CMR INSTITUTE OF TECHNOLOGY

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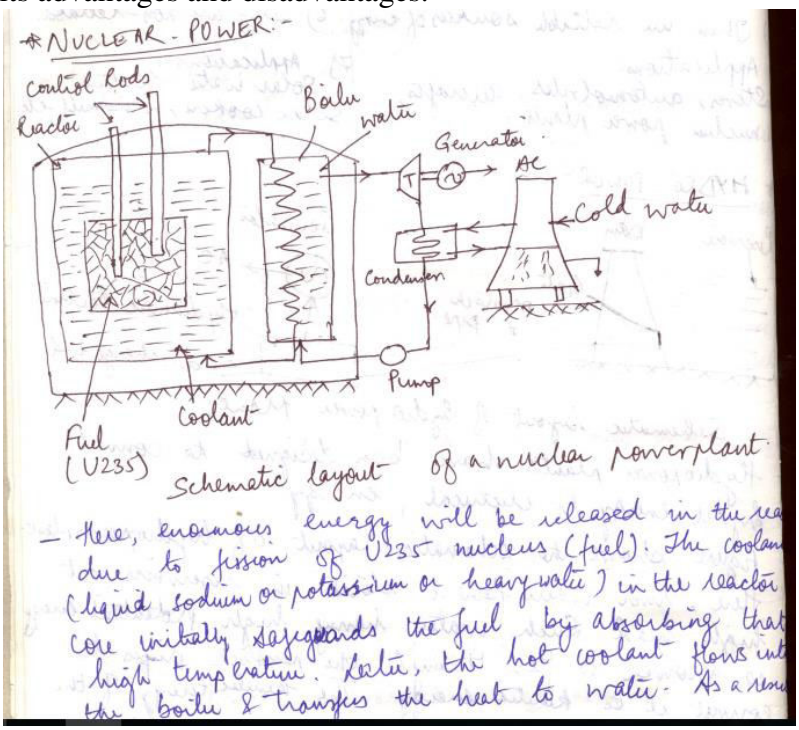
Improvement Test

Sub:	**Elements of Mechanical Engineering**							Code:	**15EME14**
Date:	18 /11 / 2016	Duration:	90 mins	Max Marks:	50	Sem:	I	Branch:	**ALL**

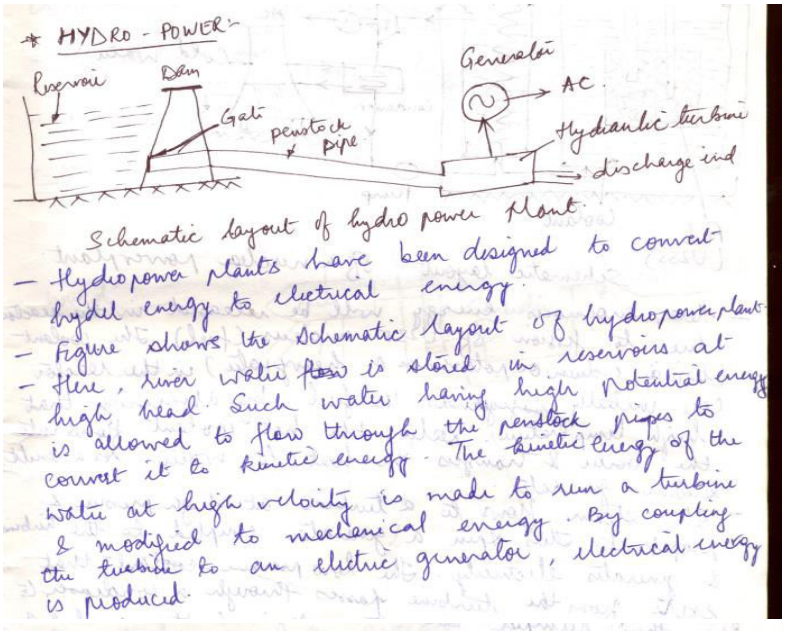
Answer Any **FIVE** Questions completely

