1BES104D

CBCS SCHEME

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1BPSC104D

First Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026

Introduction to Mechanical Engineering

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

			M	L	C
		Module – 1			
Q.1	a.	Discuss the various roles of mechanical engineers in solving the real case problems.	10	L1	CO1
	b.	With schematic diagram explain briefly the working principle of centrifugal pump.	05	L2	CO1
	c.	State the working principle of power steering with schematic sketch.	05	L1	CO1
		OR			
Q.2	a.	With block diagram explain the working of refrigeration system.	10	L2	CO1
	b.	With sketch state the working principle of Pelton turbine.	05	L1	CO1
	c.	State the functions of important parts of drone.	05	L2	CO1
		Module – 2			
Q.3	a.	Using appropriate diagrams, explain how a 4-stroke diesel engine works, and represent the cycle on a P–V diagram.	10	L2	CO2
	b.	Sketch the basic layout of an electric vehicle and label its components.	06	L2	CO2
	c.	State the advantages of Electrical vehicles.	04	L1	CO2
		OR			
Q.4	a.	What do you mean by the term Gear train? With the help of a neat sketch, explain the working of a compound gear train.	10	L2	CO2
	b.	With sketch discuss in brief about Hybrid Electrical.	10	L1	CO2
		Module – 3			
Q.5	a.	Explain the properties and applications of ferrous metals.	08	L2	CO3
	b.	Differentiate between ferrous and non ferrous metals.	06	L4	CO3
	c.	What are composite materials? List the classification of composite materials based on matrix and reinforcement materials.	06	L1	CO3
		OR			
Q.6	a.	State the advantages, disadvantages and applications of composite materials.	08	L2	CO3

	b.	What are smart materials? State the applications of smart materials.	06	L1	CO3
	c.	State advantages and disadvantages of shape memory alloys.	06	L1	CO3
		Module – 4			
Q.7	a.	Describe the classification of manufacturing processes. Explain the factors that influence the selection of a suitable manufacturing process.	08	L1	CO4
	b.	State the principles of welding and brazing.	06	L1	CO4
	c.	With sketches explain turning and knurling processes of lathe.	06	L2	CO4
		OR			
Q.8	a.	State the principle of drilling. With neat sketches explain reaming and tapping operations of drilling machine.	08	L1	CO4
	b.	With block diagram explain the basic components of CNC machine.	06	L2	CO4
	c.	Explain the principle of 3D printing. State the standard steps in 3D printing process.	06	L2	CO4
		Module – 5			
Q.9	a.	Define automation and explain different types of automation.	08	L1	CO5
	b.	What is Mechatronics system? Mention its applications.	06	L2	CO5
	c.	State the working principle of Potentiometer as sensor and mention its applications.	06	L1	CO5
		OR			
Q.10	a.	What is an optical encoder? Explain its working principle and industrial applications.	08	L2	CO5
	b.	Explain why it is necessary to integrate technology.	06	L2	CO5
	c.	What is Advanced Driver Assistance Systems (ADAS) and state its features.	06	L1	CO5

9.1) a) Role of mechanical Engginees in solving real-life problems

Mechanical engineers apply engineering principles to solve practical problems.

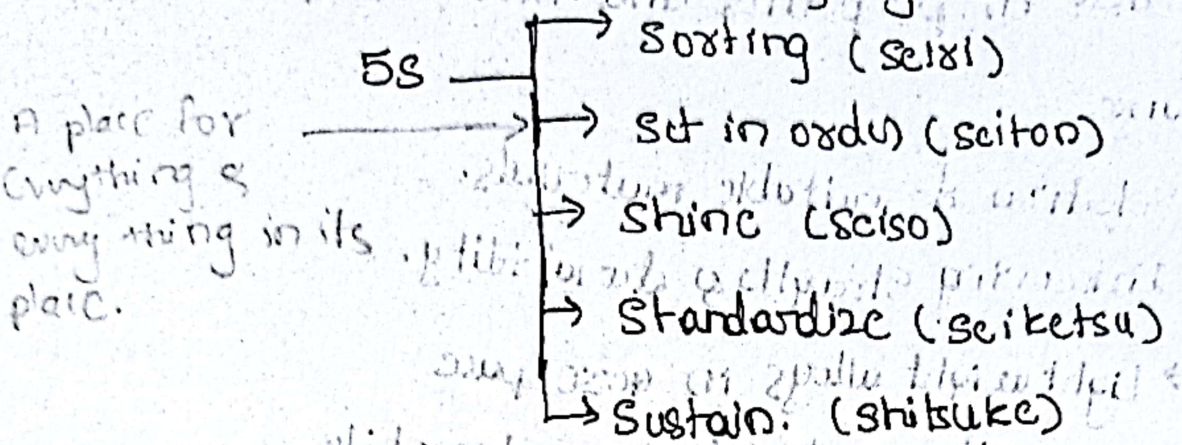
The broad categories are:

1) Energy & sustainability
   → Development of effective solar dryers, solar stills, & solar PV Panel systems.

2) Transportation & mobility:
   → Designing of fuel efficient vehicles (BS-6 engine)
   → Improveing safty and comforts.
   → Design of electric vehicles (EV).
   → Design of drones.
   → Earth movers, Military Vehicles

3) Manufacturing & automation

→ Increasing the productivity by 5S.



Japanese-derived methodology.

→ Use of sensors in manufacturing process.

→ Use of robots

→ Use of CNC machines.

4) Healthcare engineering

→ Design of medical devices & equipments.

→ Robot surgery

→ Developing & manufacturing of simple tools like scalpels & crutches

→ " " ventilators, dialysis machines, & surgical lasers.

→ Design of artificial limbs

→ MRI & CT scanning.

→ Optimizing hospital layouts, workflow, & supply chains for better efficiency.

5) Thermal comforts

→ Design of HVAC (Heating, ventilation & air conditioning) for buildings.

→ Air conditioning in aeroplanes.

6) Agriculture and rural development

→ Solar powered irrigation pumps

→ Rain water harvesting

→ Seeders machine.

→ Integrating soil moisture sensors with automated valves

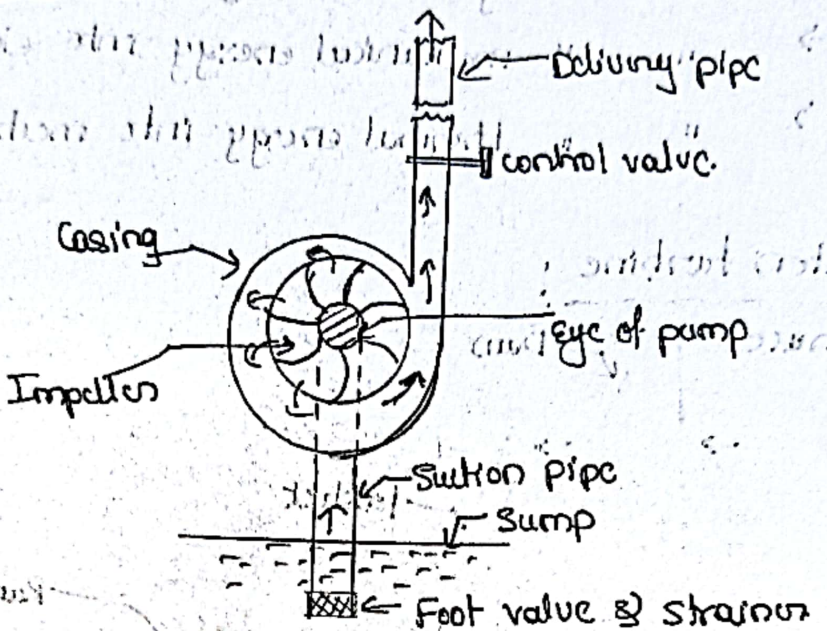
→ Drip irrigation.

→ Biogas plants.

→ Pesticide sprayers.

1b)

Centrifugal pump:



Parts of centrifugal pump:

1) Impeller:

The rotating part of a centrifugal pump. It consists of series of backward curved vanes. The impeller is mounted on a shaft which is connected to the shaft of an electric motor.

2) Casing:

It is the air-tight passage surrounding the impeller & is designed in a such a way that the kinetic energy of water discharged at the outlet of impeller is converted into pressure energy before water leaves the casing & enters the delivery pipe.

3) Suction pipe with a foot-valve & strainer:

A pipe whose one end is connected to the inlet of the pump & other end dips into water in a sump. A foot valve which is non-return valve or one way type of valve is fitted at the lower end of the suction pipe. The foot valve opens only in the upward direction. A strainer is also fitted.

