Question 1(a) [3 marks]

Define only: 1. Loudness 2. Timbre 3. Echo

Answer:

Term	Definition
Loudness	The subjective perception of sound intensity that depends on sound pressure and frequency
Timbre	The quality of sound that distinguishes different instruments or voices playing the same note
Echo	A sound reflection that arrives at the listener with a delay greater than 50ms after the direct sound

Mnemonic: "LTE: Loudness measures strength, Timbre gives uniqueness, Echo comes back delayed"

Question 1(b) [4 marks]

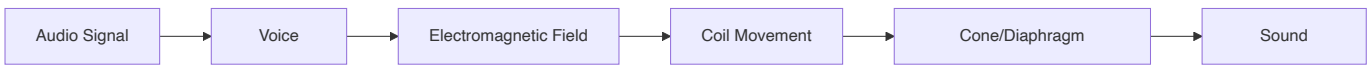
List Type of loudspeaker and explain any one of them

Answer:

Types of Loudspeakers:

Type	Key Feature
Dynamic/Moving Coil	Uses electromagnetic coil
Electrostatic	Uses charged diaphragm
Ribbon	Uses thin metal ribbon
Piezoelectric	Uses crystals that vibrate
Horn	Uses acoustic horn for amplification
Planar Magnetic	Uses magnetic strips on diaphragm

Dynamic/Moving Coil Loudspeaker:



- **Magnetic Structure**: Permanent magnet creates static magnetic field
- **Voice Coil**: Receives audio current and creates varying magnetic field
- **Diaphragm/Cone**: Attached to voice coil, vibrates to produce sound waves

Mnemonic: "COPPER-D: Coil Oscillates, Permanent magnet Pulls/Pushes, Emitting Resonance through Diaphragm"

Question 1(c) [7 marks]

List types of Microphone. State its Characteristics and explain Wireless Microphone in detail.

Answer:

Types of Microphones:

Type	Operating Principle
Dynamic	Moving coil in magnetic field
Condenser	Variable capacitance
Carbon	Variable resistance
Ribbon	Ribbon movement in magnetic field
Crystal/Piezoelectric	Crystal deformation
Electret	Permanently charged material
MEMS	Micro-Electro-Mechanical Systems

Microphone Characteristics:

- **Sensitivity**: Output level for given sound pressure
- **Frequency Response**: Range of frequencies captured
- **Directional Pattern**: Pickup pattern (omnidirectional, cardioid, etc.)
- **Impedance**: Electrical resistance to AC signals
- **Signal-to-Noise Ratio**: Desired signal vs. background noise

Wireless Microphone System:

- **Microphone Element**: Converts sound to electrical signals
- **Transmitter**: Modulates audio onto radio frequency carrier
- **Receiver**: Captures RF signal and demodulates to recover audio
- **Operating Frequency**: Uses VHF (30-300 MHz) or UHF (300-3000 MHz) bands
- **Battery Operation**: Requires power source for transmitter

Mnemonic: "WIRED: Wireless Is Radio-Enabled Device"

Question 1(c OR) [7 marks]

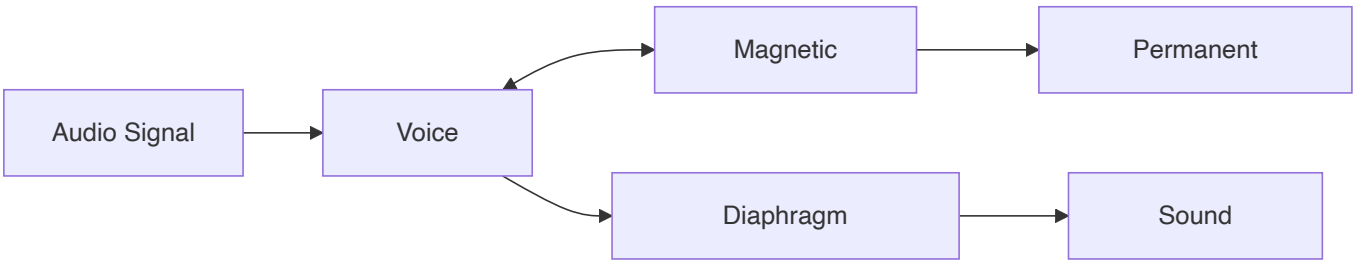
State characteristics of Loudspeakers and explain pearmeant magnet loudspeaker with its advantages and disadvantages.

Answer:

Loudspeaker Characteristics:

Characteristic	Description
Frequency Response	Range of frequencies reproduced (20Hz-20kHz ideal)
Sensitivity	Sound pressure level (dB) with 1W input at 1m distance
Impedance	Electrical resistance (typically 4, 8, or 16 ohms)
Power Handling	Maximum power without damage (watts)
Directivity	Sound dispersion pattern
Distortion	Unwanted alteration of the original signal

Permanent Magnet Loudspeaker:



Working Principle:

- Voice coil receives electrical audio signals
- Magnetic field interactions cause coil movement
- Attached diaphragm vibrates to produce sound
- Permanent magnet provides constant magnetic field

Advantages:

- **Cost-effective**: No external power for magnetic field
- **Reliable**: Simple design with fewer failure points
- **Compact**: No field coil or power supply needed
- **Efficient**: Good power-to-sound conversion

Disadvantages:

- **Limited Power**: Magnetic field strength is fixed
- **Magnet Deterioration**: Can weaken over time

- **Weight**: Strong magnets can make unit heavy
- **Heat Sensitivity**: Performance affected by temperature

Mnemonic: "PMLS: Permanent Magnet Loudly Speaks"

Question 2(a) [3 marks]

Define 1. Aspect ratio 2. Chrominance 3. Additive Mixing

Answer:

Term	Definition
Aspect Ratio	The ratio of width to height of a television or display screen (e.g., 16:9, 4:3)
Chrominance	The color information in a video signal, independent of the luminance or brightness
Additive Mixing	The process of combining different colored lights to create new colors, where mixing all primary colors produces white

