PHY4E14:COMMUNICATION ELECTRONICS

A Part

1. Define amplitude modulation and derive expression for an AM wave.
2. Discuss about the different types of pulse modulation.
3. Draw the block diagram of communication system and briefly describe the components.
4. Draw the frequency response curve of AM wave and derive expression for band width.
5. Quantitatively illustrate the frequency spectrum of AM wave.
6. Discuss about the different types of digital modulation.
7. Explain the different types of analogue modulation.
8. Enumerate the need for modulation in communication.
9. Define amplitude modulation and draw the graphical representation of an AM envelope
10. Derive the efficiency and redundancy of AM
11. Explain amplitude modulation in detail.
12. Discuss about the different types of continuous wave modulation.
13. Dicuss modulation index of AM wave and its physical significance.
14. Enumerate the significance of channel and repeaters in communication system.
15. Illustrate the working principle of synchronous/coherent detector.
16. How can synchronous detector be used to detect SSBSC ?
17. Briefly explain square law modulator.
18. How can synchronous detector be used to detect DSBSC ?
19. Compare linear and non-linear modulators.
20. Write down the principle of a balanced modulator
21. Illustrate the working principle of envelope detector.
22. Derive the efficiency and redundancy of DSBSC AM
23. Discuss about the factors influencing SNR
24. Derive the expression for total power in DSBSC AM
25. Briefly explain SNR
26. Derive the expression for total power in SSBSC AM
27. Draw the frequency response curve of SSBSC wave and derive expression for band width.
28. Quantitatively illustrate the frequency spectrum of DSBSC AM wave.
29. Differentiate between DSBSC and SSBSC.

30. Derive the efficiency and redundancy of SSBSC AM
31. Draw the frequency response curve of DSBSC wave and derive expression for band width.
32. compare SNR in normal AM,DSBSC and SSBSC AM
33. Quantitatively illustrate the frequency spectrum of SSBSC AM wave.
34. Write a short note on SNR in AM
35. Write a short note on transmission bandwidth in FM.
36. Define instantaneous phase,instantaneous phase deviation and deviation sensitivity
37. Compare direct and indirect FM generation techniques,
38. Explain the frequency spectrum of FM wave using Bessel function.
39. Derive the mathematical equation of PM wave.
40. Derive the mathematical equation of FM wave.
41. Write down the working principle of FET Varactor Diode modulator.
42. Derive average power in FM and PM modulators.
43. Write down the working principle of FET Reactance modulator.
44. Quantitatively illustrate the frequency spectrum of FM wave.
45. Write a short on NBFM and obtain it mathematically.
46. Define instantaneous frequency,instantaneous frequency deviation and deviation sensitivity
47. Write down the working principle of Foster-Seeley discriminator.
48. Compare SNR in AM and FM
49. Write a short note on SNR in FM
50. Differentiate between Foster- Seeley Discriminator and ratio detector.
51. Write down the working principle of ratio detector
52. Discuss the 2 types of PAM based on signal polarity.
53. Compare flat top PAM and Natural PAM.
54. Discuss the advantages and disadvantages of PAM
55. Briefly discuss the different types of analog pulse modulation.
56. What are the advantages and disadvantages of digital communication system
57. Write a short note on elements of digital communication system.
58. Discuss PAM in brief
59. Differentiate between PPM and PWM.
60. Illustrate PAM generation with block diagram.