4) Delivery pipe:

A pipe whose one end is connected to the outlet of the pump & other end delivers to water at a required height.

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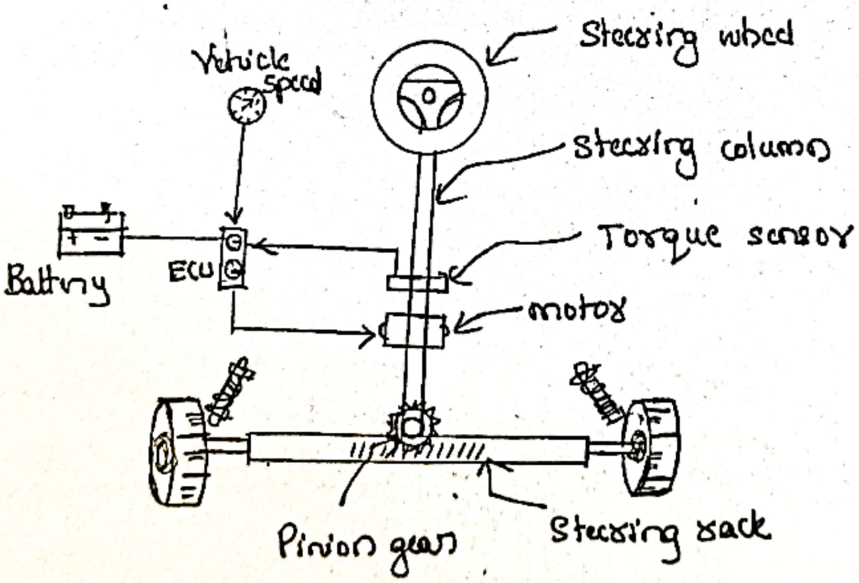
1)c) Power steering (Electric):



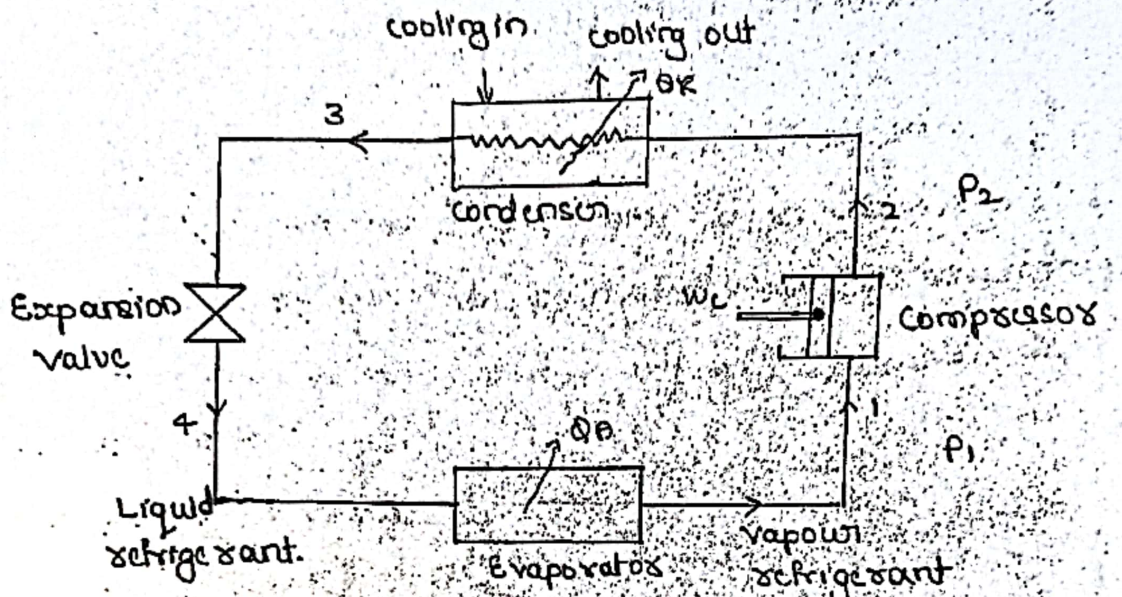
In an electric power steering system, it is the car's computer (ECU) that signals the mechanism to turn the steering wheel. The force is generated by an electric motor that often sits by the steering rack & helps move the pinion gear back & front inside the rack.

The ECU receives a signal from the car regarding speed, and a torque sensor tells the system how much force is applied to turn the steering wheel.

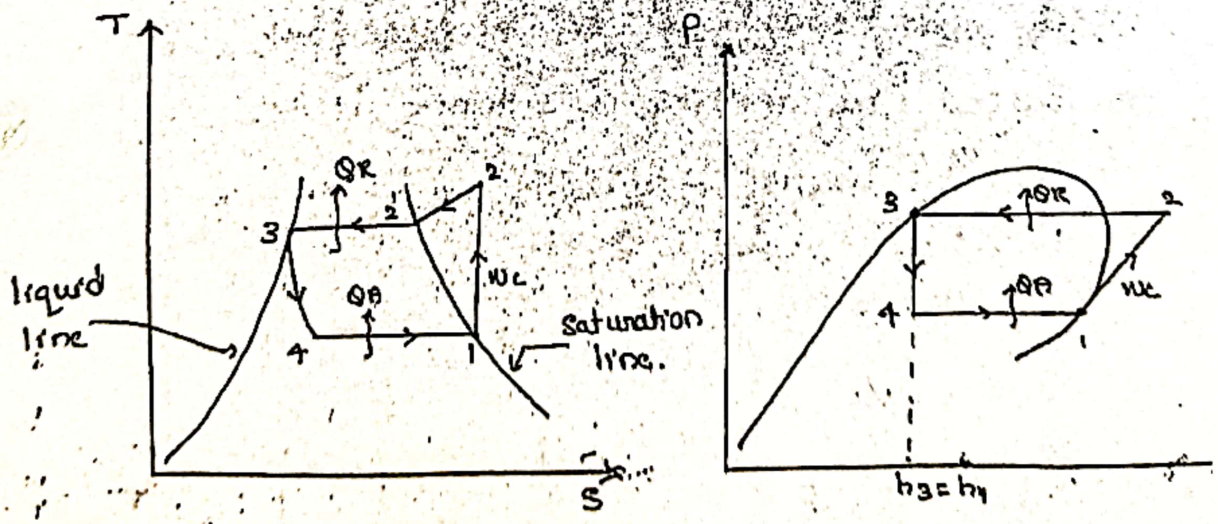
Q.2) a)

Refrigeration systems:

a) Vapour compression refrigeration system:



Corresponding T-S & Ph diagrams (Take dry compression).



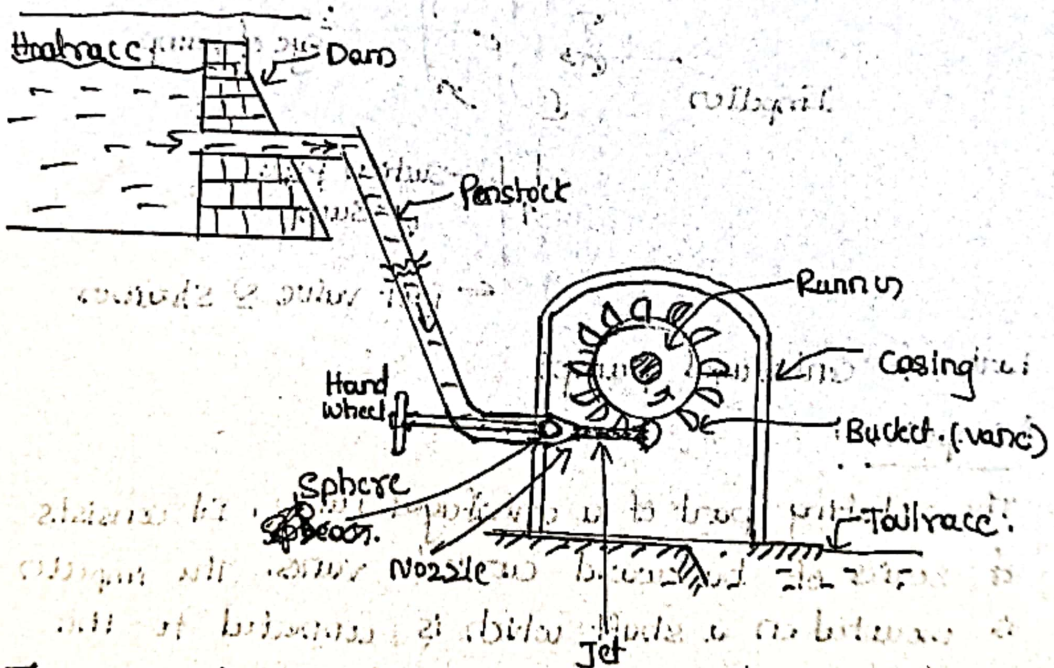
The vapour coming from the evaporator is compressed into the compressor to the high pressure (1-2).