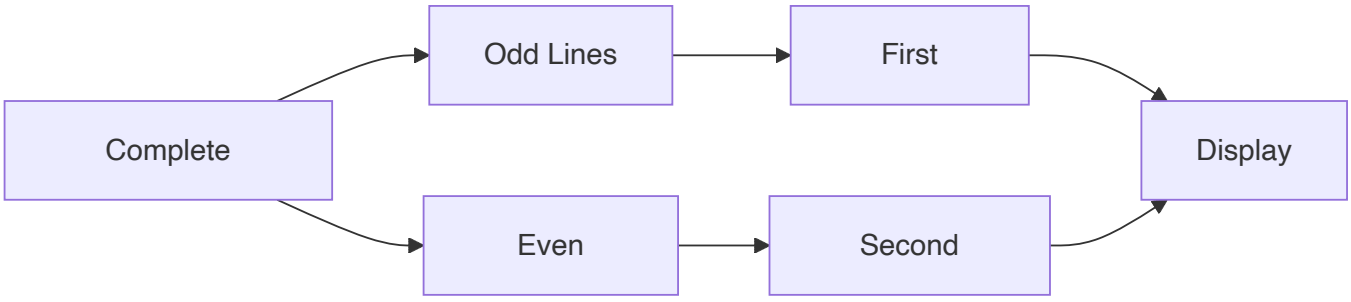
Mnemonic: "ACA: Aspect sets dimensions, Chrominance adds color, Additive mixing creates brightness"

Question 2(b) [4 marks]

Explain interlace scanning

Answer:

Interlace Scanning:



Process:

- Frame divided into two fields: odd-numbered lines and even-numbered lines
- First field displays all odd-numbered lines (1,3,5...)
- Second field displays all even-numbered lines (2,4,6...)
- Fields displayed alternately, creating illusion of full frame
- Standard rate: 50/60 fields per second (25/30 frames per second)

Key Benefit: Reduces bandwidth while maintaining perceived vertical resolution

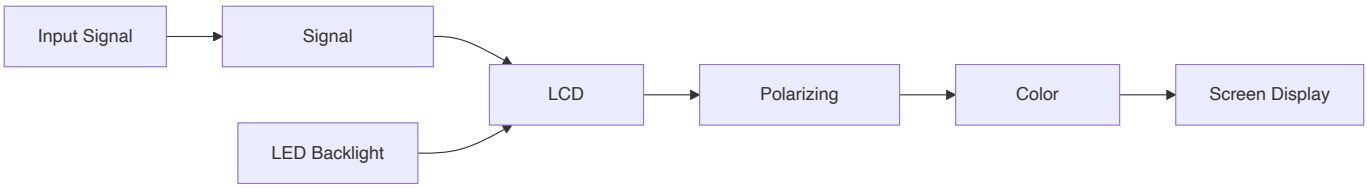
Mnemonic: "ODD-EVEN: One Display, then Delayed Extra Visual Enhancement Next"

Question 2(c) [7 marks]

Discuss working principle of LED Television. State its advantages and compare it with LCD television.

Answer:

LED TV Working Principle:



Key Components:

- **LED Backlight**: Light source (edge-lit or full-array)
- **LCD Panel**: Liquid crystal layer controls light passage
- **TFT Matrix**: Thin-film transistors control each pixel
- **Color Filters**: Create RGB colors from white backlight
- **Polarizing Filters**: Control light direction and intensity

Advantages of LED TV:

- **Energy Efficient**: Consumes less power
- **Thinner Design**: Allows for slim profile
- **Better Contrast**: Especially with local dimming
- **Longer Lifespan**: LEDs last 50,000-100,000 hours
- **Eco-Friendly**: No mercury content

Comparison with LCD TV:

Feature	LED TV	LCD TV
Backlight	LED lights	CCFL (Cold Cathode Fluorescent Lamps)
Thickness	Thinner (25-40mm)	Thicker (100-150mm)
Power Consumption	Lower	Higher
Contrast Ratio	Better (3000:1-8000:1)	Lower (1000:1-2000:1)
Color Reproduction	More vibrant	Less vibrant
Lifespan	50,000-100,000 hours	30,000-60,000 hours
Cost	Higher	Lower

Mnemonic: "LEDGE: Light Emitting Diodes Give Excellence"

Question 2(a) [3 marks]

State any six standards of Color television system.

Answer:

Standard	Region/Features
PAL (Phase Alternating Line)	Europe, Australia, 625 lines, 25 fps
NTSC (National Television System Committee)	North America, Japan, 525 lines, 30 fps
SECAM (Sequential Color with Memory)	France, Russia, 625 lines, 25 fps
PAL-M	Brazil, 525 lines, 30 fps
PAL-N	Argentina, Paraguay, Uruguay
ATSC (Advanced Television Systems Committee)	Digital standard, North America
DVB-T (Digital Video Broadcasting-Terrestrial)	Digital standard, Europe
ISDB (Integrated Services Digital Broadcasting)	Digital standard, Japan, Brazil

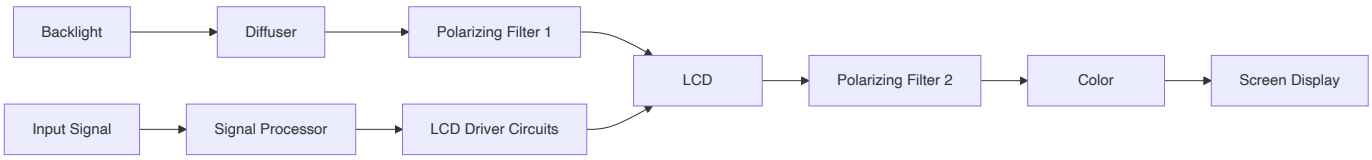
Mnemonic: "PANS-ADI: PAL, ATSC, NTSC, SECAM - All Display Images"

Question 2(b) [4 marks]

Explain working of LCD Television.

