper motor is to be used to drive a linear axis of a mechatronic system. The motor output shaft is connected to a screw thread with a 30 mm pitch. It is desired to control each axis at 0.5 mm. What is the corresponding step angle? (3)
- 12 a) Draw the schematic diagram of a machine vision system. (4)
- b) List the steps in thresholding technique in image processing. (4)
- c) Write a short note on the applications of vision sensors. (2)
- 13 a) With a neat sketch, explain the physical system and working of a pick and place robot. (6)
- b) List any *four* applications of robotic vision systems. (2)
- c) Draw sketches to discuss any *two* objectives of image segmentation. (2)
- 14 a) With a flowchart, explain the steps in building of a smart system for automatic car park barrier system. (6)
- b) List any *two* advantages of charge injection device camera for machine vision applications. (2)
- c) With a sketch, discuss 'equalization' method in histogram processing. (2)

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), DECEMBER 2019

Course Code: ME407
Course Name: MECHATRONICS

Max. Marks: 100

Duration: 3 Hours

PART A

Answer any three full questions, each carries 10 marks.

Marks

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|---|--|------------|
| 1 | Explain the working of incremental and absolute optical rotary encoders. Why gray code is used in coding absolute encoders. | (10) |
| 2 | a) Describe the working of LVDT with a neat sketch. b) Explain the working of any <i>one</i> type each of flow and pressure sensors. | (6) (4) |
| 3 | Develop a pneumatic circuit with standard symbols, to operate two cylinders in sequence. Explain its working. | (10) |
| 4 | a) Mention any <i>two</i> differences between finite position and infinite position valves. b) Illustrate the working of spool valve and poppet valve with a neat sketch. | (2) (8) |

PART B

Answer any three full questions, each carries 10 marks.

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|---|--|------------|
| 5 | Explain the principle, fabrication and working of MEMS based capacitive type pressure sensor. | (10) |
| 6 | a) Describe the DRIE process with a neat sketch. b) Prepare a comparative report of each <i>one</i> technique in CVD and PVD. | (5) (5) |
| 7 | a) Compare the salient features of hydrostatic and hydrodynamic bearing. b) Explain the working of a mechanical device using closed loop control system with the help of a suitable example. | (5) (5) |
| 8 | Two motors are to be controlled in a sequence. The second motor starts 30 seconds after the starting of first motor by a push switch. Develop a PLC ladder diagram for the following cases and describe the circuit. Case (A): Only one motor operates at a time. Case (B): Both the motor gets off together after 50 seconds. | (10) |

PART C

Answer any four full questions, each carries 10 marks.

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|---|---|------|
| 9 | Develop a mathematical model for the chassis of a car as a result of a wheel moving along a road. | (10) |
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- 10 Compare the working of permanent magnet stepper motor, variable reluctance stepper motor and hybrid stepper motor with a neat sketch. Mention the step angle achieved in each case. (10)
- 11 Illustrate the working of any *one* type of (i) Force sensor (ii) Tactile sensor. (10)
- 12 Comment on the thresholding technique used in image processing and analysis. (10)
Explain how thresholding is employed in edge detection.
- 13 a) Explain the histogram processing technique in image processing. (5)
b) Illustrate the working of Charge Coupled Device for machine vision applications. (5)
- 14 Explain the working of Barcode reader with reference to the coding schemes. (10)
Mention the steps to process the digits in a barcode for a particular product.
Develop the steps in a program for reading the barcode.

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), MARCH 2020

Course Code: ME407
Course Name: MECHATRONICS

Max. Marks: 100

Duration: 3 Hours

PART A

Answer any three full questions, each carries 10 marks.

