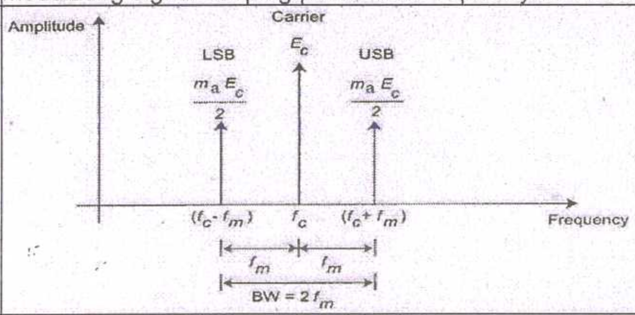
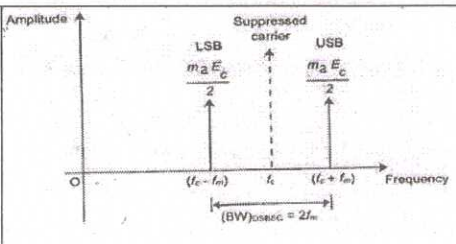
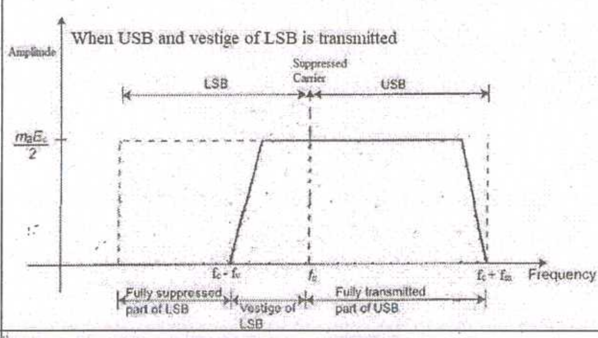
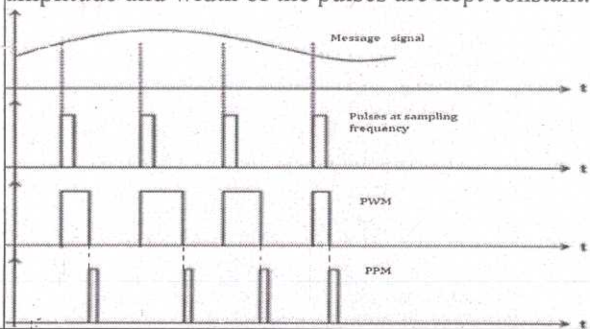
Scoring Indicators

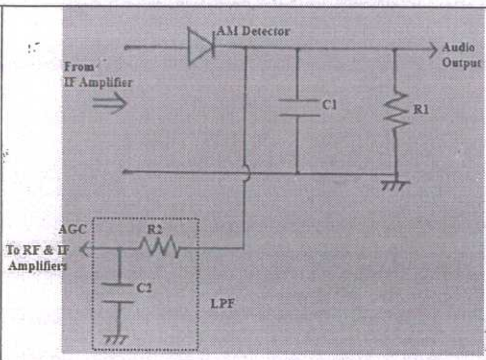
COURSE NAME : PRINCIPLES OF ELECTRONIC COMMUNICATION