Answer:

LCD Television Working:



Operating Principle:

- **Backlight**: Provides white light source
- **Polarizing Filters**: Two filters at 90° to each other
- **Liquid Crystals**: Twist/untwist to control light passage
- **TFT Array**: Controls voltage to each pixel
- **Color Filters**: Create RGB colors from white light

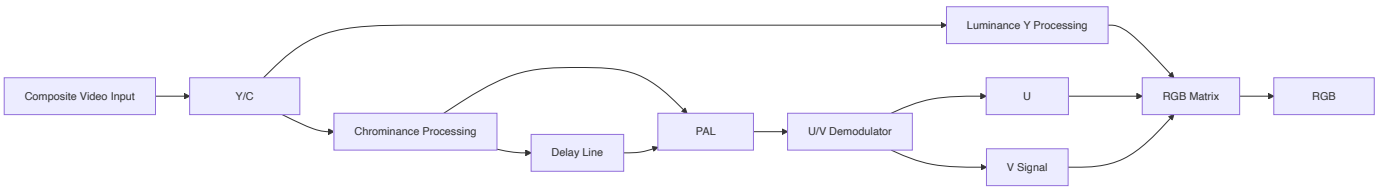
Mnemonic: "BPLTC: Backlight Passes through Liquid crystals That Color"

Question 2(c) [7 marks]

Draw and Explain block diagram of PAL-D decoder.

Answer:

PAL-D Decoder:



PAL-D Decoder Components:

- **Y/C Separator**: Separates luminance (Y) from chrominance (C)
- **Luminance Processing**: Enhances brightness and contrast
- **Chrominance Processing**: Extracts color subcarrier
- **Delay Line**: Delays signal by one line (64μs)
- **PAL Switch**: Reverses phase of V signal on alternate lines
- **U/V Demodulator**: Extracts U (B-Y) and V (R-Y) color difference signals
- **RGB Matrix**: Combines Y, U, V to produce RGB signals

Key Feature: Phase alternation corrects phase errors by averaging consecutive lines

Mnemonic: "PAL Decodes Color Right By Switching, Delaying, Unscrambling Variations"

Question 3(a) [3 marks]

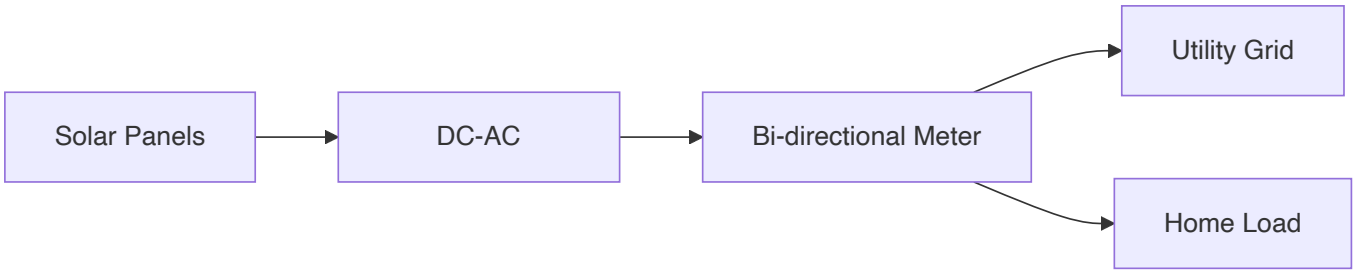
Give classification of rooftop Solar power plant and explain any one plant.

Answer:

Rooftop Solar Power Plant Types:

Type	Description
Grid-Connected	Connected to utility grid, no batteries
Off-Grid	Standalone system with battery storage
Hybrid	Can operate in both grid-connected and off-grid modes

Grid-Connected System:



- **Solar Panels**: Convert sunlight to DC electricity
- **Inverter**: Converts DC to grid-compatible AC
- **Meter**: Measures power exported/imported
- **Grid Connection**: Excess power fed to grid

Mnemonic: "GOH: Grid connects, Off-grid stores, Hybrid does both"

Question 3(b) [4 marks]

Give at least four technical specification of Refrigerator and split Air condition each.

Answer:

Refrigerator Specifications:

Specification	Typical Range/Description
Capacity	150-750 liters
Energy Rating	Star rating (1-5 stars)
Power Consumption	100-400 kWh per year
Compressor Type	Reciprocating or inverter
Defrost System	Manual, frost-free, or direct cool
Refrigerant Type	R-600a, R-134a
Temperature Range	2-8°C (refrigerator), -18 to -24°C (freezer)

Split Air Conditioner Specifications:

Specification	Typical Range/Description
Cooling Capacity	1-2 tons (12,000-24,000 BTU/hr)
Energy Efficiency Ratio (EER)	2.8-3.5 W/W
ISEER Rating	Star rating (1-5 stars)
Power Consumption	800-2500 watts
Refrigerant Type	R-32, R-410A
Noise Level	30-55 dB
Operating Temperature Range	18-32°C (indoor), -5 to 55°C (outdoor)

Mnemonic: "CERT: Capacity, Efficiency, Refrigerant Type, Temperature"

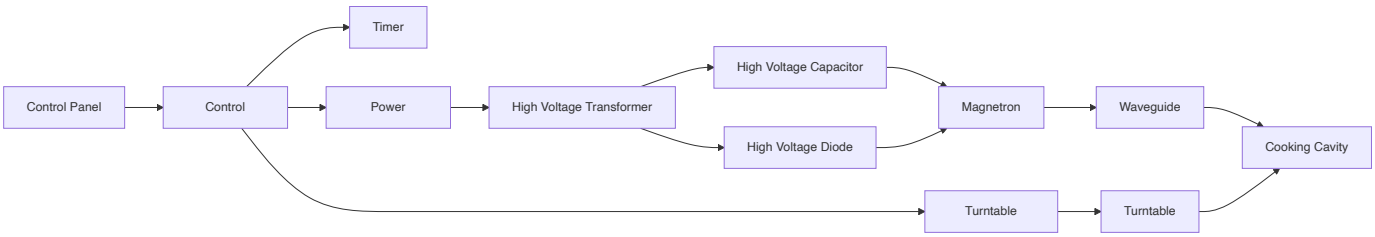
Question 3(c) [7 marks]

Explain working of Microwave oven with respect to its working principle, functional block diagram and its safety precautions while in operative condition.

Answer:

Microwave Oven Working Principle:
Food contains water molecules, which are polar. Microwaves cause these molecules to rotate rapidly (2.45 GHz), creating friction and generating heat throughout the food.

