PVP 23

Code: 23ES1101

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

BASIC CIVIL & MECHANICAL ENGINEERING
(Common for EEE, ECE, CSE)

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)	Define aggregate.	L1	CO5
1.b)	State two applications of Geotechnical Engineering.	L2	CO1
1.c)	What is contour?	L1	CO2
1.d)	Write the specifications of good quality of water.	L2	CO4
1.e)	What is railway engineering?	L2	CO4

			BL	CO	Max. Marks
UNIT-I					
2	a)	Write a detailed note on cement concrete.	L2	CO5	5 M
	b)	Explain the scope of Structural engineering and Environmental engineering.	L2	CO1	5 M

OR					
3	a)	Explain the role of Civil Engineers in the development of society.	L2	CO1	5 M
	b)	Explain the different properties of a good building brick.	L2	CO5	5 M
UNIT-II					
4	a)	Explain angular measurements and discuss instruments used.	L2	CO2	4 M
	b)	The leveling data from a field survey is as follows: 0.863, 1.247, 1.634, 2.642, 0.962, 1.984, 2.369, 1.830, 2.510, 1.630 The leveling instrument is shifted after 4^{th} and 7^{th} reading. The reduced level for benchmark is assumed as 100.000 m. Calculate the reduced levels at each station using any one method.	L2	CO2	6 M
OR					
5	a)	Explain different methods of horizontal measurements in surveying.	L2	CO2	6 M
	b)	Explain the objectives of surveying.	L2	CO2	4 M
UNIT-III					
6	a)	Discuss the importance of transportation in Nation's economic development.	L2	CO3	5 M
	b)	Explain different modes of transportation?	L2	CO4	5 M
OR					
7	a)	List out the various sources of water and explain them.	L2	CO3	5 M

	b)	Explain the concept of Rainwater Harvesting.	L2	CO4	5 M

PART – B

		BL	CO
1.f)	What are composites? Give one engineering application.	L1	CO1
1.g)	Differentiate between ferrous and non-ferrous metals with one example each.	L1	CO1
1.h)	What is 3D printing?	L1	CO1
1.i)	Define a robot in simple terms.	L1	CO1
1.j)	Mention two advantages of hydroelectric power plants.	L1	CO1

			BL	CO	Max. Marks
UNIT-I					
8	a)	Write a detailed note on the role of mechanical engineering in the manufacturing and automotive industries.	L2	CO1	5 M
	b)	Discuss smart materials, their working principle and applications in modern technology.	L2	CO1	5 M
OR					
9		Explain composites, their types and applications in mechanical engineering.	L2	CO1	10 M
UNIT-II					
10	a)	Differentiate between 3D printing and CNC manufacturing.	L2	CO2	5 M

	b)	Explain in detail about any two types of joining processes.	L2	CO2	5 M
OR					
11	a)	Explain the working principle of the Otto cycle with a neat P–V diagram.	L2	CO2	5 M
	b)	Compare Otto cycle and Diesel cycle in terms of efficiency and applications.	L2	CO2	5 M
UNIT-III					
12		Explain the working principle of a hydro power plant with a neat diagram.	L2	CO3	10 M
OR					
13		Explain about cartesian, cylindrical, spherical and articulated robot configurations.	L2	CO3	10 M

I B.Tech- I Semester - Regular Examinations – December 2025

BASIC CIVIL AND MECHANICAL ENGINEERING

Scheme of Valuation for PART-A

1. a) Define aggregate – 1mark
1. b) Presenting two applications of geotechnical engineering – 1mark
1. c) Presenting contour – 1mark
1. d) Writing specifications of good quality of water – 1mark
1. e) Presenting railway engineering – 1mark

2.a) Explanation of cement concrete -5Marks
2.b) Explanation of scope of structural engineering and environmental engineering - 5Marks

3.a) Explanation of role of civil engineer in society - 5Marks
3.b) Explanation of different properties of a good building brick -5marks

4.a) Explanation of angular measurements using instruments – 4marks
4. b) Calculation of reduced levels using any one method – 6marks

5. a) Explanation of different methods of horizontal measurements in surveying – 6marks
5. b) Explanation of objectives of surveying – 4marks

6. a) Explanation of importance of transportation in nations economic development – 5marks
6.b) Explanation of different modes of transportation – 5marks

7. a) Explanation of various sources of water – 5marks
7.b) Explanation of rainwater harvesting -5marks

I B.Tech- I Semester - Regular Examinations – December 2025

BASIC CIVIL AND MECHANICAL ENGINEERING

Key for PART-A

1. a) **Aggregate:**
These are classified by size into fine aggregate (sand) and coarse aggregate (gravel, crushed stone).

1. b) Note: Any TWO applications can be given 1 mark

Geotechnical engineering:

- The properties and behaviour of soil as a material under "soil mechanics".
- The various types of foundations for a structure, for a machine, etc. and their suitability.
- Geotechnical engineering also deals with the analysis, design and construction of foundation.

1. c) **Contour:**
It may be defined as an imaginary line passing through points of equal elevation.