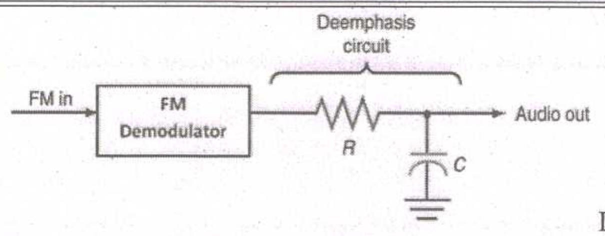
COURSE CODE : 3042 **QID :** 2110220221

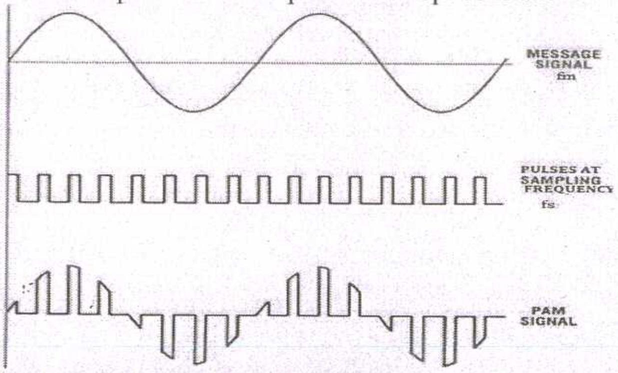
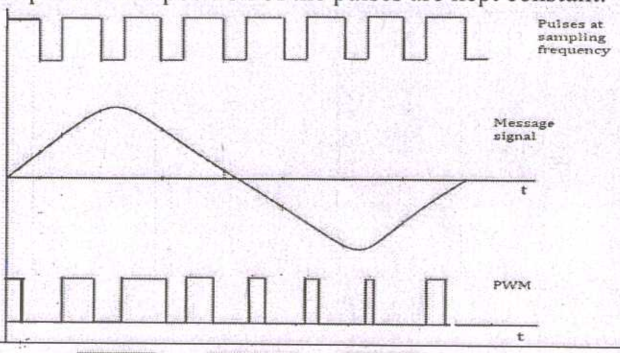
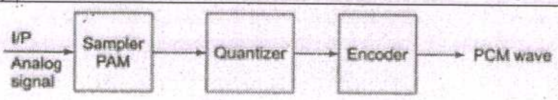
Q No	Scoring Indicators	Split score	Sub Total	Total score
	PART A			**9**
I. 1	It is a modulation in which the amplitude of the carrier wave is changes according to the instantaneous amplitude of the modulating signal keeping phase and frequency as constant.		1	
I. 2			1	
I. 3	Modulation index of FM is defined as the ratio of maximum frequency deviation of FM signal to the modulating signal frequency. $mf = \Delta f / fm$		1	
I. 4	The minimum required sampling rate fs = 2fm is called Nyquist rate.		1	
I. 5	An antenna is a specialized transducer that converts radio-frequency (RF) fields into alternating current (AC) or vice-versa. (Antenna is a means for radiating and receiving electromagnetic energy)		1	
I. 6	It is the ratio of signal power to the noise power at the receiver section.		1	
I. 7	Class C mode		1	
I. 8	Sensitivity of a receiver is its ability to receive and amplify even weak signals.		1	
I. 9	Automatic Frequency Control		1	
	PART B			24
II. 1	* Telemetry, radar and seismic prospecting, EEG monitoring of new-born's etc. also use the technique of frequency modulation. * Frequency modulation can be used for the broadcasting of FM radio. This helps in larger signal to noise ratio. * It is also used in music synthesis, some systems that use video-transmission and also for magnetic tape-recording systems.	1 x3	3	
II. 2		1.5 x 2	3	

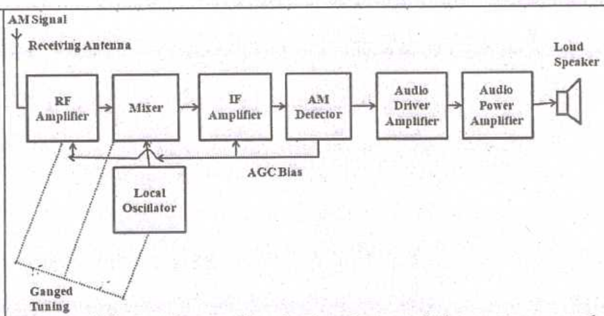
<table>
<tr><td></td><td>


</td><td></td><td></td><td></td></tr>
<tr><td>II. 3</td><td>Pulse Position Modulation (PPM)
In PPM, the message signal is sampled at regular intervals of time and the position of each sample is made proportional to the amplitude of the message signal at the instant of sampling. The amplitude and width of the pulses are kept constant.

</td><td>1+2(fig)</td><td>3</td><td></td></tr>
<tr><td>II. 4</td><td>Radiation pattern, Directivity, Radiation resistance and Efficiency, Power gain, Bandwidth, Reciprocity, Effective aperture</td><td>Any three</td><td>3</td><td></td></tr>
<tr><td>II. 5</td><td>• Available to run at high frequency
• Low interference with other microwaves
• Can be engineered for specific applications
• Accurate, low noise signals
• Very low power requirements
• Doesn't need repeaters
• Works in space
• Antennas are versatile</td><td>0.5x6</td><td>3</td><td></td></tr>
<tr><td>II. 6</td><td>• 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 prevents the frequency multiplier from drawing a large current from the carrier oscillator, thus maintaining the stability of the carrier frequency.</td><td></td><td>3</td><td></td></tr>
</table>

