

SCHEME OF VALUATION

Scoring Indicators

Revision : 2015

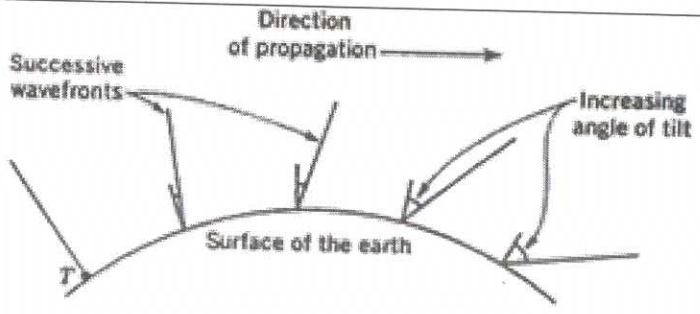
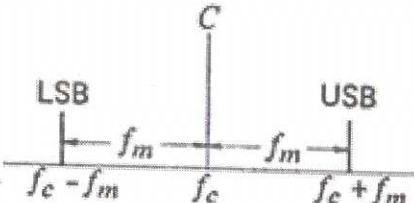
Course Code : 3041

Course : COMMUNICATION ENGINEERING

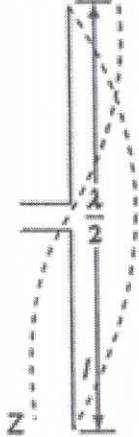
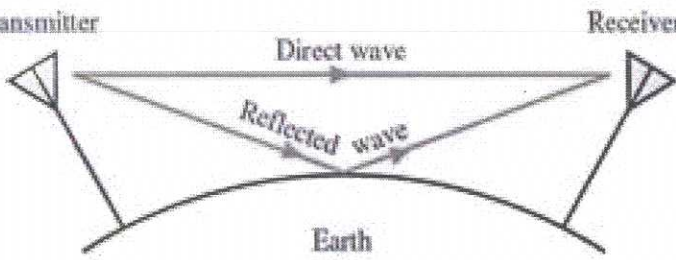
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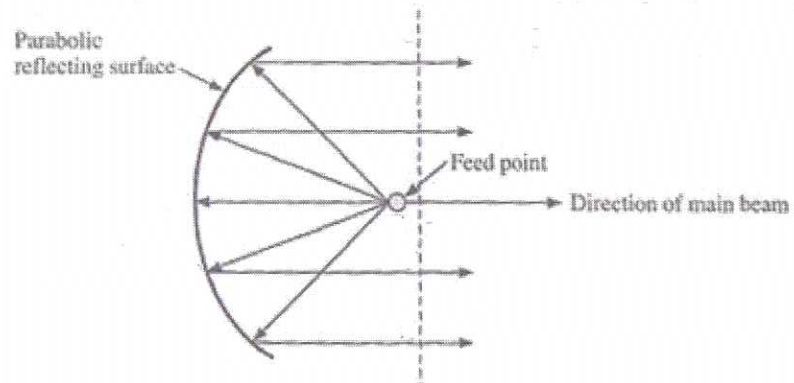
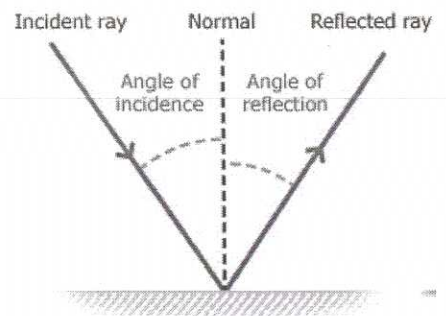
Version : A

