Set III Model Answer

End-Sem Examination-I, Winter 2025

Academic Year: 2025-2026	Semester: I
Class: FY	Program: B. Tech
Branch Code: MEC/CIV/CHEM	Pattern: 2022
Name of Course: Fundamentals of Mechanical Engineering	Course Code: FY221008

Q. No. **Solution**

Q.1. Solution:

Soln:-

Given:- $n_p = 1000$ rpm G.R = 5 : 1 $\eta = 85\% = 0.85$

$P_i = 5$ kW.

a) Input torque (T_p)

$P_i = \frac{2\pi n_p T_p}{60000}$ $\therefore T_p = \frac{P_i \times 60000}{2\pi n_p}$

$T_p = \frac{5 \times 60000}{2\pi \times 1000} = 47.746$ N-m.

b) output speed (N_g)

$G.R = \frac{n_p}{n_g}$ $n_g = \frac{n_p}{G.R} = \frac{1000}{5} = 200$ rpm

c) output power (P_o).

$\eta = \frac{P_o}{P_i}$ $\therefore P_o = \eta \times P_i = 0.85 \times 5 = 4.25$ kW

d) Output Torque (T_g).

$P_o = \frac{2\pi n_g T_g}{60,000}$ $T_g = \frac{P_o \times 60000}{2\pi n_g} = \frac{4.25 \times 60000}{2\pi \times 200}$

$T_g = 202.922$ N-m

Q.2. Solution:

Soln:-

Given $l = 5$ m $h = 4$ m $t = 0.25$ $K = 0.4$ W/m-K.

$T_1 = 30°C$ $T_2 = -10°C$.

$A = l \times h = 5 \times 4 = 20 m^2$. $t = 0.25$

$Q = \frac{KA\Delta T}{t} = \frac{0.4 \times 20 \times (30-(-10))}{0.25}$

$= \frac{0.4 \times 20 \times 40}{0.25} = 1280$ W.

$q = \frac{Q}{A} = \frac{1280}{20}$

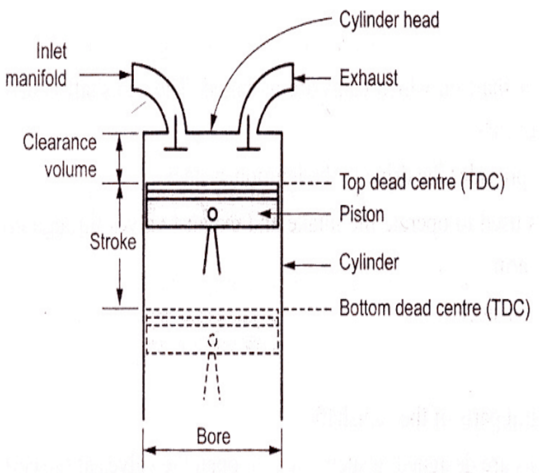
$q = 640 W/m^2$.

Q.3. a)

Point	4-Stroke Petrol Engine (Spark Ignition – S.I)	4-Stroke Diesel Engine (Compression Ignition – C.I)
Type of ignition	Spark plug is used for ignition	Self-ignition due to high compression
Fuel used	Petrol	Diesel
Compression ratio	Low (6:1 to 10:1)	High (14:1 to 25:1)
Method of fuel supply	Air-fuel mixture enters cylinder	Only air enters; fuel injected directly
Ignition system	Requires spark ignition system	No spark plug required
Thermal efficiency	Lower	Higher
Fuel economy	Lower	Better fuel economy
Speed range	Higher speed engine	Lower speed engine
Initial cost	Lower	Higher
Weight	Lighter	Heavier
Noise and vibration	Less noise, smoother operation	More noise and vibration
Maintenance cost	Lower	Higher
Applications	Cars, motorcycles, small vehicles	Trucks, buses, tractors, generators

OR

b)