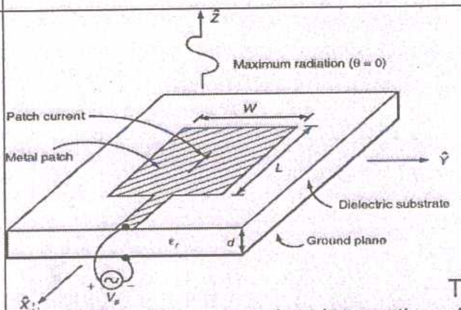
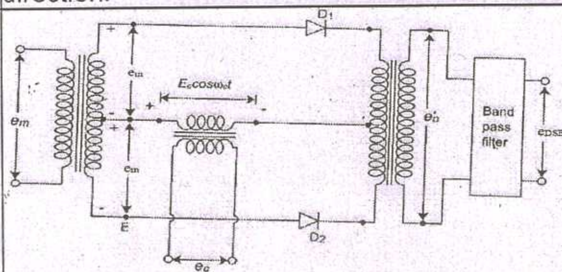
II.10	 In simple AGC, AGC bias starts to increase as the received signal level exceeds the noise level. AM detector produces a dc level that is proportional to the message signal. Low pass filter removes the audio signal producing a dc voltage. This dc voltage forms the AGC bias correction voltage. AGC bias is used to control the gain of RF and IF amplifiers by applying it to the base of the transistor. When the incoming signal level increases, AGC bias increases which reduces the gain of RF and IF amplifiers	2 +1	3	
	PART C			42
III. 1	Let the modulating signal be $e_m(t) = E_m \cos \omega_m t$ where $e_m(t)$ is the instantaneous amplitude of modulating signal Em is the maximum amplitude of modulating signal ω_m is the angular frequency of modulating signal Let the carrier signal be $ec(t) = Ec \cos \omega c t$ where $e_c(t)$ is the instantaneous amplitude of carrier signal Ec is the maximum amplitude of carrier signal ωc is the angular frequency of carrier signal FM signal is $eFM(t) = Ec \cos \theta_{FM}$ Frequency of FM signal is $f_{FM} = f_c + k_f em$ where kf is the proportionality constant Multiplying by 2π on both sides, $2\pi fFM = 2\pi fc + 2\pi kf Em \cos \omega mt$ $\omega_{FM} = \omega_c + 2\pi kf Em \cos \omega mt$ $\theta_{FM} = \int \omega_{FM} dt$ $= \int (\omega_c + 2\pi kf Em \cos \omega mt) dt$ $= \omega_c t + (2\pi kf E_m)(\sin \omega_m t / \omega_m)$;$\omega_m = 2\pi fm$ $= \omega_c t + (2\pi kf Em / 2\pi fm) \sin \omega mt$ $= \omega_c t + (kf Em / fm) \sin \omega mt$ Frequency deviation, $\Delta f = kf Em$ $\theta_{FM} = \omega_c t + (\Delta f / fm) \sin \omega mt$ Modulation index of FM, $m_f = \Delta f / f_m$ $\theta_{FM} = \omega_c t + mf \sin \omega mt$ $eFM(t) = Ec \cos \theta_{FM}$ $= Ec \cos (\omega_c t + mf \sin \omega mt)$		7	7
III. 2	Total transmitted power in AM is $P_t = P_C + P_{USB} + P_{LSB}$ where P_C is the carrier power P_{USB} is the Upper Sideband power		7	7

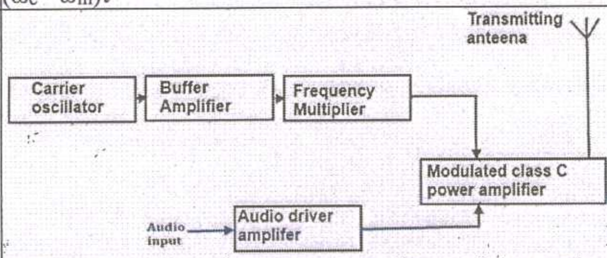
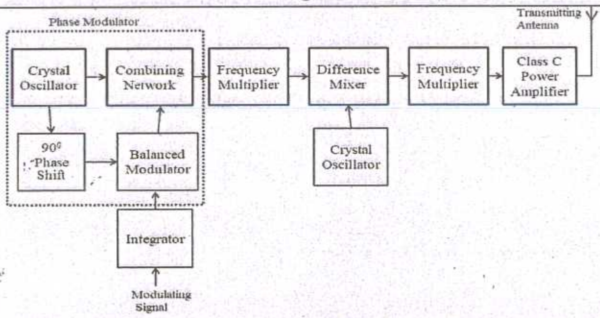
II. 7	 De-emphasis circuit is a low pass filter or integrator which allows only low frequencies to pass. It restores the original amplitude of the modulating signal	2+1	3	
II. 8	Noise is divided into two broad categories. External noise and Internal noise **External Noise** External noise is the noise introduced in the transmission channel. External noise is classified into Industrial noise Atmospheric noise Extra terrestrial noise **Internal Noise** Internal noise is the noise introduced inside the receiver itself. Internal noise is classified into Thermal noise Shot noise Transit-time noise Flicker noise		3	
II.9	Fidelity - Fidelity of a receiver is its ability to reproduce the exact replica of the transmitted message signal after demodulation Noise Figure – It is the ratio of S/N ratio at the input of the receiver to the S/N ratio at the output of the receiver.	1.5 x 2	3	