1. d) **Note: Any TWO specifications can be given 1 mark**

Good quality of water:

S. No.	Parameters	Acceptable	Maximum allowable
1.	Turbidity (JTU)	5	10
2.	TDS (mg/L)	500	2000
3.	pH	6.5–8.5	6.5–8.5
4.	Total hardness as $CaCO_3$ (mg/L)	300	600
5.	Calcium as Ca^{2+} (mg/L)	75	200
6.	Iron as Fe (mg/L)	0.3	1.0
7.	Manganese as Mn (mg/L)	0.1	0.3
8.	Nitrate NO_3- (mg/L)	45	100
9.	Chlorides as Cl^- (mg/L)	250	1000
10.	Fluorides as F^- (mg/L)	1.0	1.5
11.	Sulphates (mg/L)	200	400

1. e) **Railway Engineering:**
Rail transport is best suited for carrying bulk commodities and a large number of passengers over long distances.

2. a) **Cement Concrete:**
Cement concrete is a mixture of cement, sand, crushed rock and water which when placed in the skeleton of forms and allowed to cure, and becomes hard such as stone.

Properties of Concrete

- It has a high compressive strength and its strength depends on the proportion in which cement, sand, stones and water are mixed.
- It is free from corrosion and there is no appreciable effect of atmospheric agents on it.
- It hardens with age and the process of hardening continues for a long time after the concrete has attained sufficient strength.
- As it is weak in tension, steel reinforcement is placed in it to take up the tensile stresses. This is termed as 'Reinforced Cement Concrete'.
- It shrinks in the initial stage due to loss of water through forms. The shrinkage of cement concrete occurs as it hardens.
- It has a tendency to be porous. This is due to the presence of voids which are formed during and after its placing.
- It forms a hard surface, capable of resisting abrasion.

2. b) **Structural Engineering**: Structural engineering is the most important specialization in civil engineering. The construction of a structure needs efficient planning, design and method of construction to serve the purpose fully. Generally there are five major stepsin any construction project. These include the following:

- Positioning and arranging the various parts of the structure into a definite form toachieve best utilization.
- Finding out the magnitude, direction and nature of various forces acting on thestructure.
- Analyzing the structure to know the behaviour of the various parts of the structuresubjected to the above forces.
- Designing the structure such that its stability under the action of various loads isensured.
- Executing the work with selected construction materials and skilled workers.

Environmental Engineering: Without food man can survive for days but not without water. The responsibility of providing potable (drinking) water to the public and disposing the waste water safely is that of a civil engineer. The sources of water are precipitation and underground water. Water supply engineering deals with the location, collection of water, its treatment methods, tests for standard limits and efficient supply of water.

Used water, solid wastes, toxic wastes, etc., cannot be disposed directly since these affect the environment. Hence these have to be treated and tested for the standard limits and then disposed. Sanitary engineering deals with the collection of used water, their treatment methods and effective disposal which safeguards the whole world. The natural and artificial wastes generated and released into the atmosphere have upset the natural equilibrium. Anthropogenic or human-induced pollutants have overloaded the system.

The role of an environmental engineer is to build a bridge between biology and technology by applying all the techniques to the job of cleaning the debris. Environmental engineering deals with the methods of protecting the environment from the deleterious effects of human activity which would result in the improvement of environmental quality for the well-being of mankind.

3. a) **Role of Civil Engineers in development of society:**

Civil engineering incorporates activities such as construction of structures like buildings, dams, bridges, roads, railways, hydraulic structures, water supply and sanitary engineering. Various roles of a civil engineer are listed below.

- Investigation: The first function of a civil engineer is to collect the necessary data that is required before planning a project.
- Surveying: The objective of surveying is to prepare maps and plans to locate the various structures of a project on the surface of earth.
- Planning: Depending on the results obtained from investigation and surveying, a civil engineer should prepare the necessary drawing for the project with respect to capacity, size and location of its various components. On the basis of this drawing, a preliminary estimate should be worked out.
- Design: After planning, the safe dimension of the components required is worked out. With this dimension a detailed drawing is prepared for various components and also for the whole structure and a detailed estimate is also calculated.
- Execution: This function deals with the preparation of schedules for construction activities, floating of tenders, finalization of contracts, supervision of construction work, preparation of bills and maintenance.
- Research and Development: In addition to the above-mentioned works, a civil engineer has to engage himself in research and development to achieve economy and to improve the efficiency to meet the present and future needs.

3. b)

Different properties of good building Brick:

- Bricks should have perfect edges, well-burnt in kilns, copper coloured, free from cracks with proper rectangular shape and of standard size ($19 \times 9 \times 9$ cm).
- Bricks should give a clear ringing sound when struck with each other.
- Bricks must be homogeneous and free from voids.
- The percentage absorption of water by weight should not be greater than 20 per cent for first-class bricks and 22 per cent for second-class bricks when soaked in cold water for 24 hours.
- Bricks should be sufficiently hard, i.e., no nail impression must be present when scratched. The average weight of bricks should be 3– 3.5 kg.
- Bricks should not break when dropped from a height of 1 m.
- Bricks should have low thermal conductivity and should be soundproof.
- Bricks should not show deposits of salts when immersed in water and dried.
- The minimum crushing strength of bricks must be 3.5 N/mm^2.

4. a) **Horizontal angular measurements:**

Compass is an instrument which can be used to measure the direction of a survey line with respect to magnetic north-south. The magnetic north-south direction which is the reference direction is called meridian (reference direction) and the angle between the line and the meridian is called bearing. Use of compass for measuring direction of line simplifies the surveying to a great extent.

The types of compass that are used commonly are: (i) prismatic compass; and (ii) surveyor compass. The essential parts of both types are: magnetic needle, graduated circle, line of sight, and box to house them.