		Marks	OBE CO	OBE RBT
1.	With a neat sketch explain the working principle of nuclear power plant. State its advantages and disadvantages.	**[10]**	CO1	L1



due to ... (liquid sodium or potassium or heavy water) in the reactor core initially safeguards the fuel by absorbing that high temperature. Later, the hot coolant flows into the boiler & transfers the heat to water. As a result steam generates.
- The steam flows to a turbine at high pressure & propels it. This spin a generator coupled to the turbine & generates electricity. The low pressure coolant that exits from the turbine passes through a condenser to bring down its temperature. It is further cooled by circulating cold water drawn from a cooling tower. It is then pumped back to the boiler.
- In the mean time control rods (made of cadmium, boron or hafnium) are made to move up & down automatically to control the nuclear chain reaction to increase or decrease the temperature, hence the power.
- Energy released by nuclear reaction $E = mc^2$ where m = mass in kg, c = velocity of light = 3×10^8 m/s

2. (a) Explain the operating principle of electric power generation from hydro power plant with a neat sketch. Explain its advantages and disadvantages. **[06]** CO1 L1



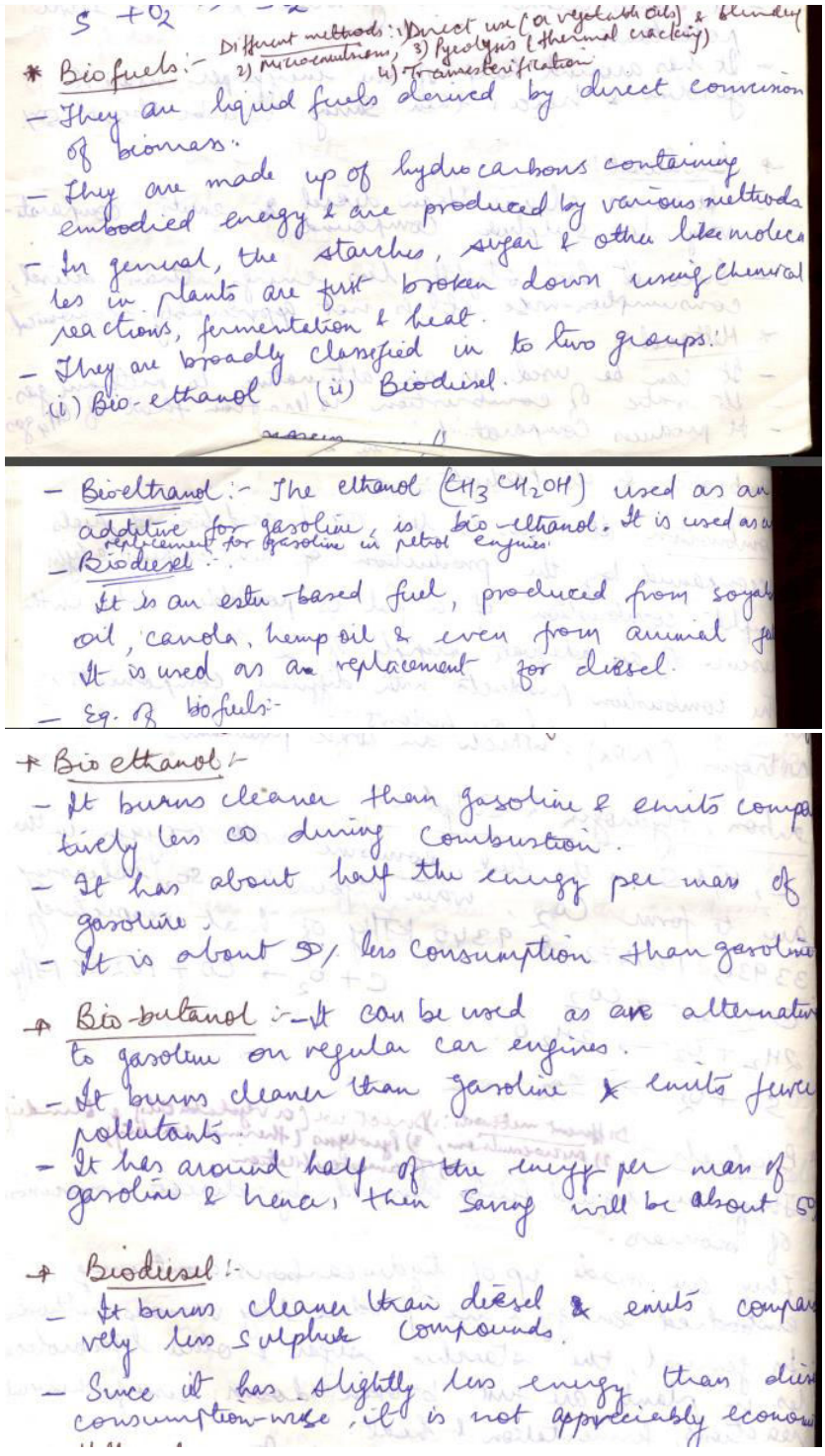
Schematic layout of hydro power plant.

