11	a)	Explain the components of electric vehicles with a neat sketch.	L2	CO2	5 M
	b)	Distinguish between SI engine and CI engine.	L2	CO2	5 M
		UNIT-III			
12	a)	Discuss the working principle of nuclear power plant and mention the advantages and disadvantages.	L2	CO3	5 M
	b)	Explain the importance of belt drives and its types in mechanical power transmission.	L2	CO3	5 M
		OR			
13	a)	Demonstrate the working of hydroelectric power plant and list out the applications.	L2	CO3	5 M
	b)	Categorize the robots and list out the different types of robot configurations.	L2	CO3	5 M

ME 25

PVP 23

Code: 23ES1201

I B.Tech - II Semester – Regular / Supplementary Examinations
MAY 2025

BASIC CIVIL & MECHANICAL ENGINEERING

(Common for CE, ME, IT, AIML, DS)

Duration: 3 hours Max. Marks: 70

Note: 1. This question paper contains two Parts: Part-A and Part-B.
2. Each Part contains:
- 5 short answer questions. Each Question carries 1 Mark and
- 3 essay questions with an internal choice from each unit. Each question carries 10 marks.

3. All parts of Question paper must be answered in one place.

BL – Blooms Level CO – Course Outcome

PART – A

		BL	CO
1.a)	List out any six disciplines of civil engineering.	L1	CO1
1.b)	Write any four construction materials.	L1	CO5
1.c)	Define levelling and state its objectives.	L1	CO2
1.d)	Distinguish the rigid and flexible pavement.	L1	CO3
1.e)	Classify the dams.	L1	CO4

			BL	CO	Max. Marks
		UNIT-I			
2	a)	Discuss about the various types of Aggregates with their sizes and shapes.	L2	CO5	5 M
	b)	Explain the significance of building construction and planning.	L2	CO1	5 M
		OR			

3	a)	Discuss the role of hydraulics and water resources engineering in ensuring better society.	L2	CO1	5 M
	b)	Explain about the prefabricated construction techniques.	L2	CO5	5 M
		UNIT-II			
4	a)	Explain how you would take horizontal measurements using surveying instruments.	L2	CO2	5 M
	b)	Explain about contour and its characteristics (with sketch).	L2	CO2	5 M
		OR			
5	a)	Write about the levelling instruments used in levelling process.	L2	CO2	5 M
	b)	What are the differences between magnetic bearing and true bearing?	L2	CO2	5 M
		UNIT-III			
6	a)	Discuss how the transportation engineering plays an important role in economic development?	L2	CO3	5 M
	b)	Illustrate the hydrological cycle and mention its parts with a neat sketch.	L2	CO4	5 M
		OR			
7	a)	Discuss the components and functions of rigid pavement.	L2	CO3	5 M
	b)	Explain about the quality of water.	L2	CO4	5 M

PART – B

		BL	CO
1.f)	Classify non-ferrous metals.	L1	CO1
1.g)	State the principle of Joining Process.	L1	CO2
1.h)	Define degrees of freedom.	L1	CO3
1.i)	What is the carbon percentage in steel?	L1	CO1
1.j)	What is meant by 2-stroke engine?	L1	CO2

			BL	CO	Max. Marks
		UNIT-I			
8	a)	What is mechanical engineering? Discuss the role of mechanical engineers in the industrial sector and society.	L2	CO1	5 M
	b)	State the applications and advantages of ceramic materials.	L2	CO1	5 M
		OR			
9	a)	Explain the role of mechanical engineer in automotive & aerospace sectors.	L2	CO1	5 M
	b)	Classify and discuss the composite materials in detail.	L2	CO1	5 M
		UNIT-II			
10	a)	Explain any two types of machining process with a neat sketch.	L2	CO2	5 M
	b)	Illustrate the components of Refrigeration & Air Conditioning cycles with a neat sketch.	L2	CO2	5 M
		OR			

I B.Tech – II Sem Regular May 2025

23ES1201

Basic Civil & Mechanical Engineering

[Common to CE, ME, IT, AIML, DS]

Scheme of Valuation

PART- B

1.f) Classification of Non Ferrous Metals – 1M

1.g) Principle of Joining Process – 1M

1.h) Definition of Degrees of Freedom – 1M

1.i)About percentage of carbon in steel – 1M

1.j) About Two stroke engine - 1M

8.a) About Mechanical Engineering -2M

Role of Mechanical Engineer in Industrial Sector and Society – 3M, Total of 5M

8.b) Applications of Ceramic Materials –2.5 M

Advantages of Ceramic Materials - 2.5 M, Total of 5M

9.a) Role of Mechanical Engineer in Automotive Sector – 2.5 M

Role of Mechanical Engineer in Aerospace Sector – 2.5 M, Total of 5M

9.b) Classification of Composite Materials –1 M

In detail Discussion on materials – 4 M, Total of 5M

10.a)Any two types of Machining , Each one – 2.5 M, total of 5 M

10.b) Sketch – 2 M, Components – 1M and Explanation – 2 M , Total of 5M

11.a) Sketch – 2 M, Components – 1M and Explanation – 2 M , Total of 5M

11.b) Nonrepetitive, minimum of 6 differences between SI and CI Engine, each difference 1 M, Total of 5M.

12.a) Working Principle – 2M, Sketch – 1 M, Advantages – 1M, Disadvantages – 1M, Total of 5 M

12.b)Importance of Belt Drives – 2M, Types with sketches and explanation in short – 3M, Total of 5 M

13.a)Working of Hydro electric Power plant – 2M, Sketch- 2 M, Applications – 1M, Total of 5M

13.b)Categorization of robots – 2M, Different Robot Configurations –3M, Total of 5

Key

PART B

Basic Mechanical Engineering

1.f) Classify Non-Ferrous Metals. **[1M]**

Aluminium, Copper, Brass, Bronze, Lead, Zinc, Tin, Nickel, Titanium, Magnesium and Precious non-ferrous metals like gold, silver and platinum.

1.g) State the Principal of Joining Processes. **[1M]**

Joining operations are used to assemble subcomponents into a final product by welding, soldering, riveting, bolting, or adhesively bonding them. Many bicycle frames, for instance, are welded together from individual pieces of metal tubing.

1.h) Define Degrees of Freedom. **[1M]**

Degrees of Freedom (DOF) is the number of independent ways in which a body can move.In mechanical systems, a rigid body in 3D space can have up to six degrees of freedom3 translational movements and 3 rotational movements.

1.i) What is the Carbon Percentage in steel. **[1M]**

Steel is one of the most widely used ferrous metals and is an alloy of iron and carbon. The carbon content in steel can vary, resulting in different types of steel with various properties. Some common types of steel include carbon steel, stainless steel, and alloy steel.