In magnetic compass, the graduations are from zero to 360° in clockwise direction when read from top. The direction of north is treated as zero degrees, east as 90°, south as 180° and west as 270°. However, while taking the readings observations are at the other end of line of sight. Hence, the readings are shifted by 180° and graduations are marked as shown in figure 1. The graduations are marked inverted because they are read through a prism.

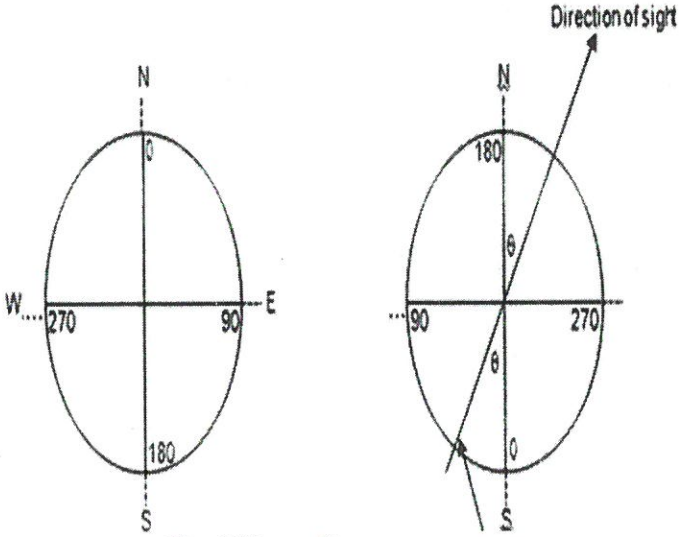


Fig. 1 Magnetic compass

In Surveyors compass graduation disc is fixed to the box and magnetic needle is free to rotate above it. There is no prism provided at viewing end, but has a narrow slit. After fixing the line of sight, the reading is directly taken from the top of the glass cover. Hence, graduations are written directly (not inverted). In this compass graduations are from zero to 90°, zero being to north or south and 90° being to east and west. An angle of 20° to north direction to the east is written as N 20° E, and an angle of 40° to east from south is written as S 40° E. Always first direction indicated is north or south and the last letter indicates east or west direction. In this system graduated circle rotates with line of sight and magnetic needle is always towards north. The reading is taken at the tip of needle. Hence, on the compass east and west are marked interchanged as shown in figure 2.

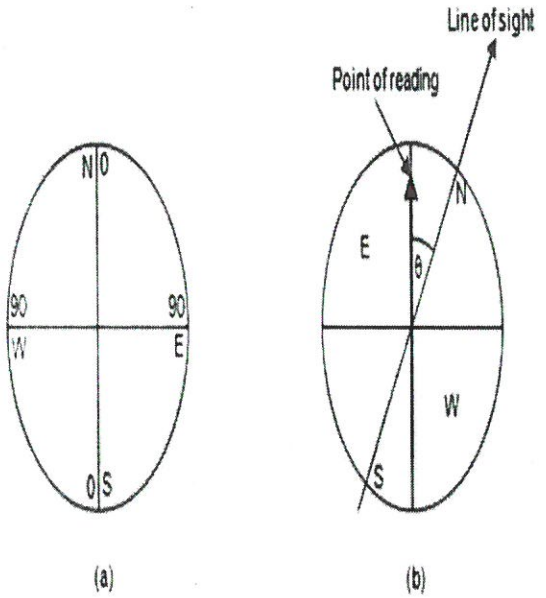


Fig. 2 Surveyors compass

4. b) **Note: <u>Any ONE method can be given 6marks</u>**

Calculation of Reduced Levels using Rise and Fall Method:

Back Sight (m)	*Intermediate Sight (m)*	*Fore Sight (m)*	*Rise (m)*	*Fall (m)*	*Reduced Level (m)*	*Remarks*
0.863					100	Bench mark
	1.247			0.384	99.616	
	1.634			0.387	99.229	
0.962		2.642		1.008	98.221	Change of Instrument
	1.984			1.022	97.199	
1.830		2.369		0.385	96.814	Change of Instrument
	2.510			0.680	96.134	
		1.630	0.88		97.014	
∑Back sight - ∑Fore sight = 3.655 – 6.641= -2.986			∑Rise - ∑Fall = 0.88 – 3.866 = -2.986		Last Reduced Level – First Reduced Level = 97.014 - 100 = -2.986	

Calculation of Reduced Levels using Height of Instrument method:

Back Sight (m)	*Intermediate Sight (m)*	*Fore Sight (m)*	*Height of instrument (m)*	*Reduced Level (m)*	*Remarks*
0.863			100.863	100	Bench mark
	1.247			99.616	
	1.634			99.229	
0.962		2.642	99.183	98.221	Change of Instrument
	1.984			97.199	
1.830		2.369	98.644	96.814	Change of Instrument
	2.510			96.134	
		1.630		97.014	
∑Back sight - ∑Fore sight = 3.655 – 6.641= -2.986			Last Reduced Level – First Reduced Level = 97.014 - 100 = -2.986		

5. a) **Horizontal measurements in surveying:**

Chain surveying: The principle of chain surveying is to divide the area into a number of triangles of suitable sides. A network of triangles is preferred here as triangle is the simple plane geometrical figure which can be plotted with the lengths of its sides alone. Chain surveying is the simplest kind of surveying.

The following instruments are required for measurements with chain and tape: Arrows, Pegs, Ranging rods, Offset rods, Plumb bobs and Line ranger.