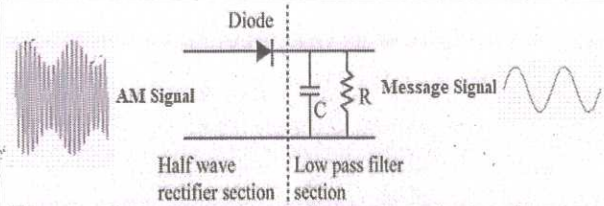
	PLSB is the Lower Sideband power $P_t=(E_c\sqrt{2/})2R+(_{m_aE_c}2\sqrt{2/})2R+(_{m_aE_c}2\sqrt{2/})2R$ $P_t= E_c2 2R+m_a2E_c2 8R+m_a2E_c2 8R$ $P_t= E_c2 2R+m_a2E_c2 4R$ $P_t= E_c2 2R[1+m_a2 2]$ $P_t= P_c[1+m_a2 2]$			
III. 3	Pc = 8KW = 8 x 1000 W = 8000 W Pt = 10.12 KW = 10.12 x 1000 W = 10120 W Pt = Pc (1 + $(m_a)_2$/2) 1 + $(m_a)_2$/2 = Pt / Pc $(m_a)_2$/2 = (Pt / Pc) – 1 $(m_a)_2$ = 2[(Pt / Pc) – 1] ma = √2[(Pt / Pc) – 1] ma = 0.72	1 1 1 1 1 1 1	7	7
III. 4	**Pulse Amplitude Modulation (PAM)** In PAM, the message signal is sampled at regular intervals of time and the amplitude of each sample is made proportional to the amplitude of the message signal at the instant of sampling. The width and position of the pulses are kept constant  **Pulse Width Modulation (PWM)** In PWM, the message signal is sampled at regular intervals of time and the width of each sample is made proportional to the amplitude of the message signal at the instant of sampling. The amplitude and position of the pulses are kept constant.  	3.5 x 2	7	7
III. 5	 Pulse code modulation is a method used to represent sampled analog signals in digital format. The main processes in PCM are Sampling, Quantization and Encoding. These processes produce a series of	4 + 3	7	7

<table>
<tr><td>III. 10</td><td>

RF
RFamplifier selects the desired signal frequency and removes the unwanted frequency signals.
The local oscillator generates a frequency component in accordance with the incoming signal frequency by capacitive tuning.
The mixer produces a constant difference frequency component of 455 KHz by capacitive tuning. This difference frequency component 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 amplifier provides enough amplification of IF.
The AM detector demodulates the AM signal back to the original message.
The audio driver amplifier amplifies the voltage of the message signal.
The power amplifier amplifies the power of the message signal which is then fed to loudspeaker.
AM detector provides the dc bias for AGC. AGC is used to adjust the gain of the RF and IF amplifiers in accordance with the received signal strength.</td><td>4 + 3</td><td>7</td><td>7</td></tr>
<tr><td>III. 11</td><td><table>
<tr><th>AM Receiver</th><th>FM Receiver</th></tr>
<tr><td>More susceptible to noise</td><td>Less susceptible to noise</td></tr>
<tr><td>Operating Frequency range 535- 1605 KHz</td><td>88-108 MHz</td></tr>
<tr><td>IF 455 KHz</td><td>IF 10.7 MHz</td></tr>
<tr><td>Detector is used for demodulation</td><td>Discriminator is used</td></tr>
<tr><td>De-emphasis is not used</td><td>De-emphasis is used</td></tr>
<tr><td>Amplitude Limiter is not used</td><td>Amplitude Limiter is used</td></tr>
<tr><td>AGC bias is obtained from detector</td><td>AGC is from amplitude limiter</td></tr>
</table></td><td>1 x 7</td><td>7</td><td>7</td></tr>
<tr><td>III. 12</td><td></td><td>4 + 3</td><td>7</td><td>7</td></tr>
</table>