1.j) What is meant by 2 stroke Engine. **[1M]**

A 2-stroke engine is a type of internal combustion engine that completes a power cycle in two strokes of the piston [one revolution of the crankshaft]. In 2-Stroke engine cycle, all four operations ie., suction, compression, expansion and exhaust are performed in two strokes of the piston

UNIT 1

8.a) What is Mechanical Engineering? Discuss the role of Mechanical Engineers in the Industrial Sector and Society. [5M]

- Mechanical Engineering is the branch of engineering focused on the design, analysis, and manufacturing of mechanical systems using principles of mechanics, energy, and materials.
- Mechanical engineers design machines, engines, tools, and systems used in various industries including automotive, aerospace, and manufacturing.
- They play a vital role in power generation (thermal, hydro, nuclear), energy efficiency, and environmental sustainability.
- In manufacturing, they oversee processes like casting, machining, welding, and automation to ensure quality and cost-effectiveness.
- They contribute to healthcare by developing medical devices, prosthetics, and bioengineering solutions.
- In society, they improve daily life through technologies such as air conditioning, refrigeration, and transportation systems.
- Mechanical engineers help address global challenges by innovating in clean energy, sustainable materials, and smart manufacturing.

8.b) State the applications and advantages of Ceramic Materials. [5M]

Applications of Ceramic Materials:

- Ceramic materials are used in electronic components such as spark plug insulators, sensors, actuators, capacitors, and memory devices.
- In the construction industry, ceramics are applied in making tiles, bricks, cement, and sanitary ware due to their hardness and durability.
- They are widely used in the aerospace and automotive sectors for components like turbine blades, heat shields, and engine parts because of their high-temperature resistance.
- In the medical field, ceramics are used in dental implants, bone grafts, and orthopedic prosthetics due to their biocompatibility.

Advantages of Ceramic Materials:

- Ceramic materials can withstand extremely high temperatures without degrading, making them suitable for thermal applications.
- They possess excellent hardness and wear resistance, which makes them ideal for use in cutting tools and abrasion-resistant surfaces.
- Ceramics are highly resistant to chemicals and corrosion, making them suitable for harsh and reactive environments.
- They have outstanding electrical insulating properties, making them essential in various electronic and electrical devices.

OR

9.a) Explain the role of mechanical engineer in automotive & aerospace sectors. [5M]

Role of Mechanical Engineers in the Automotive Sector:

- Mechanical engineers design and develop key components such as engines, transmission systems, and structural frames for vehicles.
- They improve vehicle performance by working on fuel efficiency, emission control, and safety systems like airbags and antilock brakes.
- They utilize manufacturing processes such as casting, forging, machining, and welding to produce automobile parts efficiently and accurately.
- Mechanical engineers apply computer-aided engineering (CAE) tools to simulate, analyze, and optimize the performance of various automotive systems.

Role of Mechanical Engineers in the Aerospace Sector:

- Mechanical engineers design and develop propulsion systems including jet engines, combustion systems, and control systems for aircraft.
- They use wind tunnels and simulation tools to test and optimize aerodynamic performance of aircraft components.
- They work on the selection and development of lightweight aerospace-grade materials such as titanium alloys and composite materials.
- Mechanical engineers contribute to safety and performance improvements in aircraft by designing structural and thermal systems that withstand extreme conditions.

9.b) Classify and discuss the composite materials in detail. [5M]

Compositematerialsoftenreferredtoascomposites.Theyareengineeredmaterialsmadeby combining two or more constituent materials with distinct physical and chemical properties to create a material that exhibits improved or tailored characteristics.Composites are designed to take advantage of the strengths of each constituent material while minimizing their individual weaknesses. They are widely used in various industries due to their versatility and ability to offer a balance of properties.

Classification of Composite Materials:

1. Fiber-Reinforced Composites are made by embedding fibers within a polymer matrix, which improves strength, stiffness, and durability, while the matrix provides shape and structure; they are widely used in aerospace, automotive, boats, and sports goods.
2. Metal Matrix Composites (MMCs) use metals like aluminum as the matrix and are reinforced with materials such as silicon carbide or boron carbide, offering enhanced strength and stiffness for aerospace and automotive applications.
3. Natural Fiber Composites are made using natural fibers such as wood, flax, or hemp; examples include plywood and particleboard, which are commonly used in construction, furniture, and cabinetry.
4. Polymer Matrix Composites (PMCs) consist of a polymer matrix reinforced with fibers or particles; for example, epoxy resin composites are used in aerospace, sporting goods, and marine applications due to their lightweight and high strength.
5. Carbon-Carbon Composites (C/C) are entirely made of carbon materials and are known for their high-temperature stability and low weight, making them suitable for aerospace and other high-temperature applications.
6. Biocomposites combine natural fibers like flax or sisal with biodegradable resins, making them environmentally friendly and ideal for use in automotive interiors and sustainable product designs.
7. Ceramic Matrix Composites (CMCs) have a ceramic matrix reinforced with ceramic materials such as silicon carbide, and they are used in extreme environments like gas turbine engines and aerospace components.
8. Particle-Reinforced Composites contain particles embedded in a matrix to enhance mechanical properties; a common example is concrete, which is widely used in construction for its strength and durability.

UNIT 2

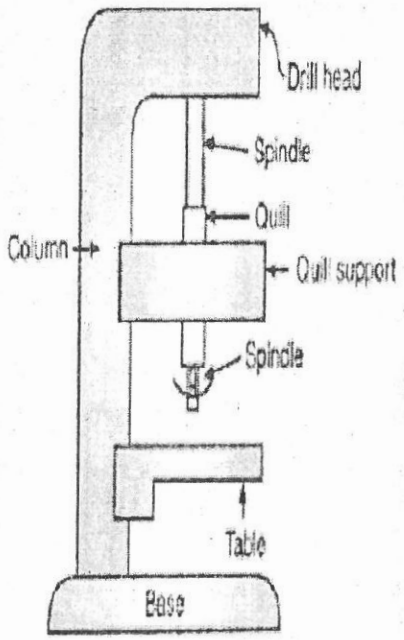
10.a) Explain any two types of machining process with a neat sketch. [5M]

- Manufacturing technologies add value by transforming raw materials into useful products through processes like casting, forming, machining, joining, and finishing, each chosen based on factors like material properties and product specifications. Engineers select appropriate methods and tools to ensure the final product meets quality and functional requirements.
- *Machining refers to processes whereby material is gradually removed* from a work-piece in the form of small chips. The most common machining methods are called drilling, sawing, milling, and turning.

