CBCS SCHEME

USN

BESCK204C/BESCKC204

Second Semester B.E./B.Tech. Degree Examination, June/July 2024
Introduction to Electronics and Communication

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Draw the block diagram of Regulated power supply and mention the function of each block.	8	L2	CO1
	b.	With the use of circuit diagram and waveforms, explain the working of Half wave rectifier with capacitor filter.	8	L2	CO1
	c.	Mention advantages of –ve feedback.	4	L1	CO1
		OR			
Q.2	a.	List out and explain the various types of amplifiers.	8	L1	CO1
	b.	With neat diagram, explain the concept of negative feedback amplifier.	7	L2	CO1
	c.	Write a note on Multistage amplifiers.	5	L1	CO1
		Module – 2			
Q.3	a.	Explain the working of RC – ladder network oscillator.	6	L2	CO2
	b.	Define Multivibrators. Explain the working of single stage astable multivibrator with diagram.	8	L1	CO2
	c.	Explain its working of Weinbridge Oscillator with diagram.	6	L2	CO2
		OR			
Q.4	a.	Define the following terms with respect to the Op_Amp : i) CMRR ii) Slew rate iii) Supply voltage rejection ratio iv) Input offset voltage v) Input offset current.	10	L1	CO2
	b.	Explain how Op_Amp can be used as i) Voltage follower ii) Integrator.	10	L2	CO2
		Module – 3			
Q.5	a.	Convert i) $(3568)_{10} = (?)_2$ ii) $(3FD)_{16} = (?)_2$ iii) $(110111)_2 = (?)_{10}$ iv) $(1234)_{10} = (?)_8$ v) $(5678)_{10} = (?)_{16}$.	10	L2	CO3
	b.	Write any four Boolean theorems and Identities.	10	L1	CO3
		OR			
Q.6	a.	Simplify the following Boolean functions : i) $Y = A\overline{B} + AB$ ii) $F = B[(A + \overline{B})(B + C)]$ iii) $Z = B(A + C) + C$.	8	L3	CO3

	b.	Explain Half adder circuit with truth table, Realize the circuit for sum and carry using basic gates.	8	L2	CO3
	c.	Write the Symbol and Truth Table of AND and OR – Gate.	4	L1	CO3
		Module – 4			
Q.7	a.	Define Embedded system and explain the classification of Embedded system based on Complexity and Deterministic behavior.	10	L2	CO4
	b.	Compare Embedded system and General computing system.	6	L1	CO4
	c.	List out the major applications areas of Embedded system.	4	L1	CO4
		OR			
Q.8	a.	With the use of diagram, explain the core of an Embedded system.	8	L2	CO4
	b.	Compare RISC and CISC.	6	L1	CO4
	c.	Write a short notes on Sensors and 7 – segment LED displays.	6	L2	CO4
		Module – 5			
Q.9	a.	With the help of block diagram, explain the basic Communication system.	10	L2	CO5
	b.	Define Noise and explain the various kinds of noises.	10	L2	CO5
		OR			
Q.10	a.	Define Multiplexing and explain types of Communication systems.	8	L2	CO5
	b.	Classify and explain the Multiple Access Techniques.	8	L2	CO5
	c.	Mention the Need for Modulation.	4	L1	CO5

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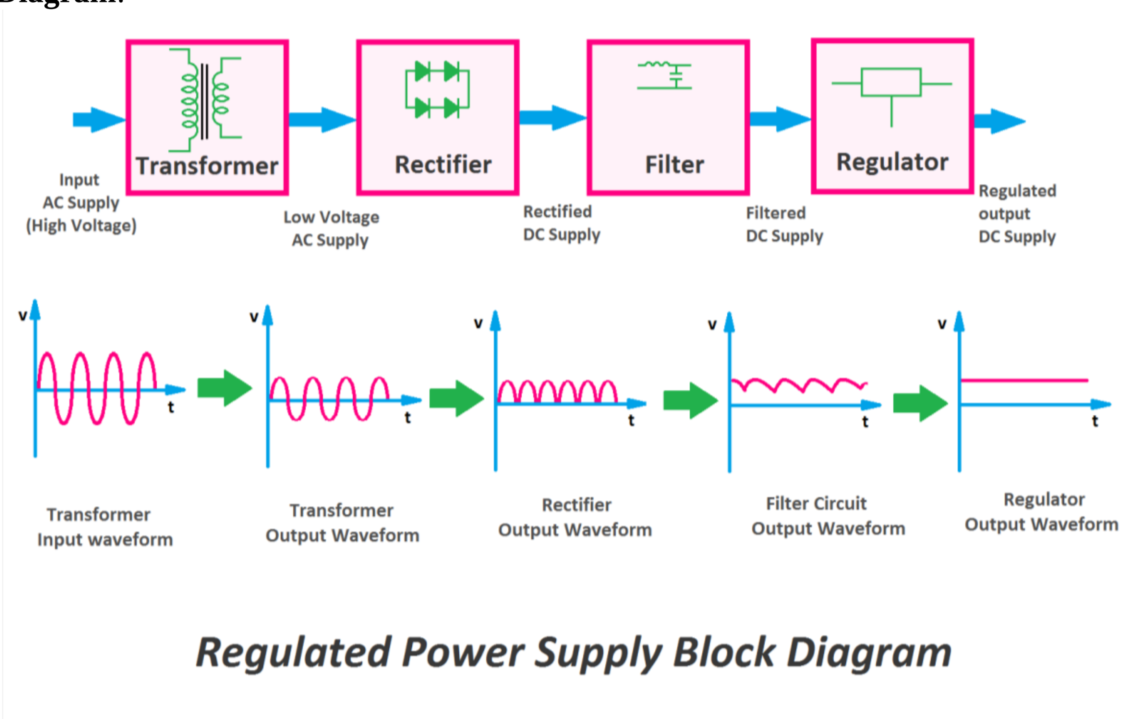
Solutions