Compass surveying:

Compass is an instrument which can be used to measure the direction of a survey line with respect to magnetic north-south. The magnetic north-south direction which is the reference direction is called meridian (reference direction) and the angle between the line and the meridian is called bearing. Use of compass for measuring direction of line simplifies the surveying to a great extent.

The types of compass that are used commonly are: (i) prismatic compass; and (ii) surveyor compass. The essential parts of both types are: magnetic needle, graduated circle, line of sight, and box to house them.

5. b) **Objectives of surveying:**

Surveying is the art of making measurements of objects on, above or beneath the ground to show their relative positions on paper. The relative position required is either horizontal, or vertical, or both.

As stated in the definition, object of surveying is to show relative positions of various objects of an area on paper and produce plan or map of that area. Various uses of surveying are listed below:

- Plans prepared to record property lines of private, public and government lands help in avoiding unnecessary controversies.
- Maps prepared for marking boundaries of countries, states, districts etc., avoid disputes.
- Locality plans help in identifying location of houses and offices in the area.
- Road maps help travellers and tourist.
- Topographic maps showing natural features like rivers, streams, hills, forests help in planning irrigation projects and flood control measures.
- For planning and estimating project works like roads, bridges, railways, airports, water supply and waste water disposal, surveying is required.
- Marine and hydrographic survey helps in planning navigation routes and harbours.
- Mine surveys are required for exploring mineral wealth.
- Geological surveys are necessary for determining different strata in the earth crust so that proper location is found for reservoirs.
- Archeological surveys are useful for unearthing relics of antiquity.
- Astronomical survey helps in the study of movements of planets and for calculating local and standard times.

6. a) **Importance of transportation in Nation's economic development:**

- For rapid economic, industrial and cultural growth of any country, a good system of transportation is very essential.
- Transportation system comprises good network of roads, railways, well-developed waterways and airways.
- Airways and waterways although help to some extent in transportation within the country, these are the primary modes of transport between countries.
- Railways, and highways, also to some extent, help in transport between countries, but their main concern is within the country itself.
- An industrialist has to transport the raw materials and then market his finished products. He can do so efficiently only through a good system of transportation.
- A farmer can market his products to the nearby market economically only through a good system of roads.
- As blood transportation through body arteries is essential for the well-being of the human being, a similar good system of transportation has actually become a measure of country's economic and social development.

6.b) **Modes of transport:**

Roadways: Road can be used by all sorts of vehicles, such as bullock carts, carriages, rickshaws, cycles, scooters, cars, jeeps, buses, trucks and lorries. Roads are equally useful for pedestrians also.

Railways: Rail transport Owing to the heavy expenditure on the basic infrastructure required, rail transport is best suited for carrying bulk commodities and a large number of passengers over long distances. This is the most commonly used and cost effective long distance transport system of the country.

Waterways: Harbour is partly enclosed area which provides safe and suitable accommodation for supplies, refuelling, repair, loading and unloading cargo. A port is a harbour where marine terminal facilities are provided and it is a place which regularly provides accommodation for the transfer of cargo and passengers to and from the ships.

Airways: Air transport provides unbroken journey over land and sea. It is the fastest and quickest means of transport. Air transport had the highest speed among all the modes of transport. Air transport is the most expensive means of transport. There is huge investment in purchasing aero planes and constructing of aerodromes. Air transport requires special preparations like wheelers links, meteorological stations, flood lights, searchlights etc.

7. a) **Sources of water:**

- **Streams:** These offer a good source of water except for the water of the first run-off. Sometimes the run-off water while flowing over the earth gets mixed with clay, sand and mineral impurities. All the suspected impurities can be restored in settling tanks up to a certain, extent, but the dissolved impurities require special treatments. The steams generally flow in valleys and are the main source of water supply to nearby villages on hill slopes.

- **Lakes:** At some places in mountains, natural basins are with impervious beds are formed. Water from springs and streams generally flows towards these basins and 'lakes' are formed. The quantity of water in a lake depends on its basin capacity, catchment area, annual rainfall, porosity of the ground, etc. The quality of water in large lakes is better than that of in small lakes. Lakes situated at high altitudes contain almost pure water which cannot be used without any treatment. Lake water is usable for only those towns and cities which are situated near them, such as Nainital.

- **Rivers:** These are born in the hills, when the discharge of a large number of springs and streams combine together. In mountains, the quantity of water in rivers remains little, and therefore, at such place these are called youthful rivers. But as the river moves forward, more and more streams combine in it and increase its discharge. Therefore, rivers grow bigger and bigger as they move forward due to increase in their catchment area. Rivers are the only surface sources of water which from which the maximum quantity of water can be easily taken. Therefore, in ancient times, towns and cities usually developed along the banks of rivers. Mostly, all the cities which are situated near rivers discharge their used water, or sewage, in the rivers. Therefore, much care should be taken while drawing water from rivers. River water has the capacity of self-purification, due to which it automatically becomes clean at some distance from the point of disposal of sewage. In summer, the quality of river water is better than that in monsoon, because in the rainy season, the run-off water also carries clay, silt and sand with it which make the water turbid. River-water should always be used after necessary treatment. Some rivers are perennial, and have water throughout the year. Therefore, they do not require any arrangement to store the water. But some rivers dry up wholly or partly in summer, and therefore, they require special arrangement to meet to the water demand during hot weather.

