K.S.R. COLLEGE OF ENGINEERING(Autonomous)

Vision of the Institution

- We envision to achieve status as an excellent educational institution in the global knowledge hub, making self-learners, experts, ethical and responsible engineers, technologists, scientists, managers, administrators and entrepreneurs who will significantly contribute to research and environment friendly sustainable growth of the nation and the world.

Mission of the Institution

- To inculcate in the students self-learning abilities that enable them to become competitive and considerate engineers, technologists, scientists, managers, administrators and entrepreneurs by diligently imparting the best of education, nurturing environmental and social needs.
- To foster and maintain a mutually beneficial partnership with global industries and Institutions through knowledge sharing, collaborative research and innovation.

DEPARTMENT OF DEPARTMENT OF MECHANICAL ENGINEERING

Vision of the Department

- To be a centre of excellence in the field of Mechanical Engineering for providing its students and faculty with opportunities to excel in education and targeted research themes in emerging areas.

  .

Mission of the Department

- To excel in academic and research activities that meets the industrial and social needs.
- To develop competent, innovative and ethical Mechanical Engineers.

Programme Educational Objectives (PEOs)

- Identify, design and apply the technical skills to solve mechanical engineering problems for enhancing the quality of life.
- Apply the modern tools and techniques to face the challenges in mechanical and related engineering areas.
- Understand the responsibility, communicate and implement innovative ideas in multidisciplinary teams ethically for uplifting the society.

COURSE FACULTY **H.O.D** **PRINCIPAL**

K.S.R. COLLEGE OF ENGINEERING (Autonomous)

Department of Automobile Engineering

Subject Name: MECHATRONICS

Subject Code: 18ME712 **Year/Semester: IV / VII**

Course Outcomes: On completion of this course, the student will be able to

CO1	Identify appropriate sensors and transducers to control mechatronics systems.
CO2	Demonstrate suitable actuator for mechanical and electrical drives.
CO3	Model control systems for electro mechanical systems.
CO4	Analyze PLC program for mechatronics systems.
CO5	Formulate a automated mechatronics system management control.

Program Outcomes (POs) and Program Specific Outcomes (PSOs)

A. Program Outcomes (POs)

Engineering Graduates will be able to :

PO1 **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals; and an engineering specialization to the solution of complex engineering problems**.**

PO2 **Problem Analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences**.**

PO3 **Design/Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations**.**

PO4 **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions**.**

PO5 **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations**.**

PO6 **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice**.**

PO7 **Environmental and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development**.**

PO8 **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice**.**

PO9 **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings**.**

PO10 **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions**.**

PO11 **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments**.**

PO12 **Life-long Learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

B. Program Specific Outcomes (PSOs)

PSO1 **Research Culture:** Read Literature, do research on new mechanical engineering problems and publish the results through patents, journals, conferences and symposium.

PSO2 **Core Values :** Contribute core universal values and social good to the community.

COURSE FACULTY **H.O.D** **PRINCIPAL**

K.S.R. COLLEGE OF ENGINEERING (Autonomous) **R 2018**

Open Elective

		L	T	P	C
18ME712	**MECHATRONICS**	3	0	0	3

Prerequisite: *Electronics and Microprocessor, Hydraulics and pneumatics.*

Objectives:

- *To study the various components of mechatronics, measurement and control systems.*
- *To apply mechanical actuation systems for hydraulic and electric systems.*
- *To model control systems for mechanical and electromechanical systems.*
- *To identify suitable PLC for mechatronics systems.*
- *To design a microprocessor based control system for machinery.*

UNIT – I MECHATRONICS , SENSORS AND TRANSDUCERS [9]

Introduction to mechatronics systems - measurement systems - control systems - microprocessor based controllers. Sensors, transducers - performance terminology - sensors for displacement, position, proximity, velocity, force, fluid pressure, liquid flow, liquid level, temperature, light sensor-selection of sensor.

UNIT – II ACTUATION SYSTEMS [9]

Pneumatic hydraulic systems - directional control valves - rotary actuators. Mechanical actuation systems - cams - gear train - ratchet and pawl - belt and chain drives - bearing electrical actuation systems -mechanical switches - solid state switches - solenoids - construction and working principle of AC and DC motors - speed control of AC and DC drives, stepper motors - switching circuitries for stepper motor - AC and DC servo motors.

UNIT – III SYSTEM MODELS AND CONTROLLERS [9]

Building blocks of mechanical, electrical, fluid and thermal systems, rotational-translational systems, electromechanical systems - hydraulic-mechanical systems. Continuous and discrete process controllers -control mode - two-step mode - proportional mode - Derivative mode-Integral mode - PID controllers-digital controllers - velocity control - adaptive control - digital logic control.

UNIT – IV PROGRAMMABLE LOGIC CONTROLLERS [9]

Basic structure - input/output processing-programming - mnemonics - timers, internal relays , counters - shift registers - master and jump controls - data handling - analog input/output - selection of a PLC.

UNIT – V DESIGN OF MECHATRONICS SYSTEMS [9]

Stages in designing mechatronics systems - traditional, possible design solutions. Case studies of mechatronics systems - pick and place robot - autonomous mobile robot - wireless surveillance balloon - engine management systems.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Identify appropriate sensors and transducers to control mechatronics systems.