Machining(Drillpress ,bandsaws ,Milling, Lathe)

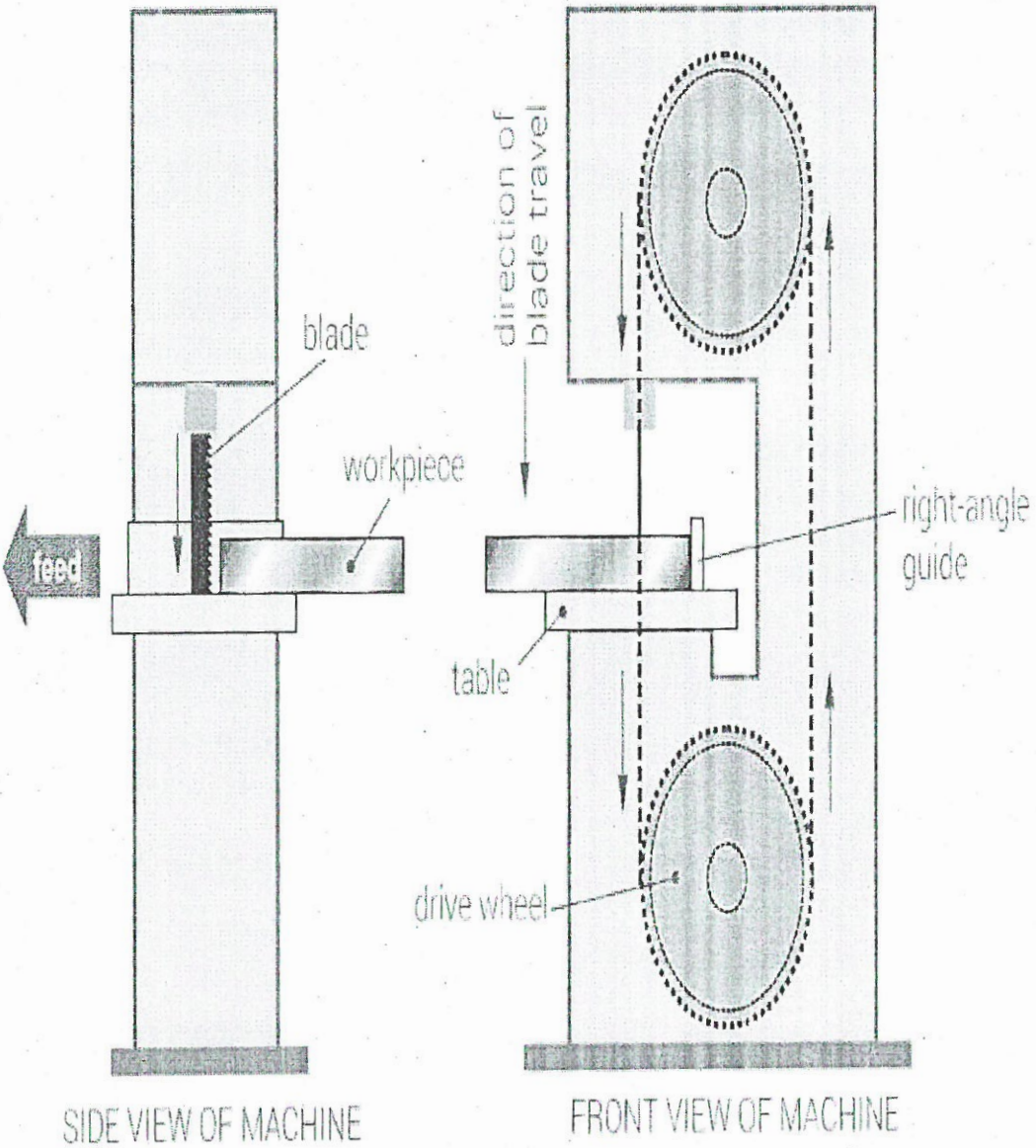
DrillPress

Machining tools include drill presses, band-saws, lathes, and milling machines. Each tool is based on the principle of removing unwanted material from a work-piece by means of the cutting action of sharpened blades. The *drill press shown in Figure is used to bore roundholesintoa*work-piece.Adrillbitisheldintherotatingchuck,and,asamachinist turns the pilot wheel, the bit is lowered into the work-piece's surface. As should be the case whenever metal is machined, the point where the bit cuts into the work-piece is lubricated. The oil reduces friction and helps remove heat from the cutting region. For safety reasons, vises and clamps are used to hold the work-piece securely and to prevent material from shifting unexpectedly.



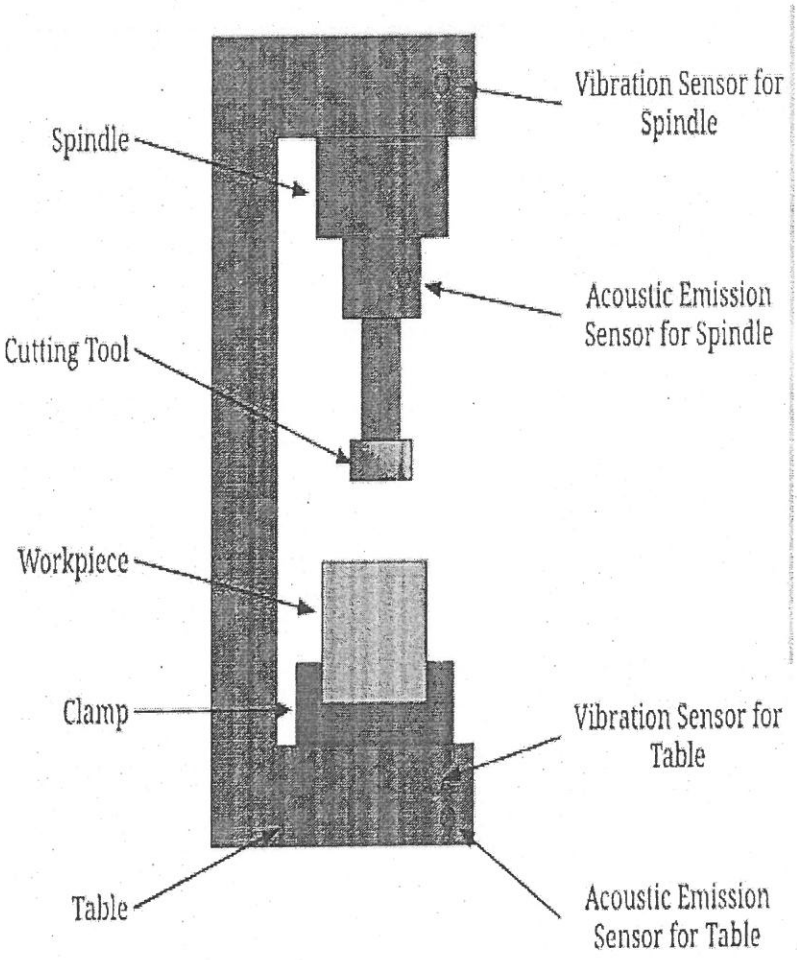
Band-saw

A machinist uses a *band saw to make rough cuts through metal.* The blade is a long, continuous loop with sharp teeth on one edge, and it rides on the drive and idler wheels.A variable-speed motor enables the operator to adjust the blade's speed depending on the type and thickness of the material being cut. The work-piece is supported on a table thatis capable of being tilted for cuts that are to be made at an angle.



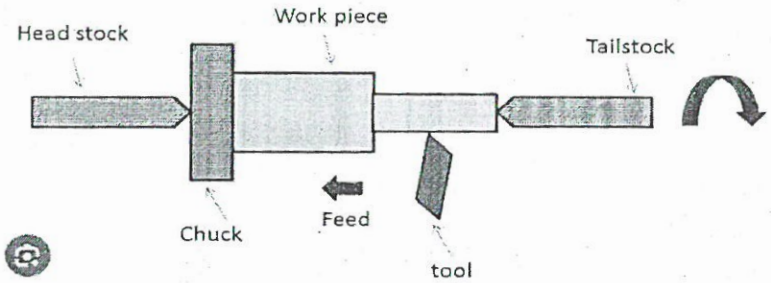
MillingMachine

1. A *milling machine (or mill)is used for machiningthe rough surfaces* of a work-piece flat and smooth and for cutting slots, grooves, and holes. The milling machine is a versatile machine tool in which the work-piece is moved slowly relative to a rotating cutting tool. The work-piece is held by a vise on an adjustable table so that the part can be accurately moved in three directions (along the plane of the table and perpendicular to it) to locate the work-piece precisely beneath the cutting bit.
2. A piece of metal plate might be cut first to an approximate shape with a band-saw, and then the millingmachine could be used to form the surfaces smooth and the edges square to their final dimensions.