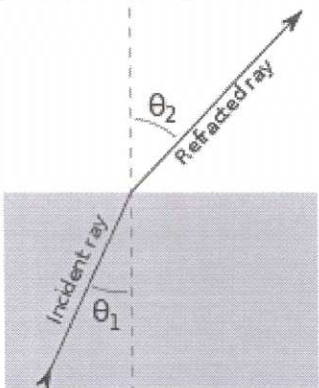
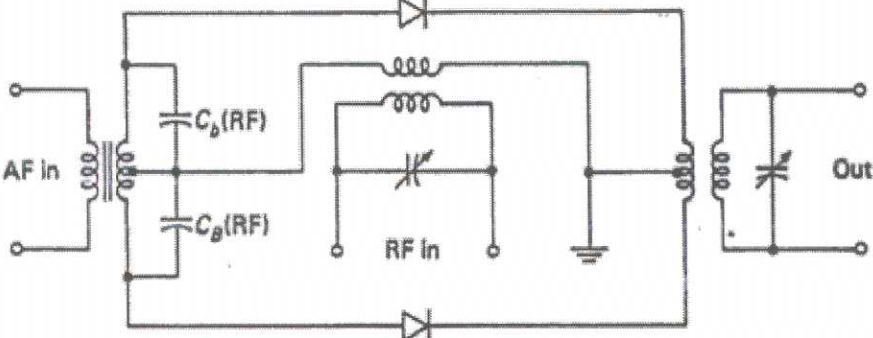
Question No.	Scoring Indicator	Split Score	Sub Total	Total
<u>PART A</u>				
I 1	D, E, F1, F2	2	2	2
I 2	Frequency modulation is the process in which the frequency of the carrier wave is varied in accordance with the instantaneous amplitude of the modulating signal, keeping amplitude and phase of the carrier wave constant.	2	2	2
I 3	The Sampling Theorem states that a signal can be exactly reproduced if it is sampled at frequency f_s , where f_s is greater than or equal to twice the maximum frequency (f_m) in the signal. $f_s \geq 2f_m$	2	2	2
I 4	Signal to noise ratio is the ratio of signal power to noise power.	2	2	2
I 5	Limiter is used in FM receiver to remove any amplitude variation or noise in the received signal.	2	2	2
<u>PART B</u>				
II 1	Critical frequency is the maximum frequency that will be returned to earth at vertical incidence.	2	6	6
	MUF (Maximum Usable Frequency) is the maximum frequency that will be returned to earth at a particular angle of incidence.	2		
	Skip distance is the minimum distance from a transmitter at which a sky wave of fixed frequency is returned to earth.	2		

<p>II 2</p>		3	6	6
<p>The propagation of radio waves over the surface of the earth is called ground wave or surface wave propagation. The transmitting and receiving antennas are close to the earth and are vertically polarized. This propagation becomes weaker as frequency increases, because more absorption of ground waves takes place at high frequency. So this propagation is suitable up to 2 MHz. It is used for short distance communication.</p>		3		
<p>II 3</p>		3	6	6
<p>Frequency components of an AM wave are carrier frequency (ω_c) with amplitude E_c, upper side band ($f_c + f_m$) having amplitude $m_a E_c/2$ and lower side band ($f_c - f_m$) having amplitude $m_a E_c/2$.</p>		3		
<p>II 4</p>	<p>Increasing the amplitude of the high frequency components of the message signal before modulation is termed as Pre-emphasis. It is done at the transmitter side. Pre-emphasis circuit is a high pass filter or differentiator which allows high frequencies to pass</p>	3	6	6
<p>Reducing the amplitude level of the received high frequency signal by the same amount as the increase in pre-emphasis is termed as De-emphasis. It is done at the receiver side. De-emphasis circuit is a low pass filter or integrator which allows only low frequencies to pass.</p>		3		

<p>II 5</p>		<p>3</p>	<p>6</p>	<p>6</p>
	<p>AFC circuit is used to stabilize the frequency of FM signal. A fraction of the output is taken from the limiter and fed to a mixer, which receives another signal from crystal oscillator. The resulting difference signal provides a dc voltage to correct any change in the master oscillator frequency.</p>	<p>3</p>		
<p>II 6</p>		<p>3</p>	<p>6</p>	<p>6</p>
	<p>The diode detector detects the envelope of the AM signal. It consists of a rectifier and a low pass filter. The capacitor charges to a voltage equal to the peak voltage of the incoming AM waveform. When the input wave's amplitude increases, the capacitor voltage is increased. When the input's amplitude falls, the capacitor voltage is reduced by being discharged by the resistor.</p>	<p>3</p>		