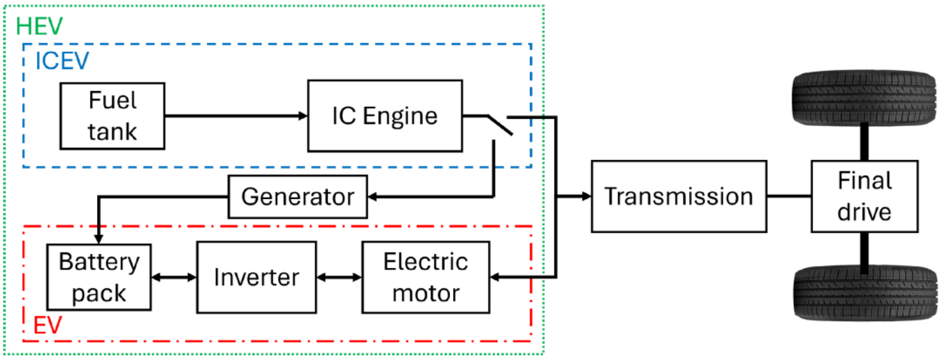
Terminologies in Engines:

i) Compression ratio(R): Ratio of Total volume and Clearance volume

ii) Stroke Length (L): Distance between TDC and BDC

iii) Swept Volume (Vs) : Volume swept by piston from TDC to BDC

iv) Clearance Volume (Vc): Volume above TDC c)



Working Principle:
IC Engine :- Power flows from IC Engine to Transmission and further to wheel
Electrical Vehicle :- Power flows from battery to motor and further motor to transmission and wheels
Hybrid Vehicle :- Power flows uses both IC engine and Battery or selects only one mode depending on terrain and load condition

OR
d)

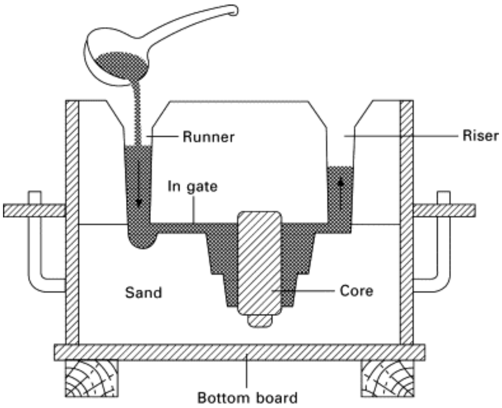
Advantages of Electric Vehicles

1. **Zero tailpipe emissions** – Environment friendly and reduces air pollution.
2. **High energy efficiency** – Converts more energy into motion compared to IC engines.
3. **Low running cost** – Electricity cost per km is much lower than petrol/diesel.
4. **Low maintenance** – Fewer moving parts; no oil changes or exhaust system.
5. **Silent operation** – Very low noise and vibration.
6. **Instant torque** – Better acceleration from standstill.

Disadvantages of Electric Vehicles

1. **High initial cost** – Battery and vehicle cost is high.
2. **Limited driving range** – Range anxiety compared to conventional vehicles.
3. **Long charging time** – Charging takes longer than refuelling.
4. **Charging infrastructure limitations** – Limited charging stations in many areas.
5. **Battery degradation** – Battery capacity reduces over time.
6. **Environmental impact of batteries** – Mining and disposal of batteries cause pollution.

Q.4. a)



i) Mould

A **mould** is a hollow cavity formed in sand which gives shape to the molten metal.
It consists of **cope and drag** parts and contains the impression of the pattern.
After pouring and solidification of molten metal, the mould is broken to obtain the casting.

ii) Core

A **core** is a sand insert placed inside the mould cavity to produce **internal cavities or hollow portions** in the casting.
It is made of **core sand** and is supported by **core prints** provided on the pattern.

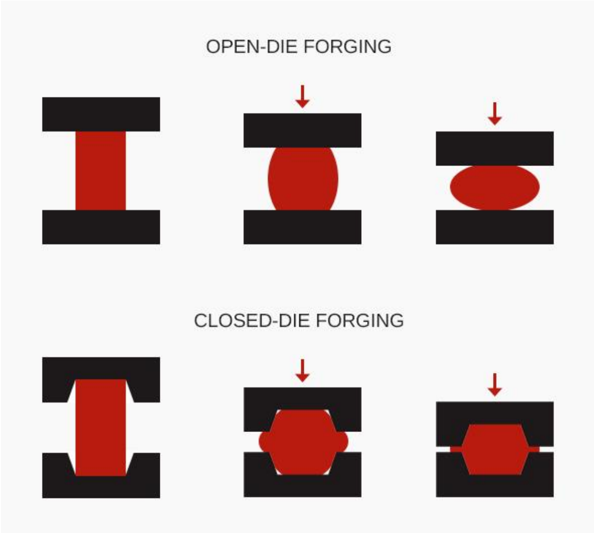
iii) Sprue and Riser

- **Sprue** is a vertical passage through which molten metal enters the mould from the pouring basin.
- **Riser** is a reservoir of molten metal provided to compensate for **shrinkage** during solidification and to ensure sound casting.

iv) Pattern

A **pattern** is a replica of the final casting used to form the mould cavity.
It is usually made slightly larger than the casting to allow for **shrinkage, machining, and draft allowances**.