Lathe

A machinist's *lathe holds a work-piece and rotates it about the centerline* as a sharpened tool removes chips of material. The lathe is therefore used to produce cylindrical shapes and other components that have an axis of symmetry. Some applications for using a lathe are the production of shafts and the resurfacing of disk brake rotors. A lathe can be used to reduce the diameter of a shaft by moving the cutting tool along the shaft's length as it rotates. Threads, shoulders that locate bearings on a shaft, and grooves for holding retaining clips can be made in this manner.



Advantages

1. Highprecisionandaccuracy,allowingforthecreationofintricateandcomplexpartswith tight tolerances.
2. Itsuitableforawiderangeofindustries,fromautomotivetoaerospacetomedicaldevices.
3. Machining can handle materials with high strength and hardness, ensuring the resultingparts possess the necessary durability and structural integrity.
4. Depending on the technique used, machining can achieve different surface finishes, from rough to extremely smooth, meeting different functional and aesthetic needs.

Disadvantages

1. Machiningoftengeneratesasignificantamountofwastematerial,especiallywhencutting away excess material from a workpiece
2. machiningprocesses canbetime-consuming, particularlyfor complexorintricate designs
3. Machining operations can generate heat, potentially affecting the material being worked on, leading to changes in its properties or causing thermal stress.
4. Machiningcanproducesignificantnoise andvibration,potentiallycausingdiscomfortfor workers and necessitating additional measures for safety and comfort.

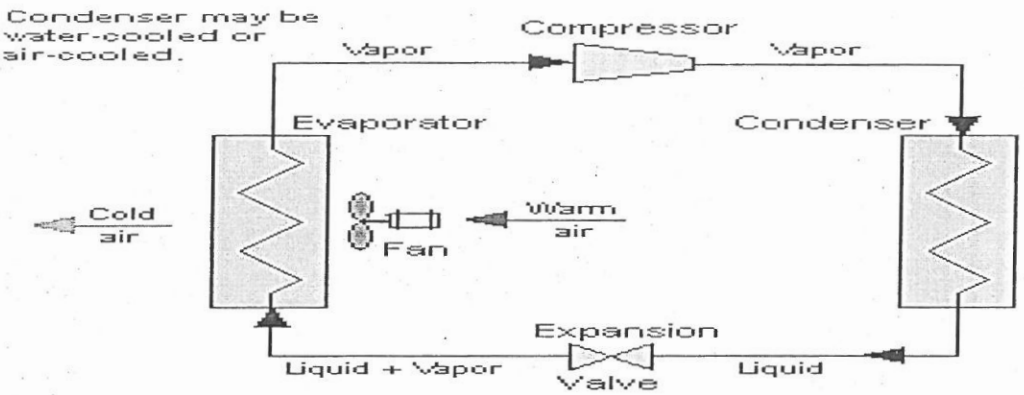
Applications

1. **AutomotiveIndustry**:Machiningiscrucialinmanufacturingcomponentslikeengine parts, transmission components
2. **AerospaceandAviation**:Machiningisvitalforproducinglightweight,high-strength components used in aircraft, such as turbine blades
3. **MedicalDevices**: Machining is used intheproduction of precise medical instruments,implants
4. **DefenseandMilitary**: Machiningisused inproducingcomponents formilitaryvehicles

10.b) Illustrate the components of Refrigeration & Air Conditioning cycles with a neat sketch. [5M]

Refrigeration is the process of artificially cooling a space or substance by extracting heat from a low-temperature area and transferring it to a high-temperature area. This thermodynamic process uses a refrigerant that circulates through components like the evaporator, compressor, condenser, and expansion valve to absorb and release heat, maintaining temperatures below ambient levels.

VapourCompressionRefrigerationCycle



The vapor compression refrigeration cycle consists of four main components: theCompressor, Condenser, Expansion valve, and Evaporator. Each component plays a crucial role in **the overall functioning** of the cycle.

Compressor: Low pressure and low temperature vapour refrigerant was sucked in to the compressor from evaporator.The compressor is the heart of the **refrigeration system** and is responsibleforcompressing**the refrigerant gas** andraisesitspressureandtemperature.This process increases the energy of the refrigerant, allowing it to absorb heat from the surroundings.

Condenser: The condenser is where the high-pressure,**high-temperature refrigerant** gas is cooled and condensed into a liquid state. This is achieved by transferring heat from the refrigerant to thesurroundingenvironment, usuallythrough theuseof **a fan or water-cooling system**. As the refrigerant cools down, it releases heat and changes **its state**from a gas to a liquid.

Expansion Valve: The expansion valve is a small device that controls the flow of the refrigerant from the high-pressure side of the system to the low-pressure side. It creates a pressure drop, which causes the refrigerant to expand rapidly. **This expansion**leads to a decrease in temperature and pressure, preparing the refrigerant for the next stage of the cycle.

Evaporator:Theevaporatoriswheretherefrigerantabsorbsheatfromthespacethatneedsto be cooled. As the low-pressure, low-temperature liquid refrigerant enters the evaporator, it evaporates into a gas by absorbing heat from the surroundings.**This heat transfer**process cools down the space, making it suitable for various applications, such as air conditioning or food preservation.

Air ConditioningCycle

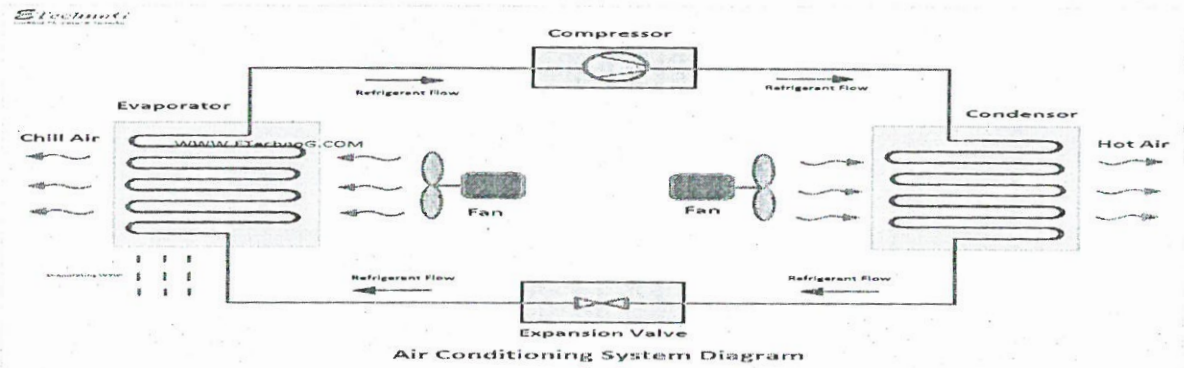
The principle of air conditioning is based on the laws of thermodynamics. An air conditioner operates using the refrigeration cycle. Specific refrigerants are needed as the working fluid in the refrigeration cycle.