Q1. Regulated Power Supply, Half-Wave Rectifier, Negative Feedback
a) Block Diagram of a Regulated Power Supply

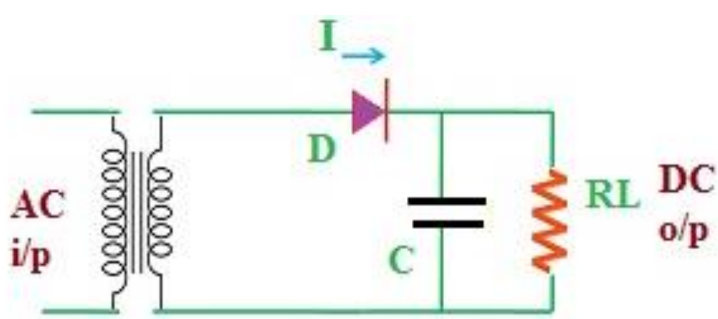
- **Diagram**:



- **Explanation**:
    1. **Transformer**: Steps down the AC mains voltage to a suitable lower voltage.
    2. **Rectifier**: Converts the AC voltage to pulsating DC. Common rectifiers include half-wave, full-wave, or bridge rectifiers.
    3. **Filter**: Smooths the pulsating DC to reduce ripples using capacitors or inductors.
    4. **Voltage Regulator**: Stabilizes the DC output voltage to remain constant despite fluctuations in input voltage or load.

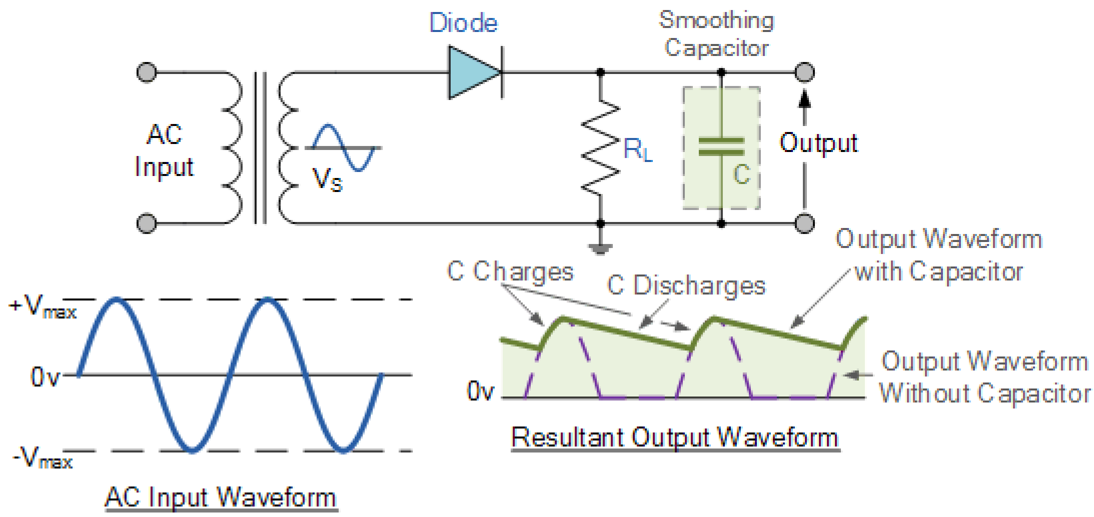
b) Half-Wave Rectifier with Capacitor Filter

- **Circuit Diagram**:



    - **Explanation**:
        - In a half-wave rectifier, only one half of the AC input signal passes through the diode to the load.

- The capacitor filter is placed parallel to the load to smooth the output by storing and releasing charge, which reduces ripples.