→ Thus the high pressure, high temperature vapour is delivered to the condenser, where it is cooled (2-3).

→ The high pressure refrigerant is thus expanded into the expansion valve & due to the expansion its temperature decrease & become liquid refrigerant.

→ The liquid refrigerant is passed through the evaporator where it absorbs all heat from the objects being cooled. & by absorbing heat the liquid refrigerant becomes vapour refrigerant & is again delivered to the compressor to repeat the cycle.

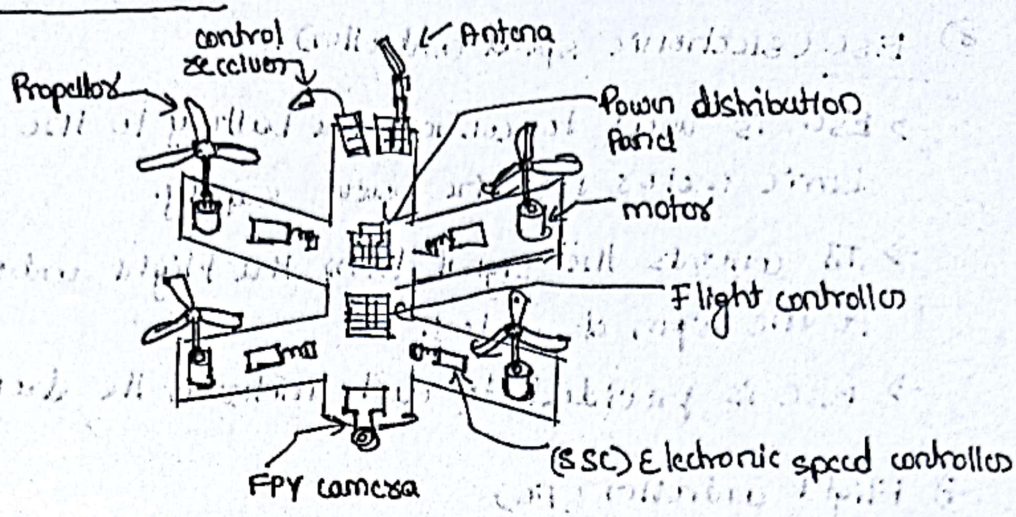
2) b) Pelton turbine:



The water from dam is made to flow through the penstock. At the end of penstock, nozzle is fitted which converts the pressure energy into high kinetic energy. The jet speed coming from the nozzle is regulated by the sphere head by varying the area. the high velocity of jet impinging over the blades of runner, due to which runner starts rotating because of impulse effect.

Q.2) c)

Parts of drone



1) Frame:

→ Should have a sufficient strength to hold the propellor momentum & additional weight

→ sturdy & less aerodynamic resistance.

2) Propellers:

→ The speed & loading lifting ability of a drone depends on shape, size & number of propellors.

→ The long propellors create huge thrust to carry heavy loads at low rpm.

→ Short propellors carry fewer loads.

3) motor:

→ Brushless & brushed type can be used for drones.

→ A brushed motor is less expensive & useful for small sized drones.

→ Brushless type motors are powerful. But they need electronic speed controllers to control their speed.

3) ESC (Electronic speed controller):

→ ESC is used to connect the battery to the electric motor for the power supply.

→ It converts the signal from the flight controller to the rpm of motor.

→ ESC is provided to each motor of the drone.

4) Flight controller (FC)

→ It is the computer processor which manages, balance & telecommunication controls using different transmitter.

→ Sensors are located in this unit for accelerometer barometer, magnetometer, gyrometer & GPS.

5) Radio transmitter

→ Sends the radio signal to ESC to pilot to control motor speed.

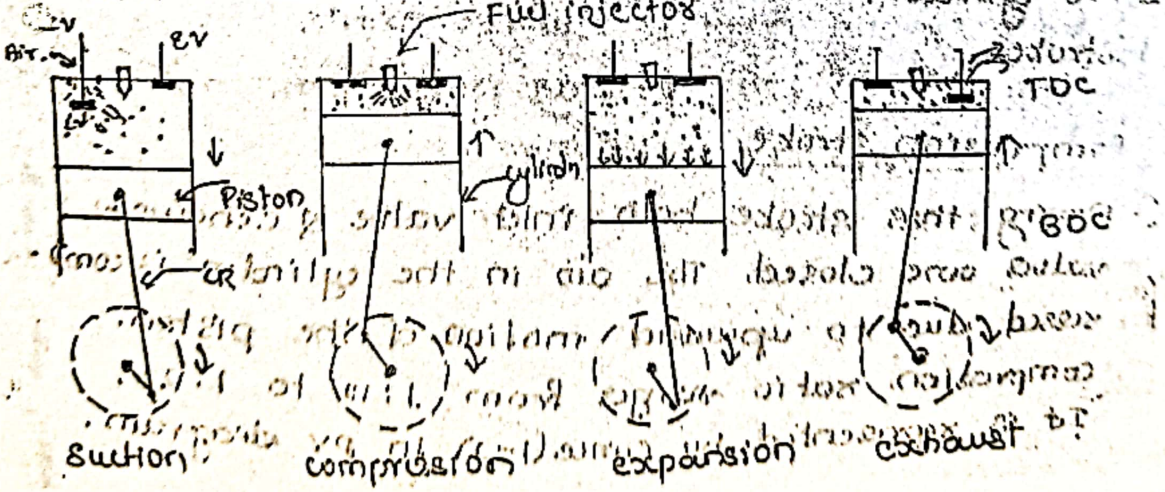
6) Radio Receiver

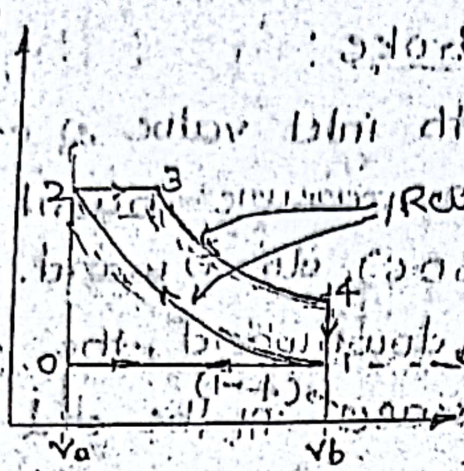
→ Receives the signal from the pilot.

7) Battery

→ High power capacity, Lithium Polymer (LiPo) is used for most drones.

8.3) a) Four stroke diesel engine (J/J 2011, 10m) (Dec 2010, 10m)





The diesel engine work on the principle of theoretical diesel cycle. Also known as constant pressure heat addition cycle.

Suction stroke

Suction stroke starts when piston is at TDC & about to move downward. Inlet valve is open at this time & exhaust valve is closed. Due to the suction created by the motion of the piston, the only atmospheric air will be drawn into the cylinder. Inlet valve closes at the end of this stroke.

Compression stroke

During this stroke both inlet valve & exhaust valve are closed. The air in the cylinder is compressed due to upward motion of the piston. Compression ratio ranges from 1:12 to 1:22. It is represented by curve (1-2) in PV diagram.

At the end of the compression, metered quantity of diesel is injected into the cylinder through injector. The high temperature of the compressed air ignites the fuel as soon as it is sprayed. This is called auto ignition.