Anairconditionergoesthrough4processes:

1. **Compression**
2. **Condensation**
3. **Expansion,**
4. **Evaporation.**

Typically, an air conditioner is made up of 4 major components; compressor, heat exchanger, fan and expansion valve.

AirConditioningSystemCycle



Air Conditioning System Diagram

AirConditioningSystemOperationThefunctioningofanair conditioningsystemfollowsaspecificsequence:

1. **Compression:** The refrigerant initially enters the compressor as a low-pressure superheated gas.
2. **Compressor:** The compressor plays a crucial role by compressing the gas, transformingit into a high-pressure superheated gas.
3. **Condensation:** Within the condenser, the gas undergoes cooling and a change of state into a vapour. Further cooling inside the condenser leads to the condensation of the refrigerant vapour, turning it into a high-pressure sub- cooled liquid.
4. **Expansion:** As the high-pressure liquid refrigerant passes through the meteringdevice, it enters a low-pressure environment. This transition causes it to rapidly change into a vapour state.
5. **Evaporation:** The refrigerant vapour then enters the evaporator, where it absorbs heat from the area being cooled. This heat absorption causes the refrigerant to boil. While passingthrough the evaporator coil, the vapour becomes superheated, transitioningit into a gas state before it re-enters the compressor, restarting the cycle.

11.a) Explain the components of Electric Vehicles with a neat sketch. [5M]

Electric vehicles (EVs) rely on electricity as their primary source of power, either as the sole fuet or to enhance the efficiency of traditional vehicle designs.
The category of EVs encompasses battery electric vehicles (BEVs), often called all-electricvehicles, as well as plug-in hybrid electric vehicles (PHEVs).
Thesevehiclesarecommonlyreferredtoaselectriccarsorsimply EVsandtheyare renowned for their immediate torque delivery and quiet driving experience.
An electric vehicle is an automotive mode of transportation propelled byone or more electric motors, utilizing electrical energy stored in an energy storage device.
The fundamental components within electric vehicles consist of the motor, controller, power source and transmission.

ElectricVehicle Components

Electricvehicles (EVs) consist ofseveral keycomponents
Motor: The motor is responsible for propelling the vehicle, converting electrical energy into mechanical power for motion.
Battery: The battery serves as the energy storage device, storing electrical power to supply the electric motor and other vehicle components.
Transmission: The transmission is responsible for transmitting the mechanical power generated by the motor to the vehicle's wheels, enabling movement.
Motor Controller: The motor controller manages the distribution of electric power from the battery to the motor, regulating power flow based on data from the accelerator pedal.
Vehicle Controller: Thiscomponentcontrolsvariousvehiclefunctions,includingmonitoring and managing different systems for safe and efficient operation.
Inverter: The power inverter plays a pivotal role in converting DC power from the batteries into AC power for the motor. It also converts AC current generated during regenerative braking back into DC current for battery recharging. When the battery is recharged, it stores electric energy, which is subsequently used to power the electric motor and other vehicle components.
The controller governs the supply of electric power to the motor, adjusting power flow in response to accelerator pedal input. The transmission transfers mechanical power from the motor to the vehicle's wheels. Some EVs employ regenerative braking to generate energy during braking or deceleration, which is then returned to the battery.

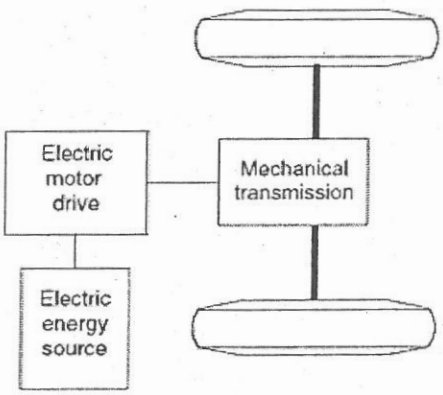


Figure: Primary electric vehicle power train

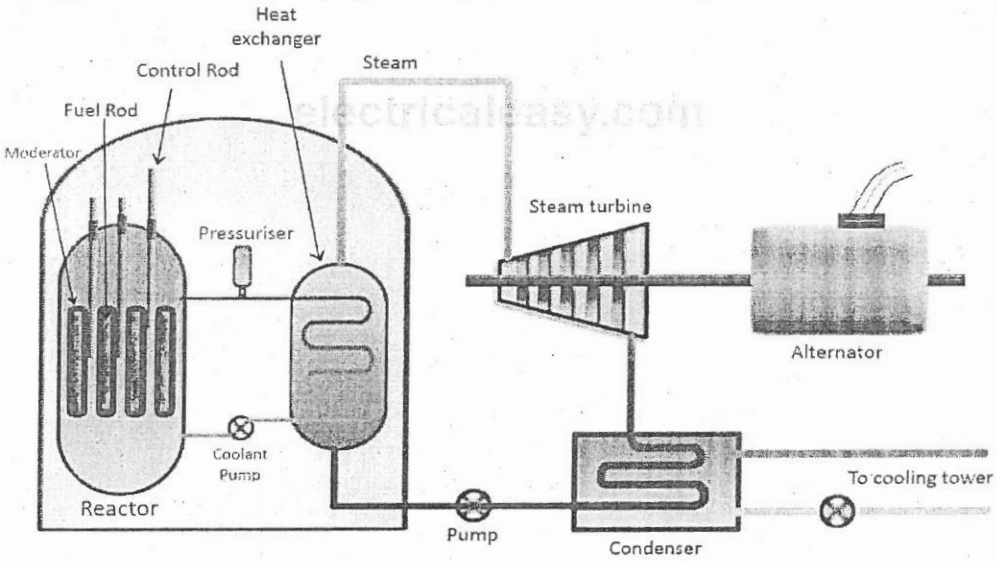
11.b) Distinguish between SI Engine and CI Engine. [5M]

S.no	Parameter	SI Engine	CI Engine
1.	**Definition**	It is an engine in which the spark is used to burn the fuel.	It is an engine in which heat of compressed air is used to burn the fuel.
2.	**Fuel used**	Petrol is used as fuel.	Diesel is used as fuel.
3.	**Operating cycle**	It operates on Otto cycle.	It operates on Diesel cycle.
4.	**Compression ratio**	Low compression ratio.	High compression ratio.
5.	**Thermal efficiency**	High thermal efficiency.	Less thermal efficiency.
6.	**Method of ignition**	Spark plug is used to produce spark for the ignition.	Heat of compressed air is used for the ignition.
7.	**Engine Speed**	High speed engines.	Low speed engines.
8.	**Pressure generated**	Low pressure is generated after combustion.	High pressure is generated after combustion.
9.	**Constant parameter during cycle**	Constant volume cycle.	Constant pressure cycle.
10.	**Intake**	Air + fuel.	Only air.
	Weight of engine	Si engine has less weight.	CI engine are heavier.
12.	**Noise production**	It produces less noise.	It produces more noise.
13.	**Production of hydrocarbon**	Less Hydrocarbon is produced.	More hydrocarbon is produced.
14.	**Starting**	The starting of SI engine is easy.	The starting of CI engine is difficult.
15.	**Maintenance cost**	Low	High
16.	**Vibration problem**	Less	Very High
17.	**Cost of engine**	Less cost	High cost

UNIT 3

12.a)Discuss the working principle of nuclear power plant and mention the advantages and disadvantages. [5M]

Nuclear power plants produce heat through the fission of heavy elements like Uranium or Thorium in a reactor, generating energy comparable to conventional thermal plants. Just one kilogram of Uranium can yield as much energy as 4,500 tons of coal, significantly lowering fuel transportation costs.