Functional Block Diagram:



Key Components:

- **Magnetron**: Generates microwave radiation (2.45 GHz)
- **Waveguide**: Directs microwaves to cooking cavity
- **Turntable**: Ensures even cooking
- **Control Circuit**: Manages timing and power
- **High Voltage Circuit**: Powers the magnetron

Safety Precautions:

- **Door Interlocks**: Multiple switches prevent operation when door is open
- **Monitoring Circuit**: Shuts down if interlocks fail

- **Cavity Mesh Screen**: Blocks microwaves from escaping
- **Never Operate Empty**: Can damage magnetron
- **No Metal Objects**: Can cause arcing and damage
- **Regular Cleaning**: Prevents food buildup and arcing
- **Avoid Damaged Seals**: May allow microwave leakage

Mnemonic: "MICROWAVE: Magnetron Initiates Cooking, Radiation Only Within Authorized Vessel Environment"

Question 3(a OR) [3 marks]

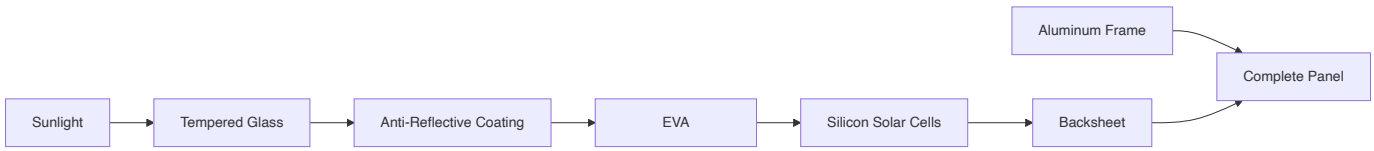
State various hardware used in rooftop solar power plant and explain solar panels used in it.

Answer:

Rooftop Solar Power Plant Hardware:

Component	Function
Solar Panels	Convert sunlight to DC electricity
Mounting Structure	Supports panels at optimal angle
Inverter	Converts DC to AC power
Batteries (optional)	Store energy for later use
Charge Controller	Regulates battery charging (in off-grid systems)
Junction Boxes	Provide connection points and protection
Meters	Measure power generation/consumption
Cables & Connectors	Transmit power between components

Solar Panels:



- **Monocrystalline**: Higher efficiency (15-22%), darker color, longer lifespan
- **Polycrystalline**: Lower cost, blue appearance, 13-17% efficiency
- **Thin-Film**: Flexible, lightweight, lower efficiency (10-12%)
- **Typical Output**: 250-400W per panel
- **Lifespan**: 25-30 years with warranty

Mnemonic: "SIMPLE: Solar panels Integrate Multiple Photovoltaic Layers Efficiently"

Question 3(b OR) [4 marks]

Give at least four technical specification of Microwave oven and washing machine each.

Answer:

Microwave Oven Specifications:

Specification	Typical Range/Description
Power Output	700-1200 watts
Capacity	15-42 liters
Frequency	2.45 GHz
Operating Modes	Microwave, grill, convection, combo
Control Type	Mechanical, digital, touch panel
Power Consumption	1000-1500 watts
Timer Range	0-60 minutes

Washing Machine Specifications:

Specification	Typical Range/Description
Capacity	5-12 kg
Washing Technology	Agitator, impeller, drum
Spin Speed	700-1600 RPM
Water Consumption	30-80 liters per cycle
Energy Rating	Star rating (1-5 stars)
Program Options	8-16 programs
Motor Type	Universal, inverter, direct drive

Mnemonic: "CPFWS: Capacity, Power, Frequency, Washing technology, Spin speed"

Question 3(c OR) [7 marks]

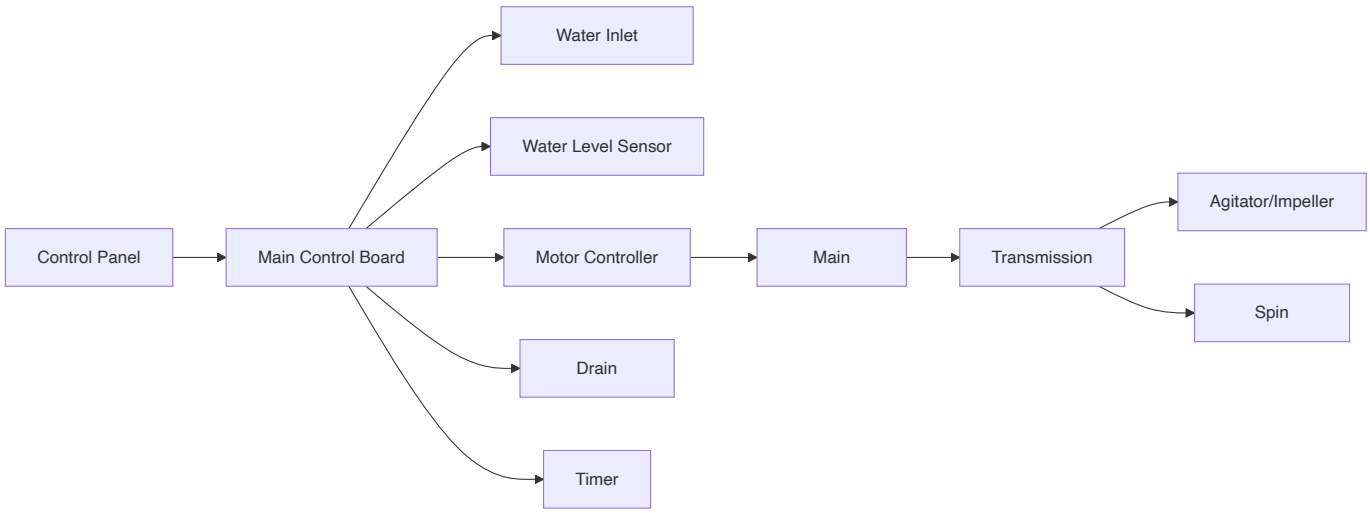
Give classification of washing machine. Explain working of top load washing machine with respect to its functional block diagram and working strategy/steps to wash clothes.