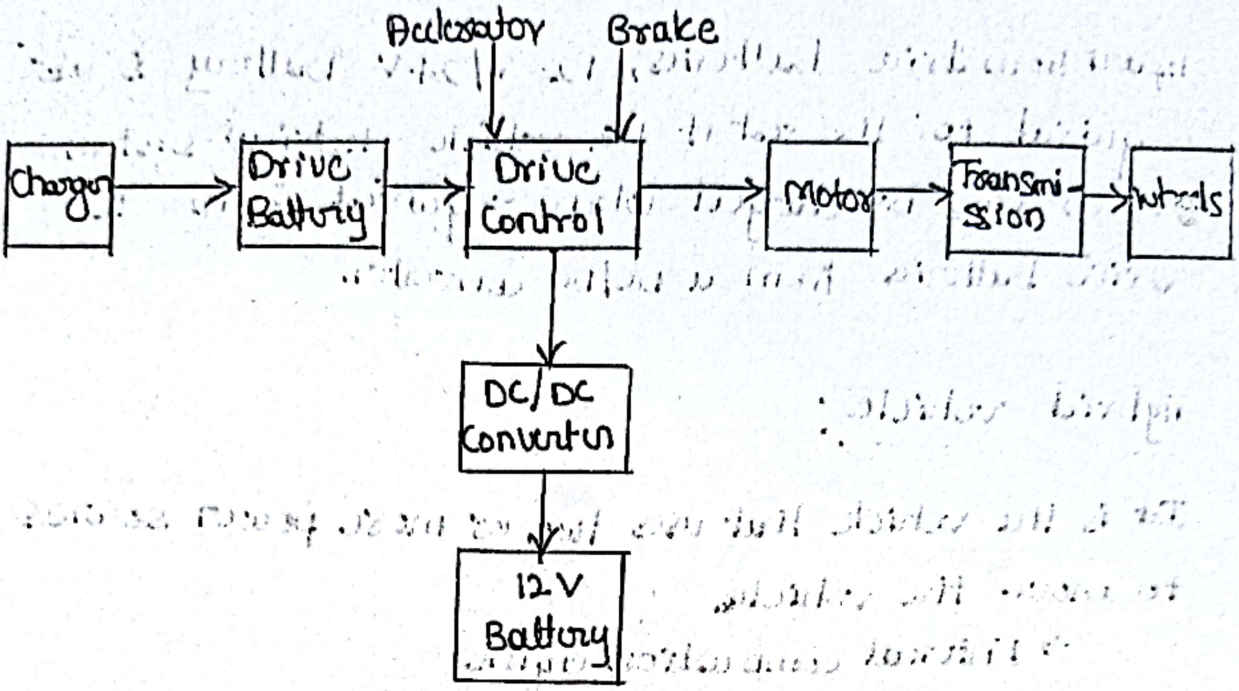
working or power stroke

During this stroke both inlet & exhaust valves are closed. The high pressure burnt gases produced by the combustion of the diesel oil pushes the piston downward with a great force. The constant pressure expansion with simultaneous combustion represented by the line 2-3 on pv diagram as the piston moves downward the pressure of the hot gases gradually decreases (4-1)

Exhaust stroke:

During this stroke exhaust is open & inlet is closed. the piston moves from BDC to TDC. The energy required to perform this stroke is supplied by a flywheel from energy absorbed during the previous stroke. The burnt gases will be expelled out of the cylinder at atmospheric pressure (1-0)

8.3) b) Electric vehicle:



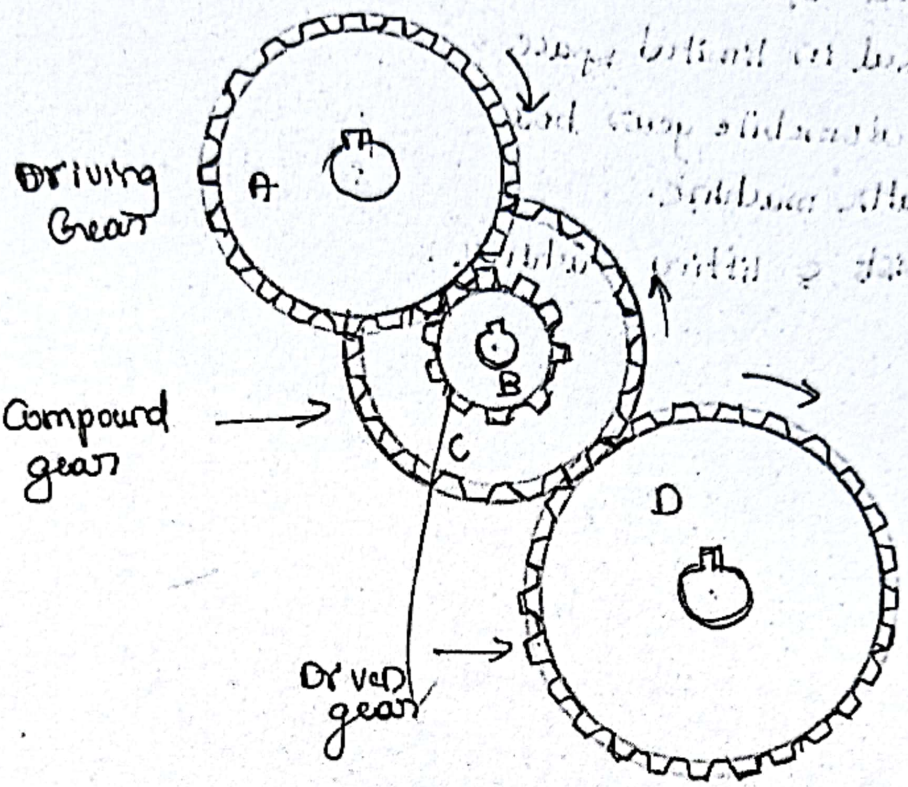
c) Advantages of EV:

1) Zero tailpipe emissions
2) Low running cost - Electricity is cheaper than petrol/diesel.
3) Low maintenance - No engine oil, few moving parts
4) High efficiency: 85-90%.
5) noise-free pollution
6) no loss of power in idling.

Gear drives:

Gear drives are preferred when considerable power has to be transmitted over a short centre distance positively with a constant velocity ratio

Q.4) a) Compound gear train :



In this intermediate shaft carries two gears which are keyed to it. When the velocity ratio is very high, a simple gear train becomes practically impossible owing to the difficulty of connecting the driving & driven gears, because the given center distance is small. In such a case a compound gear train is used. A is the driving gear, D is the driven gear, & B & C keyed to an intermediate shaft & are called compound gears. B & C mounted on same shaft, they rotate at the same speed.

4) b) **Hybrid vehicle:**

It is the vehicle that uses two or more power sources to move the vehicle.

→ Internal combustion engine

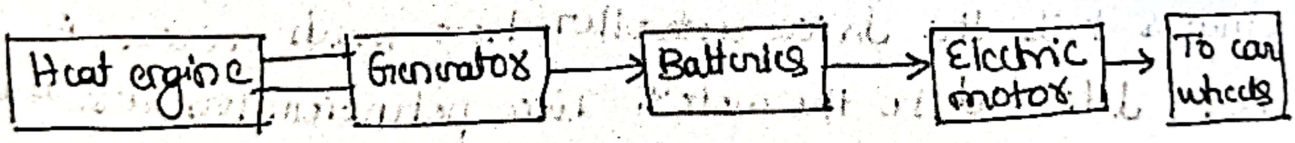
→ Electric motor with battery.

→ Electric motor is in use during slow moving city traffic & for acceleration & for hill climbing.

→ Speed running on highways, IC engine is in use.

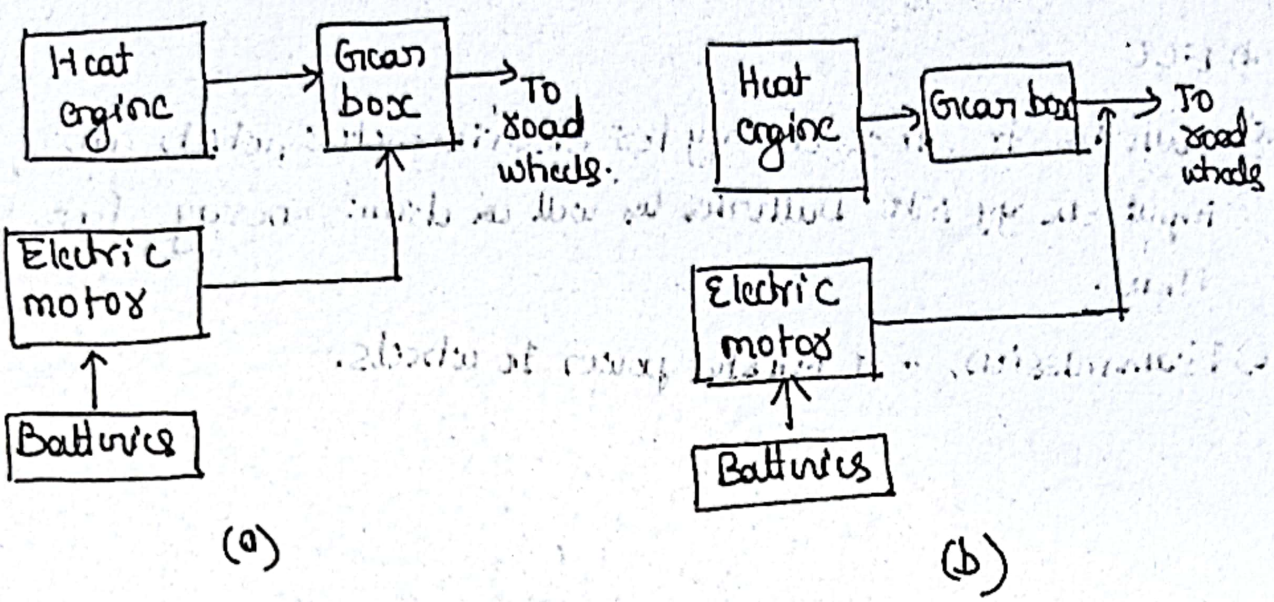
Types:

1) Series system:



→ In which engine driven generator is employed to recharge the batteries, while electric motor drives the car.