- **Ponds:** These are depressions in plains, like those of lakes in mountains, in which water is collected during the rainy season. Sometimes ponds are formed when much excavation is done for house construction in villages, and embankments for road and railways. Generally, the quantity of water is very small and contains large amount of impurities. In villages, the used water mostly flows towards ponds which further contaminate its water. The water of ponds is used for washing clothes, for bathing animals and for drinking. In some underdeveloped villages, people sometimes bathe in the dirty water of ponds. The water of ponds cannot be used for water-supply purposes due to its limited quantity and large amount of impurities.

- **Artificial Reservoirs:** Generally, It is found that there is great variation in the quantity of river water during and after the summer season. The discharge in some rivers remains sufficient to fulfill the water demand in the hot weather, but in sonic rivers the flow becomes very small and cannot meet the requirements of this season. In such cases, it becomes essential to store water for the summer season. The water can be stored in the river by constructing a hand, a weir or a dam across the river at such places where minimum area of land is submerged in the water and the reservoir basin can be made cup-shaped in order to have the maximum possible depth of water.

- **Shallow Wells:** The shallow wells are constructed in the uppermost layer of the earth's surface. They obtain their water supply from the groundwater table. The diameter of shallow wells varies from 2 to 6 metres. They may be lined or unlined from inside.

- **Deep Wells:** These obtain their quota of water from an aquifer below an impervious layer. The theory behind the functioning of a deep well is based on the flow of water from the outcrop to the site of the deep well. The outcrop is the place where the aquifer is exposed to the atmosphere. The entry of rainwater takes place at the outcrop, and it reaches the site of the deep well. During its travel, the water gets thoroughly purified; but it dissolves certain salts and may, therefore, become hard. In such cases, some treatment would be necessary to remove the hardness of water. The depth of a deep well should be decided in such a way that the location of the outcrop is not very near the site of the well. The water of a deep well is contained in the lower embedded aquifers, and hence it is always available at a pressure greater than the atmospheric pressure. The deep wells are, therefore, referred to as pressure wells.

7. b) **Rainwater Harvesting:**

The saline water from the sea gets evaporated due to the heat from the sun, forms clouds and falls as rain as freshwater. A significant part of this rainwater drains out into oceans and drains. If we are able to harness this effectively, it can be an important source which can be used for various applications. So, in short, rainwater harvesting is the process of storing rainwater for reusing rather than allowing it to run off. However, it is vital to understand the steps of rainwater harvesting before that.

Types of rainwater harvesting:

Rooftop rainwater harvesting: The system of catching rainwater right where it falls. In rooftop harvesting, the roof becomes the catchment area and the rainwater is collected on the roof of the house or building. It can either be stored in a tank or diverted to an artificial recharge system. This method is less expensive, and if implemented correctly, helps in augmenting the groundwater level of the area.

Surface rainwater harvesting: In urban areas, rainwater flows away as surface runoff. This runoff can be caught and used for recharging aquifers by adopting appropriate methods.

Advantages of rainwater harvesting:

- Promotes adequacy of underground water
- Mitigates the effect of drought
- Improves groundwater table thereby saving energy to lift water
- Storing water underground is good for the environment
- It is cost-effective
- It helps conserve water

23ES1101

I B.Tech I Semester Regular Exam

Dec 2025

Basic civil & Mechanical Engineering
(CEEE, ECE & CSE)

Scheme of Evaluation

PART-B

1.

f) $\frac{1}{2}$ mark for definition & $\frac{1}{2}$ mark for Application = 1m

g) $\frac{1}{2}$ mark for each differentiating point $\frac{1}{2} \times 2$ = 1m

h) 1 mark for definition = 1m

i) 1 mark for definition = 1m

j) $\frac{1}{2}$ mark for each advantage = $\frac{1}{2} \times 2$ = 1m

Unit I

8)

a) 2. $\frac{1}{2}$ marks for role of mechanical engineering in manufacturing
2. $\frac{1}{2}$ marks for role of mechanical Engineering in automotive industries
$2\frac{1}{2} + 2\frac{1}{2} = 5$m

b) 1 mark for explanation for smart materials
1 mark for each type of material & explanation $1 \times 4 = 4$
$1 + 4 = 5$m

9, 2 marks for explanation of composites $2 = 2$

2 marks for each type of composite specification $2 \times 4 = 8$ $+$ $= 10$ m

Application

Unit II

10

a, 1 mark for each differentiating point $1 \times 5 = 5$ m

b, $2\frac{1}{2}$ marks for each type of process $2\frac{1}{2} \times 2 = 5$ m)

(1 mark for process, 1 mark for adv & $\frac{1}{2}$ mark for dis-adv)

11,

a, 3 marks for working principle $3 + 2 = 5$ m

2 marks for P-V diagram

Unit-III

12,

c, 5 marks for working principle $= 5$ m

5 marks for neat diagram $+ 5$ m $= 10$ m

13. 2 marks for each configuration explanation $2 \times 4 = 8$ m

$\frac{1}{2}$ mark for diagram of each configuration $\frac{1}{2} \times 4 = 2$ m $+$ $= 10$ m

Part B

1

f) They are engineered materials made by combining two or more constituent materials with distinct physical and chemical properties to create a material that exhibits improved or tailored characteristics. They are used in the aerospace industry, automotive components, boat hulls and sporting goods.

