Consumer Electronics & Maintenance (4341107) - Winter 2023 Solution

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January 29, 2024

Question 1(a) [3 marks]

Explain different types of maintenance in brief.

Solution

Type of Maintenance	Description
Preventive Maintenance	Scheduled regular inspection and servicing to prevent breakdowns
Corrective Maintenance	Repairs performed after equipment failure to restore functionality
Predictive Maintenance	Uses condition monitoring to predict when maintenance will be needed

Mnemonic

"PCPro: Preventive prevents, Corrective cures, Predictive predicts"

Question 1(b) [4 marks]

Explain maintenance procedure of Washing Machine.

Solution

Maintenance Procedure:

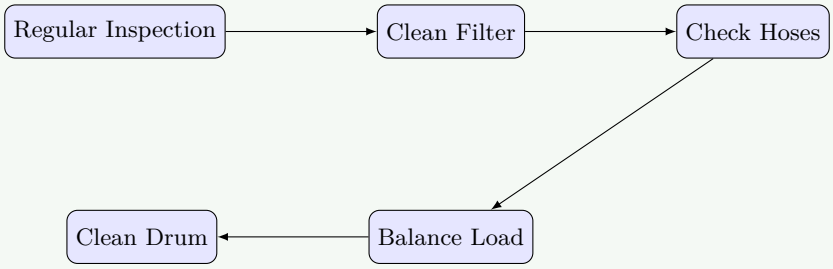

Figure 1. Washing Machine Maintenance Steps

- **Filter Cleaning**: Remove and clean lint filter monthly
- **Hose Inspection**: Check for cracks and leaks every 3 months
- **Load Distribution**: Ensure proper balancing to prevent vibration
- **Drum Cleaning**: Run empty hot water cycle with vinegar quarterly

Mnemonic

"FHLD: Filters, Hoses, Loads, Drum need regular attention"

Question 1(c) [7 marks]

Explain maintenance and troubleshooting procedure of Microwave Oven.

Solution

Maintenance Procedures:

Task	Procedure	Frequency
External Cleaning	Wipe with mild detergent	Weekly
Internal Cleaning	Clean food particles and grease	After each spill
Door Seal Check	Inspect for damage or leakage	Monthly
Ventilation Check	Ensure vents are unobstructed	Monthly

Troubleshooting:

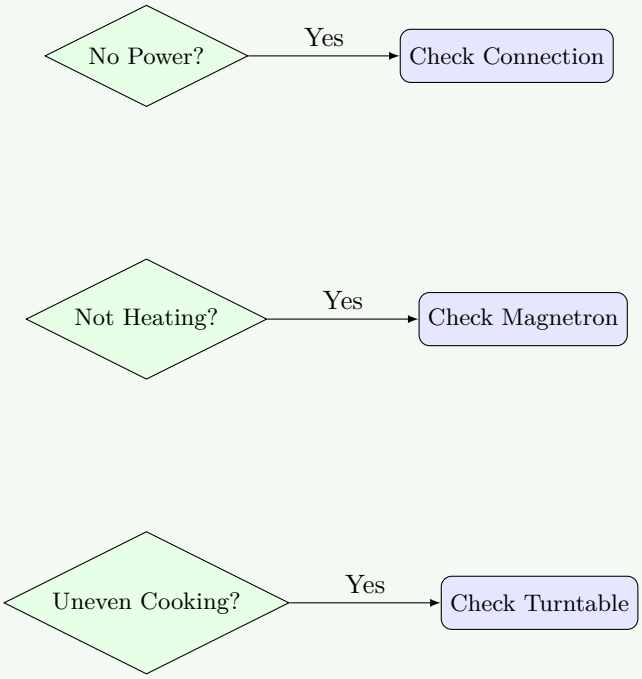

Figure 2. Microwave Troubleshooting Flow

- **Power Issues**: Check fuse, circuit breaker, and cord
- **Heating Problems**: Test door switch, high voltage capacitor, magnetron
- **Safety First**: Never operate with damaged door or seals

Mnemonic

"POWER: Power, Oven interior, Wiring, Electronics, Radiation seals"

Question 1(c) OR [7 marks]

Explain maintenance and troubleshooting procedure of projector.