- Hydropower plants have been designed to convert hydel energy to electrical energy.
- Figure shows the schematic layout of hydropower plant.
- Here, river water flow is stored in reservoirs at high head. Such water having high potential energy is allowed to flow through the penstock pipes to convert it to kinetic energy. The kinetic energy of the water at high velocity is made to run a turbine & modified to mechanical energy. By coupling the turbine to an electric generator, electrical energy is produced.

Advantages:
- environmental friendly.
- Hydro reservoirs help agriculture & control flooding.
- Maintenance cost is less.

Disadvantages:
- Creates deforestation & a lot of inconvenience to people living at that site as they have to be evacuated permanently.
- Construction cost is very high.

(b) Give examples of various bio-fuels used in engineering applications. **[04]** CO1 L1



* Biofuels:- Different methods: 1) Direct use (or vegetable oils) & blending 2) Microemulsion, 3) Pyrolysis (thermal cracking) 4) Transesterification
- They are liquid fuels derived by direct conversion of biomass.
- They are made up of hydrocarbons containing embodied energy & are produced by various methods
- In general, the starches, sugar & other like molecules in plants are first broken down using chemical reactions, fermentation & heat.
- They are broadly classified in to two groups:
(i) Bio-ethanol (ii) Biodiesel.

- Bioethanol:- The ethanol (CH_3CH_2OH) used as an additive for gasoline is bio-ethanol. It is used as a replacement for gasoline in petrol engines.
- Biodiesel:-
It is an ester-based fuel, produced from soyabean oil, canola, hemp oil & even from animal fat. It is used as a replacement for diesel.
- Eg. of biofuels:-

* Bio ethanol:-
- It burns cleaner than gasoline & emits comparatively less CO during combustion.
- It has about half the energy per mass of gasoline.
- It is about 5% less consumption than gasoline

* Bio-butanol:- It can be used as an alternative to gasoline on regular car engines.
- It burns cleaner than gasoline & emits fewer pollutants.
- It has around half of the energy per mass of gasoline & hence, then saving will be about 5%

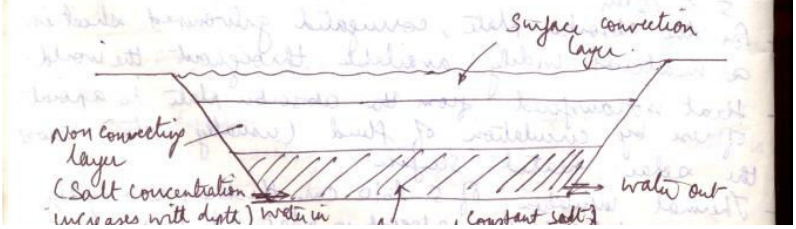
* Biodiesel:-
- It burns cleaner than diesel & emits comparatively less sulphur compounds.
- Since it has slightly less energy than diesel consumption-wise, it is not appreciably economical

3.	(a)	Explain the principle of operation of Solar Pond with a neat sketch.	**[05]**	CO1	L1

2) SOLAR POND:-

Principle of Operation of solar pond:-

- The solar pond is a simple device for collecting & storing solar heat.
- Natural ponds convert solar radiation into heat but the heat is quickly lost through convection in the pond & evaporation from its surface.
- A solar pond, on the other hand, is designed to reduce convective & evaporative heat losses so that useful amounts of heat can be collected & stored.