- **Waveforms**:
- 

  - **Input waveform**: Shows a complete AC sine wave.
  - **Output waveform (rectified)**: Shows the positive half-cycles only.
  - **Filtered output**: Shows smoothed DC with reduced ripples.

c) Advantages of Negative Feedback

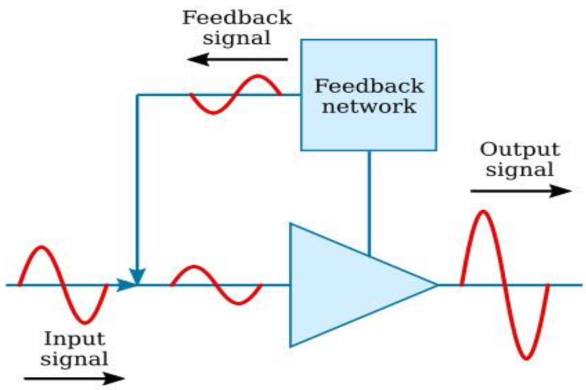
- **Reduces Distortion**: Improves signal fidelity by canceling out non-linearities.
- **Increases Bandwidth**: Allows the amplifier to handle a wider range of frequencies.
- **Stabilizes Gain**: Makes gain less sensitive to component variations.
- **Reduces Output Impedance**: Ensures better current handling.

Q2. Amplifiers, Negative Feedback, Multistage Amplifiers

a) Types of Amplifiers

- **Voltage Amplifier**: Increases the input voltage, suitable for low-power applications (e.g., audio pre-amplifiers).
- **Current Amplifier**: Amplifies current rather than voltage, typically used in communication circuits.
- **Power Amplifier**: Provides higher power for driving loudspeakers and other high-power loads.
- **Operational Amplifier (Op-Amp)**: Versatile amplifiers used for signal conditioning, mathematical operations, etc.

b) Negative Feedback Amplifier

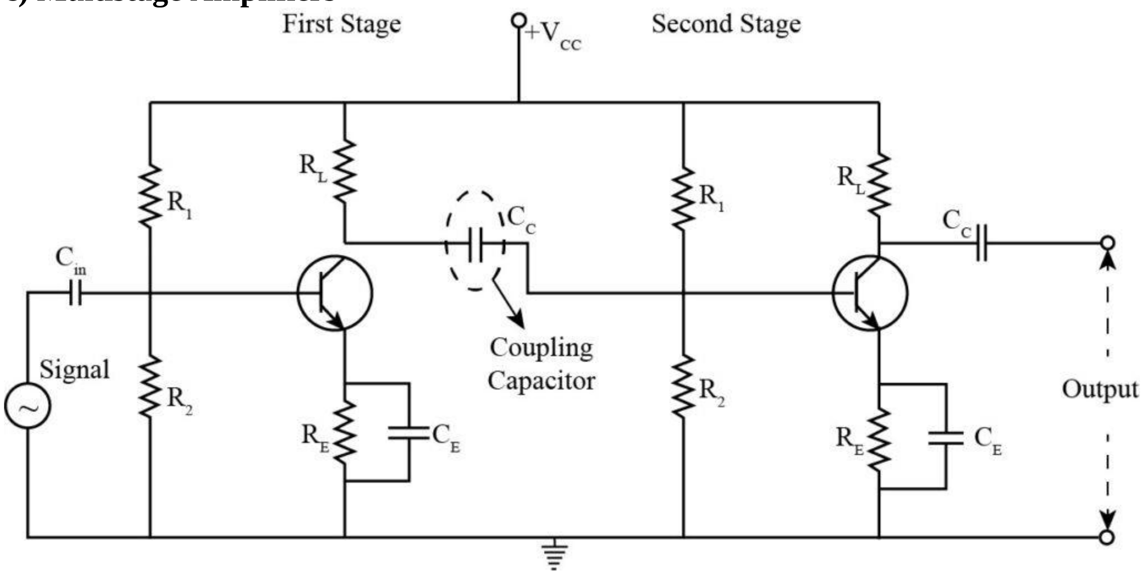


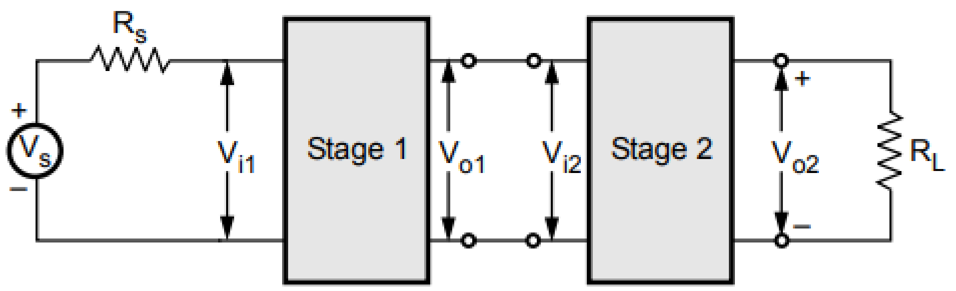
- **Diagram**:
  Feedback
- **Explanation**:
  - In a negative feedback amplifier, a portion of the output is fed back to the

input in reverse phase.