Solution

Maintenance Procedures:

Task	Procedure	Frequency
Lens Cleaning	Use lens cloth and solution	Monthly
Filter Cleaning	Remove and clean dust	Every 100 hours
Lamp Inspection	Check for discoloration/dimming	Every 300 hours
Ventilation	Ensure proper airflow	Before each use

Troubleshooting:

- **Image Issues**: Adjust focus, resolution, keystone correction
- **Lamp Problems**: Check lamp hours, replace if exceeding limit
- **Connectivity**: Verify input source and cable connections
- **Thermal Issues**: Clean filters and ensure proper ventilation

Mnemonic

"FLAMVE: Filters, Lamp, Airflow, Mounting, Voltage, Environment"

Question 2(a) [3 marks]

Explain the terms in brief: (1) Hue (2) Brightness

Solution

Term	Description
Hue	The pure color attribute that distinguishes colors (red, green, blue, etc.) based on light wavelength
Brightness	The amount of light emitted or reflected from a color, determining how light or dark it appears

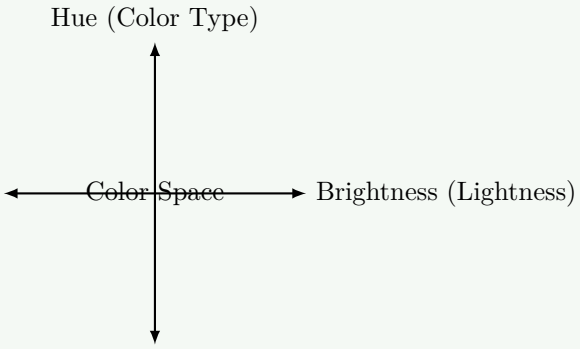

Figure 3. Hue vs Brightness

Mnemonic

"HB-WC: Hue determines What Color, Brightness determines White-to-black level"

Question 2(b) [4 marks]

Write a short note on LCD TV.

Solution

LCD TV Technology:

- **Working Principle**: Uses liquid crystals that twist/untwist to allow/block light provided by a backend backlight source.
- **Key Components**: Backlight, polarizing filters, liquid crystal matrix, color filters.
- **Advantages**: Thin profile, energy efficient, no radiation, sharp image.
- **Limitations**: Limited viewing angle, slower response time than newer technologies (OLED).

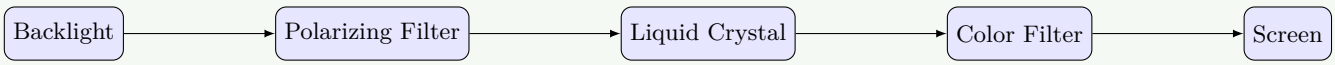

Figure 4. LCD TV Layers

Mnemonic

"BPLCS: Backlight Passes Light through Crystals to Screen"

Question 2(c) [7 marks]

Draw and explain block diagram of DTH receiver.

Solution

DTH Receiver Block Diagram:

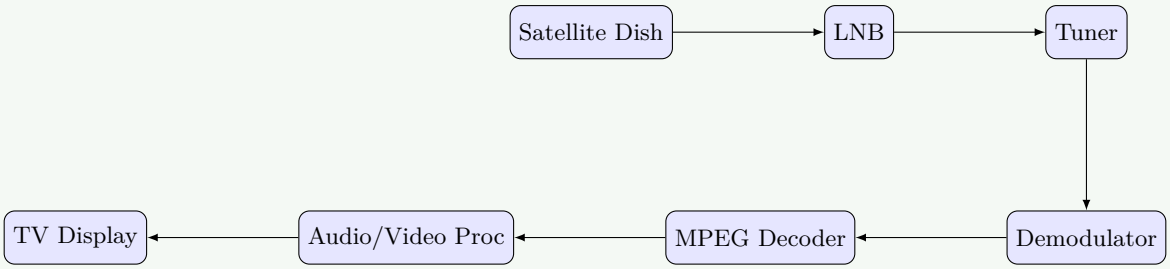

Figure 5. DTH Receiver System

- **Satellite Dish**: Captures signals from satellite.
- **LNB (Low Noise Block)**: Converts high frequency signals to lower frequency.
- **Tuner**: Selects specific channel frequency.
- **Demodulator**: Extracts digital information from carrier signal.
- **MPEG Decoder**: Decompresses video/audio data.
- **Conditional Access Module**: Controls subscription access.
- **Microcontroller**: Controls overall operation and user inputs.