CO2: Demonstrate suitable actuator for mechanical and electrical drives.

CO3: Model control systems for electro mechanical systems.

CO4: Analyze PLC program for mechatronics systems.

CO5: Formulate a automated mechatronics system management control.

Text Book :

1 Bolton.W, Mechatronics, Pearson education, New Delhi, second Edition, 2017.

2 Rajput.R.K., A text book of Mechatronics, S. Chand and Co, Delhi, Second Edition, 2018.

Reference Books :

1 Nitaigor Premchand Mahadik., Mechatronics, Tata McGraw-hill publishing company Ltd, New Delhi, Second Edition, 2007.

2 David G. Alciatore Michael B. Histand., Introduction to mechatronics and measurement system, TMH, Delhi, Second edition, 2019.

3 Michael.B.histand and David G. Alciatore, Introduction to mechatronics systems , TMH, Delhi, Second edition, 2018.

4 Dan necsulesu, Mechatronics, Pearson education Asia, Delhi, Second Edition, 2002.

5 http://nptel.ac.in

K.S.R.COLLEGE OF ENGINEERING, TIRUCHENGODE-637 215

DEPARTMENT OF AUTOMOBILE ENGINEERING

DEGREE / BRANCH : B.E., AUTOMOBILE ENGINEERING
YEAR / SEMESTER : IV /VII
NAME OF THE STAFF: **Mr. P.VIGNESH**
SUBJECT CODE : 18ME712
SUBJECT NAME : MECHATRONICS

COURSE / LESSON PLAN SCHEDULE

A) TEXT BOOK:

T_1 - W. Bolton, "Mechatronics", Pearson Education, Second Edition, 1999.

REFERENCES:

R_1 -Michael B. Histand and David G. Alciatore, " Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 2000.

R_2- Bradley D. A., Dawson D., Buru N.C. and. Loader A.J, "Mechatronics", Chapman and Hall, 1993.

R_3 -Dan Necsulesu, "Mechatronics", Pearson Education Asia, 2002 (Indian Reprint).

R_4-Dr.K.P.Ramachandran and G.K.Vijayaraghavan "Mechatronics" A.R.S Publications.

R_5- Nitaigour Premchand Mahadik, "Mechatronics", Tata McGraw-Hill publishing Company Ltd, 2003

R_6- A.Nagoor kani "Control system" First edition, RBA Publications.

B) LEGEND:

L	- Lecture	PPT	- Power Point
T	- Tutorial	BB	- Black Board
OHP	- Over Head Projector	pp	- Pages
T_X	- Reference	Ex	- Extra

Sl. No	Lecture Hour	Topics to be covered	Teaching Aid Required	Book No. /Page No
UNIT – I INTRODUCTION				
1.	L1	Introduction to Mechatronics Systems	BB	T_1/PP 17 to 18
2.	L2	Evolution, scope, components of Mechatronic systems	BB	T1/ PP 30
3.	L3	Mechanical actuators	BB	T1/PP 157 to 169
4.	L4	Hydraulic actuators	BB	T1/ PP 138 to 141
5.	L5	Pneumatic actuators	BB	T1/ PP 142 to 154
6.	L6	Automatic control, open loop and closed loop control	BB	T1/ PP 296 to 298
7.	L7	Servomechanism, block diagram algebra	BB	T1/ PP 49 to 58
8.	L8	Concept of transfer function	BB	T1/ PP 58 to 64
9.	L9	Modes of control: on/off, P, PI, PD and PID	BB	T1/ PP 300 to 309
UNIT – II SENSORS & ACTUATORS				
10	L10	Performance, terminology, characteristics, types, binary and analog	BB	T1/ PP 33
11	L11	Position Sensors: Limit switch, photoelectric switches, proximity sensors, pneumatic limit valves	BB	T1/PP 38 to 41
12	L12	Backpressure sensors, pressure switches, resolvers, incremental & absolute encoders, decoders & relays.	BB	T1/PP 53 to 56
13	L13	Displacement: Potentiometer sensors, LVDT, capacitive displacement sensors	BB	T1/PP 38 to 41
14	L14	Velocity sensors: Tachogenerator, use of encoders	BB	T1/PP 49 to 52
15	L15	Actuator types, Specifications and Control, Characteristics of AC Motors: Pulse width modulation to control AC frequency	BB	T1/PP 192 to 194
16	L16	Cycloconvertor for AC frequency control	BB	T1/PP 192 to 194
17	L17	DC Motors: Brushless DC servomotors, timing motors	BB	T1/PP 184 to 192
18	L18	SCR (Silicon Controlled Rectifiers) motors, factors for selecting motor, piezoelectric actuators, solenoids, torque motors	BB	T1/PP192 to194
UNIT – III PROGRAMMABLE CONTROLERS AND SIGNAL CONDITIONING				
19	L19	Review of logic gates, programmable logic controllers (PLC)	BB	T1/PP 460 to 465
20	L20	Basic structure, i/o processing, programming, ladder diagrams	BB	T1/PP 464 to 465