Marks

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|---|--|-----|
| 1 | a) Suggest a method of sensing temperature using a non-contact method. Explain the method with suitable sketches. | (4) |
| | b) Distinguish between the features of synchro and resolver. | (4) |
| | c) List any two active sensors. | (2) |
| 2 | a) Describe the working of piezoelectric vibration sensor. | (6) |
| | b) Describe the working principle and applications of acoustic emission sensor system. | (4) |
| 3 | a) Explain the working of the elements of a hydraulic power supply unit. | (6) |
| | b) Sketch the standard symbols for (i) 4/3 DC Valve (ii) Push Button operated poppet valve (iii) Pressure relief valve (iv) Unidirectional valve | (4) |
| 4 | a) Develop a standard circuit for a hydraulic shaper in which the backward motion of linear actuator is quicker than the forward motion. Describe the working. | (8) |
| | b) Suggest two applications for pneumatic circuits in industrial automation. | (2) |

PART B

Answer any three full questions, each carries 10 marks.

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|---|--|------|
| 5 | a) Illustrate the use of sacrificial layer in MEMS fabrication. | (4) |
| | b) Describe LIGA process to develop a micro-gear in gold material | (6) |
| 6 | a) List the factors influencing the micro-machining with wet etching. | (2) |
| | b) Illustrate the construction and working of MEMS accelerometer. | (8) |
| 7 | a) Describe the functioning of hydrostatic and aerostatic linear motion guideways. | (4) |
| | b) Illustrate the working of recirculating ball screws. | (6) |
| 8 | Explain the types of adaptive control systems used in CNC machine tools. | (10) |

PART C

Answer any four full questions, each carries 10 marks.

- 9 a) Describe the working of permanent magnet stepper motor. (6)
- b) Describe the terms pull-in torque, pull-out torque, slew range and step angle for stepper motor. (4)
- 10 a) List the basic building blocks to mathematically model a mechanical system. (2)
- b) A hot plate having capacitance C and temperature T cools in a large room having temperature T_r . Consider the thermal resistance for the system as R . Develop a mathematic model to represent change in the temperature of the hot plate with time. (8)
- 11 a) Explain one application of pulse width modulation (PWM) (2)
- b) Describe the configuration, working and features of harmonic drive. (8)
- 12 a) Discuss the features of CCD and CID cameras. (6)
- b) Describe one application of thresholding using histogram. (4)
- 13 a) Discuss the functioning of a robotic vision system (8)
- b) Suggest one application for histogram sliding (2)
- 14 In a car park system, a horizontal bar barrier is to be lifted to vertical position when a vehicle reaches nearby and pay the parking fees. The barrier remains in vertical position for 10 seconds to allow the vehicle to pass and comes back to horizontal position. This sequence is to be repeated for every vehicle. The position of barrier is to be sensed by proximity sensor and its movement is controlled by a pneumatic circuit. Develop a PLC ladder program for the sequence and pneumatic circuit for the actuation. (10)

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Seventh semester B.Tech examinations (S), September 2020

Course Code: ME407**Course Name: MECHATRONICS**

Max. Marks: 100

Duration: 3 Hours

PART A*Answer any three full questions, each carries 10 marks.*

Marks

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|---|---|-----|
| 1 | a) Define the following sensor characteristics (i) Time constant (ii) Hysteresis | (4) |
| | b) Explain the principle of Hall effect. How a proximity sensor works on the basis of Hall effect? | (6) |
| 2 | a) Illustrate the working principle of incremental and absolute rotary encoders. | (7) |
| | b) Compare binary and grey code encoders | (3) |
| 3 | a) With a neat sketch explain the working of diaphragm operated process control valve | (5) |
| | b) Explain the working of any one type of rotary actuator with a neat sketch | (5) |
| 4 | a) Distinguish between pilot operated and direct operated DCVs | (3) |
| | b) A double acting cylinder is to be advanced either by operating a push button or by a foot pedal. Once the cylinder is fully advanced, it is to be retracted to its initial position. A 3/2-way roller lever valve is to be used to detect the full extension of the cylinder. Design a pneumatic circuit for this application. | (7) |

PART B*Answer any three full questions, each carries 10 marks.*

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| 5 | a) Distinguish between bulk micromachining and surface micromachining with sketches | (5) |
| | b) Illustrate the sequence of operations in LIGA process with neat sketches | (5) |
| 6 | a) Distinguish between wet chemical etching and dry plasma etching. What are the advantages of dry plasma etching over wet chemical etching | (5) |
| | b) Explain the fabrication of MEMS based pressure sensor | (5) |
| 7 | a) Explain the mechanism of recirculating ball screw with neat sketch. How backlash can be avoided? What are the advantages of recirculating ball screw? | (10) |
| 8 | a) What is latching? Draw a simple latched circuit | (2) |