Mnemonic

"SLTDMP: Satellite, LNB, Tuner, Demodulator, MPEG, Processor"

Question 2(a) OR [3 marks]

Explain the terms in brief: (1) Luminance (2) chrominance

Solution

Term	Description
Luminance	The brightness or intensity component of a video signal (Y) that carries black and white information.
Chrominance	The color component of a video signal (Cb, Cr) that carries hue and saturation information.

Mnemonic

"LC-BH: Luminance controls Brightness, Chrominance controls Hue"

Question 2(b) OR [4 marks]

Explain Grassman's law.

Solution

Grassman's Laws of Color Mixing:

Law	Description
Symmetry	If color A matches color B, then B matches A
Proportionality	If A matches B, then nA matches nB (for any intensity n)
Additivity	If A matches B and C matches D, then A+C matches B+D

- Forms the basis of RGB color model in displays as it applies to additive light mixing.
- Allows creating any color by mixing three primary colors properly.

Mnemonic

"SPA Color: Symmetry, Proportionality, Additivity laws for Color matching"

Question 2(c) OR [7 marks]

Draw and explain block diagram of colour TV receiver.

Solution

Block Diagram:

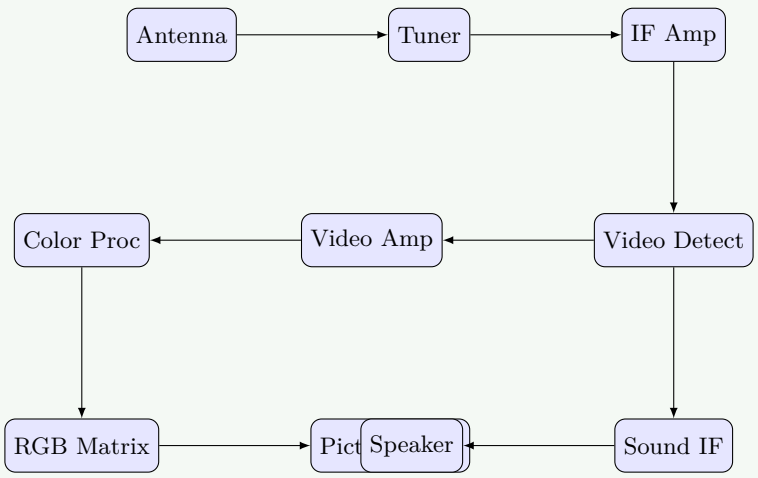

Figure 6. Color TV Receiver

- **Tuner**: Selects desired channel frequency.
- **IF Amplifier**: Amplifies intermediate frequency signals.
- **Video Detector**: Extracts video and audio information.
- **Color Processor**: Separates luminance and chrominance.
- **RGB Matrix**: Converts color signals to red, green, blue drivers.
- **Deflection Circuits**: Control electron beam scanning (H-sync, V-sync).

Question 3(a) [3 marks]

State main components of solar power system and specifications of solar power system.

Solution

Main Components:

Component	Function
Solar Panels	Convert sunlight to electricity
Charge Controller	Regulates battery charging
Battery Bank	Stores electrical energy
Inverter	Converts DC to AC electricity

Specifications:

- **Panel Rating**: 100-400W per panel
- **Battery Capacity**: 100-200Ah
- **Inverter Rating**: 500-5000W
- **System Voltage**: 12/24/48V

Mnemonic

"SCBIM: Solar panels, Controller, Battery, Inverter, Mounting"

Question 3(b) [4 marks]

List types, applications and technical specifications of microwave oven.