61. Define sampling and sampling rate
62. Write a short note on sampling process.
63. What do you mean by quantizing an analog signal?
64. Write a short note on PCM
65. Define quantization error and quantization noise.
66. Differentiate between mid-rise type and mid-thread type quantization.
67. State and explain Nyquist theorem.
68. Define quantization. Explain 2 types of quantization.
69. What are the basic elements in PCM?
70. State sampling theorem.
71. Write a short note on teleprinter and telegraph circuits.
72. Explain aliasing in communication .
73. Discuss companding in PCM systems.
74. Draw the block digram of FM receiver and explain the components
75. Write a short note on AM receiver.
76. Draw the block diagram of superheterodyne receiver and briefly explain it
77. Discuss single side band receivers.
78. Write a short note on superheterodyne receiver.
79. Differentiate between single side band and independent side band receivers.
80. Explain the frequency changer in superheterodyne receiver.
81. Explain the RF stage in superheterodyne receiver.
82. Explain the principle of superheterodyne receiver.
83. Discuss independant side band receivers.
84. Write a short note on FM receiver.
85. Draw the block digram of AM receiver and explain the components
86. Write a short note on FM transmitters.
87. Draw the block digram of AM transmitter and explain the components
88. Discuss about television transmitters.
89. Write a short note on AM transmitters.
90. Discuss about telegraph transmitters.
91. Draw the block digram of FM transmitter and explain the components

92. Write a short note on VHF systems.
93. Explain about microwave systems
94. Write a short note on UHF systems.
95. Write a short note on satellite communication systems
96. Explain sampling theorem.
97. Discuss quantization and coding of analog signals.
98. Using suitable block diagram explain the working of digital signal processing systems.
99. Distinguish between continuous-time signals and discrete-time signals. Explain the use of impulse sampler waveform?
100. What is discrete time signal? With suitable examples explain its graphical and functional representations.
101. What is meant by Exponential Discrete Time Signal?
102. Explain the following elementary Discrete Time Signals: a) Unit impulse, b) Unit step signal and c) Unit ramp signal.
103. Explain the tabular and sequence representation of a Discrete Time Signal with suitable examples.
104. Explain the functions of A/D and D/A converters in a DSP system.
105. Explain Delayed and Advanced Discrete time signals with the help of graphical representation of any arbitrary signal x(n).
106. What is meant by periodic signals? How will you find the average power of a periodic signal?
107. Explain Energy signal and Power signals.
108. What is delayed and advanced DT signals?
109. Distinguish between even and odd signals.
110. What is meant by down sampling? Explain with the help of any arbitrary DTS waveform x(n).
111. Write note on folding and shifting of discrete time signals.
112. Distinguish between symmetric and anti-symmetric signals.
113. **Write notes on Stability of LTI systems.**
114. With the help of block representations explain associative and distributive properties of convolution.
115. With the help of block representations explain commutative and associative properties of convolution.
116. With the help of block representations explain commutative and distributive properties of convolution.
117. **Write notes on Causal LTI systems**
118. Explain the properties of convolution.
119. What is the difference between a Hertzian dipole and a short dipole?
120. What do you mean by Radiation Resistance of an antenna?

121. . What do you mean by Hertzian dipole? Explain its importance in radiation theory.
122. . Write notes on Potential formulation of Electrodynamics.
123. Distinguish between near-field and far-field regions.
124. Explain antenna gain and efficiency.
125. Explain the term Gain and directivity.
126. What is radiation pattern? Explain Half Power Beam Width and Beam Width Between First Nulls.
127. Plot the E and H-plane radiation patterns of a half-wave dipole antenna and explain its radiation behavior.
128. Write note on different types of radiation patterns.
129. Explain radiation pattern. What is side-lobe level?
130. What are principal plane patterns? Give its significance.
131. Explain the terms Gain and Effective aperture
132. What is the difference between a Hertzian dipole and a half wave dipole?
133. What is the use of reflector and director elements of a Yagi antenna?
134. What do you mean by Binomial array?
135. What are the properties of log-periodic antennas?
136. Explain the principle of pattern multiplication.
137. Explain the working of Yagi antenna.
138. Distinguish between linear and binomial array.
139. . Explain the principle of antenna arrays using the example of a 2-element array.
140. Explain radio horizon and its importance in communication.
141. Explain Sky waves and Ground waves.
142. Explain the principles of sky wave propagation.
143. Explain the principles of ground wave propagation.
144. What is tropospheric scatter propagation?
145. Distinguish between space waves and sky wave propagation.
146. Explain the principles of space wave propagation.
147. Write notes on Extra-terrestrial communication.
148. **Write notes on different layers of ionospheric and attenuation possibilities of radio waves in these layers.**
149. Distinguish between critical frequency and maximum usable frequency.
150. Explain the mechanism of radio wave reflection from different layers of ionosphere.
151. What is the role of ionospheric layers in radio wave reflection phenomena.