Parallel system



→ In which heat engine and electric motor are both directly connected to the car wheels which make it possible for both of them to supply power.

Series-parallel system

Mild hybrid " → in which engine provides main source of power & the electric motor provides additional power when ever required (during acceleration).

Main components:

1) Heat engine
   → I.C. engine installed in hybrid vehicles are usually smaller than those in ordinary cars.
2) Fuel tank - to store petrol or diesel.
3) Electric motor generator, which acts as a motor when the electrical energy is supplied to it & can also act as a

Q.5) a) **Ferrous metals:**

Metals have a iron as basic element, called ferrous metals.

Types:

1) Pig iron
2) Wrought iron
3) Cast iron → Grey cast iron
   → White "
   → Chilled "
   → Malleable "
   → Alloyed "
4) Steel → Low alloy steel → Low carbon steel
   → Medium "
   → High "
   → High "

Caste iron:

→ Remelting pig iron is refining it gives cast iron.
→ Carbon content varies from 2.1 to 6.7% & silicon 1 to 3%.
→ Cast iron is a brittle material & has poor ductility & also malleability.
→ It cannot be forged, rolled, extruded, drawn or pressed at room temperature.
→ It has a low melting point & therefore easily melted & casted into required final shape & size.

Applications:

→ Engine blocks
→ Machine tool beds
→ Pipes & pipe fittings
→ Automobile parts
→ Flywheels
→ Pump housings
→ Gears "
→ Cylinder heads
→ Manhole covers
→ Brake drums & discs

Steel :

It has been defined as a alloy of iron & carbon. Most of the steels have carbon not more than 1.5%. steel with carbon less than 0.2% are weak. As the carbon % increases, the tensile strength & yield strength increase but ductility decreases.

Properties :

→ Steel has wide range of mechanical properties which include from very soft condition to a very hard condition.

→ Steel can be heat treated to obtain desired ductility & strength.

→ Steel possess good machinability and weldability.

→ It is cheap & readily available in wide variety.

→ Steel is extensively used as a variety of structural members.

Applications :

1) Construction industry
   - → Beams, columns
   - → Bridges
   - → Roof structures

2) Automobile industry
   - → Car body frames
   - → Engine parts
   - → Gears & shafts
   - → Chassis.

3) Machinery manufacturing
   → machine tools
   → cutting tools
   → Dies & moulds
   → machines.

4) Railway industry
   → Railway tracks
   → Train wheels
   → Coach bodies

5) Household applications
   → Kitchen utensils
   → Furniture
   → Tanks.

6) water pipes, hubs, oil & gas pipelines.

7) Tools - spanners, Hammers, screwdrivers.

8) Transmission towers.

9) Aircraft components. (High strength steel).

5) b)

Ferrous metals	Non-ferrous metals.
→ Contains iron	→ Do not contain iron
→ Generally strong	→ Less strong than ferrous.
→ Heavy in weight	→ Lighter.
→ Less corrosion resistant	→ more corrosion resistance
→ Mostly magnetic	→ Non-magnetic
→ Less expensive	→ more expensive
→ Lower electrical conductivity	→ High electrical conductivity.
→ Mild steel, caste iron wrought iron. SS.	→ copper, aluminium, brass, lead, bronze, zinc

5) c) Composite materials:

Composite materials are made from two or more constituent materials. These materials may include base material, reinforcing materials elements, fillers, & binders. These materials can be organic, metals, or ceramics. These materials are separately manufactured & then combined together, mechanically or metallurgically.

Typical form of developed composite materials include:

→ Composite building materials as cement & concrete.
→ Reinforced plastics such as fibre-reinforced polymer
→ Metal-metal composites
→ Ceramic composites
→ Carbon reinforced plastics.

Constituents of composites:

1) Matrix
2) Reinforcement

1) Matrix:

Matrix is the base material that holds the reinforcement together and gives shape to the composite.

→ Holds reinforcement in position
→ Transfers load to reinforcement
→ Protects reinforcement from damage
→ Gives shape to the composite.

Ex: Polymers (Plastic, Epoxy)
- Metals (Aluminium, titanium)
- Ceramics.

2) Reinforcement:

→ It is the strength providing material in the composite.
→ Improves stiffness
→ Improve mechanical properties
→ Increases durability.

Ex: - Glass fiber
- Carbon fiber
- Kevlar fiber
- Particle (sand, ceramics)

Types

1) Fiber reinforcement
2) Particle "
3) Flake "

Classification of composite:

1) Matrix materials
2) Reinforcing material structure
3) Laminate composites

Q.6) a) Advantages:

→ Composites have high strength-to-weight ratio.
→ High fatigue strength.
→ High torsional stiffness.
→ Light in weight.
→ Parts of different size can be fabricated.
→ It is corrosion resistance.
→ Good weather resistance.
→ It has low thermal conductivity.
→ High dielectric strength.
→ Non-magnetic
→ Lower maintenance.

Disadvantages:

→ Composites are more brittle & thus more easily damaged.
→ Reuse & disposal of composites may be difficult.
→ Special tools and drills are usually needed.
→ High cost of raw material.
→ Maintaining higher dimensional accuracy is difficult.
→ Difficulty to attach.
→ matrix is normally weak & , therefore, have low toughness.

Applications:

Brenval

→ Boat decking - boat hulls, submersible, pressure hull
→ Civil engg. → bridges, column wraps, cladding.
→ Sports - bike frames, archery bows, fishing rods, tennis rackets

Automobile system (mmc).

→ Suspension system for damping.
→ Valves for high temperature
→ Housing for lubricating pump
→ Drive shaft.
→ Connecting rod.

other composites are used in

→ Car body
→ Bumpers
→ Instrument panel (dash board)
→ Radiator grill.

Aircraft:

- 50% of the airframe is made from composites.
  → main landing gear door
  → Nose "
  → Helicopter rotor blades
  → Propeller of aircraft.
  → Aircraft seats
  → composites are being used on aircraft body to deflect away detection by radar waves and also by absorbing them.

b) **Smart materials:**

Smart materials are designed substance that changes their physical or chemical properties, such as shape, color, or viscosity - in a controlled, reversible manner in response to external stimuli like:

- temprature
- Pressure
- Electric
- Magnetic fields.
- Light
- Moisture

Applications:

→ Sensors, microphones, fuel injectors, vibration control, ultrasonic devices.

Applications:

→ shock absorbers
→ Dampers in vehicles
→ Prosthetic limbs
→ vibration control syetem.

c) **Advantages of smart materials:**

→ Improve system performance.
→ Reduce maintenance
→ Increase safety
→ Automatic control
→ Energy efficient.

Disadvantages:

→ High cost
→ Complex design
→ Limited availability
→ Temprature limitations.