21	L21	Logic functions, latching, sequencing, timers	BB	T1/PP 471 to 476
22	L22	Jumps, analog i/o, applications	BB	T1/PP 477 to 481
23	L23	Signal conditioning process, clock signal, voltage divider, rectification	BB	T1/PP 70
24	L24	Operational Amplifiers: inverting and non-inverting	BB	T1/PP 72 to 81
25	L25	Summing, integrating, differential, logarithmic, comparator	BB	T1/PP 72 to 81
26	L26	Interfacing input output ports, serial and parallel interfacing requirements	BB	T1/PP 440 to 455
27	L27	Buffers, handshaking, polling and interrupts	BB	T1/PP 440 to 455
UNIT – IV - COMPUTER NUMERICAL CONTROL SYSTEMS & MICROCONTROLLER				
28	L28	Structure of CNC controller, reference pulse & sampled data type CNC system.	BB	T1/PP460 to 463
29	L29	(a) Position and velocity control loops for i) Point to Point control: incremental and absolute	BB	T1/PP 464 to 472
30	L30	open and closed control loops, deceleration diagram in PTP system, loop comparator in absolute systems	BB	T1/PP 472 to 475
31	L31	Continuous Path Control loop for position and velocity control, two axis contouring system for constant frequency & constant velocity commands.	BB	T1/PP 475 to 476
32	L32	(b) Adaptive Control: Principle, Adaptive control for a machine tool, adaptive control with optimization (ACO) and with constraints (ACC), applications for m/c tools like lathe, grinding etc.	BB	T1/PP 317 to 321
33	L33	Comparison between microprocessor and micro controller	BB	T1/PP 359
34	L34	Organization of a microcontroller system, architecture of MCS 51 controller	BB	T1/PP 359 to 372
35	L35	Pin diagram of 8051, addressing modes	BB	T1/PP 359 to 372
36	L36	Instruction types and set - Applications.	BB	T1/PP 389 to 391
UNIT – V - MEMS AND DESIGN OF MECHATRONIC SYSTEMS				
37	L37	Overview of MEMS & Microsystems, Typical MEMS & Micro system products & applications	BB	R4/PP 5 to 5.3
38	L38	Micro sensors and micro actuators: Phototransistors, pressure sensors, thermal sensors,	BB	T1/PP 518 to 524 R4/PP 5.3 to 5.4

39	L39	Micro grippers, micro motors, micro valves, micro pumps.	BB	T1/PP524 to 534 R4/PP 5.4 to 5.19
40	L40	Micro manufacturing: Bulk manufacturing, surface manufacturing, LIGA Process.	BB	T1/PP524 to 534 R4/PP 5.4 to 5.19
41	L41	The design process, traditional and mechatronic designs,Case Studies of Mechatronics Systems, Pick and place robot	BB	T1/PP 534 to 535 R4/PP 5.19 to 5.22
42	L42	Case Studies of Mechatronics Systems, Pick and place robot	BB	T1/PP 534 to 535 R4/PP 5.19 to 5.22
43	L43	automatic Car Park Systems	BB	T1/PP 534 to 541 R4/PP 5.22 to 5.23
44	L44	Engine Management Systems.	BB	T1/PP 542 to 543 R4/PP 5.23 to 5.26
45	L45	Engine Management Systems.	BB	T1/PP 542 to 543 R4/PP 5.23 to 5.26

PREPARED BY
(P.VIGNESH)

H.O.D./AE
(Dr. R.VENKATACHALAM)

MECHATRONICS

UNIT-I

2 MARKS QUESTIONS AND ANSWER

1. Define Mechatronics.
   Mechatronics may be defined as a multi-disciplanary field of study that implies the synergistic integration of electronics engineering, electrical engineering, control engineering and computer technology with mechanical engineering for the design, manufacturing, analyze and maintenance of a wide of engineering products and processes.

2. What are the components of Mechatronics system?
   - Actuators
   - Sensors
   - Input signal conditioning and interfacing
   - Digital control architectures
   - Graphical displays
   - Output signal conditing and interfacing

3. What is meant by a system in mechatronics?
   The system is a group of physical components combined to perform a specific function. Any mechatronics devices consist of systems.

4. What are the main applications of mechatronics?
   Whashing machines, dish washers, micro ovens, cameras, camcorders.
   Large scale applications:
   - Robots
   - Automatic conveyors
   - Computer-controlled machines

5. Waht are the basic functions of control systems?
   - To minimize the error between the actual and the desired output
   - To minimize the time response to load changes in the system

6. What are the types of control systems?
   a. Open loop systems
   b. Closed loop systems

7. List down the requirements of control systems.
   i. Stability
   ii. Accuracy
   iii. Response

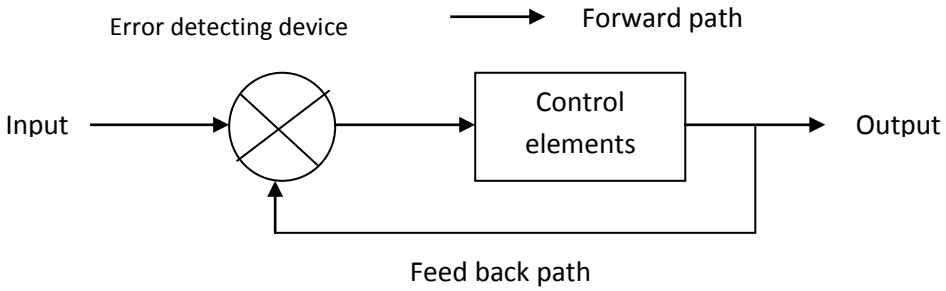
8. Give example for closed loop and open loop systems.
   Closed loop system – Automatic water level controller
   Open loop system -- Electric fire