Solution

Type	Features
Solo	Basic heating and defrosting only
Grill	Additional grilling element
Convection	Has heating element and fan for baking
Combination	Integrates microwave, grill and convection

Applications: Food reheating, Defrosting, Cooking, Baking.
Specs: Power (700-1200W), Capacity (20-40L), Frequency (2.45 GHz).

Question 3(c) [7 marks]

Explain working of Air conditioner and Refrigerator

Solution

Working Principle:

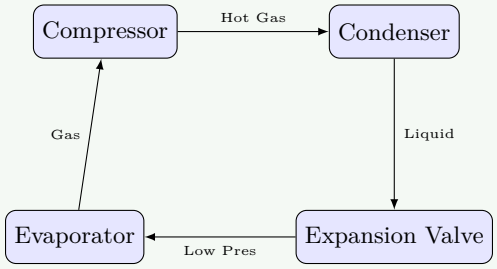

Figure 7. Refrigeration Cycle (AC/Fridge)

Cycle Components:

- **Compressor**: Pressurizes refrigerant gas.
- **Condenser**: Releases heat, converts gas to liquid.
- **Expansion Valve**: Reduces pressure/temperature.
- **Evaporator**: Absorbs heat from room/box, converts liquid to gas.

Differences: AC cools room (18-26°C), Fridge cools cabinet (2-8°C).

Question 3(a) OR [3 marks]

List technical specifications of Air conditioner and Refrigerator

Solution

Spec	Air Conditioner	Refrigerator
Capacity	1-2 ton (12k-24k BTU)	100-500 liters
Power	1000-2500 watts	100-400 watts
Efficiency	ISEER/Star Rating 3-5	BEE Star Rating 3-5
Gas	R32, R410A	R600a, R134a

Question 3(b) OR [4 marks]

Explain electronic controller for washing machine.

Solution

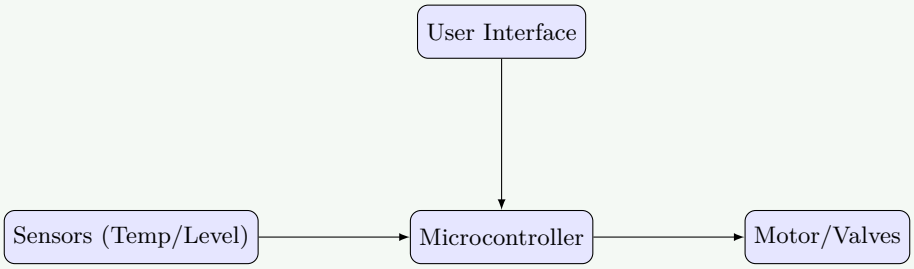

Figure 8. Electronic Control System

- **Microcontroller**: Central CPU managing operations.

- **Sensors**: Water level, temperature, load balance.
- **Actuators**: Motor driver, water valves, drain pump.

Mnemonic

"MIST-WAD: Microcontroller Integrates Sensors and Timers for Water, Agitation and Drainage"

Question 3(c) OR [7 marks]

Draw and explain block diagram of Microwave oven. List wiring and safety instructions

Solution

Block Diagram:

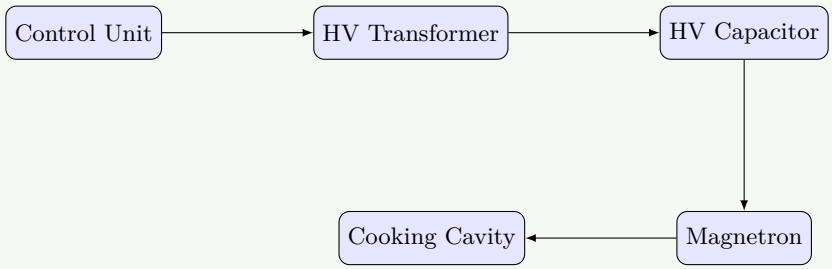

Figure 9. Microwave Internal System

- **Magnetron**: Generates microwaves (2.45 GHz).
- **HV Transformer**: Steps up voltage to 2-4kV.
- **Safety**: Never operate with open door; ensure grounding; don't override interlocks.
- **Wiring**: Use 15-20A dedicated circuit with proper ground.