WorkingofaNuclearPowerPlant

In a nuclear power plant, heavy elements like Uranium-235 or Thorium-232 undergo nuclear fission in a reactor, releasing a large amount of heat. This heat is absorbed by a coolant, which can be water, gas, or liquid metal. The heated coolant flows through a heat exchanger, converting water into high-temperature steam. The steam drives a turbine connected to an alternator, generating electricity. After use, the steam is condensed back into water and recycled, while the generated electricity is stepped up by a transformer for long-distance transmission.

Advantages:

1. Generatingelectricityfromnuclearreactions innuclearpowerplantsdoesnotproducepollution.
2. Reactoroperatingcostsarerelativelylow,with alifespanofaround50-60 years.
3. Nuclearpower offers reliability and consistency over extended periods, independent of weather conditions.
4. Uranium,akeyfuelsource,isabundant andmoreenduringthanfossilfuels.
5. Nuclear power plants provide energy security by reducing dependence on fluctuating fossil fuel prices and global environmental regulations.

Disadvantages:

1. Properstorage of usednuclear fuel posesa significantchallenge, occupyinglarge areasfor many years.
2. Vigilanceisrequiredfor thesafetyandradiationlevelsofwastestorage facilities.
3. Theriskofnuclearaccidents,suchastheFukushimaincidentinJapan,canhavelastingand intergenerational effects due to radiation exposure.
4. Theimmensepowerofnuclearenergyposessecurityconcernsifmisused,potentiallythreatening humanity.

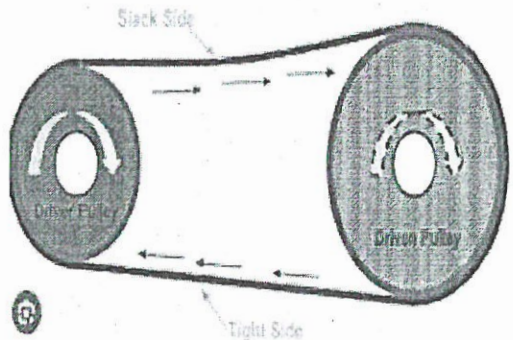
12.b) Explain the importance of belt drives and its types in mechanical power transmission. [5M]

Introduction - Belt Drives, Chain, Rope drives, Gear Drives

- The power is transmitted from one shaft to the other by means of belts, chains and gears.
- The belts and ropes are flexible members which are used where distance between the two shafts is large.
- The chains also have flexibility but they are preferred for intermediate distances.
- The gears are used when the shafts are very close with each other.
- Belts and ropes transmit power due to the friction between the belt or rope and the pulley.

Belt Drives

In case of belts, friction between the belt and pulley is used to transmit power. In practice, there is always some amount of slip between belt and pulleys.



- A belt drive is a method of transferring rotary motion between two shafts.
- A belt drive includes one pulley on each shaft and one or more continuous belts over the two pulleys.
- The motion of the driving pulley is, generally, transferred to the driven pulley via the friction between the belt and the pulley

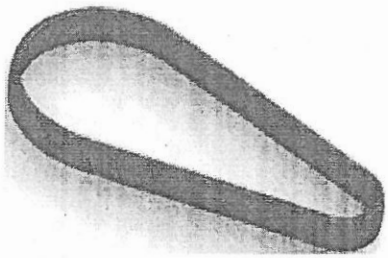
Classification

Based on Belt Type

1. **Flat Belts :** Simple, flat belts made of rubber, leather etc. They're generally used for low-power applications. They are used to transfer rotational power in industrial equipment and conveyor systems. Flat belts have a low profile with a positive grip, which makes them suitable for high-speed drive applications.

Features of Flat belts:

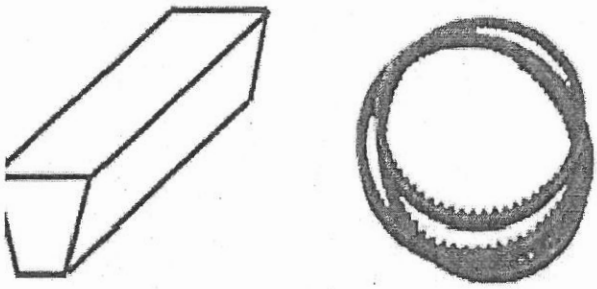
1) A flat belt can deliver high power at high belt speeds
2) Low noise operation
3) High efficiency (up to 98%)
4) Small bending loss due to small bending cross-section
5) High flexibility
6) No need for grooves
7) Long service life as they handle dust and dirt reasonably well
8) Can be reinforced for greater strength



2. **V-Belts:** These belts have a trapezoidal cross-section, offering better grip and higher power transmission compared to flat belts. They are widely used in industrial machinery and automotive applications.

   Important features of V belts are as follows:

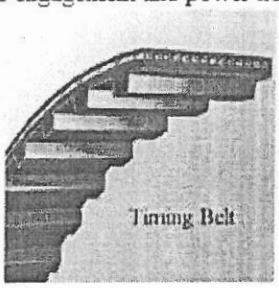
1) Available in a wide range of sizes, strengths, and materials
2) High power transmission capacity at high belt speeds
3) Low cost
4) Easy installation
5) Compact arrangement

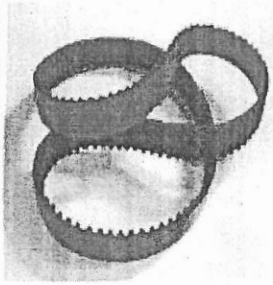


3. **Timing belts:** Also known as toothed belts or synchronous belts, are a specific type of belt drive used in machinery and engines where precise motion transfer is crucial. They have teeth that mesh with grooves on the pulleys, enabling accurate power transmission and synchronization between rotating shafts. Here's more detail on timing belts:

   Components:

- **Belt:** Typically made of rubber or polymer materials reinforced with fibers like fiberglass or Kevlar for strength and durability. The teeth are often made of nylon or other high-strength materials.
- **Pulleys:** Have matching grooves or teeth that correspond to those on the belt. They ensure precise engagement and power transfer.