Answer:

Washing Machine Classification:

Type	Subtype	Key Features
Top Load	Agitator	Central post that rotates
	Impeller	Rotating disk at bottom
Front Load	Horizontal Axis	Tumbling action, water efficient
By Automation	Fully Automatic	Complete cycle automation
	Semi-Automatic	Manual intervention required
By Function	Washer Only	Washing function only
	Washer-Dryer	Combined washing and drying

Top Load Washing Machine Functional Block Diagram:



Working Strategy/Steps:

1. **Fill Phase**:
   - Water inlet valve opens
   - Tub fills to preset level
   - Detergent mixed with water
2. **Wash Phase**:
   - Motor drives agitator/impeller
   - Creates water currents
   - Clothing moves through soapy water
   - Dirt loosened by mechanical action
3. **Drain Phase**:
   - Drain pump activates
   - Soapy water removed

4. **Rinse Phase**:
    - Fresh water enters
    - Agitator/impeller removes soap residue
    - May repeat multiple times
5. **Spin Phase**:
    - Basket rotates at high speed
    - Centrifugal force removes water
    - Clothes partially dried

Mnemonic: "FWDRS: Fill, Wash, Drain, Rinse, Spin"

Question 4(a) [3 marks]

Explain working principle of laser printer. Give its technical specifications.

Answer:

Laser Printer Working Principle:
Based on electrophotography where a laser beam creates an electrostatic image on a photosensitive drum, which attracts toner particles that are then transferred to paper and fused with heat.

Technical Specifications:

Specification	Typical Range/Values
Print Resolution	600-1200 dpi
Print Speed	20-50 ppm (pages per minute)
Duty Cycle	10,000-100,000 pages/month
Memory	64-512 MB
Connectivity	USB, Ethernet, Wi-Fi
Paper Capacity	250-500 sheets
Power Consumption	300-800W (active), <10W (standby)

Mnemonic: "RSCDCP: Resolution, Speed, Cycle, Duty, Connectivity, Power"

Question 4(b) [4 marks]

Explain working principle of Photo copier machine. State its technical specifications.

Answer:

Photocopier Working Principle:
Uses xerography (dry copying) process where light reflects off the original document onto a charged photoreceptor drum, creating an electrical image that attracts toner particles which are transferred and fused to paper.

Technical Specifications:

Specification	Typical Values
Copy Speed	20-60 cpm (copies per minute)
Resolution	600-1200 dpi
Paper Size Support	A5 to A3
Zoom Range	25%-400%
Paper Capacity	250-2000 sheets
Warm-up Time	10-30 seconds
Multiple Copy	1-999 copies
Power Consumption	1.0-1.5 kW (operating)

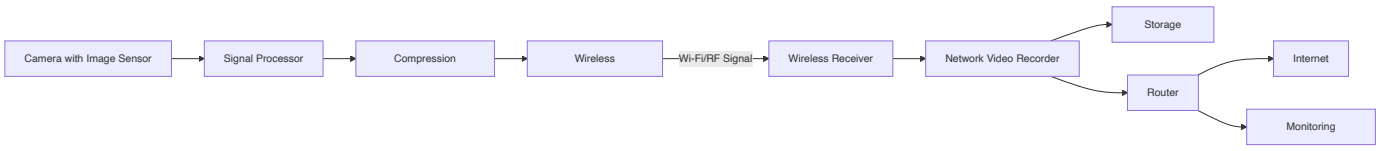
Mnemonic: "CRSPWMP: Copy speed, Resolution, Size, Paper capacity, Warm-up, Multiple copy, Power"

Question 4(c) [7 marks]

Draw and explain schematic of wireless CCTV camera system. Explain Network video recorder. State types of camera used in CCTV system and explain any one of them.

Answer:

Wireless CCTV Camera System:



Network Video Recorder (NVR):

- **Function**: Records video streams from IP cameras
- **Key Components**:
  - CPU: Processes multiple video streams
  - Storage: Multiple hard drives (2-16TB typical)
  - Network Interface: Connects to cameras and network

    - Video Management Software: Controls recording schedules
- **Features**:
    - Motion detection recording
    - Remote access capabilities
    - Video analytics
    - Simultaneous recording and playback

Types of CCTV Cameras:

Camera Type	Key Features
Dome Camera	Ceiling mounted, vandal-resistant
Bullet Camera	Long-range viewing, weather-resistant
PTZ Camera	Pan, tilt, zoom capabilities
Box Camera	Customizable lens options
Thermal Camera	Heat detection, works in darkness
Fisheye/360° Camera	Wide-angle panoramic view

IP Camera Explained:

- Uses digital signal processing
- Connects directly to network
- Has built-in web server
- Higher resolution (2-8MP typical)
- Power over Ethernet (PoE) capability
- Two-way audio communication
- Advanced analytics capabilities

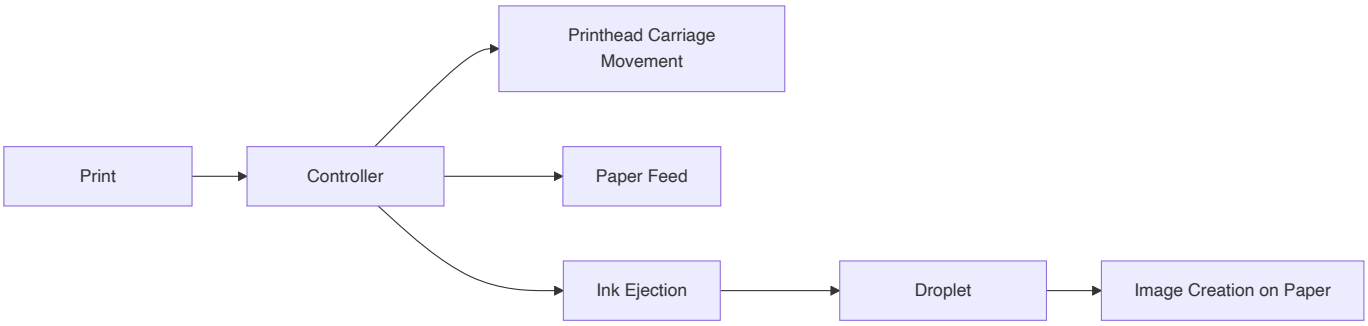
Mnemonic: "WISP-NET: Wireless Images Securely Processed, Networked, Enabling Tracking"

Question 4(a OR) [3 marks]

Explain working principle of inkjet printer. Give its technical specifications.