9. Compare open loop control and closed loop control systems.

Open loop control systems	Closed loop control systems
1. It is suitable where accurate positioning of the tools is not required. 2. System is very simple. 3. It is suitable for rough work. 4. Error is not currently checked and rectified.	1. The feed back signal controls the table position accurately. 2. The system is mostly used almost in all automation process. 3. It is not suitable for rough work. 4. Error is currently checked and rectified.

10. Sketch and name elements of feed back system.

The basic elements of a good feed back system are



- Forward path
- Feed back path
- Error detecting device
- Amplifier
- Compensating network

11. Define actuator.

An actuator is an output device which performs useful work.

12. Classify actuators based on motion.

i. Linear motion
   - Single acting cylinders
   - Double acting cylinders

ii. Rotary motion
   - Air motors
   - Rotary actuators

iii. Flow control valves

13. Mention the various components of a hydraulic system.

a. Motor
b. Filter
c. Pump
d. Pressure regulator
e. Control valve
f. Piston and cylinder

14. What is called pneumatic system?

    Systems using gas for power transmission are called pneumatic systems and industrial systems are usually based on air.

15. List down the various components of a pneumatic system.
    i. Motor driven compressor
    ii. Air receiver
    iii. Directional control
    iv. Pneumatic cylinder

16. What are the types of pumps used as energy source in a hydraulic system?
    i. Hydrodynamic pump (centrifugal pump)
    ii. Positive displacement pump
        a. Gear pumps
        b. Vane pumps
        c. Piston pumps

17. What is the purpose of filters in hydraulic systems?

    Filters are used to prevent dirt or dust entering important elements of the hydraulic system like valves, seal etc. Filters are used to remove very finer particles.

18. What are the factors to be considered foe selecting compressors?

    The type of air compressor is selected dependent upon quality of air, pressure, and cleanliness.

19. State the purpose of providing air dryers.

    The air is to reduce the temperature of the air to a dew point which ensures that the water in the air condenses and drops out easily.

20. State the functions of a control valve

    The primary function of a control valve is to direct and regulate the flow of fluid from an energy source to the various loading devices. Normally, control valves are used for the purpose of sensing, processing, and controlling, and involve the following:
    - Allowing the passage of air/ fluid and directing it to a loading line.
    - Cancel the signal by blocking its signal.
    - Alter or generate the signal.
    - Release the air atmosphere or return the fluid to tank.

21. List different control valves.
    i. Directional control valves (DCVs)
    ii. Non return valves
    iii. Flow control valves
    iv. Pressure control valves
    v. Combinational valves
    vi. Solenoid valves.

22. Write objectives of DVCs?

The directional control valves are used for controlling the passage of a fluid signal. This is done by generating, canceling or redirecting signals.

12 MARK QUESTIONS

1. Define open loop and closed control and explain with an example. List out the difference between the open and closed loop system.
2. What is sequential control? Explain with example.
3. Explain the working operations of pneumatic and hydraulic systems with examples
4. What is the purpose of direction control valve and mention its any one of the application
5. Explain with the working operations of rotary actuators with linear cylinder and vane type semi rotary systems.
6. Briefly explain with the different types of cam and in its displacement diagram
7. What is discrete processes controllers?

UNIT-II

2 MARK QUESTIONS AND ANSWER

1. What is the purpose of a sensor?
   Sensor is used for an element which produces a signal relating to the quantity being measured. I.e., an electrical resistance temperature element, the quantity being measured is temperature and the sensor transforms an input of temperature into a change in resistance.

2. Define transducer?
   The term transducer is often used in place of the term sensor. Transducer are defined as elements that when subject to some physical change experience a related change. Thus, sensors are transducers.

3. What are the terms that define the performance of the transducers?
   The terms are,
   a. Range and span
   b. Error
   c. Accuracy
   d. Sensitivity
   e. Hysteresis error
   f. Non – linearity error
   g. Repeatability / reproducibility
   h. Stability
   i. Dead band / time
   j. Resolution
   k. Output impedance.

4. Write about the static characteristics?
   The static characteristics are the values given when the steady – state conditions occur. i.e., the values given when the transducer has settled down after having received some input.

5. Write about dynamic characteristics?
   The dynamic characteristics refer to the behavior between the time that the input value changes and the times that the value given by the transducer settles down to the steady – state value. Dynamic characteristics are stated in terms of the response of the transducer to inputs in particular forms.

6. What are the terms that you can find from the dynamic characteristics?
   The terms are,
   a. Response time
   b. Time constant
   c. Rise time
   d. Settling time.

7. What is a displacement sensor?
   Displacement sensors are concerned with the measurement of the amout by which some object has been moved.
8. What is a position sensor?
   Position sensors are concerned with the determination of the position of some object with reference to some reference point.