Question 4(a) [3 marks]

Draw block diagram of Photocopier.

Solution

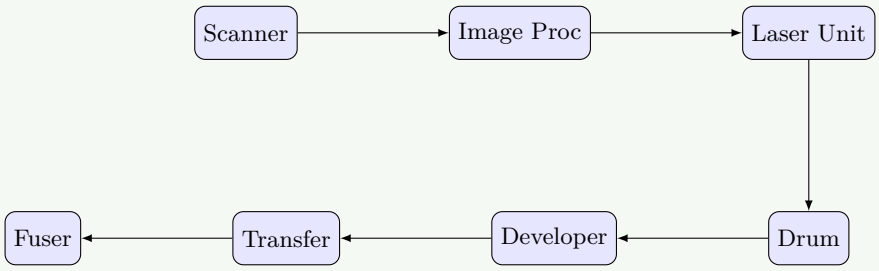

Figure 10. Photocopier Process

Question 4(b) [4 marks]

List specifications of MF printer and CCTV.

Solution

MF Printer	CCTV
Res: 600-1200 dpi	Res: 2-8 MP
Speed: 15-40 ppm	FPS: 15-30 fps
Scan: 300-600 dpi	Night Vision: 10-30m
Conn: USB, WiFi	Storage: 1-8 TB

Question 4(c) [7 marks]

Explain working of laser printer with block diagram.

Solution

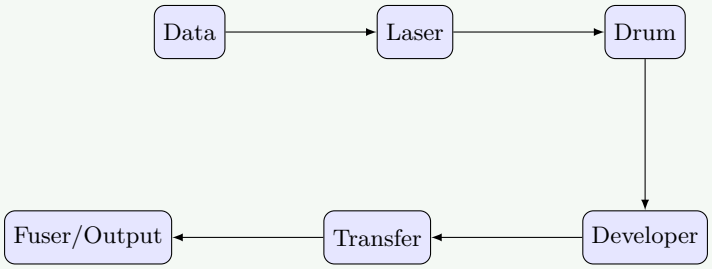

Figure 11. Laser Printer Cycle

Process Stages:
1. **Charging**: Drum gets uniform charge.
2. **Writing**: Laser discharges image areas.
3. **Developing**: Toner sticks to discharged areas.
4. **Transfer**: Toner moves to paper.
5. **Fusing**: Heat melts toner onto paper.
6. **Cleaning**: Residual toner removed.

Mnemonic

"CWTFC: Charge, Write, Transfer, Fuse, Clean cycle"

Question 4(a) OR [3 marks]

Draw block diagram of CCTV.

Solution

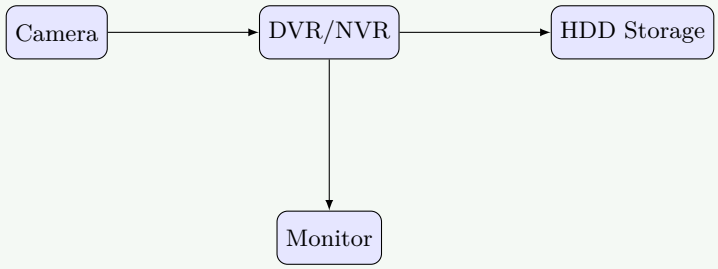

Figure 12. Basic CCTV System

Question 4(b) OR [4 marks]

List specifications of inkjet printer and Photocopier.

Solution

Inkjet Printer	Photocopier
Res: 1200-4800 dpi	Res: 600-1200 dpi
Speed: 8-20 ppm	Speed: 20-60 cpm
Ink: Dye/Pigment	Toner: Dry Powder
Duty: 1-5k pages/mo	Duty: 10k-100k pg/mo

Question 4(c) OR [7 marks]

Explain working of LCD projector with block diagram and list its specifications.

