EEEN 462 -ANALOGUE COMMUNICATION
CONTINUOUS ASSESSMET TEST
Tuesday, 26 August 2025

Answer All 30 Questions

1. For an even periodic function, the Fourier series consists of.....
◯ Only sine terms
◯ Only cosine terms
◯ Both sine and cosine terms
◯ Neither sine nor cosine terms

2. The Fourier series of a real-valued periodic signal has.....
◯ Complex coefficients
◯ Only real coefficients
◯ Symmetric coefficients
◯ Both b and c

3.A 3 dB power gain implies a linear power ratio of .....
◯ 1.5
◯ 2
◯ 3
Explanation: $10\log10(x)=3 \Rightarrow \log10(x)=0.3 \Rightarrow x=10\ 0.3 \approx 2$

4. 0 dBm equals:
◯ 0 W
◯ 1 mW
◯ 1 W
Explanation: dBm references 1 mW (0 dBm = 1 mW).

5. A 20 dB attenuator followed by a 30 dB amplifier has net gain .....
◯ 10 dB
◯ 50 dB
◯ 10 dB

Explanation: 20+30 = 10 dB

6. Which of the following is a significant disadvantage of FDM compared to Time Division Multiplexing (TDM)?
◯ It requires complex synchronization between endpoints.
◯ It is highly susceptible to inter-symbol interference.
◯ It is inefficient in its use of bandwidth due to guard bands and analog filtering.
◯ It cannot be used for digital signal transmission.

Explanation: The need for guard bands and the practical limitations of analog filters (which cannot have perfectly sharp cutoffs) mean that some bandwidth is wasted. This makes FDM less spectrally efficient than TDM, which uses the entire channel bandwidth for one signal at a time in rapid succession

7. What is the fundamental principle that allows QAM to transmit two independent message signals over the same frequency band?

◯ It uses two different carrier frequencies that are very close together
◯ It splits the signal into upper and lower sidebands via filtering.
◯ It utilizes two carrier waves of the same frequency but in phase quadrature (90° phase shift).
◯ It assigns different time slots to each of the two message signals.

Explanation: This is the core concept of QAM. The in-phase (I) carrier (cos(ωt)) and the quadrature (Q) carrier (sin(ωt)) are orthogonal, meaning they can be modulated independently and separated at the receiver without interference, allowing two data streams on one frequency.

8. A QAM **receiver** detects the following symbol over one symbol period: $s(t)=3\cos(\omega_c t)-4\sin(\omega_c t)$. What are the in-phase (I) and quadrature (Q) baseband components that were transmitted?

◯ I = 3, Q = -4
◯ I = 3, Q = 4
◯ I = -3, Q = -4
◯ I = -4, Q = 3

Explanation: The standard form of a QAM signal is: $s(t)=I\cos(\omega ct)-Q\sin(\omega ct)$

- Comparing this directly with the given signal $s(t)=3\cos(\omega ct)-4\sin(\omega ct)$, we can identify the coefficients.
- Therefore, the in-phase component **I = 3**.
- The quadrature component **Q = 4**. (Note: The standard form uses - Q sin, so if the received signal has -4 sin, it implies Q=4).

9. A 1 MHz carrier signal with an amplitude of 40 V is modulated by a 5 kHz sinusoidal wave with an amplitude of 15 V. What is the modulation index and the amplitude of the lower sideband (LSB)?

◯ m = 0.375, LSB Amplitude = 7.5 V
◯ m = 0.375, LSB Amplitude = 2.81 V
◯ m = 0.6, LSB Amplitude = 12 V
◯ m = 0.6, LSB Amplitude = 4.5 V

Explanation:

Modulation Index (m): The modulation index is given by $m = A_m / A_c$, where A_m is the

amplitude of the modulating signal and A_c is the amplitude of the carrier.

- m = 15 V / 40 V = 0.375
- Sideband Amplitude: The amplitude of each sideband (USB and LSB) is given by (m * A_c) / 2.
  - Sideband Amplitude = (0.375 * 40 V) / 2 = (15 V) / 2 = 7.5 V

10. An AM transmitter produces a carrier power of P_c = 1000 W. If the modulation index is 0.5 to 1.0, what is the total transmitted power?

◯ 1000 W
◯ 1125 W
◯ 1250 W
◯ 1500 W

Explanation: The total power in an AM wave is given by P_T = P_c (1 + m^2/2), where P_c is the carrier power.

11. An AM signal is described by the equation: v(t) = 10[1 + 0.8 cos(2π×10^3t)] cos(2π×10^6t). What is the ratio of power in the sidebands to the total power?

◯ 0.113
◯ 0.132
◯ 0.242
◯ 0.471

Explanation:
The power relationship in AM is key. The total power is the sum of carrier power and sideband power: $P_T = P_c + P_{USB} + P_{LSB}$.
The standard form is $v(t) = A_c[1 + m \cos(\omega_m t)] \cos(\omega_c t)$. Comparing, we see A_c = 10 V and m = 0.8.
The power in the sidebands is $P_{sb} = P_c (m^2/2)$.
The total power is $P_T = P_c (1 + m^2/2)$.
Therefore, the ratio is: $(P_{sb} / P_T) = m^2 / (2 + m^2) = (0.8)^2 / (2 + (0.8)^2) = 0.64 / (2 + 0.64) = 0.64 / 2.64 \approx 0.2424$

12. An oscilloscope is used to display the waveform of an AM signal. The peak-to-peak amplitude of the envelope is measured as 12 V, and the minimum amplitude is 4 V. What is the modulation index and the carrier amplitude?