9. What is a proximity sensor?
   Proximity sensors are a form of position sensor and are used to determine when an object has moved to within some particular critical distance of the sensor.

10. What are the two basic types of the displacement and the position transducers?
The two basic types are,
a. Contact sensors
b. Non contacting sensors.

11. Write about the contact sensors?
In contact sensors the measured object comes into mechanical contact with the sensor. For those linear displacement methods involving contact, there is usually a sensing shaft, which is in direct contact with the object being monitored by a sensor.

12. What is the use of the contact sensors?
The movement of the shaft may be used to cause changes in electrical voltage, resistance, capacitance, or mutual inductance. For angular displacement methods involving mechanical connection, the rotation of a shaft might directly drive, through gears, the rotation of the transducer element.

13. Write about the strain – gauged element?
The electrical resistance strain gauge is a metal wire, metal foil strip, or a strip of semiconductor material, which is wafer – like and can be stuck onto surfaces like a postage stamp.

14. What is gauge factor?
When the strain – gauged element is subjected to strain, its resistance R changes, the fractional change in resistance □ R/R beingproportional to the strain.
i.e. □ R/R = G□ □ , where G, the constant of proportionality is termed as the gauge factor.

15. Write about the gauge factors for different types of strain gauges?
The gauge factor of metal wire or foil strain gauges with the metals generally used is about 2.0. Silicon p – and n – type semiconductor strain gauges have gauge factors of about + 100 or more for p- type silicon and – 100 or more for n – type silicon.

16. What is the capacitance of a parallel plate capacitor?
The capacitance of a parallel plate capacitor is given by,
$C = \varepsilon_r \varepsilon_0 A/d$
Where, ε_r the relative permittivity of the dielectrio between the plates.
ε_0– a constant called the permittivity of free space
A – the area of overlap between the two plates
d – the plate separation.

17. Write about LVDT?
The Linear Variable Differential Transformer consists of three coils symmetrically spaced along an insulated tube. The central coil is the primary coil and the other two are identical secondary coils, which are connected in series in such a way that their outputs oppose each other.

18. How does an LVDT work?
When there is an alternating voltage input to the primary coil, alternating e.m.f.s are induced in the secondary coils. With the magnetic core central, the amount of magnetic material in each of the secondary coil is the same.

19. What are the uses of LVDT?
The uses are as follows.
a. Widely used as primary transducers for monitoring displacements.

b. Also used as secondary transducers in the measurement of force, weight and pressure.

20. Write about inductive proximity switch?
Inductive proximity switch consists of a coil wound round a core. When the end of the coil is close to a metal object is inductance changes. This change can be monitored by its effect on a resonant circuit and the change used to trigger a switch. It can only be used for the detection of metal objects and is best with ferrous metals.

21. What is an encoder?
An encoder is a device that provides a digital output as a result of a linear or angular displacement.

22. What are the two types of position encoders?
The two types of position encoders are,
a. Incremental encoders
b. Absolute encoders.

23. What is an incremental encoder?
An incremental encoder is used for the measurement of angular displacement. A beam of light passes through slots in a disc and is detected by a suitable light sensor. When the disc is rotated, the sensor produces a pulsed output with the number of pulses being proportional to the angle through which the disc is rotated. Hence, the angular position of the disc is determined.

24. Write about absolute encoder?
An absolute encoder is used for the measurement of angular displacement. This gives an output in the form of a binary number of several digits, each such number representing a particular angular position. The rotating disc has three concentric circles of slots and three sensors to detect the light pulses.

25. What are the uses of photosensitive devices?
Photosensitive devices can be used to detect the presence of an opaque object by it breaking a beam of light or infrared radiation, falling on such a device or by detecting the light reflected back by the object.

26. Write about Hall effect sensors?
When a beam of charged particles passes through a magnetic field, forces act on the particles and the beam is deflected from its straight line path. A current flowing in a conductor is like a beam of moving charges and thus can be deflected by a magnetic field.

27. What is Hall co-efficient?
The transverse potential difference is given by,

$$V = \frac{BI}{T} KH$$

Where, KH = Hall co-efficient,
B = Magnetic flux density at right angles to the plate,
I = Current
T = Plate thickness.

28. What is a tachogenerator?
A tachogenerator is used to measure angular velocity. Variable reluctance tachogenerator consists of a toothed wheel of ferromagnetic material, attached to the

rotating shaft. As the wheel rotates, the teeth move past the coil and the air gap between the coil and the ferromagnetic material changes and so the flux. The resulting cyclic change in the flux produces an alternating e.m.f. in the coil.

29. Write about pyroelectric sensor?
A pyroelectric sensor consists of a polarized pyroelectric crystal with thin metal film electrodes on opposite faces. Ions are drawn from the surrounding air and electrons from any measurement circuit connected to the sensor to balance the surface charge.

30. Write about the principle of load cell?
Force – measuring transducer is based on the use of electrical resistance strain gauges to monitor the strain produced in some member when stretched, compressed or bent by the application of the force. The arrangement is referred to as load cell.

31. Write about piezoelectric sensors?
Piezoelectric materials when stretched or compressed generate electric charges with one face of the material becoming positively charged and the opposite face negatively charged. As a result, a voltage is produced.