- This feedback reduces the gain slightly but stabilizes the circuit, reduces distortion, and increases bandwidth.

c) Multistage Amplifiers





Block diagram of two stage cascade amplifier

Therefore V_{o2}/V_{i1} is the overall voltage gain of two stage amplifier and it can be given as,

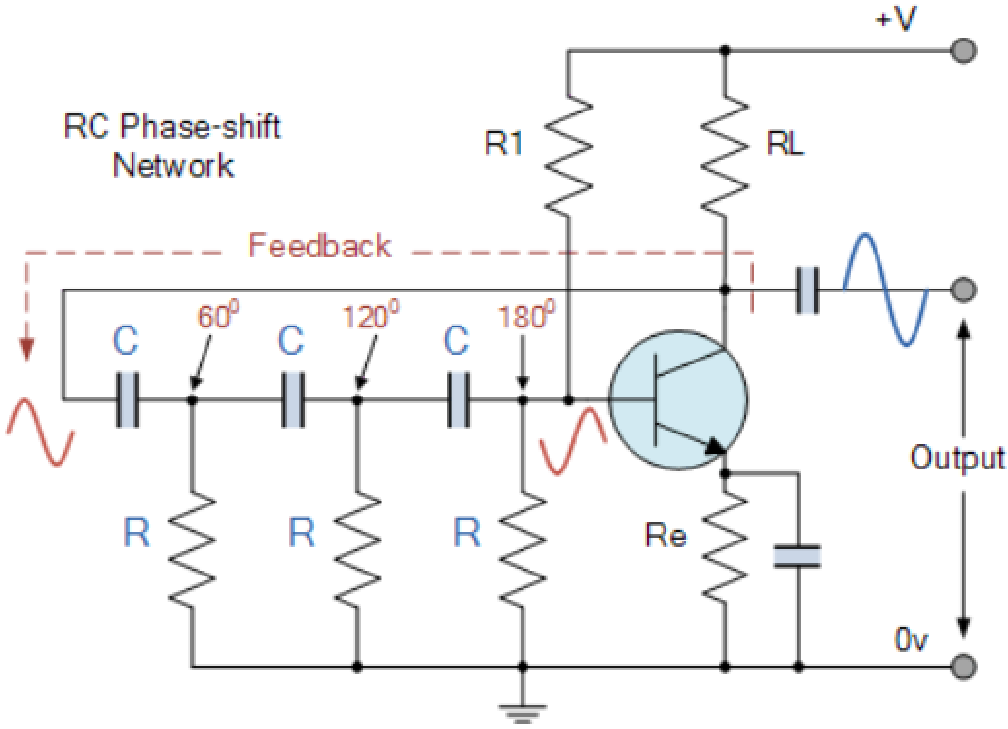
$$A_v = \frac{V_{o2}}{V_{i1}} = \frac{V_{o2}}{V_{i2}} \frac{V_{i2}}{V_{i1}}$$

We know that, $V_{o1} = V_{i2}$

$$\therefore \quad A_v = \frac{V_{o2}}{V_{i2}} \frac{V_{o1}}{V_{i1}} = A_{v2}\, A_{v1} \quad \dots (8.1.1)$$

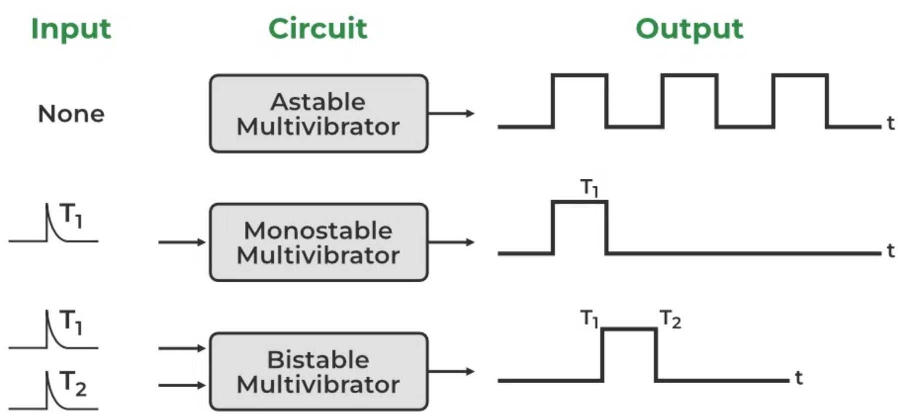
- **Explanation**:
  - **Multistage Configuration**: Uses multiple amplifier stages in series.
  - **Purpose**: To achieve higher overall gain and improved frequency response.
  - **Applications**: Common in radio frequency (RF) amplifiers, audio amplifiers, and signal processing.