- b) Consider a pneumatic system with single-solenoid controlled valves and involving two cylinders A and B, with limit switches a-, a+, b-, b+ detecting the limits of the piston rod movements. Design a ladder programme with the requirement being when the start switch is triggered, the sequence A+, B+, A-, 10s time delay, B- occurs and stop at that point until the start switch is triggered again. (8)

PART C

Answer any four full questions, each carries 10 marks.

- 9 a) Write down the describing equations of basic mechanical building blocks. (3)
b) Derive the mathematical model for a quarter car suspension system (7)
- 10 a) Illustrate the working of harmonic drive with neat sketches. List out its applications (8)
b) What are the advantages of harmonic drive? (2)
- 11 a) Explain the working of piezoelectric type tactile sensor (4)
b) Explain the constructional features and working of brushless DC motor (6)
- 12 Illustrate the working of Vidicon camera and CCD with neat sketches (10)
- 13 a) Explain how thresholding is used for segmentation in industrial vision applications? (7)
b) Illustrate the histogram processing technique for enhancing the image contrast (3)
- 14 With the help of a neat sketch explain the different mechatronics modules used in automatic car park barrier system (10)

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Seventh Semester B.Tech Degree Examination (Regular and Supplementary), December 2020

Course Code: ME407**Course Name: MECHATRONICS**

Max. Marks: 100

Duration: 3 Hours

PART A*Answer any three full questions, each carries 10 marks.*

Marks

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|---|---|-----|
| 1 | a) Explain with schematic diagram the working of synchros. | (5) |
| | b) Illustrate the principle of operation of turbine meter for the measurement of liquid flow. | (5) |
| 2 | a) Some temperature-controlled switches are operated by bimetallic strips. Describe how they work. | (5) |
| | b) Explain any two static characteristics of a sensor | (5) |
| 3 | a) Draw the symbol for a pressure sequence valve. | (2) |
| | b) Design a circuit in which pressure sequence valve is used to initiate an operation only when another operation has been completed. | (8) |
| 4 | a) What is meant by rotary actuator? | (2) |
| | b) Draw a vane motor and show important parts. | (3) |
| | c) With a neat diagram explain the working of pilot operated check valve. | (5) |

PART B*Answer any three full questions, each carries 10 marks.*

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| 5 | a) Explain evaporation process for MEMS fabrication with neat sketch. | (5) |
| | b) Compare dry etching process with wet etching process. | (5) |
| 6 | What is a gyroscope? Describe the working of MEMS based piezoelectric plate gyroscope with suitable diagram. Also Illustrate the steps in its fabrication. | (10) |
| 7 | a) Name the technique used to eliminate backlash in a ball screw. Illustrate the method of doing it. | (6) |
| | b) Explain two methods used for input/output processing in PLC. | (4) |
| 8 | a) Represent the basic structure of PLC with the help of a block diagram. | (5) |
| | b) What is the purpose of cascaded timers in PLC? Explain with example. | (5) |

PART C

Answer any four full questions, each carries 10 marks.

- 9 a) What are the basic building blocks of mechanical systems? Obtain their describing equations. (5)
- b) Explain the working principle of any one light based range finder. (5)
- 10 a) Propose a model for the metal wheel of a railway carriage running on a metal track. (4)
- b) Illustrate the working of harmonic drives with sketches. (6)
- 11 Describe the working of a permanent magnet DC motor and brushless permanent magnet DC motor with diagrams. Identify their differences. (10)
- 12 a) Explain histogram processing technique for image processing. (5)
- b) Describe the applications of vision systems with examples. (5)
- 13 a) Using a schematic diagram, explain the working of Vidicon camera. (5)
- b) Compare the effects of resolution and quantization on the usefulness of an image. (5)
- 14 With the help of a block diagram show different elements of car engine management system. Explain functions of important components. (10)