◯ m = 0.5, Ac = 8 V
◯ m = 0.5, Ac = 6.67 V
◯ m = 0.4, Ac = 8 V
◯ m = 0.4, Ac = 10 V

The modulation index can be found from the envelope displayed on an oscilloscope using the formula:
$m = (V_{max} - V_{min}) / (V_{max} + V_{min})$

m = (12 - 4) / (12 + 4) = 0.5

13. What is the mathematical expression for an FM wave?

◯ $s(t) = A_c \cos(2\pi f_c t + \beta \sin(2\pi f_m t))$
◯ $s(t) = A_c [1 + m(t)] \cos(2\pi f_c t)$
◯ $s(t) = A_c \cos(2\pi f_c t) + A_m \cos(2\pi f_m t)$
◯ $s(t) = A_c \sin(2\pi f_c t) \times m(t)$

14. An FM modulator has a sensitivity of k_f = 15 kHz/V. If the modulating signal is $m(t)$ = 2 cos($2\pi 5000t$) volts, what is the bandwidth of the modulated signal as calculated by Carson's rule?

A) 40 kHz
B) 50 kHz
C) 70 kHz
D) 100 kHz

MODEL ANS

The peak frequency deviation is Δf = k_f × |$m(t)$|_max = 15 kHz/V × 2 V = 30 kHz.
The modulation frequency is f_m = 5000 Hz = 5 kHz.
Carson's rule states: Bandwidth ≈ 2(Δf + f_m) = 2(30 kHz + 5 kHz) = 2(35 kHz) = 70 kHz.

15. A 1 MHz carrier is frequency modulated by a sinusoidal test tone of 5 kHz, producing a frequency deviation of 10 kHz. The modulated signal is passed through a series of frequency multipliers with a total multiplication factor of 12. What are the final carrier frequency and modulation index after multiplication?

A) Carrier: 12 MHz, Modulation Index: 2
B) Carrier: 12 MHz, Modulation Index: 24
C) Carrier: 12 MHz, Modulation Index: 1.2
D) Carrier: 1 MHz, Modulation Index: 24

MODEL ANS

Frequency multipliers affect both the carrier frequency and the frequency deviation. The multiplication factor (N = 12) multiplies both parameters.
Final Carrier Frequency = Initial Carrier Frequency × N = 1 MHz × 12 = 12 MHz
Final Frequency Deviation (Δf) = Initial Δf × N = 10 kHz × 12 = 120 kHz
The modulation frequency (f_m = 5 kHz) remains unchanged.
Therefore, the final modulation index (β) = Final Δf / f_m = 120 kHz / 5 kHz = 24.

16. In analog telephony, how many voice channels are typically combined in a basic FDM group?

◯ 12
◯ 24
◯ 60
◯ 600

17. Which modulation technique is most commonly used in analog FDM systems to minimize bandwidth?

◯ Amplitude Modulation (AM)

◯ Frequency Modulation (FM)
◯ Single Sideband Suppressed Carrier (SSB-SC)
◯ Phase Modulation (PM)

18. In the analog telephone hierarchy, what is the frequency range of a basic group?
◯ 0-4 kHz
◯ 60-108 kHz
◯ 312-552 kHz
◯ 564-3084 kHz

19. In a hierarchical FDM system, what is formed by combining five basic groups?
◯ A mastergroup
◯ A supergroup
◯ A hypergroup
◯ A jumbogroup

20. Instrument Landing System (ILS) provides precision guidance for aircraft in: .....
◯ En-route navigation
◯ Approach and landing
◯ Taxiing
◯ Take-off

21. The modulation scheme for ILS localizer signals is .....
◯ DSB-SC with 90 Hz and 150 Hz tones
◯ FM with 90 Hz and 150 Hz tones
◯ AM with 90 Hz and 150 Hz tones
◯ PCM

22. The purpose of interlaced scanning is to .....
◯ Increase resolution
◯ Reduce flicker without doubling bandwidth
◯ Enable colour transmission
◯ Improve audio synchronization

23. The standard PAL channel bandwidth is .....
◯ 4.2 MHz
◯ 5.5 MHz
◯ 6 MHz
◯ 8 MHz

24. FM stereo multiplexing uses a pilot tone at:
◯ 19 kHz
◯ 38 kHz
◯ 67 kHz

◯ 100 kHz

25. The L−R signal in stereo FM is modulated using.....

◯ DSB-SC
◯ SSB
◯ VSB
◯ FM

26. FM broadcasting's frequency range (88–108 MHz) places it in the:

◯ HF band
◯ VHF band
◯ UHF band
◯ SHF band

27. The function of horizontal blanking is to .....

◯ Reset CRT beam from right to left
◯ Insert vertical sync pulses
◯ Transmit audio subcarriers
◯ Enable closed captioning

28. Composite video signals combine .....

◯ Luminance + chrominance + sync
◯ R/G/B + audio
◯ I/Q + luminance
◯ Digital transport streams

29. The primary purpose of a broadcast station's license is to .....

◯ Grant ownership of a specific frequency.
◯ Grant permission to use a specific frequency at a specific location and power for the public interest.
◯ Protect the station's intellectual property.
◯ Allow the station to charge subscription fees.

30. Within the ITU framework, the world is divided into three regions for spectrum planning. Kenya is located in.....

◯ Region 1
◯ Region 2
◯ Region 3
◯ It is not part of this system.