Q3. Oscillators and Multivibrators
a) RC Ladder Network Oscillator



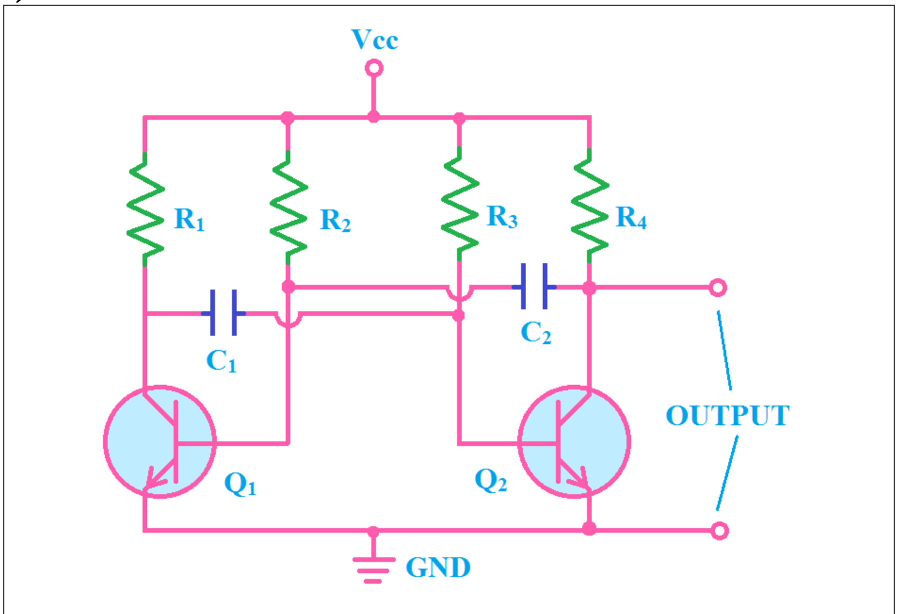
- **Explanation**:
  - An RC ladder network oscillator uses a network of resistors and capacitors in series and parallel to create a phase shift.
  - The phase shift in each RC section adds up to create a total shift of 180 degrees, which enables oscillation.
  - **Applications**: Audio frequency generation, sine wave generation.

b) Multivibrators



- **Definition**: A multivibrator is an electronic circuit that switches between two states, used for generating square waves and timing signals.
- **Astable Multivibrator**:
  - **Diagram**

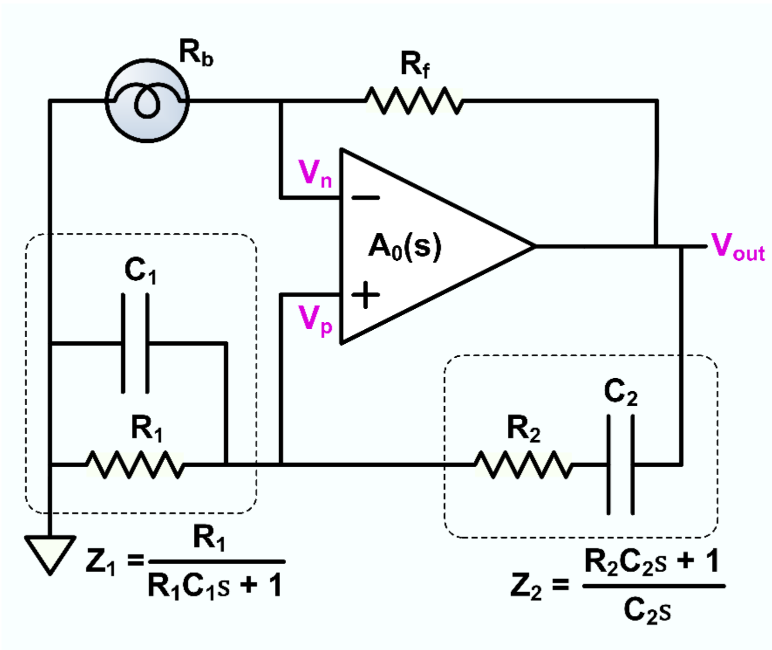
b) Astable Multivibrator



Astable Multivibrator Circuit using BJT

- **Explanation**:
  - An astable multivibrator has no stable state and continuously switches between two states, generating a square wave output.
  - It consists of two transistors, two capacitors, and resistors configured so that one transistor conducts while the other does not.
  - This switching action repeats, creating an oscillating output.

c) Weinbridge Oscillator



- **Diagram**:
- **Explanation**:
  - The Weinbridge oscillator produces a low-distortion sine wave output.
  - It uses a positive feedback loop through an RC network that sets the frequency and a negative feedback loop for stabilization.
  - **Applications**: Used in audio signal generation, test equipment, and function generators.