Answer:

Inkjet Printer Working Principle:
Creates images by propelling tiny droplets of liquid ink onto paper. The printhead contains hundreds of microscopic nozzles that eject ink droplets precisely where needed to form text and images.



Technical Specifications:

Specification	Typical Values
Print Resolution	1200-4800 dpi
Print Speed	8-20 ppm (black), 4-15 ppm (color)
Ink Type	Dye-based or pigment-based
Connectivity	USB, Wi-Fi, Ethernet
Paper Capacity	100-250 sheets
Droplet Size	1-3 picoliters
Color System	4-8 ink cartridges

Mnemonic: "RIPS-CCD: Resolution, Ink type, Print speed, Size of droplet, Connectivity, Capacity, Droplet"

Question 4(b OR) [4 marks]

Explain maintenance and trouble shooting of television receiver and Washing machine.

Answer:

Television Maintenance:

Maintenance Task	Frequency
Dust cleaning	Monthly
Software updates	As available
Screen cleaning	Weekly
Ventilation check	Monthly
Brightness/contrast adjustment	As needed

Television Troubleshooting:

Problem	Possible Solution
No power	Check power cable, outlet, fuse
No picture but sound works	Check video cable, picture settings
No sound but picture works	Check audio settings, speaker connections
Poor picture quality	Adjust settings, check signal strength
Remote not working	Replace batteries, clean IR sensor

Washing Machine Maintenance:

Maintenance Task	Frequency
Clean drum and gasket	Monthly
Check/clean filter	Monthly
Clean detergent drawer	Monthly
Run empty hot cycle	Quarterly
Check hoses for leaks	Quarterly

Washing Machine Troubleshooting:

Problem	Possible Solution
Not spinning	Check load balance, door lock
Leaking water	Check hoses, door seal, drain pump
Not draining	Clean filter, check drain hose
Excessive vibration	Level machine, check suspension
Door won't open	Wait for safety lock release

Mnemonic: "CREST: Clean Regularly, Examine connections, Service filters, Test functions"

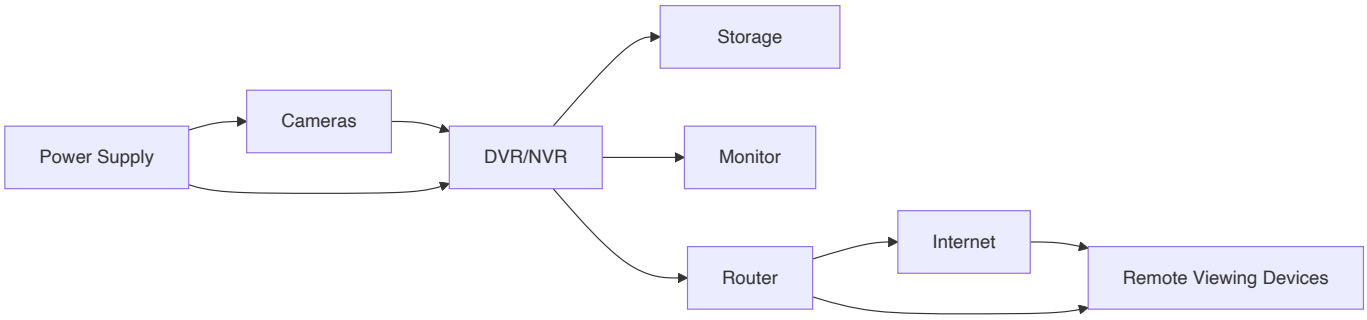
Question 4(c OR) [7 marks]

Define CCTV. Explain with schematic CCTV camera system installed in a home. Describe analog camera, Digital camera and IP camera and differentiate them.

Answer:

CCTV (Closed-Circuit Television):
A video surveillance system that transmits signals to a specific, limited set of monitors, unlike broadcast television. It's used for surveillance and security monitoring in homes, businesses, and public spaces.

Home CCTV System Schematic:



Camera Types:

Analog Camera:

- Transmits continuous analog signal via coaxial cable
- Typically 720×576 resolution (standard definition)
- Requires DVR (Digital Video Recorder) for recording
- Limited cable run distance (300-500m)
- Simpler installation, lower cost

Digital Camera:

- Converts analog signal to digital at camera
- Uses coaxial cable or twisted pair for transmission
- Better resolution than analog (up to 2MP)
- Improved image quality and stability
- Works with traditional DVR systems

IP Camera:

- Fully digital from capture to transmission
- Connects directly to network via Ethernet/Wi-Fi
- High resolution (2-8MP or higher)
- Uses NVR (Network Video Recorder) for recording
- Advanced features: remote viewing, analytics, PoE

Comparison Table:

Feature	Analog Camera	Digital Camera	IP Camera
Signal	Analog	Analog-to-Digital	Digital
Resolution	SD (up to 700 TVL)	HD (up to 2MP)	HD/UHD (2-12MP)
Cabling	Coaxial	Coaxial/Twisted pair	Ethernet/Wi-Fi
Recorder	DVR	DVR	NVR
Setup Complexity	Low	Medium	High
Price	Lower	Medium	Higher
Remote Access	Limited	Limited	Advanced

Mnemonic: "ADI: Analog uses Decaying technology, IP represents Innovation"

Question 5(a) [3 marks]

Define maintenance. State its types. Explain any one of them.

Answer:

Maintenance:
The process of preserving equipment in operational condition by regular inspection, servicing, repair, and replacement of components to prevent failures and extend equipment life.

Types of Maintenance:

Type	Description
Preventive	Scheduled regular maintenance to prevent failures
Predictive	Based on monitoring and data analysis to predict failures
Corrective/Breakdown	Performed after equipment failure occurs
Condition-based	Based on actual equipment condition
Reliability-centered	Focuses on maintaining system function

Preventive Maintenance:

- Conducted at scheduled intervals regardless of equipment condition
- Includes cleaning, lubricating, adjusting, and replacing wear components
- Aims to prevent unexpected failures and extend equipment life
- Follows manufacturer's service recommendations
- Examples: filter changes, belt replacements, calibration, lubrication

Mnemonic: "PPCR: Prevent Problems through Checkups Regularly"

Question 5(b) [4 marks]

Explaining maintenance of PA systems and Home theatre system.