g) Ferrous metals are a category of metals that are primarily composed of iron and have iron as their main constituent. Eg: Steel
Non-ferrous metals are metals that do not contain significant amounts of iron in their composition. Eg: Aluminium

h) 3D printing is the construction of a three-dimensional object from a CAD model or a digital 3D model

i) A robot is a 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

j) 1. Provides consistent power without fluctuations, even during increased load conditions.
2. Allows controlled water supply for downstream agriculture

Unit - I

8 a) **Role of mechanical engineering in manufacturing sector**

- Manufacturing is the process of converting the raw material into a finished product. The technology had taken a great leap in the manufacturing sector. Along with side of conventional manufacturing methods other manufacturing methods are also practicing in the industry.
- Lean manufacturing, just in time manufacturing (JIT), Flexible manufacturing system (FMS), Computer Integrated manufacturing (CIM) are already in use.
- Along with this additive manufacturing is getting its importance in the new product development which reduces the material and time
- Additive Manufacturing (3D Printing): 3D printing technologies allow for rapid prototyping and customized production, reducing waste and lead times.
- Robotics and Automation: The use of robots for repetitive and complex tasks, including collaborative robots (cobots) working alongside humans. Augmented Reality (AR) and Virtual.

Mechanical Engineering in Automotive Sector: The automobile market seen a considerable change in the advance of technology.

- Electric vehicles are the next alternative to the conventional fossil fueled vehicles.
- Providing the better customer ride experience electric vehicles are the future of automobile market.
- Also, Hybrid vehicles are already in market uses dual fuel technology like electric and gasoline.

- Automation is another aspect in the automobile industry. Use of mechatronics, internet, AI automobile manufacturers are striving for the better user interface and comfort in automobile experience.
- Mechanical Engineering in Automotive Sector Electric Vehicles (EVs): The development of EVs, driven by advancements in battery technology, is revolutionizing the automotive industry with reduced emissions and increased energy efficiency. Autonomous Vehicles: Self-driving cars are being developed with advanced sensors, AI algorithms and connectivity to enhance safety and reduce traffic congestion.

8 b) Smart materials also known as intelligent or responsive materials. These materials can be altered or controlled in response to external stimuli, such as temperature, pressure, electric or magnetic fields, light or chemical compounds. These materials have the ability to sense changes in their environment and adapt their behavior accordingly. Smart materials find applications in various fields, including engineering, materials science, electronics and healthcare.

Shape Memory Alloys (SMAs): These materials can "remember" a specific shape and return to it when subjected to temperature changes. Nickel titanium (NiTi) is a well-known shape memory alloy.
Piezoelectric Materials: Piezoelectric materials generate an electric charge when mechanical stress is applied or vice versa. They are used in sensors, actuators, and energy harvesting devices.

Electrostrictive and Magnetostrictive Materials: These materials change their shape in response to electric or magnetic fields, respectively. They are used in sensors, transducers, and vibration control systems.

Thermoelectric Materials: Thermoelectric materials can convert heat into electricity or vice versa. They are used in thermoelectric generators and coolers.

Electrochromic Materials: Electrochromic materials change their color or optical properties in response to an applied voltage. They are used in smart windows and displays

9. Composites are engineered materials made by 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.

Fiber-Reinforced Composites: It is a type of composite material where fibers are embedded within a polymer matrix. These fibers provide enhanced mechanical properties, such as increased strength, stiffness, and durability, while the polymer matrix helps to hold the fibers together and provide shape and structure. The choice of fibers and the type of polymer matrix can be tailored to meet specific application requirement Eg: Fiber-Reinforced Plastics (FRP): These composites consist of a plastic matrix reinforced with fibers like fiberglass, carbon or aramid (Kevlar). They are used in the aerospace industry, automotive components, boat hulls and sporting goods.
Metal Matrix Composites (MMCs): It is a type of composite material where a metal matrix is reinforced with another material, often in the form of particles or fibers. These reinforcing materials, which are typically non-metallic, enhance the mechanical, thermal, and other properties of the metal matrix. Eg: Aluminum Matrix Composites: These composites use aluminum as the

matrix and may incorporate materials like silicon carbide or boron carbide as reinforcement. They offer improved strength and stiffness for aerospace and automotive applications.

Natural Fiber Composites: Eg: Wood Composites: Plywood and particleboard are examples of composites made by bonding woodveneers or particles with adhesives. They are used in construction, furniture and cabinetry.

Polymer Matrix Composites (PMCs): Eg: Epoxy Resin Composites: These composites are used in the aerospace industry, sporting goods and marine applications due to their lightweight and high-strength properties.

Carbon-Carbon Composites (C/C): Eg: Carbon-carbon composites are made entirely of carbon and are known for their high temperature stability and lightweight properties. They are used in aerospace and high temperature applications.

Bio composites: Eg: Biocomposites use natural fibers like flax, hemp, or sisal combined with biodegradable resins. They are utilized in the automotive industry for interior components and in eco-friendly products.

Ceramic Matrix Composites (CMCs): Eg: Silicon Carbide/Silicon Carbide (SiC/SiC): SiC/SiC composites are used in high-temperature and harsh environments, such as gas turbine engines and aerospace components.