Q4. Operational Amplifier Parameters and Applications

a) Op-Amp Terms

1. **CMRR (Common Mode Rejection Ratio)**: Measures the ability of an op-amp to reject common-mode signals. Higher CMRR values indicate better performance in differential signal amplification.
2. **Slew Rate**: Maximum rate of change of the output voltage per unit time, expressed in volts per microsecond (V/µs). A higher slew rate indicates the op-amp can handle rapid changes in input.
3. **Supply Voltage Rejection Ratio (SVRR)**: Indicates how much the op-amp's output is affected by fluctuations in the power supply.
4. **Input Offset Voltage**: The small DC voltage required at the input to make the output zero. Ideally, this should be zero.
5. **Input Offset Current**: The difference in bias currents between the op-amp’s two input terminals.

b) Op-Amp Applications

1. **Voltage Follower**:
   - **Diagram**: Input connected directly to the non-inverting input of the op-amp, and the output fed back to the inverting input.
   - **Explanation**: It has a unity gain (1) and provides high input impedance, which helps in buffering and isolation between stages.
2. **Integrator**:
   - **Diagram**: An op-amp with a capacitor in the feedback loop and a resistor at the input.
   - **Explanation**: The output voltage is the integral of the input voltage, making it useful for signal processing applications like creating a ramp output from a pulse input.

Q5. Number System Conversions and Boolean Theorems

a) Conversions

1. **3568 (DEC) to BIN**: 3568 in decimal converts to binary as 110111110000.
2. **3FD (HEX) to BIN**: 3FD in hexadecimal is 001111111101 in binary.
3. **110111 (BIN) to DEC**: 110111 in binary converts to 55 in decimal.
4. **1234 (DEC) to OCT**: 1234 in decimal converts to 2322 in octal.
5. **5678 (DEC) to HEX**: 5678 in decimal converts to 162E in hexadecimal.

b) Boolean Theorems and Identities

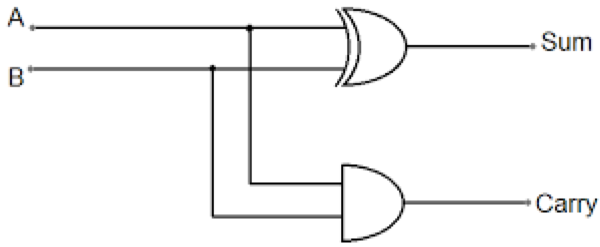
1. **Identity Law**: A+0=AA + 0 = AA+0=A and A·1=AA \cdot 1 = AA·1=A.
2. **Null Law**: A+1=1A + 1 = 1A+1=1 and A·0=0A \cdot 0 = 0A·0=0.
3. **Complement Law**: A+A′=1A + A' = 1A+A′=1 and A·A′=0A \cdot A' = 0A·A′=0.
4. **Idempotent Law**: A+A=AA + A = AA+A=A and A·A=AA \cdot A = AA·A=A.

Q6. Boolean Simplifications, Half-Adder, AND/OR Gates

a) Boolean Simplifications

1. **Y = AB + AB'**: Simplifies to Y=AY = AY=A.
2. **F = B[(A + B)(B + C)]**: Apply distribution to simplify.
3. **Z = B(A + C) + C**: Use Boolean theorems to simplify.

b) Half-Adder Circui



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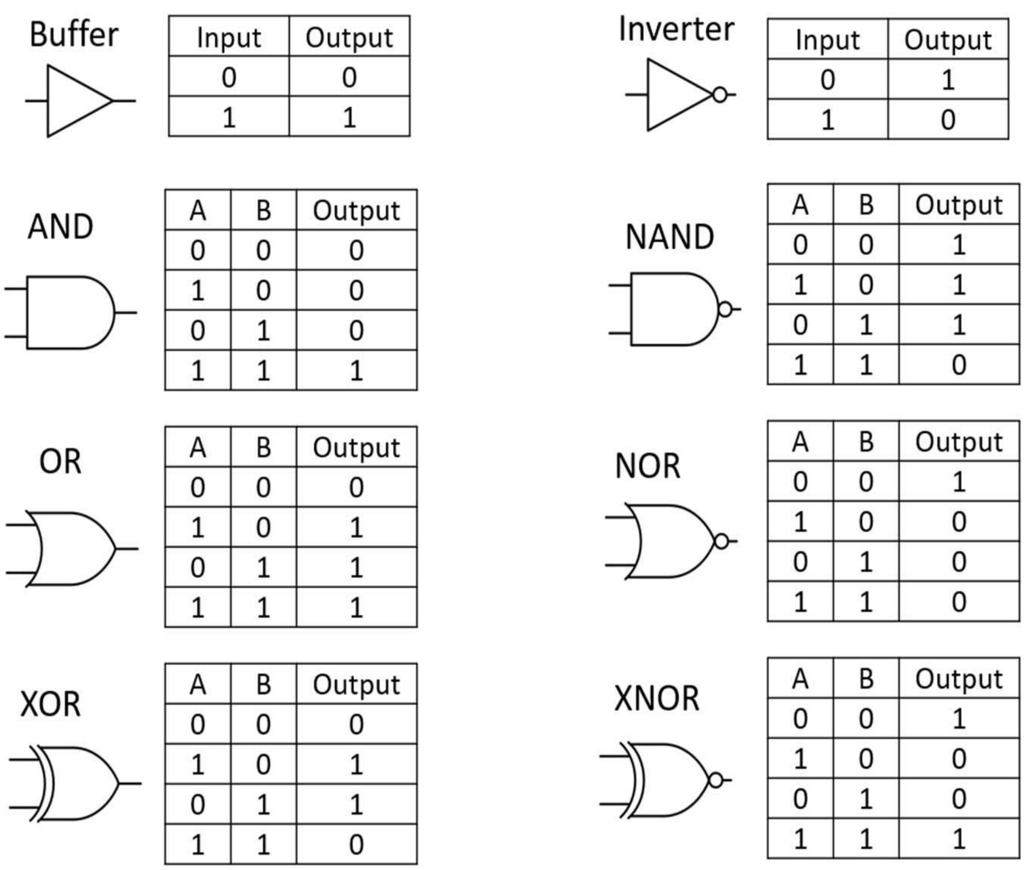
- **Truth Table**:

A	**B**	**Sum**	**Carry**
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

- **Circuit Diagram**:
  - **Sum**: Implemented using an XOR gate.
  - **Carry**: Implemented using an AND gate.

c) Symbols and Truth Tables of AND and OR Gates



Buffer

Input	Output
0	0
1	1

Inverter

Input	Output
0	1
1	0

AND

A	B	Output
0	0	0
1	0	0
0	1	0
1	1	1

NAND

A	B	Output
0	0	1
1	0	1
0	1	1
1	1	0

OR

A	B	Output
0	0	0
1	0	1
0	1	1
1	1	1

NOR

A	B	Output
0	0	1
1	0	0
0	1	0
1	1	0

XOR

A	B	Output
0	0	0
1	0	1
0	1	1
1	1	0

XNOR

A	B	Output
0	0	1
1	0	0
0	1	0
1	1	1

-
-

- **AND Gate**:
  - **Symbol**: A "D" shape with two inputs.
  - **Truth Table**:

A	B	A AND B
0	0	0
0	1	0
1	0	0
1	1	1

- **OR Gate**:
  - **Symbol**: Curved shape with two inputs.
  - **Truth Table**:

A	B	A OR B
0	0	0
0	1	1
1	0	1
1	1	1

Q7. Embedded Systems and General Computing

a) Embedded Systems

- **Definition**: Embedded systems are specialized computing systems designed to perform dedicated functions.
- **Classification**:
  - **Based on Complexity**: Simple, medium, and complex systems.
  - **Deterministic Behavior**: Real-time (strict timing constraints) and non-real-time systems.

b) Comparison with General Computing

- **Embedded Systems**: Task-specific, optimized for performance, and usually real-time.
- **General Computing Systems**: Multipurpose, support a wide range of applications, and are not necessarily real-time.

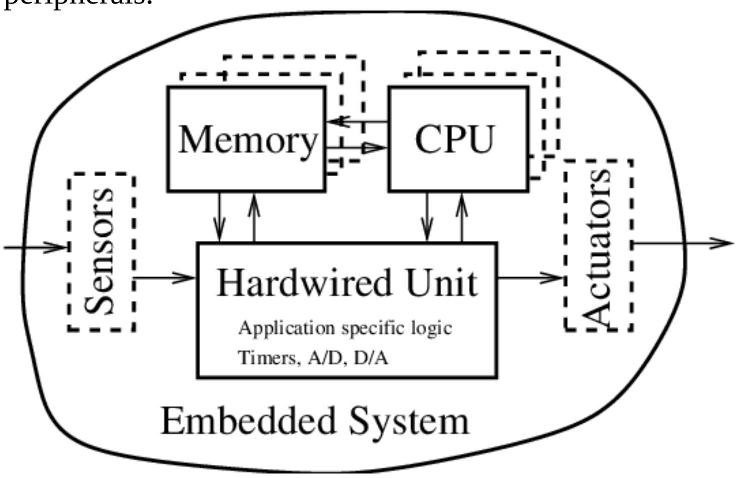
c) Application Areas

- **Applications**: Automotive (ECUs), medical devices (pacemakers), industrial automation, and consumer electronics.

Q8. Embedded Core, RISC vs. CISC, Sensors and Displays

a) Core of an Embedded System

- **Diagram**: Shows components like CPU, memory, input/output interfaces, and peripherals.