OR
b)



Forging – Definition

Forging is a metal forming process in which the metal is shaped by **plastic deformation under compressive forces** using hammers or presses, usually with the help of **dies**.
Forging improves **grain structure, strength, and toughness** of the material.

Types of Forging Based on Types of Dies Used

1) Open Die Forging (Smith Forging)

- In this method, the metal is placed between **flat or simple-shaped dies**.
- The dies do not completely enclose the workpiece.
- The metal flows freely in lateral direction.
- Used for **large and simple components** like shafts, discs, and rings.

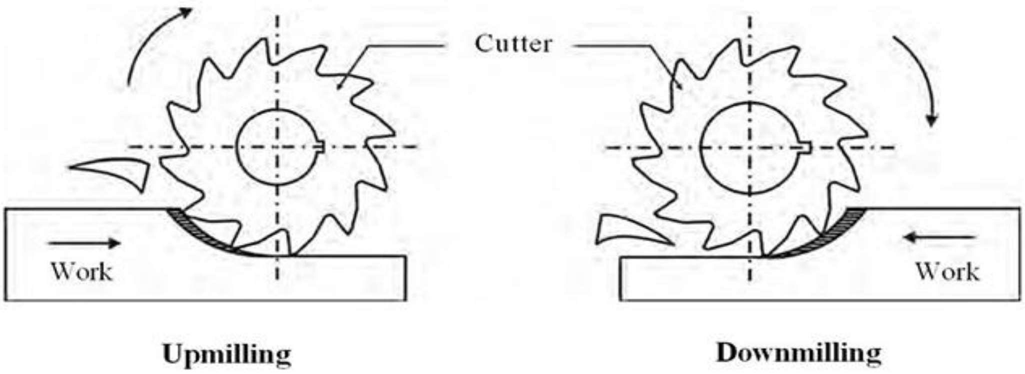
Examples: Crankshafts, spindles, heavy machine parts.

2) Closed Die Forging (Impression Die Forging)

- The workpiece is placed between **shaped dies** which completely enclose the metal.
- The metal flows within the die cavity to take the required shape.
- Excess metal flows out as **flash**, which is later trimmed.

Examples: Connecting rods, spanners, gear blanks.

c)



Upmilling and Down Milling

Up Milling (Conventional Milling)

- In **up milling**, the cutter rotates **against the direction of feed**.
- Chip thickness starts from **zero and increases** to maximum.
- Cutting force tends to **lift the workpiece** from the table.
- More friction and tool wear occur.
- Suitable for **rough surfaces and casted workpieces**.

Example: Used in conventional milling machines.

Down Milling (Climb Milling)

- In **down milling**, the cutter rotates **in the same direction as feed**.
- Chip thickness starts from **maximum and decreases** to zero.
- Cutting force presses the workpiece **against the table**.
- Better surface finish and longer tool life.
- Requires **rigid machines with backlash elimination**.

Example: Used in CNC milling machines.

OR
d)

Sr. No.	Soldering	Welding
1	Joining is done using filler metal only	Joining is done by melting base metals
2	Base metals do not melt	Base metals melt and fuse together
3	Low operating temperature (below 450°C)	High operating temperature
4	Joint strength is low	Joint strength is high
5	Suitable for thin sheets and electrical work	Suitable for thick and structural components
6	Heat affected zone is very small	Heat affected zone is large
7	Equipment used is simple and low cost	Equipment is complex and costly
8	Examples: Electronic circuits, plumbing joints	Examples: Bridges, frames, pressure vessels

Q.5. a)