32. What are the applications of the tactile sensor?
A tactile sensor is a particular form of pressure sensor. Such a sensor is used on the 'fingertips' of robotic hands to determine when a 'hand' has come into contact with an object. They are also used for touch display screens where a physical contact has to be sensed.

33. Write about the tactile sensor?
Two layers of the film are used and are separated by a soft film, which transmits vibrations. The lower PVDF film has an alternating voltage applied to it and this results in mechanical oscillations of the film. These vibrations cause an alternating voltage to be produced, when pressure is applied to the upper PVDF film.

12 MARK QUESTIONS

1. What is transducer? Explain with examples the following terms related to transducer.
    a) Range span and errors
    b) Accuracy and stability
    c) Sensitivity and repeatability
    d) Resolution and dead time
2. Explain with dynamic characteristics of a transducer. Explain in detail about the selection of a sensor
3. Explain the principle and operations of LVDT with neat sketch
4. What are the devices used for the measurement of temperature? Explain with the thermocouple type of sensor for measuring temperature.
5. Explain the principle and operations of any one type of light sensors
6. Name the elements that can be used as position, displacement and proximity sensor and explain its operations in details.
7. Explian briefly with the working of mechanical switching devices
    a) Solenoids
    b) Relays

8. Explian briefly D.C motor control by using MOSFETs
9. Discuss briefly the electronic controls of A.C motors.
10. What are servo motors? Explain briefly.

UNIT-III
2 MARK QUESTIONS AND ANSWER

1. What is a PLC?
   A programmable Logic Controller (PLC) is defined as a digital electronic device that uses a programmable memory to store instructions and to implement functions such as logic, sequencing, timing, counting and arithmetic in order to control machines and processes.

2. What is main advantage of PLC?
   PLC's have great advantage that it is possible to modify a control system without having to rewire the connections to the input and output devices.

3. What are the features of PLC as a controller?
   The features of PLC as a controller are,
   a. They are rugged and designed to withstand vibrations, temperature, humidity and noise.
   b. The interfacing for inputs and outputs is inside the controller.
   c. They are easily programmed and have an easily understood programming language.

4. Write about the architecture of a PLC?
   It consists essentially of a central processing unit (CPU), memory and input/output circuitry. The CPU controls and processes all the operations within the PLC. It is supplied with a clock with a frequency between 1 and 8 MHz. It also has a bus system, memory and input/output units, a system ROM for permanent storage, RAM for the users program and temporary buffers.

5. How are programs entered?
   Programs are entered into the input / output unit from a panel, which can vary from small keyboards with liquid crystals to those using a visual display unit (VDU) with keyboard and screen display. Alternatively, the programs can be entered into the system by means of a link to a PC.

6. Write about the input / output channels?
   The input/output channels provide signal conditioning and isolation functions so that sensors and actuators can be generally directly connected to them without the need for other circuitry. Common input voltages are 5 V and 24V. Common output voltages are 24 V and 240 V.

7. Write about the relay?
   With the relay type, the signal from the PLC output is used to operate a relay and so is able to switch currents of the order of a few amperes in an external circuit. The relay isolates the PLC from the external circuit and can be used for both D.C. and A.C. switching. Relays are, however, relatively slow to operate.

8. What are optoisolators?
   Optoisolators are used with transistor switches to provide isolation between the external circuit and the PLC. They are also used to provide isolation.

9. What is ladder programming?
   The ladder programming involves each program task being specified as though a

rung of a ladder. Thus such a rung could specify that the state of switches A and B, the inputs, be examined and if A and B are both closed then a solenoid, the output is energized.

10. What are the methods used for input / output processing?
    There are two methods used for input / output processing. They are
    a. Continuous updating
    b. Mass input/output copying.

11. What is continuous updating?
    This involves the CPU scanning the input channels as they occur in the program instructions. Each input point is examined individually and its effect on the program determined. Each input is scanned with a 3 ms delay, before the program has the instruction for a logic operation to be executed and an output to occur. This process is called continuous updating.

12. What is the disadvantage of continuous updating?
    Because of the 3 ms delay in the continuous updating on each input, the time taken to examine several hundred input/output points can become comparatively long.

13. Write about the mass input/output copying?
    To allow a more rapid execution of a program, a specific area of RAM is used as a buffer store between the control logic and the input/output unit. At the start of each program cycle the CPU scans all the inputs and copies their status into the input/output address in RAM. At the end of each program cycle all the outputs are transferred from RAM to the output channels. The outputs are latched so that they retain their status until the next updating.

14. What is a LATCH circuit?
    The term latch circuit is used for the circuit used to carry out such an operation. It is a self – maintaining circuit in that, after being energized, it maintains that state until another input is received. It remembers its last state.

15. Define the term point and delay–on?
    The term point is used for a data point and so is a timing, marker (internal relay) or counter element. Thus, the 16 points for timers means that there are 16 timer circuits. The term delay on is used to indicate that this type of timer waits for a fixed delay period before turning on.

16. Write about timer circuit?
    A timer circuit is specified by stating the interval to be times and the conditions or events that are to start and / or stop the timer. They are commonly regarded as delays with coils which, when energized, result in the closing or opening of input contacts after some preset time.