152. Explain virtual height in sky wave propagation.
153. What is meant by critical frequency?
154. What is Secant law in sky wave propagation?
155. What is skip distance?
156. Write note on different layers of ionosphere.

B Part

157. Discuss the theory of amplitude modulation quantitatively .
158. Explain amplitude modulation with multiple sine waves.
159. Quantitatively discuss the multitone amplitude modulation.
160. Derive the mathematical equations for an AM wave and validate the concept with necessary theory.
161. explain square law modulator and product modulator in detail.
162. Explain square law detector and modulator in detail.
163. Discuss DSBSC Both qualitatively and quantitatively.
164. Explain the methods for generation of SSBSC in detail.
165. Explain the filter method and phase shift method for the generation of SSBSC in detail.
166. Discuss SSBSC Both qualitatively and quantitatively.
167. Explain the frequency discriminator method and phase discriminator method for the generation of SSBSC in detail.
168. Explain the theory of angle modulation qualitatively and quantitatively.
169. Explain the the direct methods of FM generation.
170. Discuss the armstrong method of FM generation. How is it different from the direct method of FM generation?
171. Explain Foster-Seeley discriminator. How is it different from ratio detector?
172. Explain the theory Pulse Amplitude modulation
173. Explain the components of digital communication in detail. Give the flowchart of modulation and explain each type.
174. Discuss PAM in detail.
175. Explain the theory Pulse Code modulation
176. Explain sampling and quantization in detail.
177. Discuss PCM in detail.
178. Discuss how sampling and quantization is significant in communication electronics.
179. Explain the superheterodyne receiver, AM receiver and FM receiver in detail.
180. Explain the AM receiver,FM receiver and independent side band receivers in detail.

181. Explain superheterodyne receivers and single side band receivers in detail.

182. Discuss about any 3 types of receivers.

183. Write about AM and television transmitters.

184. Discuss about AM transmitters, FM transmitters .

185. Explain about any 3 transmitters.

186. Write about FM and telegraph transmitters.

187. Explain the principles of Analog to Digital conversion and Digital to Analog conversion.

188. **Explain the working principles of a digital signal processing system. Discuss with the help of suitable circuits/block diagrams the role of A/D and D/A conversion circuits in DSP systems.**

189. **What is meant by LTI system. Explain the response of LTI of any arbitrary signals in terms of convolution. Explain the properties of convolution.**

190. Analyze the radiation characteristics of a Hertzian dipole. How will you combine these dipoles to form a short dipole antenna.

191. Analyze the radiation from an oscillating current element and discuss about the power radiated by it.

192. Analyze the radiation from a Hertzian dipole and obtain expressions for the electric and magnetic field components in the far-field region.

193. Analyze the radiation from a quarter wave monopole antenna. Draw the radiation patterns

194. Derive expressions for the radiated far-field E and H components of a quarter wave monopole antenna. How it differs from that of a half wave dipole radiator?

195. Analyze the radiation from a half wave dipole antenna. Draw the radiation patterns.

196. Explain the principles of linear array and binomial array. Explain the significance of reduction of number of side-lobes in an array antenna.

197. Distinguish between end-fire and broad-side array for isotropic radiating antennas. Analyze the radiation behavior of an n-element array and explain the method for changing its radiation from end-fire to broad-side mode.

198. Explain the working principles of linear array, binomial array and log-periodic array used in radio communication networks.

199. . Starting with a 2-element array, analyze the radiation properties of an n-element array of isotropic antennas.

200. Explain the principles of Ground waves, Sky waves and Space wave propagations in radio wave communication.

201. . Explain different layers of ionosphere. How these layers change during day and night. Explain the mechanism of reflection and transmission of radio waves from different layers of ionosphere in terms of refractive index/ion density and frequency.