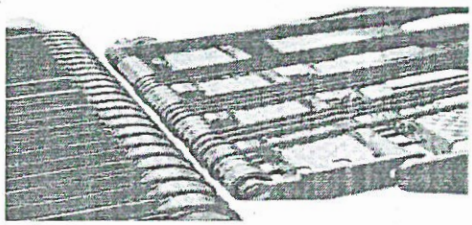




Toothed Pulley

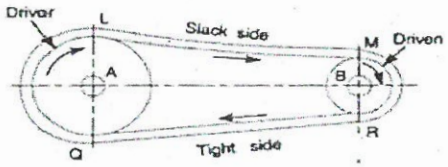
4. **Round belts**: These belts have circular cross-section and fit into U or V-shaped grooves in a pulley.

1) Round belts are used in motion control as well as power transmission applications.
2) These belts find use in line shafts, industrial conveyors, packaging machinery, photocopiers, printers, etc.
3) In applications where belts are expected to twist and turn a lot, contacting multiple pulleys in the process, round belts are highly suitable.
4) Due to their very nature, these belts can transmit power and provide friction from any part of their circular surface

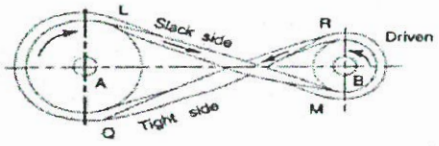


Based on Power Transmission Method:

1. **Open Belt Drive:** The belt is in contact with the pulleys in an open configuration. It's easy to install and adjust but may experience slip.



2. **Cross Belt Drive:** Used when shafts are far apart. Two or more belts are crossed to transmit power between non-parallel shafts.



Applications

1) **Industrial Machinery**
   a) **Conveyors:** Used in industries like manufacturing, mining, and logistics for transporting goods or materials.

   b) **Machine Tools:** Belt drives are integral in lathes, milling machines, grinders, and other machining equipment.
   c) **Pumps and Compressors**

2) **Automotive**

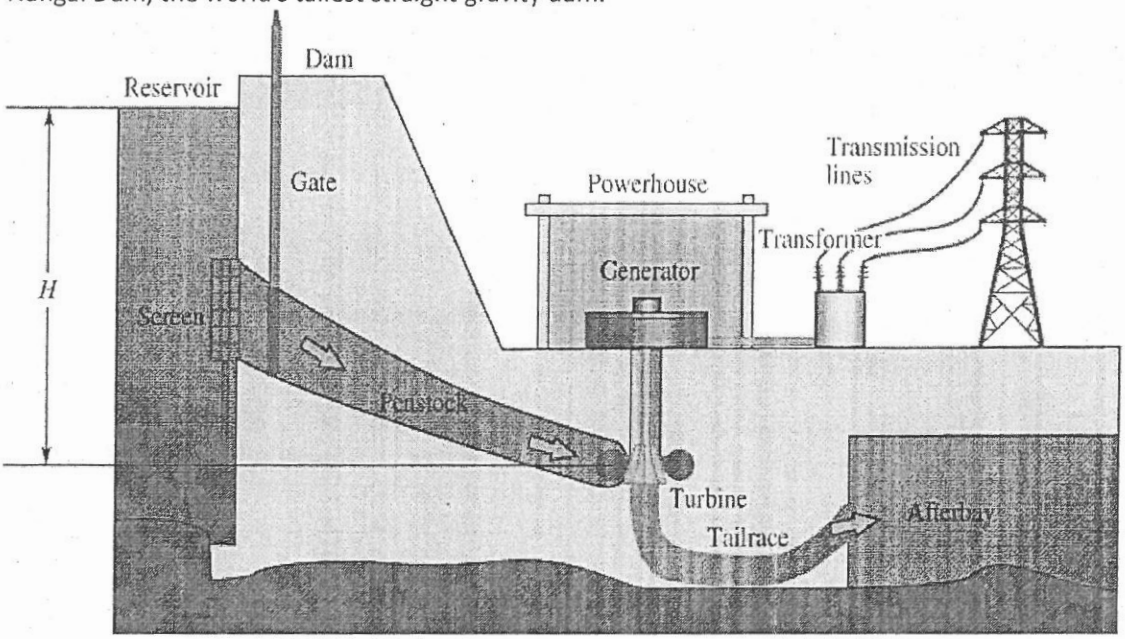
   Engine Systems: Timing belts are used to synchronize the camshaft and crankshaft in internal combustion engines.

3) **Home Appliances**

   a) **Washing Machines:** Belts facilitate the rotation of the drum during washing and spinning cycles
   b) **Fitness Equipment:** Treadmills, stationary bikes, and other exercise machines often use belt drives for the rotating components.

13.a) Demonstratethe working of hydroelectric power plant and list out the applications. [5M]

Hydropower is a clean, renewable, and cost-effective energy source harnessed from the flow of water, operating in a continuous natural cycle. It generates electricity by using the movement of water from higher to lower elevations to rotate turbines, which drive generators. India's largest hydroelectric plant is on the Koyna River in Maharashtra (1920 MW), and it also houses the Bhakra Nangal Dam, the world's tallest straight gravity dam.



WorkingPrincipleThe principle behind hydroelectric power generation involves converting the potential energy stored in waterinto kinetic energy, whichisthenutilized to spin a turbine,ultimatelygeneratingelectricity through a generator.

WorkingProcedure:

1. The dam serves as a barrier, raising the water level in the reservoir to increase its potential energy. Theheight differencebetweenthereservoirandthepenstockisthekeyfactorbehindthepressurethat drives the turbine, generating power.
2. Whenthecontrol gatesare opened,waterflowsthrough the penstocktowardthe turbine.Alongthe penstock's length, surge tanks and trash racks are strategically placed. The surge tank is vital for preventing water hammering, compensating for sudden changes in load on the turbine and ensuring a consistent flow of water to the turbine, preventing power output fluctuations.
3. Trash racks remove impurities from the water before it reaches the turbine, reducing wear and tear on the turbine and extending its lifespan.
4. As water strikes the turbine blades, it converts the pressure energy into mechanical energy, whichis then transformed into electrical energy by the generator. The resulting high-voltage electricity is transmitted to the power grid via transmission lines.

Applications:

Historicallyusedformechanical milling.

Generateselectricityfortowns,industries,schools,hospitalsandmore

13.b)Categorize the Robots and List out the different types of robot configurations. [5M]

Robot: A robot isa machine that can perform complex actions automatically, often with little to no human intervention.Robots can be guided by an external control device or have the control embedded within.

Roboticsisamultidisciplinaryfieldthatinvolvesthedesign,construction,operation,anduseof robots.It's a branch of engineering and computer science that aims to create intelligent machines that can assist humans

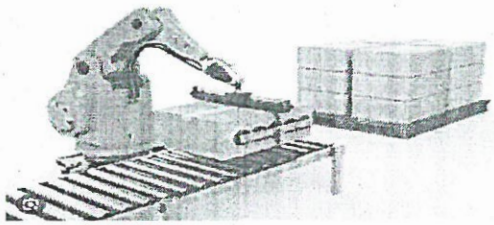
Categorization of Robots:

PickandPlaceRobots

a) Pick and Place, stacking and sorting parts on production line are repetitive and monotonous task. We can automate the tasks using pick and place robots.
b) Pickandplacerobotsutilizesensors,advancedvisiontechnologyandroboticarmtopickan object from one location and drop it at another location.
c) They have application in manufacturing unit to automate production process and improve quality and productivity.