II 7	AM Receiver	FM Receiver	1x6	6	6	
	Frequency range 535- 1065 KHz	Frequency range 88-108 MHz				
	IF 455 KHz	IF 10.7 MHz				
	Detector used for demodulation	Discriminator used for demodulation				
	De-emphasis not used	De-emphasis used				
	Limiter not used	Limiter used				
	AGC bias from detector	AGC bias from limiter				
PART C				5	9	15
III a				4		
	<p>The half wave dipole is formed from a conducting wire which is half wavelength long. It is fed at the centre where the impedance falls to its lowest value of 73Ω. The voltage and current levels vary along the length of the antenna. The current at the edges is zero, but the voltage is at its maximum. The current reaches a maximum and the voltage a minimum at the centre. It is used in radio and television receivers.</p>					
III b				3	6	

	<p>Space waves are radio waves of very high frequency (above 30 MHz). Space wave propagation is also called Line-of-sight (LOS) propagation. In line of sight propagation, a space wave travels in a straight line from transmitting antenna to the receiving antenna. So the two antennas must be able to see each other. Space wave has two components – direct wave and indirect wave. Direct waves travel directly from the transmitting antenna to the receiving antenna. Indirect waves reach the receiver after reflection from the ground. So it undergoes a phase shift of 180°.</p>	3		
IV a		5	9	15
	<p>In the transmission mode, the signal from the feed (horn antenna) which is placed at the focus illuminates the parabola. The parabola reflects the wave parallel to the parabolic axis. In the receiving mode, when the wave hits the parabola, the wave gets reflected to the focal point. The horn antenna at its focus receives the signal.</p>	4		
IV b		2	6	
	<p>Bouncing back of a light ray after hitting any surface is known as reflection.</p>	1		

		2	
	<p>Refraction is the change in the direction of propagation of light as it passes from one medium to another medium of different refractive indices.</p>	1	
V a	 <p>The diode in the balanced modulator use the nonlinear resistance property for producing modulated signals. Carrier voltage is applied in phase at both the diodes, while modulating voltage appears 180° out of phase at the diode inputs as they are at opposite ends of a center tapped transformer. The modulated output currents of the two diodes are combined in the center tapped primary of the output transformer, which then gets subtracted. The output of the balanced modulator contains two sidebands.</p> <p>The input voltage at diode D1 is $(v_c + v_m)$ and input voltage at diode D2 is $(v_c - v_m)$.</p> <p>The primary current of the output transformer is $i_1 = i_{d1} - i_{d2}$</p>	5	9 15
		4	

Where,

$$i_{d1} = a + b(v_c + v_m) + c(v_c + v_m)^2 \text{ and}$$

$$i_{d2} = a + b(v_c - v_m) + c(v_c - v_m)^2$$

Thus,

$$i_1 = i_{d1} - i_{d2}$$

$$= 2b v_m + 4c v_m v_c$$

The modulating and carrier voltage are represented as,

$$v_m = V_m \sin \omega_m t \text{ and } v_c = V_c \sin \omega_c t$$

$$i_1 = 2b V_m \sin \omega_m t + 4c m V_c^2 \cos(\omega_c - \omega_m) t - 4c m V_c^2 \cos(\omega_c + \omega_m) t$$