202. . Discuss the reflection and refraction of radio waves from Ionosphere. Obtain expressions for critical frequency and maximum usable frequency. What is skip distance?

203. Explain different layers of ionosphere. Discuss the propagation of radio waves through ionosphere and explain the reflection mechanism of waves from different layers in terms of refractive index. Distinguish

between critical frequency and maximum usable frequency.

C Part

204. Derive the expression for AM , power and current relations in AM.

205. An AM amplifier has radio frequency output of 50 W at 100% modulation index with internal loss in modulator 10 W.
A. What is the unwanted carrier power?
B.What power output is required from the modulator?
C. If the percentage modulation is reduced to 75%, how much output is needed from modulator?

206. Find the total modulated power,side power and net modulation index for AM signal expressed in volts
$Y=10\cos(2\pi x10^6 t) + 5\cos(2\pi x10^6 t)\cos(2\pi x10^3 t) + 2\cos(2\pi x10^6 t)\cos(4\pi x10^3 t)$

207. In an AM system, if the modulation index is doubled, find out by what factor the ratio of total sideband power to the carrier power increases?

208. . For an AM wave, the maximum amplitude is found to be 10 V while the minimum amplitude is 6 V. Determine the modulation index and amplitude of original carrier signal.

209. .Prove that in AM, maximum average power transmitted by AM is 1.5 times the carrier power.

210. An audio signal of 1 KHz is used to modulate a carrier 500 KHZ. Determine side band frequencies and band width required.

211. . A carrier frequency of 10 MHz with peak amplitude 10 V is amplitude modulated by a 10 KHz signal of 3 V. Determine the modulation index, amplitude of side bands and frequencies of LSB and USB.

212. The rms antenna current of an AM radio transmitter is 10 A when unmodulated and 12 A when sinusoidally modulated. Calculate the modulation index.

213. The antenna current of an AM broadcast transmitter modulated to a depth of 40% by an audio sine wave is 11 amperes. It increase to 12 amperes as a result of simultaneous modulation by another sine wave. Find the new modulation index.

214. Derive the mathematics of multitone AM.

215. Determine efficiency and the percentage of total power carried by sidebands in AM wave for tone modulation when μ=1,0.5,0.3

216. A carrier wave of frequency f = 1mHz with a pack voltage of 20V is used to modulate a signal of frequency 1kHz with a pack voltage of 10v. Find out the following:
(i) μ
(ii) Frequencies of the modulated wave
(iii) Bandwidth

217. Quantitatively analyse a product/balanced modulator.

218. How can synchronous detector used to detect SSBSC and DSBSC?

219. Quantitatively analyse a square law demodulator.

220. Quantitatively analyse a square law modulator.

221. . Consider the message signal X(t) = cos (2πt) volt and carrier wave c(t) = 50 cos (100πt) Obtain an expression of AM for m = 0.75

222. The amplitude of a sinusoidal carrier is modulated by a single sinusoid to obtain AM signal s(t)= 5 cos 1600πt + 20 cos 1800πt + 5 cos 2000πt. Calculate modulation index.

223. One input to AM modulator is 500 KHZ carrier with an amplitude 20Vp The second input is a 10KHZ signal with amplitude to cause a change in out put wave of 7.5Vp . Determine (a) Upper and lower side frequencies (b) Modulation coefficient and percentage modulation (c) peak amplitude of the modulated carrier and upper and lower side frequency voltages. (d) maximum and minimum amplitude of the envelope.

224. A modulating signal of frequency 5 kHz and peak voltage of 6 V is used to modulate a carrier of frequency 10 MHz and peak voltage of 10 V. Determine 1) modulation index 2) frequency of LSB and USB 3)Amplitude of LSB and USB.

225. Consider the following AM wave y= 10(1 + 0.5 sin $2\pi f_m t$) cos $2\pi f_c t$. Calculate the average side band power.