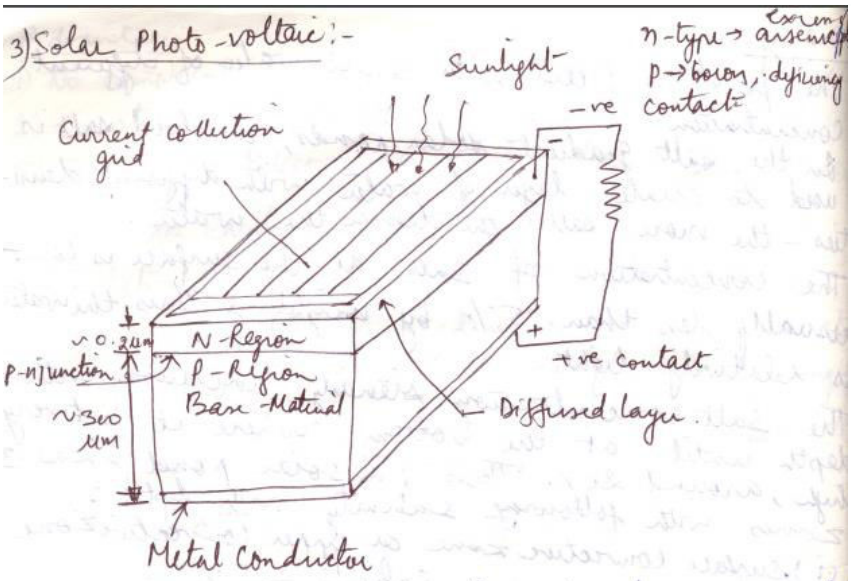


Working:-

- The pond is filled with salt-water of different concentration.
- In the salt gradient solar ponds, dissolved salt is used to create layer of water with different densities – the more salt, the denser the water.
- The concentration of salt at the surface is low:- usually less than 5% by weight & thus the water is relatively light.
- The salt concentration steadily increases with depth until at the bottom where it is very high, around 20%. Thus, a solar pond has 3 zones with following salinity with depth:
  (i) Surface convective zone or Upper convective zone (UCZ) = 0.3 – 0.5 m, Salinity < 5%.
  (ii) Non-convective zone (NCZ) = 1-1.5 m, Salinity increases with depth.
  (iii) Storage zone Lower convective zone (LCZ) = 1.2 – 2 m, Salinity ≅ 20%.

(b)	Explain with a neat sketch the principle of working of Photo-Voltaic cell.	**[05]**	CO1	L1

3) Solar Photo-voltaic:-



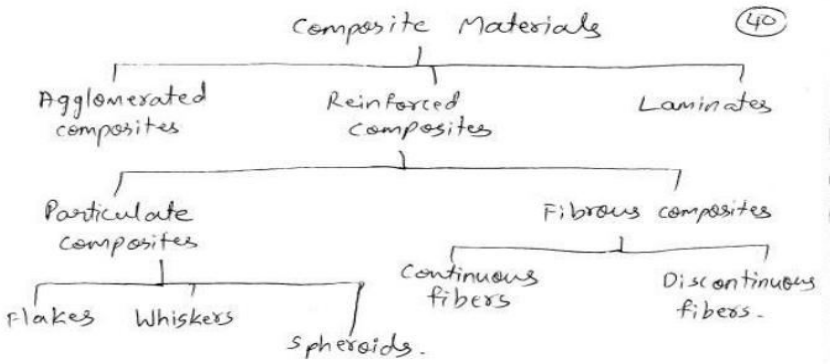
- It is the direct conversion of solar energy into electricity using the photovoltaic effect in semiconductor materials. Its basic unit is solar cell. Its schematic arrangement is shown in figure.
- When sun rays falls on the top of the cell, the glass plates scatter them over its surface. It helps the photons to strike the thin n-type silicon side & penetrate through p-n junction of the semiconductor. The semiconductor absorbs the photons & creates free electrons. As a result, an electric field builds near the p-n junction hence the n-region becomes -vely charged & p-region becomes +vely charged. If an external load is applied from n to p, the charge difference will drive current through them, which can be stored in the current collection grid.

4.	(a)	What is a Composite Material? Explain how composites are classified.	**[06]**	CO5	L1

(c) Composite Materials:-

It is defined as a structural material that consists of two or more constituents having dissimilar characteristics and are created synthetically or artificially.

Eg:- Glass reinforced plastics, plywood, carbon fiber reinforced composites.



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(b) List the applications of Composites in Automobiles **[04]** CO5 L1

Applications of Composites:-

Automobiles:-

(i) Nylon reinforced rubber composites used for automobile tyres.
(ii) Fiberglass body of automobiles.
(iii) Spring and drive shafts for automobiles.
(iv) Aluminium alloy reinforced with alumina fibers (Aluminium oxide) is used in pistons and connecting rods.
(v) Glass reinforced polymers are used for front panels because of its high energy absorbing capacity during crash.

(42)

(vi) Suspension is also manufactured using composite materials.
(vii) Aluminium alloy composites are used for tyre rims.
(viii) Dashboards are usually made of polymer matrix composites.