Q7) a) Classification of manufacturing process:

1) Shaping processes
   - → Casting
   - → Forging
   - → Rolling
   - → Extrusion
   - → Moulding

2) Machining process
   - → Turning
   - → Drilling
   - → Milling
   - → Shaping
   - → Grinding

3) Joining process
   - → Welding
   - → Soldering
   - → Brazing
   - → Riveting
   - →

4) Forming processes
   - → Bending
   - → Drawing
   - → Deep drawing
   - → Spinning

5) Modern manufacturing process
   - → CNC machining
   - → 3D printing
   - → Laser cutting
   - → Electrical discharge machining
   - → Water jet machining

Process selection criteria: depends on:

Factors affecting the process selection:

1) Material type – metal, plastic, ceramic, composite.
2) Shape & size of component – simple & complex, small & large.
3) Dimensional accuracy required – : High precision - machining
: Low precision – : casting
4) Surface finish required – Grinding, honing
5) Cost – m/c cost, tool cost, labour cost.
6) Mechanical properties required – strength, hardness, & toughness.

Ex:

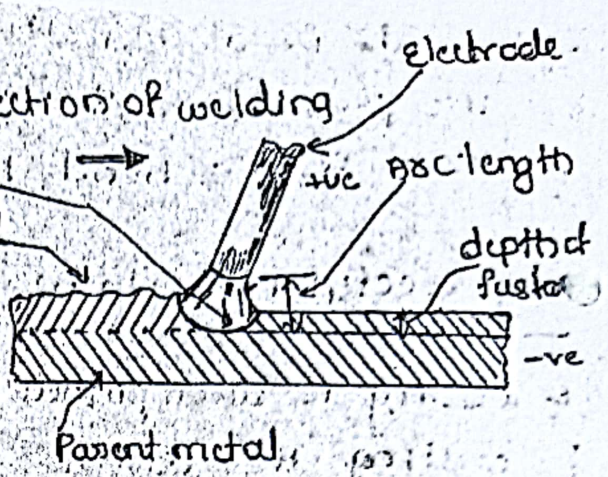
Complex internal cavity – Casting

High accuracy shaft – Turning + Grinding

Thin sheet component – Sheet metal forming

Mass production of bolts – Forging

Q.7) b) Arc welding:



Arc welding is a most extensively employed method of joining metal parts. The source of heat is an electric arc.

The arc column is generated between an anode (electrode), which is positive pole of dc (direct current) power supply, & the cathode (work piece), the -ve pole. When electrode is brought to touch with work piece (-ve) & separated for a small distance (2 to 4mm) such that the current continuous to flow through the path of ionized particles, called plasma, an electric arc is formed.

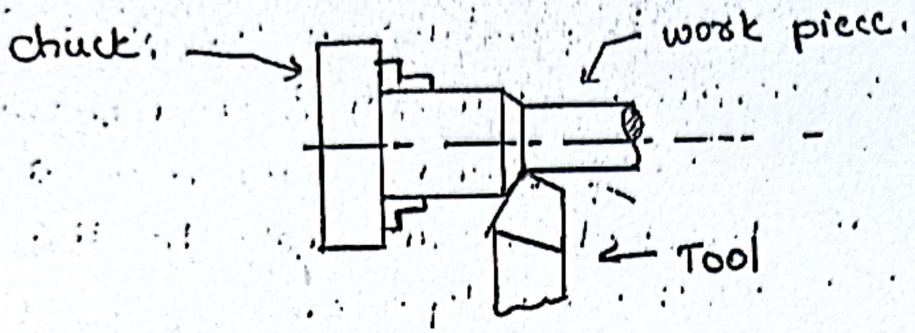
This ionized gas column acts as a high-resistance conductor that enables more ions to flow from the anode to the cathode. Heat is generated as ions

Brazing:

It is a method of joining two similar or dissimilar metals using a special fusible alloy. It produces joints stronger than alloy.

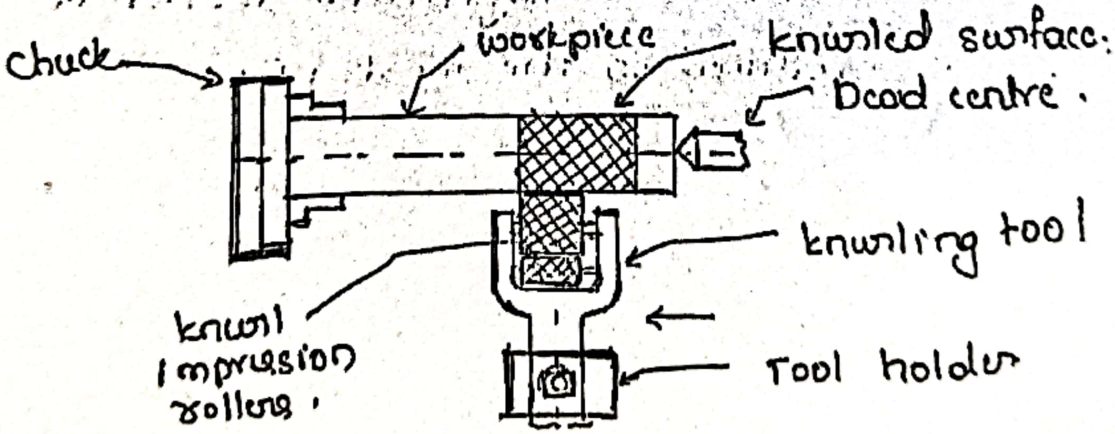
During brazing, the base metal of the two pieces to be joined is not melted. The filler metal must have ability to wet the surfaces of the base metal. The material used in brazing are copper base & silver base alloys.

7) c) i) Plain turning:



The work is supported between the centres which permits the rotation of work piece. The single point cutting tool is fed perpendicular to the a-xis of rotation known as depth of cut, & moved parallel to the axis of rotation. The straight turning produces a cylindrical surface by rem-oving excess metal from the work piece.

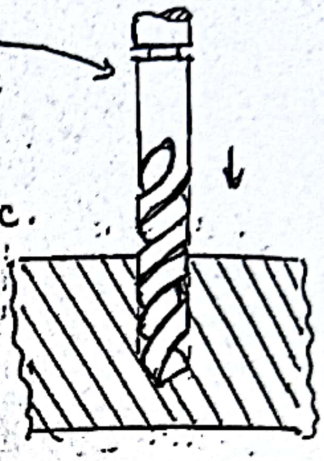
ii) knurling: (Dec 2010)



knurling is a process of embossing a diamond shaped pattern on the surface of the work piece. The purpose of knurling is to provide effective gri-pping surface on a workpiece to prevent it from slipping when operated by hand.

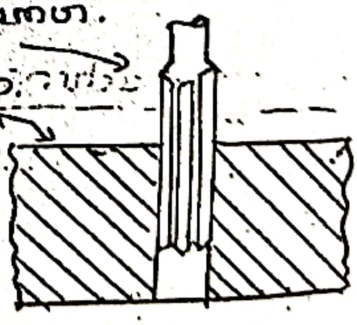
The operation is performed by a knurling tool which consists of hardened steel rollers. The tool is held rigidly on the tool post & all the rollers are pressed against the revolving workpiece. Usually work is rotated at a speed of 60 to 80 rpm.

08) a) Drilling: (VTU, 2001) (3m)



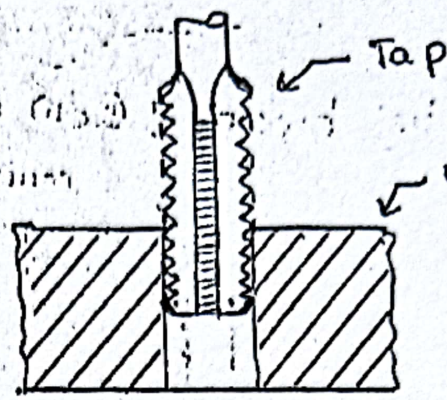
Drilling is the operation to produce a cylindrical hole by removing metal by the rotating edge of a cutting tool called drill. Before drilling centre of hole is located on a work piece by a centre punch with its indentation. Drill point is pressed at this centre point located by a centre punch, to produce a required hole.

b) Boring: Reaming: (2011, 3m)



Reaming is an accurate way of sizing & finishing a hole which has been previously drilled. In order to finish the hole & bring it to accurate size, the hole is drilled slightly undersize. The speed of the tool is half of that drilling & automatic feed may be employed; The tool used is known as reamer, which has multiple cutting edge.