226. Compare transmission efficiency in normal AM,DSBSC and SSBSC.

227. Derive expressions for SSBSC and DSBSC

228. . The equation of an AM wave is e =100 (1 + 0.6 sin 6280t) sin($2\pi x10^6 t$). Calculate 1) modulation index, 2)frequency of carrier wave 3)frequency of modulating wave and 4) frequency of LSB and USB

229. A modulating signal 10sin (2π x 10^3 t) is used to modulate a carrier signal 10 sin(2π x10^4 t). Find the modulation index, percentage modulation, frequencies of sideband components and their amplitudes and also determine the band width of the modulating signal.

230. A carrier signal c(t) =20 cos($2\pi x10^6 t$) is modulated by a message signal m(t) =20 cos($8\pi x10^3 t$) to generate DSBSC. Calculate band width, total power and modulation index.

231. Use Carson's rule to compute the bandwidth that would be required to transmit a baseband signal with a frequency range from 300 Hz to 3kHz using NBFM with maximum deviation of 5 kHz.

232. In a FM system, if the maximum value of deviation is 75 kHz and the maximum modulating frequency is 10 kHz, calculate the deviation ratio and bandwidth using Carson;s rule.

233. A FM wave is represented by the following equation,

$V = 10 \sin (10^8 t + 3 \sin 10^3 t)$

Find a) carrier and modulating frequencies b) modulation index and maximum deviation c) power transmitted by this FM wave in 10 ohm resistor.

234. Explain Varactor diode modulator.

235. Derive mathematical equation for PM and FM.

236. A FM wave is represented by the following equation,

$V = 10 \sin (5 \times 10^8 t + 4 \sin 1250 t)$

Find a) carrier and modulating frequencies b) modulation index and maximum deviation c) power transmitted by this FM wave in 5 ohm resistor.

237. The carrier frequency of an FM broadcast transmitter is 100 MHz and maximum frequency deviation is 75 kHz. If the highest audio frequency modulating carrier is 15 kHz, what is the approximate bandwidth of the signal

238. Define NBFM. Obtain it mathematically.

239. Determine the percentage modulation for an FM wave with frequency deviation of 10 kHz if the maximum deviation allowed is 25 kHz.

240. Explain FET modulance reactor.

241. Explain Foster - Seeley discriminator.

242. Discuss about Pulse amplitude modulation.

243. Explain quantisation of signals in communication electronics.

244. Explain sampling process in communication electronics.

245. Define PCM. Explain the elements of PCM.

246. Discuss Nyquist theorem and sampling theorem.

247. Explain aliasing and companding in PCM.

248. Explain superheterodyne receiver

249. Discuss about independent side band receivers.

250. Discuss about AM receiver

251. Explain FM receiver

252. Write in detail about AM transmitter.

253. Write in detail about television and telegraph transmitters.

254. Write in detail about FM transmitter.

255. Write in detail about satellite communication.

256. Write in detail about microwave systems.

257. Write a note about UHF and VHf systems

258. Explain sampling theorem using suitable analog waveform and sampling sequence.

259. Discuss the principles of A/D and D/A conversion.

260. Explain using suitable waveforms and block diagrams, the principles of Analogue to Digital conversion.

261. Draw the block diagram for the realization of the Discrete time system,

$y(n) = 0.25\ y(n-1) + 0.5\ x(n) + 0.5\ x(n-1)$.

262. If $x(n) = x_e(n) + x_o(n)$, where 'e' and 'o' stands for even and odd, show that

$x_e(n) = [x(n) + x(-n)]/2$ and $x_0(n) = [x(n) - x(-n)]/2$

263. Obtain the block diagram for the realization of the discrete time system,

$y(n) = 0.5\ y(n-1) + 0.5\ x(n-1) + 2\ x(n)$.

264. Graphically represent the signal

$$\{3, 2, 2, 2, 0, 1, 2, 3, 4\}$$
$$\uparrow$$

Obtain the waveforms of $x(-n)$ and $x(-n + 2)$ using the method of folding and shifting. Represent the results in tabular and functional form.