N001 G90 M04 S1500
N001- Program line no 1 G90- Absolute Programing
M04 – Spindle spin in Anticlockwise S1500 – Spindle RPM 1500
N002 M06 T02
N002 – Program line no 2 M06 – Tool Change T02 – Select tool no 02
N003 M08
N003 – Program line no 3 M08 – Coolant On
N004 G01 Z50 X-80
N004 –Program line no 4 G01 – Linear Interpolation
Z50 – Tool travel in +ve Z direction 50mm
X-80 – Tool travel in -ve X direction 80mm

OR

An **Automatic Storage and Retrieval System (AS/RS)** is a **computer-controlled material handling system** used to automatically **store and retrieve materials** from predefined storage locations with minimum human intervention. It is widely used in **modern manufacturing, warehousing, and flexible manufacturing systems (FMS)**.

AS/RS consists of **storage racks, storage/retrieval machines (SRM), conveyors, sensors, and a computerized control system**. When a storage or retrieval command is given, the SRM automatically moves to the specified location, places or picks up the material, and transfers it to the required station.

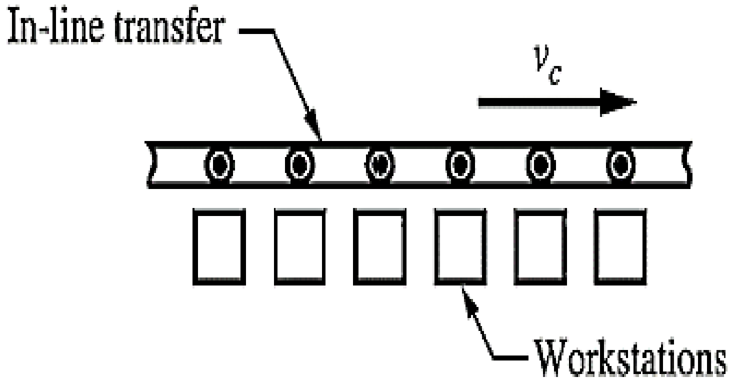
Advantages:

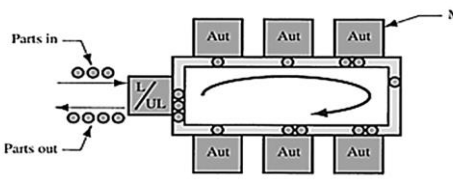
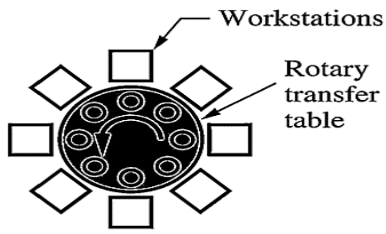
- High storage density and efficient space utilization
- Fast and accurate material handling
- Reduced labour cost and human error
- Improved inventory control and safety

Applications:

- Automated warehouses
- Manufacturing industries
- Distribution centres
- CIM and FMS environments

c) FMS (Flexible Manufacturing System):
FMS is an integrated manufacturing setup with automated machines, material handling systems, and computer control, designed to produce a variety of products with minimal manual intervention. It allows quick changeovers, handles varying product volumes, and enhances production flexibility and efficiency.
i) In-line FMS



ii) U-type FMS	iii) Rotary FMS
	

OR

d) Terms Associated with CIM

a) Computer Aided Design (CAD)

Computer Aided Design (CAD) is the use of computer systems to **create, modify, analyze, and optimize product designs**.

Functions:

- Preparation of 2D drawings and 3D models
- Easy modification and improvement of design
- Accurate dimensioning and detailing
- Reduces design time and errors

b) Computer Aided Process Planning (CAPP)

Computer Aided Process Planning (CAPP) is the use of computers to **plan the manufacturing process of a component**.

Functions:

- Selection of machines, tools, and operations
- Determination of sequence of operations
- Estimation of machining time and cost
- Acts as a link between CAD and CAM

c) Computer Aided Manufacturing (CAM)

Computer Aided Manufacturing (CAM) refers to the use of computers to **control and automate manufacturing operations**.

Functions:

- CNC program generation
- Machine tool control
- Production scheduling and monitoring
- Improves accuracy and productivity

d) Computer Aided Business Planning (CABP)

Computer Aided Business Planning (CABP) involves the use of computers to **manage business-related activities of a manufacturing organization**.

Functions:

- Production planning and control
- Inventory and materials management
- Costing, finance, and marketing support
- Decision making and resource optimization