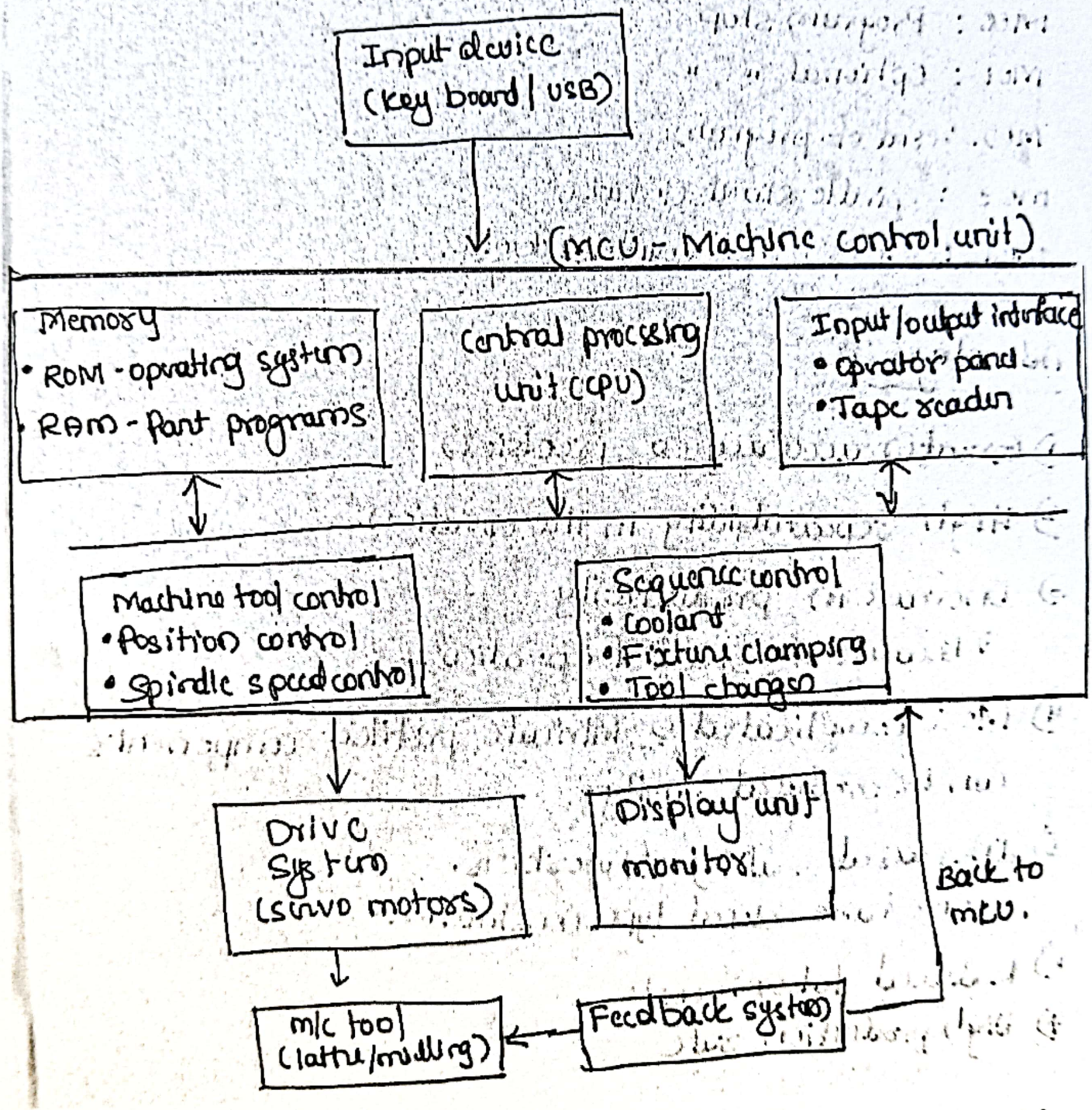
Tapping: (2011, 3m)



It is the opration of cutting internal threads by means of a cutting tool called tap. A tap may be considered as bolt with accurate threads cut on it.

The thread act as a cutting edges which are hardened & ground. When tap is screwed into the hole it removes metal & cuts internal threads.

b) Components :



CNC (computer Numerical control) is an automated manufacturing system in which machine tools are controlled by a computer program using numerical data (G-codes & M-codes).

Example:

G-codes

G00 : Rapid traverse

G01 : Linear movement

G02 : Circular " (clockwise)

G03 : " " (anticlockwise)

G04 : Dwell

M-codes:

M00 : Program stop

M01 : Optional " "

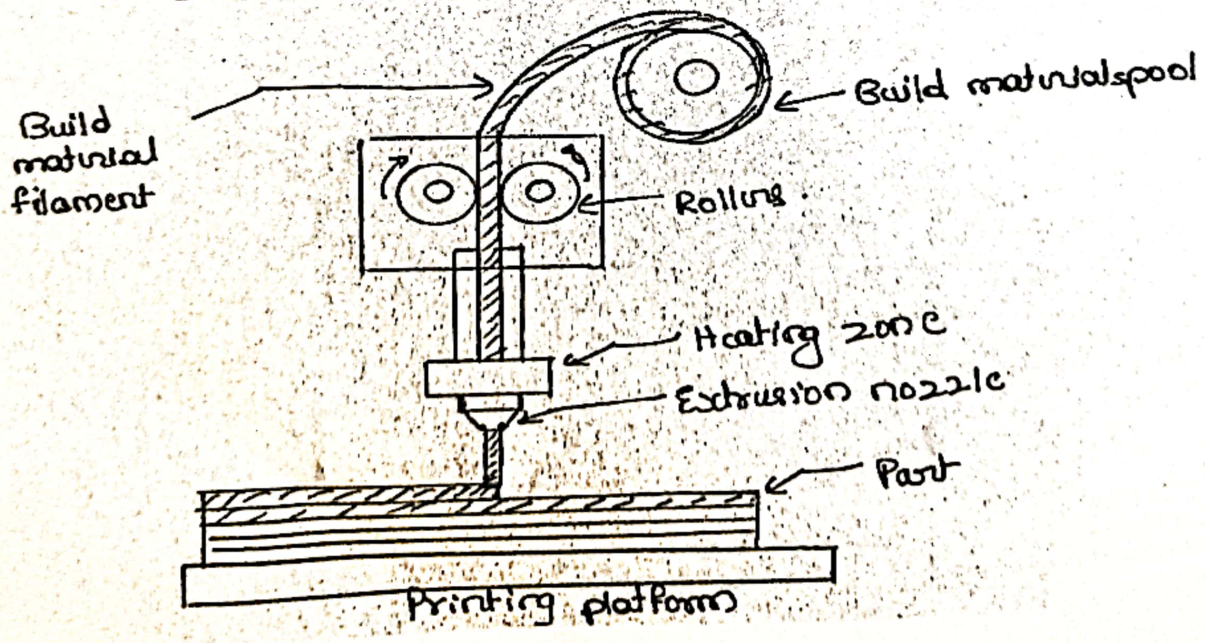
M02 : End of program

m03 : spindle start clockwise

m04 : " " counterclockwise.

Q.8) c) Basic principles of 3D printing:

3D printing (Additive manufacturing) is a process of creating a three-dimensional object by adding material layer by layer based on a digital model.



→ Creation of 3D model using computer aided design software or a 3D scanner.

→ Software slices the digital model into hundreds or thousands of thin, horizontal 2D layers & generates G-code, which acts as instructions for the printer.

→ The printer constructs the object layer-by-layer, bonding materials like plastic, metal, or resin, as per digital instructions.

→ Once printing completed, objects may require cleaning, removal of supports to achieve final shape.

Q.9) a) **Automation:**

It is the technology involved in automated operation between machine or a process or a system that operates automatically. Creation and application of technology to monitor and control the production & delivery of products & service to the customer.

Types of automation

1) Fixed automation
2) Programmable
3) Flexible

1) Fixed automation:

→ In this, the sequence of manufacturing, development or processing are fixed by the instruments configuration.

→ Involves fixed sequence of operations which reduces the setup time & also production efforts.

→ These are commonly used where continuous high demands for production at high volume is needed.

→ Ex: Bottle plants, packing plants.

→ It has inflexibility to accommodate various products.

2) Programmable automation:

→ It is possible to change the sequence of operation.

→ It allows to accommodate products of different configuration.

→ New programme can also be developed and loaded into the system.

→ Used in batch production of components in low to medium size volume.

→ Ex: CNC machine, Industrial robots, PLC controlled system.

3) Flexible automation:

→ Varied products can be developed continuously with little or no loss of time between changes from one product to another.