Answer:

PA System Maintenance:

Component	Maintenance Task
Speakers	Check connections, inspect for damage, clean dust
Amplifiers	Clean cooling vents, check for overheating, inspect cables
Microphones	Clean grilles, check cables, test for proper operation
Cables	Inspect for damage, verify connections are tight
Mixers	Clean faders/knobs, check input/output levels

Key Procedures:

- Verify proper grounding to avoid noise
- Test system at low volume before use
- Keep equipment dry and dust-free
- Follow manufacturer's cleaning instructions
- Document any issues for troubleshooting

Home Theatre System Maintenance:

Component	Maintenance Task
AV Receiver	Keep ventilated, update firmware, check connections
Speakers	Check connections, clean dust, verify positioning
Subwoofer	Check for rattling, adjust placement for optimal sound
Display Device	Clean screen properly, check settings
Source Devices	Clean optical drives, update firmware

Key Procedures:

- Calibrate audio settings periodically
- Verify proper HDMI connections
- Keep remote controls clean and with fresh batteries
- Maintain proper ventilation for all components
- Run speaker test tones to verify all channels

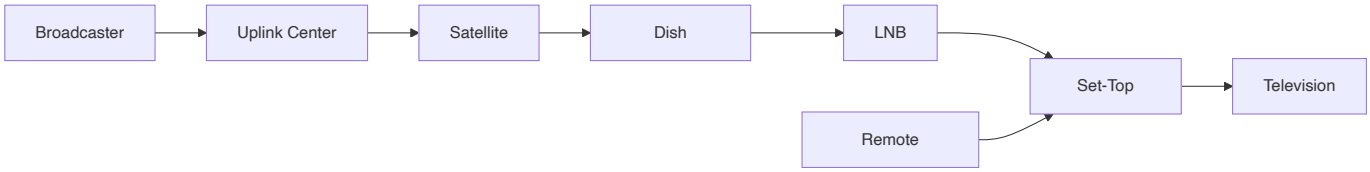
Mnemonic: "CAVS: Clean, Adjust, Verify connections, Service regularly"

Question 5(c) [7 marks]

Draw and Explain block diagram of DTH technology. Discuss hardware components used in DTH system. Discuss various modern features currently provided in current DTH system.

Answer:

DTH (Direct To Home) Technology Block Diagram:



DTH Hardware Components:

1. **Satellite Dish Antenna**:
   - Parabolic reflector that captures satellite signals
   - Size typically 45-90cm diameter
   - Must be accurately aligned to satellite position
2. **LNB (Low Noise Block)**:
   - Receives signals reflected by dish
   - Amplifies weak signals while minimizing noise
   - Converts high frequency signals to lower frequency
   - Typical frequency: 10.7-12.75 GHz down to 950-2150 MHz
3. **Coaxial Cable**:
   - Connects LNB to set-top box
   - RG-6 type with F-connectors
   - Minimal signal loss characteristics
4. **Set-Top Box (STB)**:
   - Demodulates and decodes satellite signals
   - Contains conditional access system
   - Processes MPEG-2/MPEG-4/H.264 video
   - Provides user interface and program guide
5. **Smart Card**:
   - Contains subscriber information
   - Enables decryption of encrypted channels
   - Stores subscription details

Modern Features of DTH Systems:

Feature	Description
HD & 4K Channels	High-definition and ultra-high-definition content
Interactive TV	On-demand content, voting, games
Multi-room Viewing	Same subscription on multiple TVs
Recording Capability	Built-in or external DVR functionality
Mobile App Control	Remote control via smartphone
Voice Control	Voice-activated commands
Catch-up TV	Watch missed programs for several days
OTT Integration	Access to Netflix, Prime Video, etc.
Content Recommendation	AI-based personalized suggestions
Parental Controls	Content restriction based on ratings

Mnemonic: "DISH-STB: Direct Information Satellite Hub - Signals Transmitted to Box"

Question 5(a OR) [3 marks]

Differentiate between predictive and preventive maintenance.

Answer:

Aspect	Predictive Maintenance	Preventive Maintenance
Basis	Equipment condition	Time or usage intervals
Approach	Data-driven monitoring	Pre-scheduled service
Timing	Just before failure predicted	Regular intervals regardless of condition
Tools Used	Sensors, vibration analysis, thermal imaging	Maintenance schedules, checklists
Cost	Higher initial setup, lower long-term	Lower initial, potentially higher long-term
Downtime	Minimal, planned	Regular planned downtime
Resource Efficiency	Higher (service only when needed)	Lower (may service unnecessarily)
Example	Oil analysis showing degradation triggers change	Oil changed every 5,000 km regardless of condition

Mnemonic: "TIME vs DATA: Timed Intervals Maintenance Everywhere vs Data Analysis Triggers Action"

Question 5(b OR) [4 marks]

Describe troubleshooting procedure and safety precautions for microwave oven.

Answer:

Microwave Oven Troubleshooting Procedure:

1. **Initial Assessment**:
    - Verify power connection and outlet
    - Check display/lights for power indication
    - Listen for normal operational sounds
2. **Common Issues and Checks**:
    - **No Power**: Check fuse, door switches, control board
    - **No Heating**: Check magnetron, high voltage components
    - **Turntable Not Working**: Check motor, drive coupling
    - **Noisy Operation**: Inspect fan, magnetron, turntable
    - **Sparking**: Look for metal objects, damaged rack/cavity
3. **Diagnostic Steps**:
    - Check error codes on display
    - Test door interlock switches

- Verify proper voltage at components
- Inspect for burnt components or wiring

Safety Precautions:

Precaution	Reason
Unplug Before Service	Prevents electric shock
Discharge Capacitor	Stores lethal voltage even when unplugged
Wait 60 Seconds	Allows capacitor to discharge naturally
Never Run Empty	Can damage magnetron
Check Microwave Leakage	Using calibrated leakage detector
Don't Defeat Interlocks	Essential safety feature
Wear Insulated Gloves	Protection from electrical shock
Verify Repairs	Test thoroughly before returning to service