	digits, each digit represented as a binary code. This forms a PCM signal. The analog message signal is sampled at regular intervals of time and the amplitude of each sample is made proportional to the amplitude of the message signal at the instant of sampling. The total amplitude range of the signal is divided into a number of standard levels. The number of levels is a power of 2. The samples are approximated to the nearest standard level amplitude to form a digit. This process is called quantization. The digits are the converted to binary pulses using an encoder. Thus PCM signal consist of a series of binary coded pulses.			
III. 6	 The microstrip antenna was invented to allow convenient integration of an antenna and other driving circuitry of a communication system on a common printed-circuit board or a semiconductor chip. The integrated-circuit technology for the antenna fabrication allowed high dimensional accuracy, which was otherwise difficult to achieve in traditional fabrication methods. Microstrip antenna consists of a dielectric substrate of certain thickness *d*, having a complete metalization on one of its surfaces and of a metal "patch" on the other side. The substrate is usually thin ($d \ll \lambda$). The metal patch on the front surface can have rectangular shape is commonly used. One common connection is to feed from a microstrip line, connecting the microstrip antenna at the center of one of its edges. The microstrip line may be connected to a feeding circuitry or directly fed by connecting a signal source across the microstrip line and the ground plane. The microstrip antenna produces maximum radiation in the broadside direction and ideally no radiation in the end-fire direction.	4+3	7	7
III. 7	 Balanced modulator is used for generating DSB-SC signal. It uses non-linear devices such as diode or FET. Modulating signal appears 180_0 phase shifted at the diodes since they are fed to a centre tapped transformer. The carrier voltage is applied to the two diodes in phase. The currents id1 and id2 are therefore flowing in opposite direction. The primary current of the output transformer is $i_p = i_{d1} - i_{d2}$	2 + 2 + 3	7	7

	$= 2 b e_m + 4 c e_c e_m$ The output voltage is $V0 = \alpha\ ip$ $= 2 \alpha b e_m + 4 \alpha c e_c e_m$ The modulating and carrier voltage are represented as, $e_m = E_m \cos \omega_m t$ and $e_c = E_c \cos\omega_c t$ $V_0 = 2 \alpha b E_m \cos\omega_m t + 4 \alpha c E_m E_c \cos \omega_c t \cos\omega_m t$ $= 2 \alpha b E_m \cos\omega_m t + 4 \alpha c E_m E_c [(1/2) \cos (\omega_c + \omega_m)t + (1/2) \cos (\omega_c - \omega_m)t]$ $= 2 \alpha b E_m \cos\omega_m t + 2 \alpha c E_m E_c \cos (\omega_c + \omega_m)t + 2 \alpha c E_m E_c \cos (\omega_c - \omega_m)t$			
III. 8	 Buffer amplifier matches the output impedance of the carrier oscillator with the input impedance of the frequency multiplier. The frequency multiplier increases the frequency of the carrier to the required value. The carrier signal is then applied to the modulated class C power amplifier. The audio driver amplifier amplifies the voltage of the audio message signal. Modulated class C power amplifier generates the AM signal and amplifies the power of the AM signal to the required value. The transmitting antenna radiates the AM signal	4 + 3	7	7
III. 9	 In this method, FM is obtained through phase modulation. If the modulating signal is integrated before it is applied to the phase modulator, the output of phase modulator is a FM signal. The crystal oscillator generates the carrier at low frequency, which is 90° phase shifted and applied to the balanced modulator. The modulating signal is integrated and applied to the balanced modulator. The output of the balanced modulator is a DSB-SC wave. The DSB-SC wave and the original carrier frequency are combined in a combining network to produce a low modulation index, low frequency deviation NBFM (Narrow Band FM). The first frequency multiplier converts NBFM to WBFM (Wide Band FM). The mixer shifts WBFM to a suitable frequency band. The second frequency multiplier is used to increase frequency deviation. The power level of the FM signal is raised to the desired level by the power amplifier. The transmitting antenna radiates the FM signal.	4 + 3	7	7

	 The envelope detector produces an output voltage proportional to the envelope of the AM signal. The envelope is the AM signal. It consists of a half wave rectifier with a capacitor filter. During the positive half cycle, the diode is forward biased and current flows through the circuit. During the negative half cycle, the diode is reverse biased and no current flows through the circuit. Thus a rectified form of AM is available at the cathode of the diode. The capacitor charges upto the peak voltage of the rectified AM. When the AM amplitude decreases, the capacitor discharges. The discharging time depends on RC time constant. By choosing optimum value of RC time constant, output message signal is obtained.			