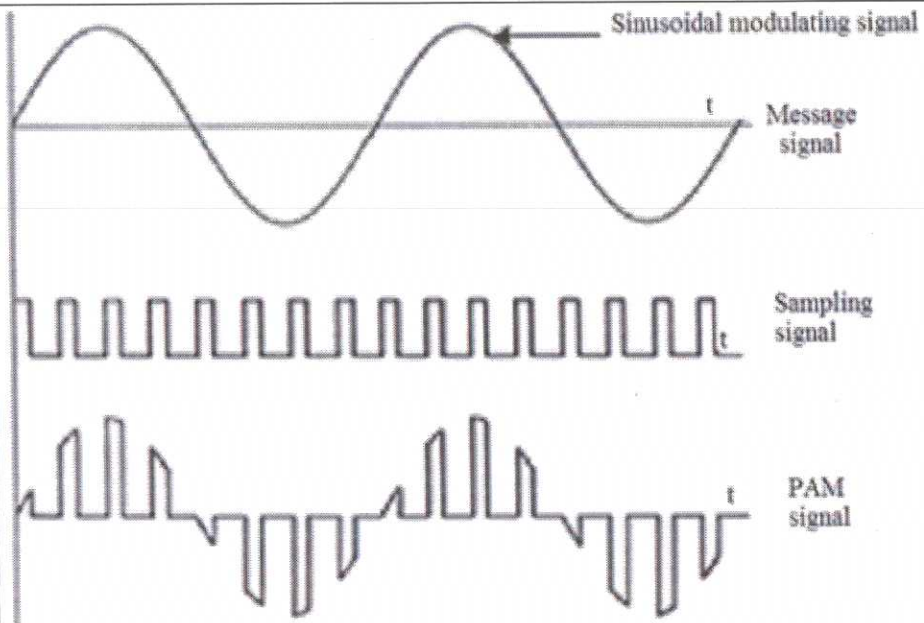
The output voltage is

$$v_0 = \alpha i_1$$

$$= 2\alpha b V_m \sin \omega_m t + 4\alpha c m V_c^2 \cos(\omega_c - \omega_m) t - 4\alpha c m V_c^2 \cos(\omega_c + \omega_m) t$$

The above equation shows that carrier has been cancelled out, leaving only two sidebands and the modulating frequency. The modulating frequency from the output is eliminated by the tuning of the output transformer.

V b



3

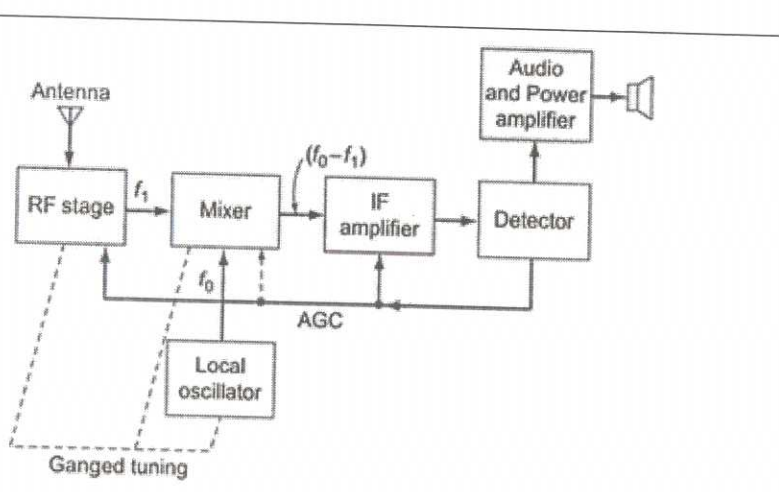
6

	<p>PWM</p>	3		
VI a	<p>Let the modulating signal be</p> $e_m(t) = E_m \cos \omega_m t$ <p>Let the carrier signal be</p> $e_c(t) = E_c \cos \omega_c t$ <p>Amplitude of AM wave is</p> $A = E_c + e_m(t)$ $= E_c + E_m \cos \omega_m t$ $= E_c [1 + (E_m / E_c) \cos \omega_m t]$ $= E_c [1 + m_a \cos \omega_m t]$ <p>The general expression for AM signal is</p> $e_{AM}(t) = A \cos \omega_c t$ $= E_c [1 + m_a \cos \omega_m t] \cos \omega_c t$ $= E_c \cos \omega_c t + m_a E_c \cos \omega_m t \cos \omega_c t$ $= E_c \cos \omega_c t + (m_a E_c / 2) \cdot \cos (\omega_c + \omega_m) t + (m_a E_c / 2) \cdot \cos (\omega_c - \omega_m) t$	9	9	15
VI b	<p>Reduction in height of antenna</p> <p>Avoids mixing of signals</p> <p>Multiplexing is possible</p> <p>Increases range of communication</p> <p>Effect of noise is reduced</p> <p>Improves quality of reception</p>	6	6	

VII a	<p style="text-align: center;">PHASE MODULATOR</p>	5	9	15
	<p>In this method, FM is obtained through phase modulation. The crystal oscillator generates the carrier at low frequency which is applied to the balanced modulator. The modulating signal is also applied to the balanced modulator. The balanced modulator produces two side bands. The 90° phase shifted carrier and sidebands are added in the adder. The output of the adder is a NBFM wave. This wave has a low frequency and low modulation index. The first frequency multiplier converts NBFM to WBFM. The mixer shifts WBFM to a suitable frequency band. The second frequency multiplier is used to increase frequency deviation. FM signal is then passed through a power amplifier to raise the power level of the FM signal.</p>	4		
VII b	<p>Filtering Pre-emphasis and de-emphasis Impedance matching Increase signal power Decrease noise power</p>	6	6	
VIII a		5	9	15