Solution

Working Process:

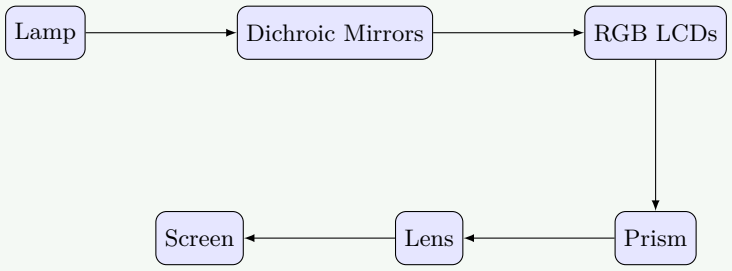

Figure 13. LCD Projector

- **Lamp**: High intensity source.
- **Mirrors**: Split light into Red, Green, Blue.
- **LCDs**: Modulate light for each color.
- **Prism**: Recombines light beams.

Specs: Res (XGA/FHD), Brightness (2000-5000 Lumens), Lamp Life (3000-6000 hrs).

Question 5(a) [3 marks]

Draw block diagram of PA system.

Solution

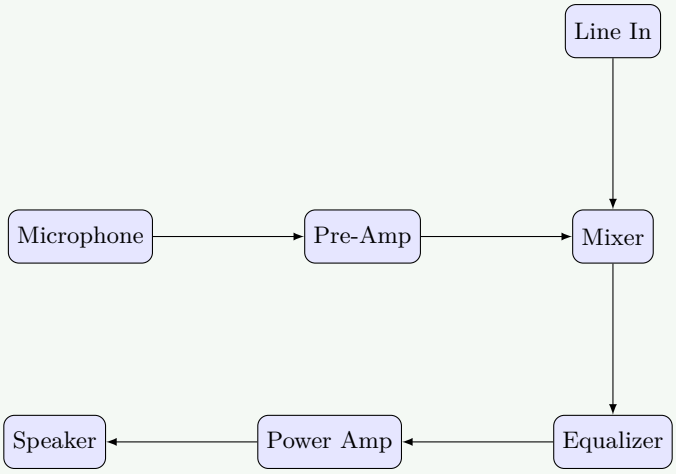

Figure 14. Public Address System

Mnemonic

"MMEPS: Microphone, Mixer, Equalizer, Power amp, Speakers"

Question 5(b) [4 marks]

Explain tweeter and woofer.

Solution

Feature	Tweeter	Woofer
Frequency	High (2kHz-20kHz)	Low (20Hz-2kHz)
Size	Small (0.5"-1.5")	Large (4"-15")
Diaphragm	Light, rigid	Heavy, flexible
Role	Treble/Detail	Bass/Power

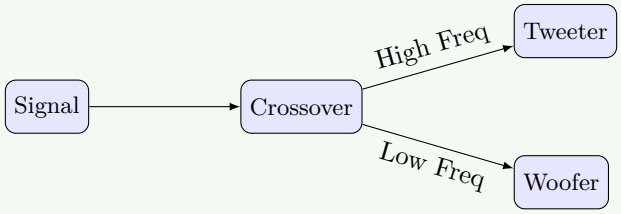

Figure 15. Speaker Crossover

Mnemonic

"THSL: Tweeters catch Highs (Small/Light), Woofers catch Lows"

Question 5(c) [7 marks]

Define microphone. List types of microphone and explain working of any one type of microphone.

Solution

Definition: Electroacoustic transducer converting sound waves into electrical signals.
Types: Dynamic, Condenser, Ribbon, Carbon, Piezo, MEMS.
Dynamic Microphone Working:

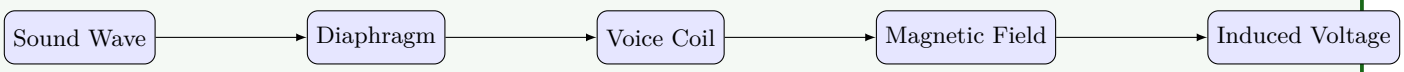

Figure 16. Dynamic Mic Principle

- **Sound Capture**: Sound waves hit diaphragm.
- **Transduction**: Coil moves in magnetic field.
- **Output**: Movement induces voltage (Faraday's Law).
- **Pros**: Rugged, no power needed, high acoustic handling.