5. Explain Polar, Cylindrical and Cartesian Co-ordinate configurations of robots with neat labeled sketches. **[10]** CO4 L1

6. (a) What are the different types of automation and explain each one of them with atleast one application. **[06]** CO4 L1

Based on their configuration:-

→ Polar configuration (spherical configuration):-

R = Rotational motion
T = Twisting motion
L = Linear motion

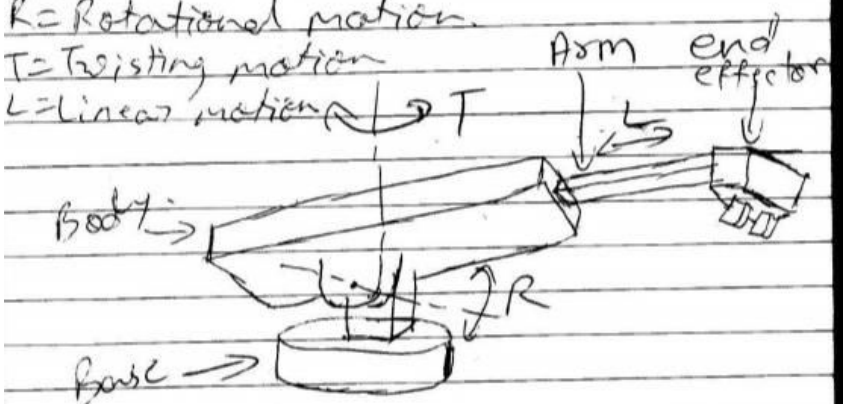


Fig 3.19. Polar configuration Robot

Polar configuration robot has a body which has a pivot point around which it can rotate. Then it can twist around the axis perpendicular to the pivot axis. Then the body has an arm extending out of it at the end of which there is an end effector. This arm can move linearly inward and outward on a rack and pinion arrangement. The work space covered by polar configuration robot is a sphere hence its also called as spherical configuration robot.

② → Cylindrical Configuration :-

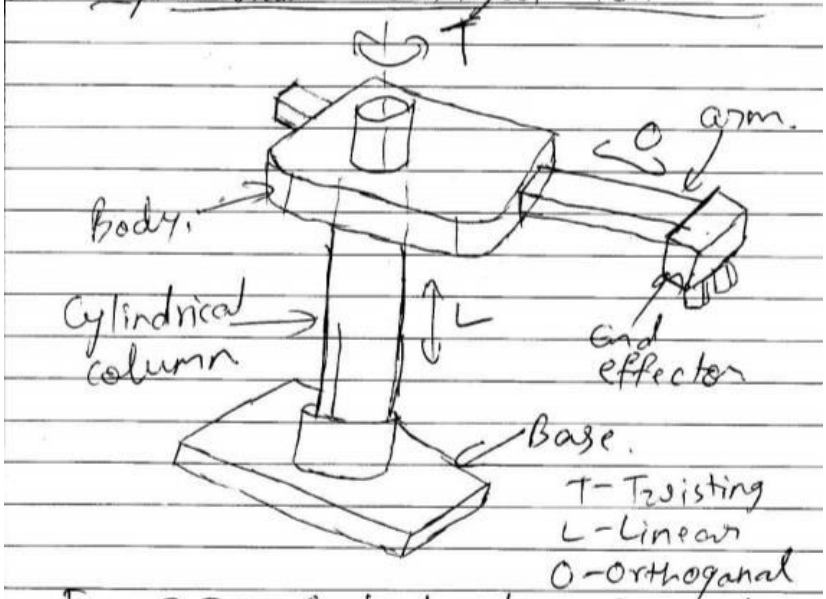


Fig 3.20 Cylindrical configuration Robot.

This configuration robot has a cylindrical column attached to the base and the body of the robot is allowed to move up and down (linearly) along the length of the column and it is also allowed to twist around the axis of the column. Out of the body of the robot, an arm can extend out or can be retracted inside. At the end of the arm there is an end effector. The workspace covered by the robot is a cylinder.