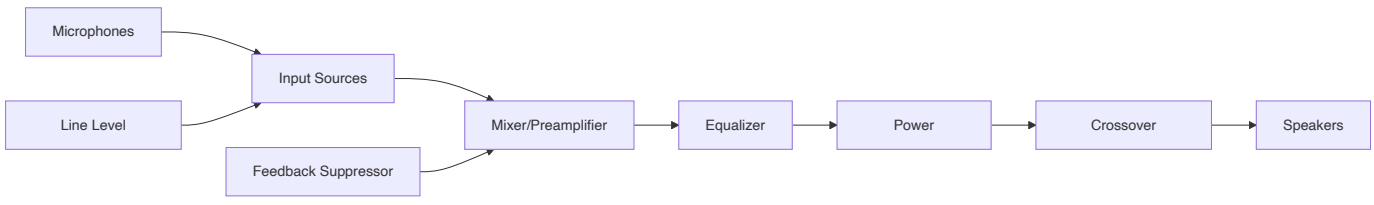
Mnemonic: "DUEL-SAFE: Disconnect power, Use discharge tool, Examine systematically, Look for damage - Safety Always First, Every time"

Question 5(c OR) [7 marks]

Draw and explain block diagram of PA system. Discuss design parameters while designing for auditorium. Draw connection diagram of four 8 Ohm speakers to PA system amplifier having 8 Ohm as output impedance.

Answer:

PA System Block Diagram:



PA System Components:

- **Input Sources**: Microphones, instruments, media players
- **Mixer/Preamplifier**: Combines and adjusts input signals
- **Equalizer**: Adjusts frequency response
- **Power Amplifier**: Increases signal power to drive speakers
- **Crossover Network**: Divides frequencies for appropriate speakers
- **Speakers**: Converts electrical signals to sound

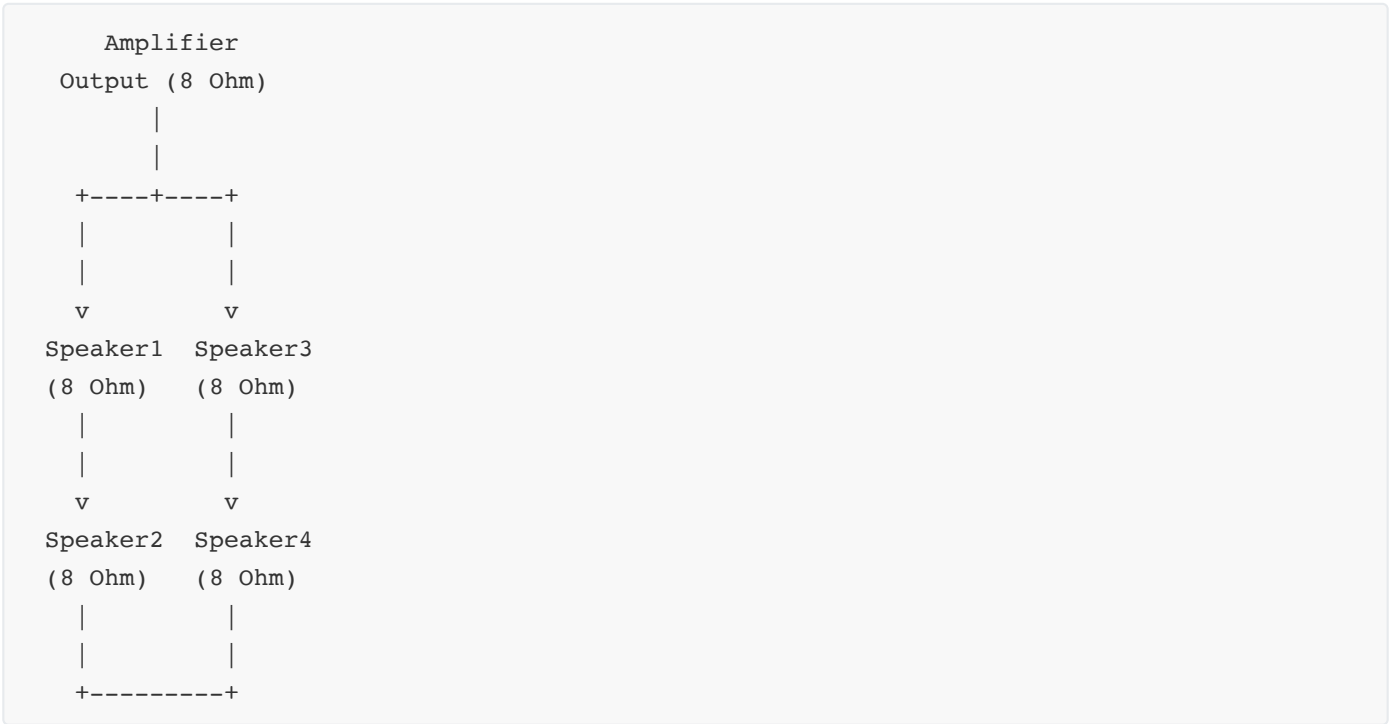
- **Feedback Suppressor**: Prevents audio feedback

Auditorium Design Parameters:

Parameter	Consideration
Room Acoustics	Reverberation time (1.0-2.0s optimal), echo control
Speaker Placement	Coverage angle, distance, height, minimizing feedback
Power Requirements	1-2W per person for speech, 2-3W for music
Frequency Response	100Hz-12kHz for speech, 40Hz-16kHz for music
Speech Intelligibility	STI (Speech Transmission Index) > 0.60
Ambient Noise	NC-25 to NC-30 (Noise Criterion)
Sound Pressure Level	85-95dB for optimal listening
Line Array vs. Point Source	Based on room size and shape

Connection Diagram for 8Ω Speakers to 8Ω Amplifier:

Series-Parallel Connection:



- Two parallel branches of two speakers in series
- Each series branch = 16Ω (8Ω + 8Ω)
- Two 16Ω branches in parallel = 8Ω total (16Ω ÷ 2)
- Maintains proper impedance match with amplifier
- Distributes power evenly to all speakers

Mnemonic: "PASS: Proper Amplification, Speaker placement, Series-parallel wiring"