265. Sketch the block diagram of the digital system
$y(n) = 0.31\ x(n) + 0.72\ x(n-1) + 0.99\ y(n-1)$.

266. Represent the response of LTI systems to arbitrary inputs in terms of convolution sum.

267. The impulse response of a linear time invariant system is given by h(n)

$$h(n) = \underset{\uparrow}{\{1, 2, 1, -1\}}$$

Determine the response of the system to the input signal given by x(n)

$$x(n) = \underset{\uparrow}{\{1, 2, 3, 1\}}$$

268. With the help of suitable block diagrams, explain the properties of convolution.

269. Obtain an expression for the radiation resistance of a Hertzian dipole.

270. Find the radiation resistance of Hertzian dipoles of length λ/20,λ/30and λ/100

271. Find the radiation resistance of Hertzian dipoles of length λ/40,λ/60and λ/80.

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272. Obtain the radiation resistance of a quarter wave monopole antenna.

273. Obtain an expression for the radiation resistance of a half wave dipole.

274. What do you mean by Radiation Resistance of an antenna? Calculate the radiation resistance of a half wave dipole.

275. What do you mean by pattern multiplication? Obtain the radiation pattern corresponding to an array of 8 isotropic antennas using the principle of pattern multiplication.

276. Obtain an expression for the array factor for an n-element array.

277. Analyze an array of n isotropic radiators and find an expression for the array factor.

278. **Determine the range of line-of-sight if the height of the transmitting antenna is 60m and the height of the receiving antenna is 6m. Assume standard atmosphere.**

279. **A communication system is to be established at a frequency of 60MHz with a transmitted power of 1kW. The field strength of the directive antenna is 3 times that of a half-wave antenna. ht = 50m, hr = 5m. A field strength of 80μV/m is required to give satisfactory reception. Find the range of the system.**

280. **What is radio horizon? Find the maximum range of tropospheric transmission for which the height of the transmitting antenna is 100ft and that of receiving antenna is 50ft.**

281. **A receiving antenna is located at 80km from the transmitting antenna. The height of the transmitting antenna is 100m. What is the required height of the receiving antenna?**

282. **Explain radio horizon. Find the maximum height that can be covered by a space wave when the antenna heights are 80m and 50m.**

283. **What is radio horizon of an antenna? Find the radio horizon distance of a transmitting antenna whose height is 80m.**

284. Explain Virtual height and Skip distance. Calculate the critical frequency for E layer with maximum ionic density 1.7x106 /cc.

285. **Determine (a) the radio horizon distance for a transmitting antenna of height 300feet, (b) the radio horizon distance of a receiving antenna with a height of 100feet, and (c) the maximum range of space wave communication for the above antenna heights.**

286. **A sky wave is incident on D-layer at an angle of 30°. Find the angle of refraction if the frequency of the transmitted wave is 50MHz.**

287. For any given ionospheric layer obtain a relation for the highest frequency that will be reflected for vertical incidence.

288. **What is the critical angle of propagation for D-layer if the transmitting and receiving antennas are separated by 500km?**

289. **When the maximum electron density of the ionospheric layer corresponds to refractive index of 0.92 at the frequency of 10MHz, find the range if the frequency is MUF itself. The height of the ray reflection point on the ionospheric layer is 400km. Assume flat earth and negligible effect of earth's magnetic field.**

290. **What is critical frequency? If the critical frequency of an ionized layer is 1.5MHz, find the electron density of the layer.**

291. **Determine the critical frequency of EM wave for D (400electrons/cm^3), E ($5x10^5$ electrons/cm3) and F ($2x10^6$ electrons/cm^3) layers.**

292. **Find out the relative permittivity of D, E and F layers of the ionosphere for an EM wave of frequency 50MHz. The electron density of D layer is 400 electrons/cm^3, E layer is 5x10^5 electrons/cm^3 and F layer is 2x10^6 electrons/cm^3.**

293. **Find the frequency of the propagating wave for D-layer to have refractive index of 0.5.**

294. **For any given ionospheric layer obtain a relation for the highest frequency that will be reflected for vertical incidence.**

D Part

E Part