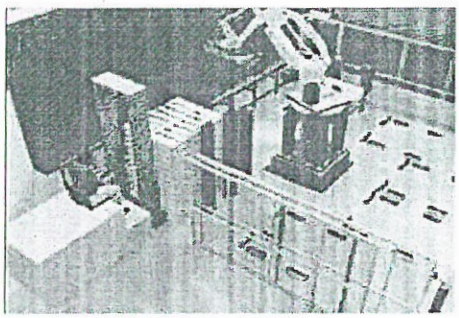
Palletizing

a) Palletizing is a common industrial process where products or items are stacked onto pallets in aspecific arrangement for storage, transportation, or further processing.
b) Robotpalletizingreferstotheuse ofroboticsystemstoautomatethistask.



Machineloadingandunloading

a) Machine loading and unloading operations utilize a robot to load and unload parts at a production machine.
b) Thisrequirestherobottobeequippedwithagripperthat cangraspparts.
c) Usuallythegrippermust bedesignedspecificallyfortheparticularpart geometry.

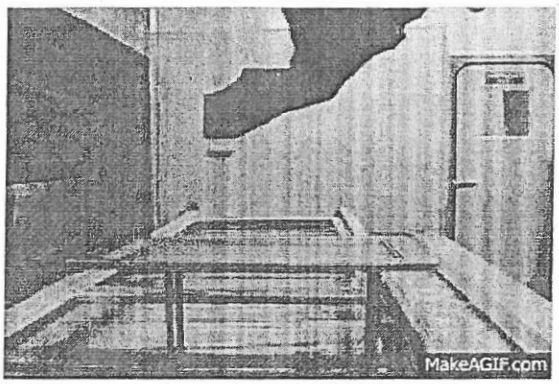


RobotsforweldingOperation

Robotweldingistheuseofmechanizedprogrammabletools(robots),whichcompletelyautomate a welding process by both performing the weld and handling the part.

Spraypaintingusingrobots

Robotic spray painting arm is a painting process in which spray painting is done by robots arm to reduce the human load. Robotic spray painting arm has been used for many year in automotive spray painting applications.

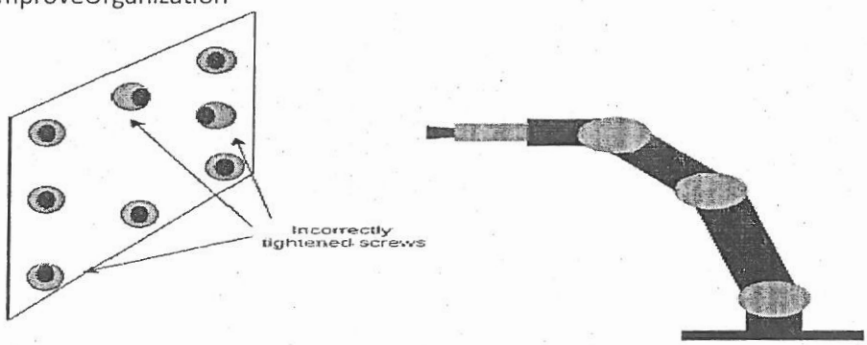


RoboticInspection

Robotic visual inspection refers to a camera and lighting gear mounted on the end-effector of a robot and the robot moves to inspect multiple points on the same object/test piece for features. The robot can be programmed to automatically detect a sequence of locations on the object.

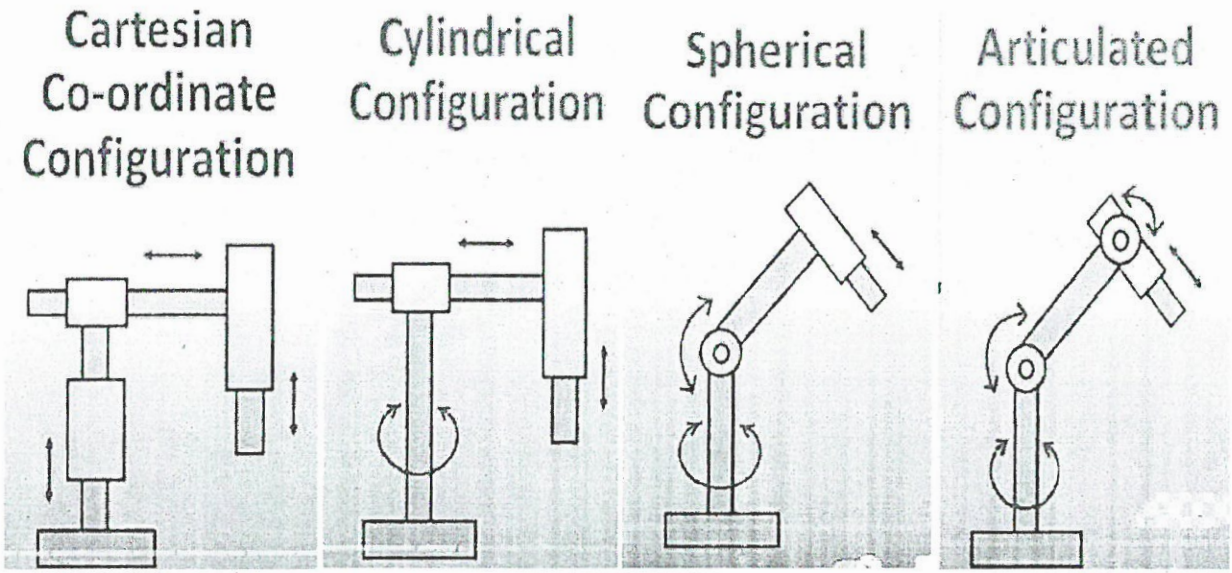
Therearenumerous reasonsthatcompaniesmaychoosetouserobotstoconduct inspections

a) RobotsCanGoPlacesPeople Can't
b) UsingRobots ImprovesWorker Safety
c) RobotsIncrease Efficiency
d) RobotsImproveOrganization



List out the Different Types of Robot Configurations:

RobotConfigurations



1. CartesianCoordinateSystem(P-P-P)

TheCartesiancoordinateisalsocalledrectangularcoordinatesystem.Inthissystem,the3sliding

correspondingtomovingthewristupanddowninandoutandback,forth configuration is represented by (Prismatic- Prismatic- Prismatic).

2. CylindricalCoordinateSystem(R-P-P)

The cylindrical robot has a rotary joint for rotation and a prismatic joint for angular motion around the joint axis. The rotary joint moves in a rotational movement around the common axis. In contrast, the prismatic joint will move in a linear motion.

3. SphericalorPolarCoordinatesystem(R-R-P)

Polar robots are robot configurations with a combined linear joint and two rotary joints, with an arm connected to a robotic base and a twisting joint. Also known as spherical robots, the axes create a spherical work envelope and a polar coordinate system

4. ArticulatedArm(R-R-R)

Configurations with three rotaryjoints. The best example for this type of configuration has been observed in some of the type of robots specially known as SCARA.