	<p>The carrier oscillator generates the carrier signal. Buffer amplifier matches the output impedance of the carrier oscillator with the input impedance of the frequency multiplier. It also isolates the carrier oscillator and frequency multiplier. This is required so that the multiplier does not draw a large current from the carrier oscillator. If this occurs, the frequency of the carrier oscillator will not remain stable. The frequency multiplier generates higher harmonics of carrier oscillator frequency. The power of the carrier signal is then amplified in the power amplifier stage.</p> <p>The audio signal to be transmitted is obtained from the microphone. The audio driver amplifier amplifies the voltage of this signal. This amplification is necessary to drive the audio power amplifier. Class A or a class B power amplifier amplifies the power of the audio signal. The modulating audio signal and the carrier signal, after power amplification, are applied to this modulated class C power amplifier. The modulation takes place at this stage. The class C amplifier also amplifies the power of the AM signal to the required transmitting power. This signal is passed to the antenna, which radiates the signal.</p>	4		
VIII b	<p>External noise is the noise created outside the receiver.</p> <ul style="list-style-type: none"> • Industrial noise (Man-made noise) • Atmospheric noise • Extraterrestrial noise <p>Industrial noise (Man-made noise) -It is caused by human made electrical sources (motors, generators and ignition).</p> <p>Atmospheric noise - It is due to naturally occurring disturbances in earth's atmosphere such as lightening.</p> <p>Extraterrestrial noise - It is electrical noise due to solar and cosmic activity.</p>	6	6	

IX a		5	9	15
	<p>RF amplifier selects the desired signal frequency and removes the unwanted frequency signals. The signal is then applied to the mixer along with the local oscillator signal where the wanted signal is converted down to the intermediate frequency (10.7 MHz). IF section consists of a series of IF amplifiers and band pass filters to achieve receiver gain and selectivity. Limiter removes the amplitude variations in the FM signal. Discriminator section converts the IF signal back to the original message. De-emphasis section compensates for the amplitude boosting of the high frequency components in the transmitter. The audio amplifier amplifies the demodulated signal. AGC circuit is used to adjust the gain of the receiver in accordance with the received signal strength.</p>	4		
IX b	<p>Intermediate frequency (IF) should be carefully chosen as</p> <ul style="list-style-type: none"> - High IF results in poor selectivity and therefore poor rejection of adjacent channels. - High IF increases difficulty in tracking of signals in the receivers. - Low IF results in poor image frequency rejection. - Low IF makes selectivity too sharp resulting in cutting of wanted side bands. - Low IF results in frequency variation of local oscillator signal. Hence frequency stability of local oscillator should be high. - IF must not fall within the tuning range of the receiver. 	6	6	

X a		5	9	15
	<p>RF amplifier selects the desired signal frequency and removes the unwanted frequency signals. The signal is then applied to the mixer along with the local oscillator signal. The mixer produces a constant difference frequency component of 455 KHz. This is the intermediate frequency and the principle is called super heterodyning. The tuning capacitors used in RF amplifier, local oscillator and mixer are ganged together. IF section consists of a series of IF amplifiers and band pass filters to achieve receiver gain and selectivity. The detector converts the IF signal back to the original message. The audio amplifier amplifies the demodulated signal. AGC circuit is used to adjust the gain of the receiver in accordance with the received signal strength.</p>	4		
X b	<p>Selectivity – It is the ability to accept the desired band of frequency and reject all other unwanted frequencies.</p> <p>Fidelity - Fidelity of a receiver is its ability to reproduce the exact replica of the transmitted signals at the receiver output.</p> <p>Sensitivity - Sensitivity of a receiver is its ability to identify and amplify weak signals at the receiver output.</p> <p>Noise Figure – It is the ratio of S/N ratio at the input to the S/N ratio at the output expressed in decibel.</p>	6 (an y thre e)	6	