Particle-Reinforced Composites: Eg: Concrete: Concrete is a composite material with aggregates (such as sand and gravel) reinforcing a cementitious matrix. It is used in construction for its high compressive strength and durability

Unit -II

10. a) Differences between 3D printing and CNC manufacturing

3D Printing	CNC Manufacturing
Additive process – material is added layer by layer to create the part	Subtractive process – material is removed from a solid block using cutting tools
Very little material wastage	High material wastage due to cutting and removal
Easily produces complex and internal geometries	Difficult and sometimes impossible to make very complex internal shapes
Moderate accuracy and surface finish	High accuracy and better surface finish
Suitable for prototyping and low-volume production	Suitable for mass production and high-strength components

10 b) Types of Joining processes

1. Welding 2. Brazing 3. Soldering

Welding is a fabrication process whereby two or more parts are fused together by means of heat, pressure or both forming a join as the parts cool. Welding is usually used on metals and thermoplastic. Some materials require the use of specific processes and techniques. The parts that are joined are known as a parent material. The material added to help form the join is called filler or

consumable. The form of these materials may see them referred to as parent plate or pipe, filler wire, consumable electrode (for arc welding)

Advantages of Welding: • Strong Joints: Welding creates durable, strong joints, often as strong as or stronger than the base materials. • Versatility: It can be applied to join different types of materials like metals, thermoplastics, and more.

Disadvantages • Complexity: Welding requires skilled labor and can be a complex process, especially for specialized applications. • Safety Concerns: Welding involves exposure to intense heat, UV radiation, fumes, and potential hazards like electric shock or burns

Any two applications can be given marks

11 a) Otto cycle :

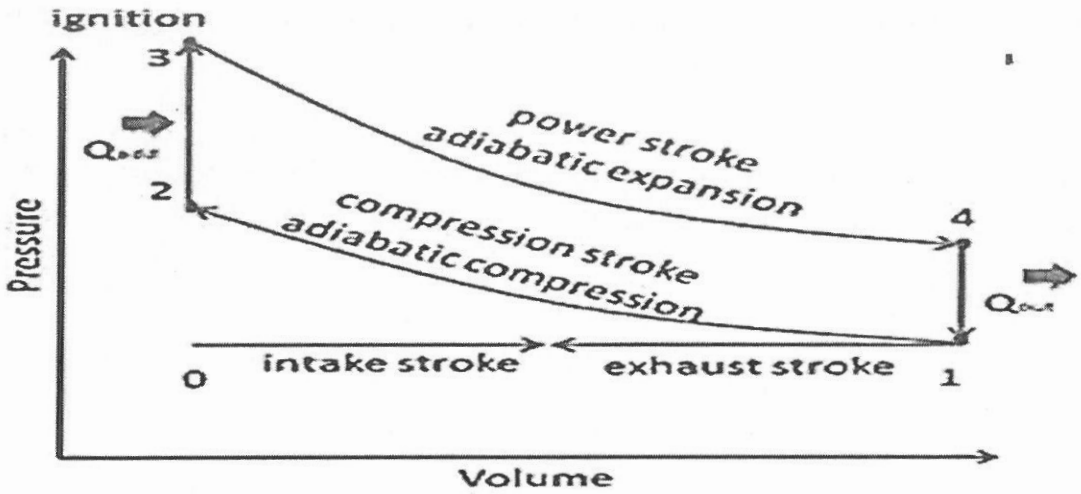
It is the thermodynamic cycle most commonly found in automobile engines with constant volume combustion. Otto Cycle is petrol cycle which operates on spark ignition. The Otto cycle is a description of what happens to a gas as it is subjected to changes of pressure, temperature, volume, addition of heat and removal of heat.

In an ideal Otto cycle, the system executing the cycle undergoes a series of four internally reversible processes: Two reversible adiabatic processes alternated with two isochoric processes. Adiabatic compression (compression stroke) : The gas (fuel-air mixture) is compressed adiabatically from state 1 to state 2, as the piston moves from bottom dead center to top dead center. The surroundings do work on the gas, increasing its temperature and compressing it. The changes in volumes and its the ratio (V1 / V2) is known as the compression ratio.

Isochoric compression (ignition phase) : In this phase (between state 2 and state 3) there is a constant-volume (the piston is at rest) heat transfer to the air from an external source while the piston is at rest at top dead center. This process is intended to represent the ignition of the fuel–air mixture injected into the chamber and the subsequent rapid burning. The pressure rises and the ratio (P3 / P2) is known as the "explosion ratio".

Adiabatic expansion (power stroke): The gas expands adiabatically from state 3 to state 4, as the piston moves from top dead center to bottom dead center. The gas does work on the surroundings (piston) and loses an amount of internal energy equal to the work that leaves the system. The volume ratio (V4 / V3) is known as the isentropic expansion ration, but for Otto cycle, it is equal to the compression ratio.

Isochoric decompression (exhaust stroke): In this phase the cycle completes by a constant-volume process in which heat is rejected from the air while the piston is at bottom dead center. The working gas pressure drops instantaneously from point 4 to point 1. The exhaust valve opens at point 4. The exhaust stroke is directly after this decompression. As the piston moves from bottom dead center (point 1) to top dead center (point 0) with the exhaust valve opened, the gaseous mixture is vented to the atmosphere and the process starts anew.