17. Write about internal relays?
    The term internal relay, auxiliary relay or marker is used for what can be considered as an internal relay in the PLC. These behave like relays with their associated contacts, but in reality are not actual relays with their associated by the software of the PLC. Internal relays are often used when there are programs with multiple input conditions.

18. Write about counters?
    Counters are used when there is a need to count a specified number of contact operations. Example – where items pass along a conveyor into boxes, and when the

specified number of items has passed into a box the next item is diverted into another box.

19. What is an up counter?
    An up counter would count up to the preset value i.e., events are added until the number reaches the set value. When the set value is reached the counters contact changes state.
20. What is a down counter?
    Down counter means that the computer counts down from the preset value to zero i.e., events are subtracted from the set value. When zero is reached the counters contact changes state.

21. Write about shift register?
    The term shift register is used because the bits can be shifted along by one bit when there is a suitable input to the register.

22. What are the inputs of shift register?
    There are three inputs of shift register. They are,
    a. One to load data into the first element of the register (OUT).
    b. One as the shift command (SFT).
    c. One for resetting(RST).

23. What the operations that are carried out with a PLC on data words?
    The operations that are carried out with a PLC on data words are,
    a. Moving data
    b. Comparison of magnitudes of data
    c. Arithmetic operations such as addition and subtraction
    d. Conversions between binary coded decimal (BCD), binary and octal.

24. What are the criteria need for the selection of a PLC?
    The criteria needed for the selection of a PLC are the following.
    a. Input/output capacity is required.
    b. Types of inputs/outputs are required.
    c. Size of memory required.
    d. Speed and power is required for the CPU.

12 MARK QUESTIONS

1. What are the advantages of PLC over a relay control system?
2. What are the logic functions used for switches in serious and in parallel?
3. Write a relay diagram, given that two push button switches turn on an output device when both seitchws are closed.
4. Describe three basic elements of an I/O address.
5. Write a ladder diagram logic program for following condition:
   a. Turn on a light, 20s after switch S1 has been turn on
   b. Turn on lights only for 20s after switch S1 has been turned on
   c. Turn off light after 20 seconds of switch S1 has been turned off.
6. Design an operational amplifier circut that can be used to produce an output that ranges from 0 t0 -5 V when the input goes from 0 to 100 mV.
7. Write the types of amplifier. Explain with neat skecth.

UNIT-IV

2 MARK QUESTIONS AND ANSWER

1. What is microprocessor?
   The microprocessor is a program controlled semiconductor device (IC), which fetches (from member), decodes and executes instructions. It is used as CPU (Central processing Unit) in computers

2. What are the advantages of microprocessor?
   Microprocessors are now rapidly replacing the mechanical cam operated controller and being used in general to carry out control functions. They have the greater advantage that a greater variety of programs became feasible.

3. What are types of registers?

   Registers can be classified as:
   1. General purpose registers
   2. Temporary registers a) Temporary data register b) W and Z registers
   3. Special purpose register
      A) Accumulator b) Flag registers c) Instruction register
   4. Sixteen bit registers
      a) Program counter (PC) b) Stack pointer (SP)

4. What is Program counter (PC)?

   The program counter is a special purpose register which, at a given time , stores the address of the next instruction to be fetched. Program counter acts as a pointer to the next instruction.

5. What is stack pointer (PC)?

   The struck is a reserve area of the memory in the RAM where temporary information may be stored. A 16-bit stack pointer is used to hold the address of the mosses recent stack entry.

6. What is addressing?

   Every instruction of a program has to operate on a data. The method of specifying the data to be operated by the instruction is called Addressing.

7. What is immediate addressing?

   In immediate addressing mode, the data is specified in the instruction itself. The data will be a part of the program instruction.
   Example: MVIB, 3EH-Move the data $3E_H$ given in the instruction to B-register.

8. What is direct addressing?

   In direct addressing mode, the address of the data is specified in the instruction. The data will be in memory, in this addressing mode, the program instruction and data can be stored in different memory blocks.
   Example: LDA 1050_H- Load the data available in memory location 1050_H in accumulator

9. What is register addressing?

   In register addressing mode, the instruction specifies the name of the register in which the data is available.

Example: MOVA, B-Move the content of B-register to A-register.

10. What are the two types of memories?

The two types of memories are,
a. Static memory (SRAM)
b. Dynamic memory (DRAM)

11. Write about the SRAM?

a. This memory is made up of flip – flops, and it sores the bit as a voltage.
b. Each memory cell requires six transistors.
c. The memory chip has low density, but high speed.
d. More expensive, and consumes more power.
e. Also known as cache memory.

13. What are the advantages of DRAM?

The advantages of DRAM are,
a. This memory is made up of MOS transistor gates and it stores the bit as a charge.
b. It has high density.
c. Low power consumption
d. Cheaper than static memory
e. Economic to use when the system memory size is atleast 8K for small systems.

14. What are the disadvantages of DRAM?

The disadvantages of DRAM are,
a. The charge (bit information) leaks.
b. Stored information needs to be read and written again every few milliseconds this is called refreshing the memory.
c. Requires extra circuitry, adding to the cost of the system.