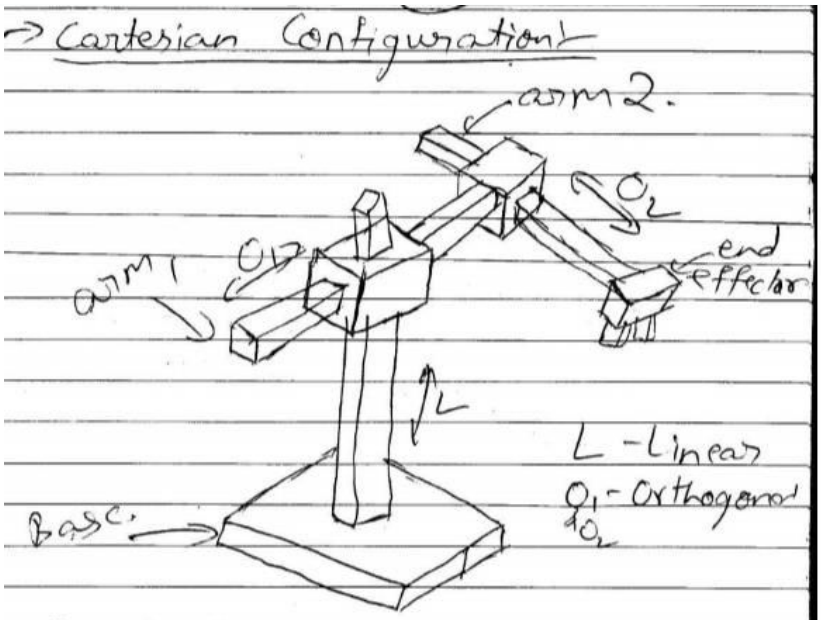


Fig 3.22 Cartesian configuration robot

This configuration has a

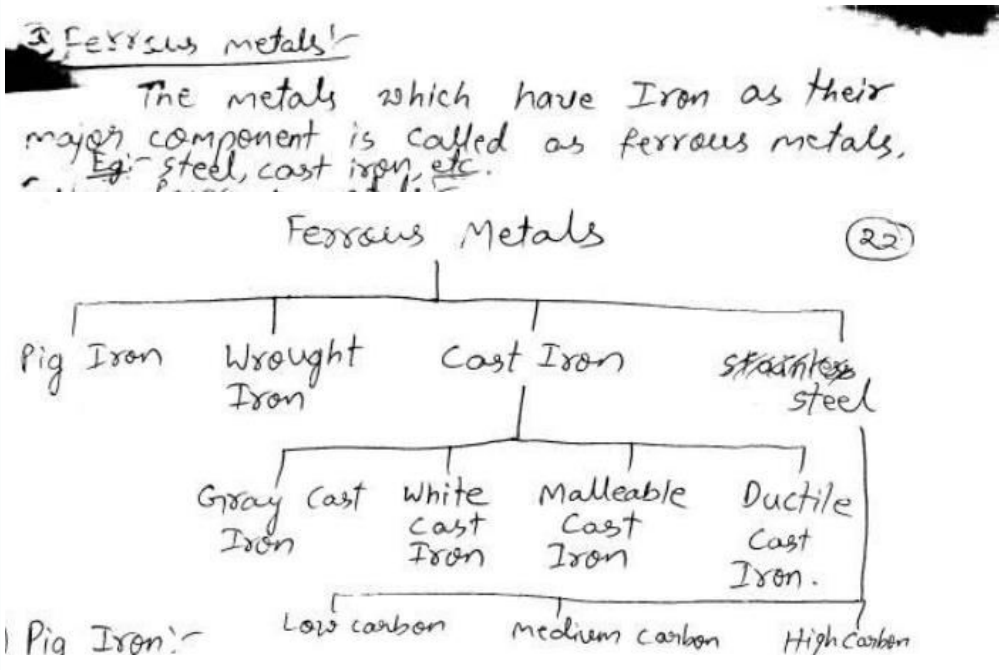
(59)

vertical rectangular column attached to the base and there is another arm perpendicular to this column (arm 1) then there is the second arm (arm 2) which is perpendicular to the first arm (arm 1). So it has one linear motion & two orthogonal motions. The workspace covered by the robot is a rectangular block.

(b) List out the differences between NC and CNC machines. **[04]** CO4 L2

N.C. M/c.	C.N.C. M/c
→ The part program is entered by using punch cards & punch tapes	→ Part program is entered by using input devices like keyboard, mouse, C.D., D.V.D. etc.
→ No feedback loop.	→ Feedback loop is present
→ Only one program can be written in one tape.	→ Many programs can be stored in the memory.
→ Tape reader acts as M.C.U.	→ Micro-processor acts as M.C.U
→ Editting of program is difficult.	→ Editting the program is simple.
→ Less flexible.	→ More flexible.
→ Less productivity.	→ High productivity
→ Moderate cost.	→ High cost.