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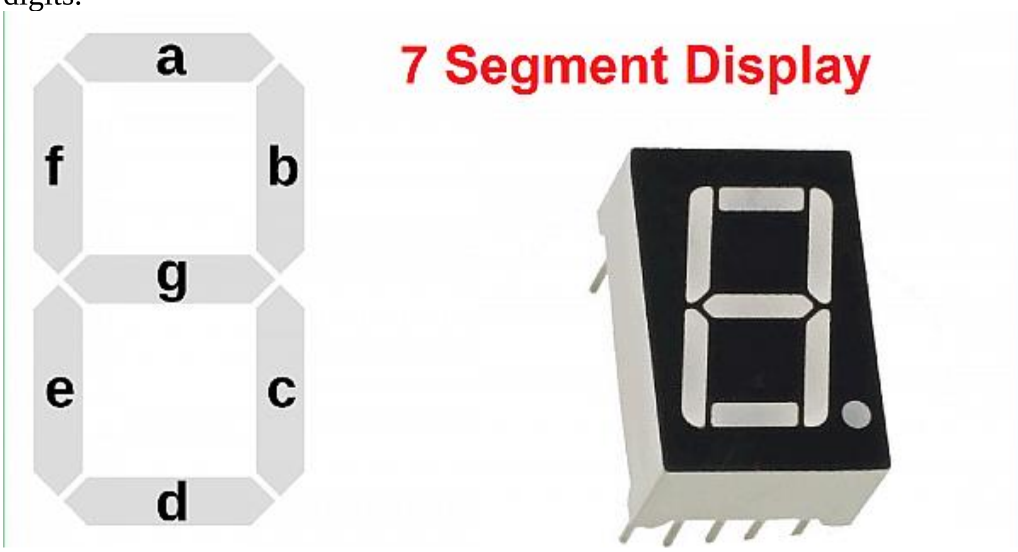
- **Explanation**: Each part's role in managing input data, processing, and controlling outputs.

b) RISC vs. CISC

- **RISC (Reduced Instruction Set Computer)**: Fewer instructions, faster performance.
- **CISC (Complex Instruction Set Computer)**: More instructions, optimized for complex tasks.

c) Sensors and 7-Segment Displays

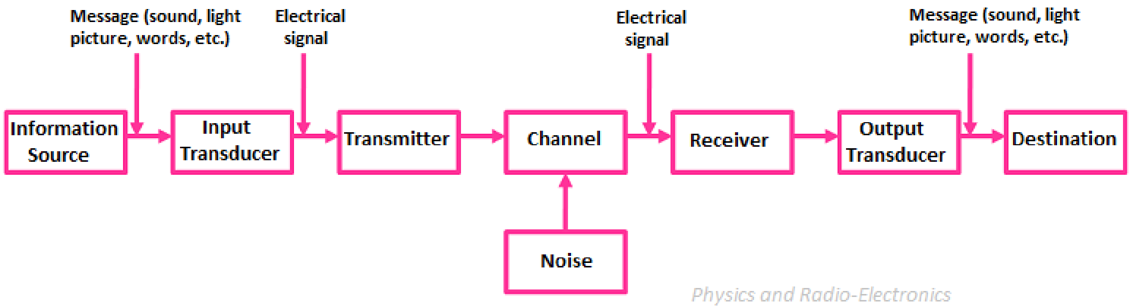
- **Sensors**: Convert physical quantities into electrical signals.
- **7-Segment LED Display**: Numeric display using seven LEDs to represent digits.



Q9. Communication System and Noise

a) Basic Communication System

- **Diagram**: Includes transmitter, channel, and receiver.



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- **Explanation**: A communication system establishes a link between a sender (transmitter) and a receiver to transfer information. This process starts with an information source that generates the data to be sent, such as voice or text. Since some forms of information, like sound, cannot travel far directly, they first pass through an input transducer (e.g., a microphone) to convert non-electrical signals into electrical signals for transmission.

- The transmitter then processes and modifies this signal using modulation to strengthen it for travel through a communication channel. Channels can be wired (like coaxial cables) or wireless (like air), but they may weaken the signal due to interference or distance, a process called attenuation. To combat this, amplifiers are used at various points to boost the signal strength.

- During transmission, signals often pick up noise, unwanted disturbances that degrade the information quality. At the receiving end, the receiver captures the signal from the channel and uses an output transducer (like a loudspeaker) to revert it to its original form, such as sound or light. Finally, the destination is where humans consume or interpret the transmitted information, like watching TV or listening to music.

- Each part of the communication system, from input transducers to receivers, plays a crucial role in effectively transferring information across distances.

b) Types of Noise

1. **Thermal Noise**: Caused by thermal agitation of electrons.
2. **Intermodulation Noise**: Arises from non-linearities in devices.
3. **Cross-Talk**: Signal interference between adjacent channels.
4. **Impulse Noise**: Short bursts of noise from external disturbances.

Q10. Multiplexing, Communication Techniques, and Modulation

a) Multiplexing

- **Definition**: Technique to transmit multiple signals over a single channel.
- **Types**: Time-Division Multiplexing (TDM), Frequency-Division Multiplexing (FDM), Code-Division Multiplexing (CDM).

b) Multiple Access Techniques

- **TDMA (Time Division Multiple Access)**: Divides time into slots for each user.
- **FDMA (Frequency Division Multiple Access)**: Assigns each user a different frequency.
- **CDMA (Code Division Multiple Access)**: Uses unique codes for each user.

c) Need for Modulation

- **Purpose**: Modulation enables long-distance signal transmission by shifting the frequency of the baseband signal to a higher frequency band.