15. What is flash memory?

The flash memory must be erased either in its entirely or at the sector level. The memory chips can be erased and programmed atleast a million times. The power supply requirement for programming these chips 2was around 12V, but now chips are available that can be programmed using a power supply as low as 1.8 V. Hence, this memory is ideally suited for low – power systems.

16. What is meant by CNC?

CNC is a microprocessor based control system that accepts a set of program instructions, processes and sends output control information to a machine tool, accepts feedback information acquired from a transducer placed on the machine tool and based both on the instructions and feedback, assures that proper motion, speed and operation occur.

17. What are the various functions of microprocessor in CNC systems?

It effects control system functions and peripheral devices for data communication, machine tool interfacing and machine tool status monitoring.

18. What are the various types of CNC control schemes used depending on the positioning and motion?

Point to Point control and Continuous Path Control.

19. What are the various types of interpolations to carry out continuous path controls?

Interpolations – Linear, Circular, Helical and Parabolic

20. Distinguish between open loop and closed loop CNC systems.

Open Loop CNC systems	Closed Loop CNC systems
A microprocessor based control system that accepts set of instructions and sends output control information to a machine tool. It does not have proper motion, speed and operation.	A microprocessor based control system that accepts set of instructions and sends output control information to a machine tool, accepts feedback information from the transducer. It assures proper motion, speed and operation.

21. What are the types of CNC controllers available in CNC machines?

    Automatic Acceleration / Deceleration control, Feed rate control, Interpolation and servo computation control, Sequence control.

22. Distinguish between incremental and absolute measuring devices.

Incremental measuring device	Absolute measuring device
The datum can be selected anywhere along the length of the scale and hence at any position within the working range of the machine tool.	The datum is fixed and unique within the working range of the machine tool.
It can be varied only within certain limits. This situation is necessary for machines that perform a single stroke operation.	No such situation arises due to datum is fixed.

23. What is contouring?

    It is the most complex, the most flexible and expensive type of machine tool control. It is capable of performing both Point to Point control and straight cut operations. It has the capacity for simultaneous control of more than one axis movement of the machine tool.

24. What is meant by Linear and Circular Interpolation?

    Linear Interpolation is the most basic and used when a straight line path is to be generated in continuous path NC. Two or three axis linear interpolation routines are sometimes distinguished in practice.

    Circular Interpolation schemes have been developed that permit the programming of a path consisting of a circular arc by specifying the following parameters of the arc: the coordinates of its end points, the coordinates of its center, its radius and direction of the cutter along the arc.

12 MARK QUESTIONS

1. Distinguish between micro controller and micro processor.
2. Explain the architecture of 8051.
3. Explain the various types of addressing modes
4. Explain in brief adaptive control system.
5. Explain the various types of interpolation systems.
6. Explain the two axis contouring system

UNIT-V
2 MARK QUESTIONS AND ANSWER

1. What are the number of stages in the design process?
   The design process can be considered as a number of stages.
   They are,
   a. The need
   b. Analysis of the problem
   c. Preparation of a specification
   d. Generation of possible solutions
   e. Selections of a suitable solution
   f. Production of a detailed design
   g. Production of working drawings.

2. What are the advantages of the microprocessor controlled system?
   The microprocessor controlled system can cope easily with giving precision and programmed control. The system is much more flexible. This improvement in flexibility is a common characteristic of Mechatronics systems when compared with traditional systems.

3. What is the advantage of using PLC solution over mechanical solution?
   A PLC solution could involve the arrangement with the given ladder program.
   This would have the advantage over the rotating cam of having off and on times which can be adjusted by purely changing the timer preset values in the program whereas a different cam is needed if the times have to be changed with the mechanical solution.

4. What are the axes of a pick and place robot?
   The robot has three axes about which motion can occur.
   a. Rotation in a clockwise or counter clockwise direction of the unit on its base.
   b. Arm extension or contraction and arm up or down.
   c. Gripper can open or close.

5. How do the movements of robot take place?
   Clockwise rotation of the unit might result from the piston in a cylinder being extended and the counter clockwise direction by its retraction. Likewise the upward movement of the arm might result from the piston in a linear cylinder being extended and the downward motion from it retracting, the extension of the arm by the piston in another cylinder extending and its return movement by the piston retracting.

6. What is the use of PLC in automatic car park system?
   An illustration of the use of a PLC in the coin operated barriers for a car park.
   The in-barrier is to open when the correct money is inserted in the collection box and the out – barrier is to open when a car is detected at the car park side of the barrier.

7. How does a car park barrier works?
When a current flows through the solenoid of valve, the piston in a cylinder moves upwards and causes the barrier to rotate about its pivot and rise to let a car

12 MARK QUESTIONS

1. Explain the various stages in designing Mechatronics system.
2. Briefly explain traditional and Mechatronics designs.
3. Compare the traditional and Mechatronics design.
4. Explain possible design solutions.
5. Describe the two configurations of stepper motor in operation.
6. How simple weighing works using traditional mechanical system?
7. Explain the working of a weighing scale using Mechatronics solution compare this overall traditional mechanical system.
8. Describe pick and place robot with its movements.
9. Explain the working of an automatic car parking system with neat sketch.
10. Describe engine management system.