



EEEN 462 – ANALOGUE COMMUNICATION

FM STUDIO BROADCASTING – STUDY GUIDE

1. **FM broadcasting operates in which frequency band?**
 - a) 535–1605 kHz
 - b) 88–108 MHz
 - c) 470–890 MHz
 - d) 2.4–2.5 GHz
2. **The primary advantage of FM over AM is:**
 - a) Longer propagation range
 - b) Better noise immunity
 - c) Smaller bandwidth
 - d) Simpler receiver design
3. **Frequency modulation varies the carrier's _____ according to the message signal.**
 - a) Amplitude
 - b) Frequency
 - c) Phase
 - d) Wavelength
4. **The modulation index (β) for FM is calculated as:**
 - a) $\beta = \frac{\Delta f}{f_m}$
 - b) $\beta = \frac{f_m}{\Delta f}$
 - c) $\beta = \frac{\Delta f}{f_c}$
 - d) $\beta = \frac{f_c}{f_m}$
5. **Carson's rule estimates FM bandwidth as:**
 - a) $B = 2(\Delta f + f_m)$
 - b) $B = 2\Delta f$

- c) $B=f_m$
- d) $B=\Delta f/f_m$

6. **For commercial FM radio, the maximum frequency deviation (Δf) is**

- a) ± 5 kHz
- b) ± 75 kHz
- c) ± 200 kHz
- d) ± 25 kHz

7. **Pre-emphasis in FM transmitters**

- a) Attenuates high frequencies
- b) Amplifies high frequencies
- c) Suppresses the carrier
- d) Reduces harmonic distortion

8. **De-emphasis in FM receivers restores the original signal by**

- a) Amplifying low frequencies
- b) Attenuating high frequencies
- c) Compensating for phase errors
- d) Enhancing signal-to-noise ratio

9. **The capture effect in FM describes:**

- a) Multipath interference reduction
- b) Stronger signals suppressing weaker ones
- c) Automatic frequency control
- d) Stereo channel separation

10. **FM stereo multiplexing uses a pilot tone at:**

- a) 19 kHz
- b) 38 kHz
- c) 67 kHz
- d) 100 kHz

11. **The L-R signal in stereo FM is modulated using.....**

- a) DSB-SC
- b) SSB
- c) VSB
- d) FM

12. A phase-locked loop (PLL) demodulator works by

- a) Comparing phase between carrier and VCO
- b) Envelope detection
- c) Frequency discrimination
- d) Slope detection

13. The primary cause of FM threshold effect is:

- a) Multipath fading
- b) Carrier frequency drift
- c) Insufficient signal-to-noise ratio (SNR)
- d) Adjacent channel interference

14. Commercial FM channel spacing is:

- a) 10 kHz
- b) 100 kHz
- c) 200 kHz
- d) 1 MHz

15. The purpose of a limiter circuit in an FM receiver is to:

- a) Remove amplitude variations
- b) Enhance frequency deviation
- c) Generate the pilot tone
- d) Reduce harmonic distortion

16. Noise in FM is primarily:

- a) Additive and Gaussian
- b) Multiplicative
- c) Impulsive
- d) Phase-distorted

17. Stereo FM's SCA (Subsidiary Communications Authorization) subcarrier is typically at:

- a) 19 kHz
- b) 38 kHz
- c) 67 kHz
- d) 92 kHz

18. A Foster-Seeley discriminator converts FM to AM using:

- a) A tuned circuit with diodes

- b) A PLL
- c) A balanced modulator
- d) A voltage-controlled oscillator

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

- a) HF band
- b) VHF band
- c) UHF band
- d) SHF band

20. **The signal-to-noise improvement ratio in FM is proportional to:**

- a) β^2
- b) β
- c) f_c
- d) f_m

TRUE/FALSE QUESTIONS

- 21. FM signals propagate via ground waves, enabling long-distance reception.
- 22. Pre-emphasis boosts high frequencies before transmission to combat high-frequency noise.
- 23. The modulation index (β) remains constant if both Δf and f_m double.
- 24. FM requires less bandwidth than AM for the same baseband signal.
- 25. Stereo FM decodes the L+R and L–R signals to reconstruct left/right channels.

Short Answer Questions (3 points each)

- 26. **Explain why FM is less susceptible to noise than AM.**
- 27. **Describe how Carson's rule balances bandwidth efficiency and fidelity.**
- 28. **What is the role of the 19 kHz pilot tone in stereo FM?**
- 29. **Explain the threshold effect in FM and its impact on receiver performance.**
- 30. **Compare pre-emphasis/de-emphasis with companding in terms of noise reduction.**

MODEL ANSWERS

Multiple Choice

1. b
2. b
3. b
4. a
5. a
6. b
7. b
8. b
9. b
10. a
11. a
12. a
13. c
14. c
15. a
16. a
17. c
18. a
19. b
20. a

True/False

21. F (FM uses line-of-sight propagation; limited by curvature of Earth)
22. T
23. T ($\beta = \Delta f/f_m$; if both double, β unchanged)
24. F (FM uses wider bandwidth than AM)

25. T

Short Answers

26. **Noise immunity:** FM encodes information in frequency variations, while noise primarily affects amplitude. Limiters remove amplitude noise, and higher modulation indices spread signals over wider bandwidths, diluting noise power.
27. **Carson's rule:** $B \approx 2(\Delta f + f_m)$ ensures ~98% of signal power is retained. Balances fidelity (capturing sidebands) with spectral efficiency by avoiding excessive bandwidth.
28. **Pilot tone purpose:** Synchronizes the receiver's 38 kHz subcarrier oscillator for coherent demodulation of the L-R DSB-SC signal, enabling stereo channel separation.
29. **Threshold effect:** Below a critical SNR, noise dominates, causing "click" artifacts and sudden SNR degradation. Impacts weak-signal reception in fringe areas.
30. **Pre-emphasis vs. companding:**
- **Pre-emphasis:** Boosts high frequencies pre-transmission; de-emphasis attenuates them post-demodulation, reducing high-frequency noise.

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