Practical 12: Understand the Working of SMPS (Switch Mode Power Supply)

SMPS stands for **Switch Mode Power Supply**, which is used in computers to convert high-voltage AC (Alternating Current) into regulated low-voltage DC (Direct Current).
All internal computer components like motherboard, CPU, GPU, HDD, SSD, and fans run on DC power, not AC.
So **SMPS is one of the most important hardware components of a computer system.**

What is SMPS?

SMPS is an electronic device that:

- Converts **230V AC** from wall socket
- Into multiple **DC outputs** (12V, 5V, 3.3V)
- Using high-frequency switching technology

It is more efficient, cooler, and safer than old linear power supplies.

Why SMPS Is Used in Computers?

- Provides stable DC power
- Prevents voltage fluctuations
- Gives multiple voltage outputs
- Energy efficient (70%–90% efficiency)
- Lightweight and compact

- Protects system from overload or short circuits

Working of SMPS (Step-by-Step)

SMPS converts AC → DC in **five major stages**:

Step 1: AC Input (230V)

- SMPS receives **AC power** from wall socket.
- It passes through **EMI filters** to remove noise.

Step 2: Rectification & Filtering

- AC is converted into **unregulated DC** using a **bridge rectifier**.
- A capacitor smoothens the DC output.

(This DC is not stable yet.)

Step 3: High-Frequency Switching

- A **MOSFET switch** rapidly turns ON/OFF thousands of times per second.
- This high-frequency switching reduces power loss and heat, making SMPS efficient.

Step 4: Step-Down Transformer

- High-frequency signal goes to a small transformer.
- It converts high-voltage DC to different low voltages:

- **+12V DC** → CPU, GPU, fans
- **+5V DC** → USB, motherboard logic
- **+3.3V DC** → RAM, chipset

Step 5: Output Rectification & Regulation

- Each output passes through:
  - Rectifier
  - Filter
  - Voltage regulator

This ensures **stable & clean DC power**.

Step 6: Feedback Control

- SMPS constantly monitors output voltage.
- If voltage drops or increases, feedback adjusts switching speed to maintain balance.

This prevents damage and provides stable power to PC components.

5. SMPS Output Voltages and Their Uses

Voltage Output	Use
+12V	CPU, GPU, hard drives, fans

+5V	USB ports, some logic circuits
+3.3V	RAM, chipsets, PCIe devices
–12V	Legacy ports (RS-232)
+5VSB (Standby)	Power-On button, wake-up features

Types of SMPS in Computers

1. ATX SMPS

- Most common in PCs
- Standard motherboard connector: **24-pin ATX**

2. SFX SMPS

- Smaller form factor for compact PCs

3. Server Power Supplies

- High power rating
- Redundant power options

Connectors of SMPS

1. 24-pin ATX Connector

- Main power to motherboard

2. 4-pin/8-pin CPU Connector

- Power to processor

3. SATA Power Connector

- SSD, HDD, DVD drives

4. PCIe 6/8-pin Connector

- Graphics cards (GPU)

5. Molex Connector

- Old HDDs, fans, RGB devices

Protection Features in SMPS

SMPS protects the computer using:

1. OCP (Over Current Protection)

Prevents damage when current becomes too high.

2. OVP (Over Voltage Protection)

Controls sudden voltage spikes.

3. SCP (Short Circuit Protection)

Shuts down SMPS if short circuit occurs.

4. OTP (Over Temperature Protection)

Stops power when SMPS overheats.

5. UVP (Under Voltage Protection)

Maintains stable minimum voltage.

These protections keep your PC safe.

Advantages of SMPS

- High efficiency
- Less heat generation
- Lightweight
- Multiple voltage outputs
- Better protection
- Reliable and long-lasting

Applications of SMPS

- Desktop PCs
- Laptops
- Servers
- TVs
- Routers
- Printers
- Industrial machines

- Mobile chargers

SMPS is used in almost all electronic devices today.