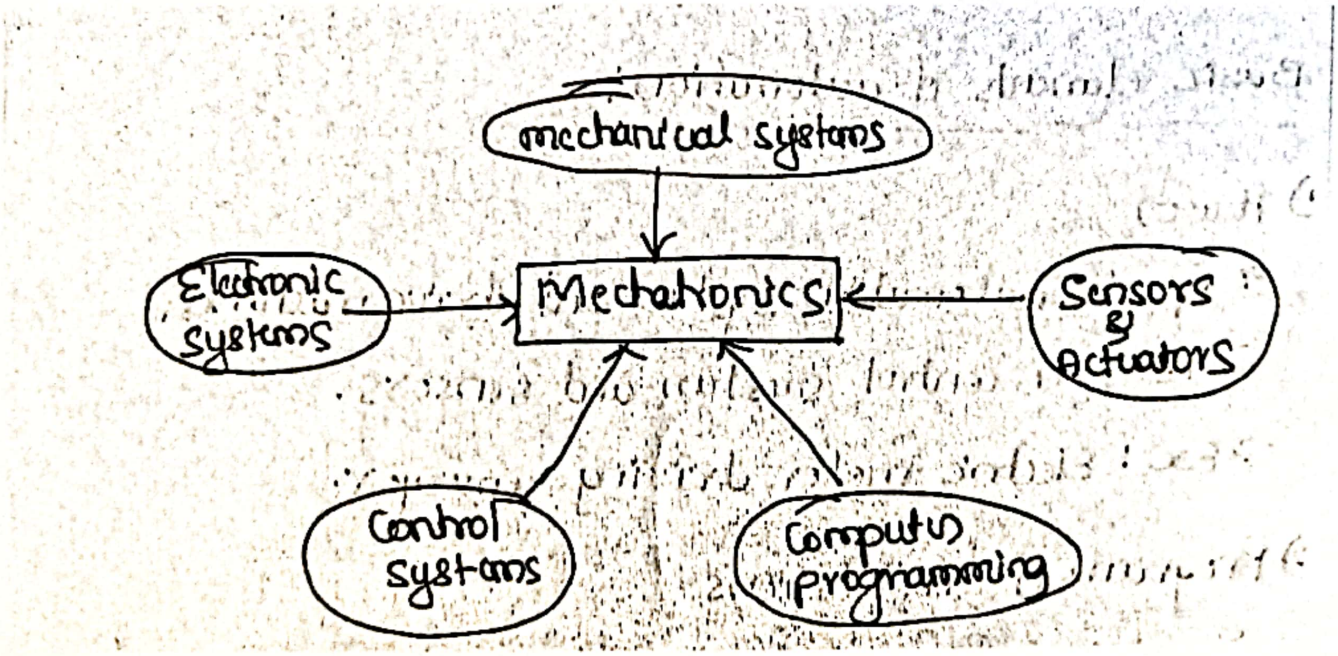
→ Ability to produce various products.

→ Suitable for medium production volume.

→ Ex: Flexible manufacting system (FMS), automated robotic production line, CIM.

Q9) b) Mechatronic system:

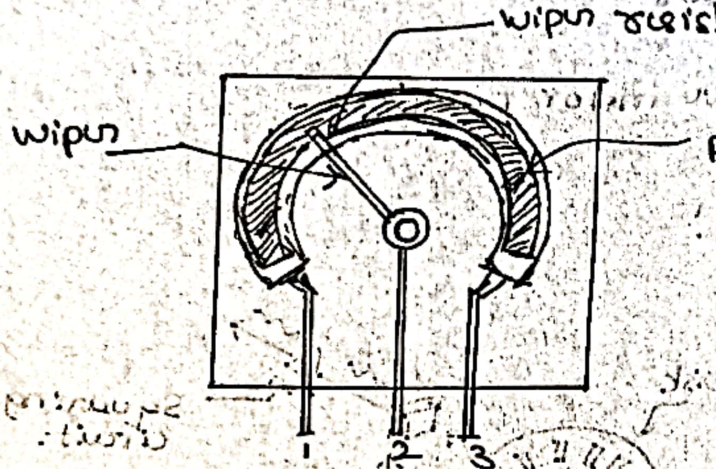
It is the integration of mechanical engineering, electronics, control system, and computer technology to design and operate intelligent systems and products.



Applications:

1) High-speed precise robotic assembly, packaging & inspection.
2) Self-driving vehicles.
3) Autopilot, drones.
4) Surgical robots.
5) Bomb disposal robots, unmanned underwater vehicles.
6) CNC machines.
7) Automated assembly systems.
8) Washing machines, cameras, printers.

Q9) c) Potentiometer as a sensor:



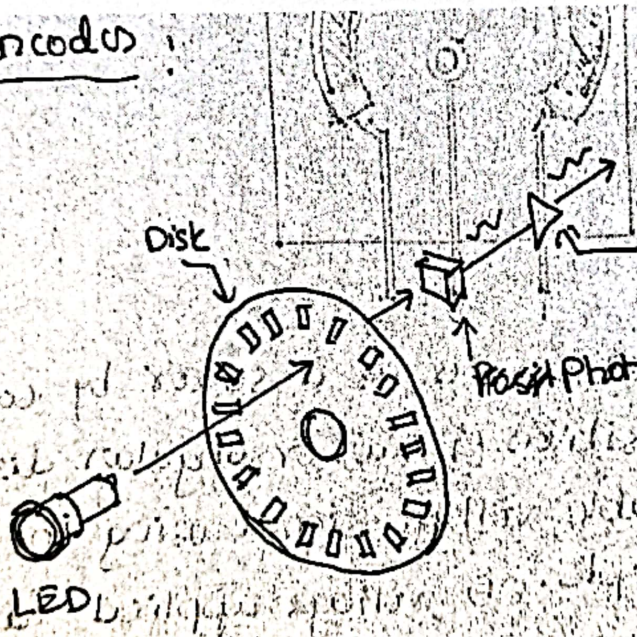
A potentiometer operates as a sensor by converting mechanical position (linear or angular displacement) into a variable voltage signal using the voltage driven principle. A voltage applied across a resistive element creates a potential gradient. A moving wiper, connected to the object being measured taps off a voltage proportional to its position.

As mechanical input (eg. rotating a knob or sliding a lever) moves the wiper, the resistance on either side of the wiper changes, resulting in a variable voltage output.

Applications:

→ Position measurement in robot.
→ Volume control in audio systems.
→ Fuel level sensor
→ Joysticks
→ Controlling servo motor positions.

Q.10) a) Optical encoder:



It translates mechanical motion (rotation or linear) into electrical signals (pulses) using a light source (LED) shining through a patterned disk (code wheel) onto a photodetector.

As the shaft rotates, the disk's alternating transparent / opaque segments block or pass light, creating pulses that indicate position, velocity and direction.

Applications :

→ motor speed control, robotic arms, conveyors.
→ Precision positioning of cutting tools in CNC.
→ Scanners in medical equipment.
→ Electric power steering and transmission systems.

b) need of integration of technologies

Technology integration is the seamless incorporation of digital tools into daily routines to enhance efficiency, engagement, & productivity across education, business & healthcare.

→ Enhanced efficiency & productivity
- AI powered robots into manufacturing enabling faster, high-precision assembly, & ~~tea~~
- Advanced 3D modelling & AI allow for faster prototyping & simulation.

→ Predictive maintenance & reduced downtime.
- Sensors embedded in systems monitor performance in real-time.

→ Smarter, more complex designs
- AI algorithms can simulate and analyze thousands of design options
- Digital twins.

→ Sustainability and green technology
- HVAC, EVs, advanced power generation to reduce carbon footprints.

→ Data-driven decision making
- Analyzing large data sets collected from sensors allows engineers to identify trends, improve product designs.

c) Advanced Driver Assistance system (ADAS)

→ ADAS are electronic sensor-based technologies in vehicles designed to enhance safety and driving comforts.

→ By monitoring surroundings for hazards, ADAS warns drivers or takes autonomous action - such as braking or steering - to prevent accidents and improve situation awareness.

Key features:

→ Adaptive cruise control
- Automatically adjust vehicle speed to maintain a safe distance from the car ahead.

→ Automatic emergency braking
- Detects imminent collisions and applies brakes if the driver fails to react.

→ Lane departure warning
- Alerts the driver or steers the vehicle back if it drifts out of its lane.

→ Blind spot detection.
- monitors and alerts the driver to vehicle in blind spots during lane change.

→ Traffic sign Recognition
  • Reads road signs & displays them to driver.
→ Parking Assistance
  • Use sensors to guide the driver or automatically park the car.
→ Adjust headlights based on various lighting conditions.

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