Mnemonic

"DDCMIO: Diaphragm Displaces Coil in Magnetic field Inducing Output"

Question 5(a) OR [3 marks]

Define: (1) Pitch (2) Loudspeaker (3) Reverberation.

Solution

- **Pitch**: Perceived frequency of sound (High/Low tone).
- **Loudspeaker**: Transducer converting electrical signals to sound waves.
- **Reverberation**: Persistence of sound after source stops due to reflections.

Figure 17. Sound Propagation

Mnemonic

"PLR Sound: Pitch(Tone), Loudspeaker(Producer), Reverb(Echo)"

Question 5(b) OR [4 marks]

Draw block diagram of Home theatre sound system and explain in brief.

Solution

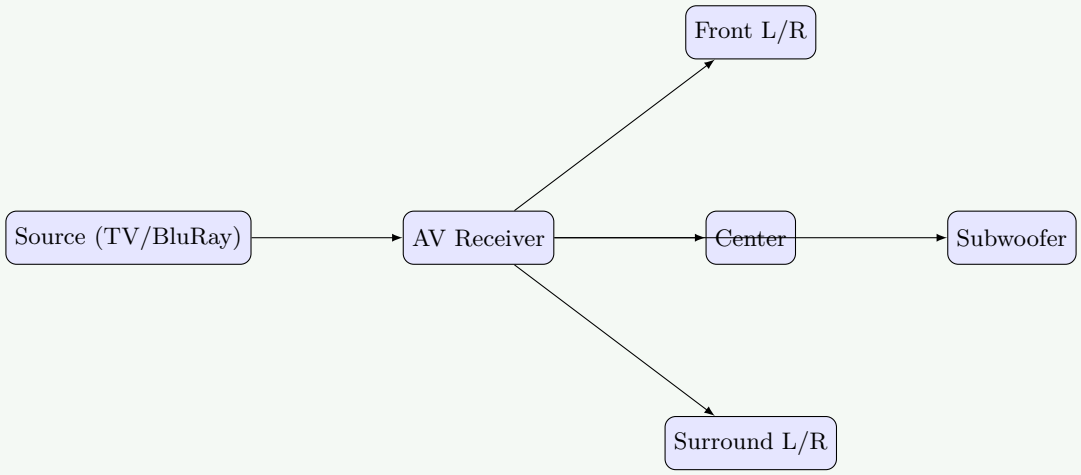

Figure 18. 5.1 Home Theatre System

- **Receiver**: Processes amplification and decoding.
- **Center**: Dialog clarity.
- **Front/Surround**: Stereo and ambient effects.
- **Subwoofer**: Low Frequency Effects (LFE).

Question 5(c) OR [7 marks]

Explain Electrostatic loudspeaker and permanent magnet loudspeaker.

Solution

Feature	Electrostatic	Permanent Magnet
Principle	Electrostatic force (Capacitive)	Electromagnetic induction
Parts	Stator plates, Charged film	Magnet, Voice Coil, Cone
Power	Needs HV Bias Supply	Driven by signal only
Quality	Low distortion, fast transient	Good bass, efficient

Permanent Magnet Working:

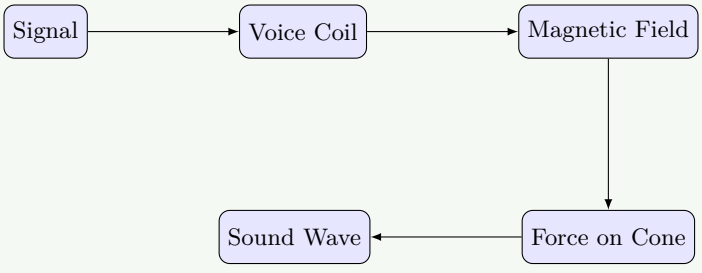

Figure 19. Moving Coil Speaker

Mnemonic

"ESPM: Electrostatic(Static Charge), Permanent Magnet(Magnetic Coil)"