7 (a) What is a ferrous metal? Give some examples. Also, give the classification of ferrous metals. **[04]** CO5 L1



(b) List the different types of Cast Iron and explain their properties. **[06]** CO5 L1

Medium carbon High Carbon

1) Pig Iron:-

→ Its named pig iron because the iron obtained from blast furnace was cast in a shape resembling a litter of piglets suckling.

→ Pig iron is produced in a blast furnace. It is the first product in the process of converting iron ore into useful metal.

→ Composition:-

Carbon — 3 to 4%.
Silicon — 1 to 3%
Manganese — 0.1 to 1%
Phosphorus — 0.3 to 1.7%
Sulphur — below 1%
Iron — Remainder.

→ Pig iron is very brittle because of its high carbon content.

→ Melting point of pig iron is in the range of 1150°C to 1200°C.

→ Melting point is around 300°C lower than pure iron (wrought iron) because of high carbon content. (23)

→ Pig iron is very hard.

Applications:-

→ It is used for the production of wrought iron.

→ Its used in the steel making process with the scrap metal.

→ Its also used to produce gray cast iron.

② Wrought Iron:-

→ Wrought Iron is almost pure iron around 99.6% iron with traces of silicate slag.

→ Composition:-

Carbon – 0.02 – 0.03%
Phosphorus – 0.05 – 0.25%
Silicon – 0.02 – 0.10%
Slag – 0.05 – 1.50%
Sulphur – 0.008 – 0.02%
Iron – Remainder,

→ Wrought iron has very high ductility due to less percentage of carbon content.

→ Because of high ductility wrought iron is shaped by hammering, pressing or forging.

→ Bridge railings,
→ Drainage lines
→ sludge tanks.
→ Condenser tubes
→ Diesel exhaust piping in train engines
→ Hull and deck plating in ships.
→ Gas collection hoods in labs and industries to collect harmful gases and channel it through the exhaust.
→ Coal handling equipment.
→ Cooling tower spray tubes.

③ Cast Iron:-

Cast iron as its name indicates has very good casting properties because it has very good flowability, i.e, it can flow to the

→ Composition:-
Carbon – 2.5 – 3.8%
Silicon – 1.1 – 2.8%
Manganese – 0.4 – 1%
Phosphorus – 0.15%
Sulphur :– 0.10%
Iron – Remainder.

→ Carbon is present in form of graphite flakes
→ The length of each flake may vary from 0.5mm to 0.1mm.
→ The melting point is in the range of 1127°C to 1204°C.
→ Brinell hardness number is 260.
→ Density is 7.2g/cm³.
→ When fractured it appears to be gray in colour because of the presence of graphite flakes.
→ It has the lowest melting point of all ferrous alloys.

Course Outcomes		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1:	Discuss the various energy sources and their applications based on their advantages and disadvantages. Familiarize with different types of boilers along with their construction and working.	1	-	-	-	-	-	-	-	-	-	-	-
CO2:	Explain the energy conversion mechanism involved in different prime movers like IC engines & turbines.	-	-	-	-	-	-	-	-	-	-	-	-
CO3:	Differentiate between the metal removal process using lathe, drilling & milling machines.	-	-	-	-	-	-	-	-	-	-	-	-
CO4:	Identify different types of industrial robots and discuss about different levels of automation.	1	-	-	-	-	-	-	-	-	-	-	-
CO5:	Discuss the application and usage of various engineering materials along with some common joining processes.	1	-	-	-	-	-	-	-	-	-	-	-
CO6:	Differentiate between different refrigeration systems and explain air-conditioning systems.	-	-	-	-	-	-	-	-	-	-	-	-

Cognitive level	KEYWORDS
L1	List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc.
L2	summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
L3	Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover.
L4	Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer.
L5	Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize.

PO1 - *Engineering knowledge*; PO2 - *Problem analysis*; PO3 - *Design/development of solutions*; PO4 - *Conduct investigations of complex problems*; PO5 - *Modern tool usage*; PO6 - *The Engineer and society*; PO7- *Environment and sustainability*; PO8 – *Ethics*; PO9 - *Individual and team work*; PO10 - *Communication*; PO11 - *Project management and finance*; PO12 - *Life-long learning*