11 b) Comparision of Ottocycle and Diesel cycle

	Otto Cycle	Diesel Cycle
Type of Engine	Used in spark-ignition (SI) engines	Used in compression-ignition (CI) engines
Ignition Method	Spark ignition (fuel–air mixture ignited by spark)	Compression ignition (fuel injected into hot compressed air)
Compression Ratio	Lower (typically 6–10) to avoid knocking	Higher (typically 14–22) due to absence of knock limits
Thermal Efficiency	Lower for same max temp/pressure	Higher due to higher compression ratio
Fuel Used	Petrol / gasoline	Diesel
Heat Addition	At (approx.) constant volume	At (approx.) constant pressure
Application	Cars, light vehicles	Heavy vehicles, generators

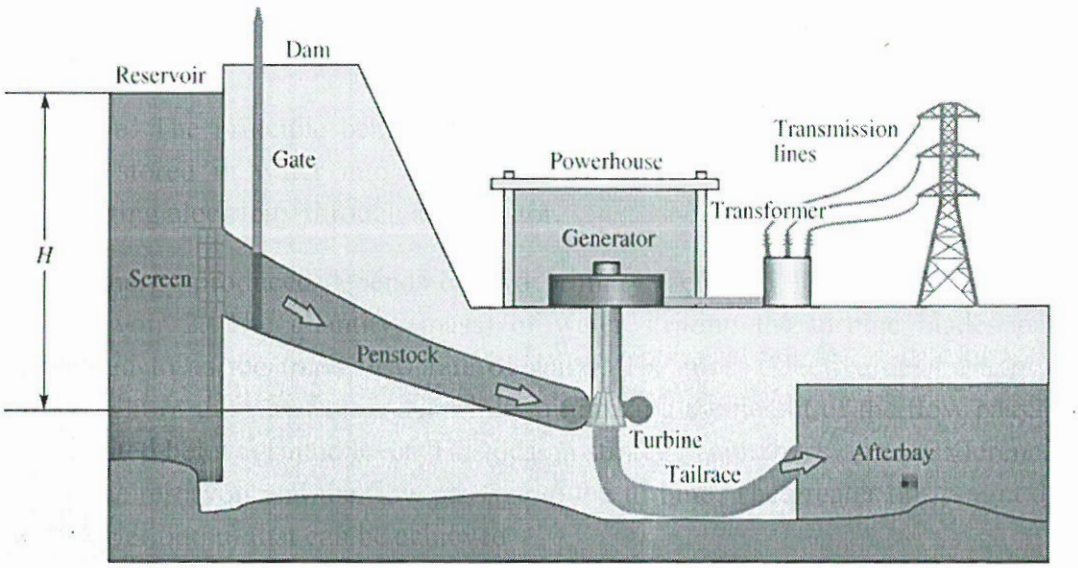
Unit -III

12. Hydro power plant: Energy harnessed from the flow of water represents one of the most potent sources of clean, renewable and cost-effective energy. This resource operates in a perpetual cycle, water evaporates into the clouds, falls like rain and repeats the process, making it an enduring and sustainable energy source. It occupies a substantial share in global electricity generation from renewable sources.

The fundamental concept revolves around the movement of water from higher elevations to lower ones, causing turbines to rotate and this rotational motion is transformed into electricity through generators in hydroelectric power plants. India is home to the Bhakra Nangal Dam, the world's tallest straight gravity dam and the largest of its kind in the country.

Working Principle: The principle behind hydroelectric power generation involves converting the potential energy stored in water into kinetic energy, which is then utilized to spin a turbine, ultimately generating electricity through a generator.

The amount of energy produced depends on two primary factors: 1.The height at which water is stored in a reservoir 2. The quantity (mass) of water striking the turbine blades per second, commonly referred to as the mass flow rate of water. The most effective design approach is to maximize the height of the water reservoir while minimizing the height of the flow passage, which may even be situated below ground level. This design strategy capitalizes on the difference in water height between the reservoir and the flow passage to the turbine. The greater this height difference, the higher the power output that can be achieved



13. Robot configurations

Cartesian Coordinate System(P-P-P) The Cartesian coordinate is also called rectangular coordinate system. In this system, the 3 sliding corresponding to moving the wrist up and down in and out and back , forth takes place. This configuration is represented by (Prismatic- Prismatic Prismatic).

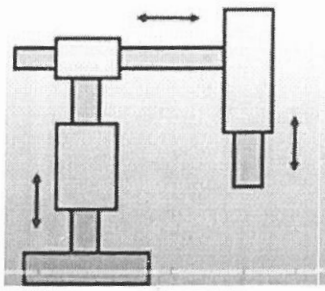
2. Cylindrical Coordinate System(R-P-P) The cylindrical robot has a rotary joint for rotation and a prismatic joint for angular motion around the joint axis. The rotary joint moves in a rotational movement around the common axis. In contrast, the prismatic joint will move in a linear motion.

3. Spherical or Polar Coordinate system(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

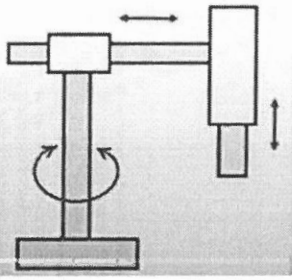
4. Articulated Arm (R-R-R) configurations with three rotary joints. The best example for this type of configuration has been observed in some of the type of robots specially known as SCARA.

Robot Configurations

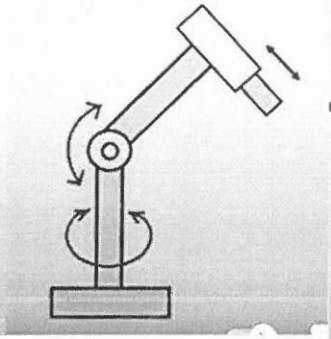
Cartesian Co-ordinate Configuration



Cylindrical Configuration



Spherical Configuration



Articulated Configuration