

# 2020

## **RANK** *Improvement* **WORKBOOK**



**Answer key and Hint of  
Objective & Conventional *Questions***

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**Electrical Engineering  
Communication Systems**



**MADE EASY**  
Publications

# 1

## Amplitude Modulation

### LEVEL 1 Objective Solutions

1. (d)
2. (b)
3. (a)
4. (a)
5. (c)

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### LEVEL 2 Objective Solutions

6. (c)
7. (c)

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**LEVEL 3** Conventional Solutions

**Solution: 1**

(a) 
$$s(t) = A_c [1 + \mu \cos \omega_m t] \cos \omega_c t$$

$$= A_c \cos \omega_c t + \frac{A_c \mu}{2} \cos(\omega_c + \omega_m)t + \frac{A_c \mu}{2} \cos(\omega_c - \omega_m)t$$

(b) Minimum level of the envelope,

Modulation index,

$$E_{\min} = 1 \text{ V}$$

$$\mu = 0.70$$

$$\mu = \frac{E_{\max} - E_{\min}}{E_{\max} + E_{\min}} = \frac{E_{\max} - 1 \text{ V}}{E_{\max} + 1 \text{ V}}$$

$$0.7 E_{\max} + 0.7 \text{ V} = E_{\max} - 1 \text{ V}$$

$$0.3 E_{\max} = 1.7 \text{ V}$$

$$E_{\max} = \frac{1.7}{0.3} \text{ V} = \frac{17}{3} \text{ V}$$

Maximum level of the envelop,  $E_{\max} = \frac{17}{3} \text{ V}$

(c) For an AM signal,

$$P_t = P_c \left( 1 + \frac{\mu^2}{2} \right)$$

Percentage of the total power wasted on the carrier is,

$$\frac{P_c}{P_t} \times 100 = \left( \frac{2}{2 + \mu^2} \right) \times 100\%$$

$$= \left( \frac{2}{2 + (0.49)} \right) \times 100\% = 80.32\%$$

**Solution: 2**

(a) 
$$u(t) = 5 \cos(1800\pi t) + 20 \cos(2000\pi t) + 5 \cos(2200\pi t)$$

$$= 20 \left( 1 + \frac{1}{2} \cos(200\pi t) \right) \cos(2000\pi t)$$

The modulating signal is  $m(t) = \cos(2\pi 100t)$  whereas the carrier signal is  $c(t) = 20 \cos(2\pi 1000t)$ .

(b) Since  $-1 \leq \cos(2\pi 100t) \leq 1$ , we immediately have that the modulation index is  $\alpha = \frac{1}{2}$ .

(c) The power of the carrier component is  $P_{\text{carrier}} = \frac{400}{2} = 200$ , whereas the power in the sidebands is

$$P_{\text{sidebands}} = \frac{400\alpha^2}{2} = 50.$$

Hence,

$$\frac{P_{\text{sidebands}}}{P_{\text{carrier}}} = \frac{50}{200} = \frac{1}{4}$$



# 2

## Angle Modulation

### LEVEL 1 Objective Solutions

1. (d)

2. (d)

3. (c)

4. (c)

5. (d)

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### LEVEL 2 Objective Solutions

6. (b)

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# 3

## Random Variables and Noise

### LEVEL 1 Objective Solutions

1. (a)

2. (b)

3. (c)

4. (b)

5. (a)

6. (d)

7. (d)



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# 4

## Baseband Pulse Modulation

### LEVEL 1 Objective Solutions

1. (b)
2. (0.5)
3. (c)
4. (d)

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### LEVEL 2 Objective Solutions

5. (716.2)
6. (b)
7. (b)



# 5

## Bandpass Digital Transmitter

### LEVEL 1 Objective Solutions

1. (c)

2. (c)

3. (b)

4. (c)

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### LEVEL 2 Objective Solutions

5. (d)

6. (a)

7. (b)

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# 6

## Information Theory and Coding

### LEVEL 1 Objective Solutions

1. (13.7)

2. (14.4)

3. (c)

4. (d)

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### LEVEL 2 Objective Solutions

5. (a)

6. (d)

7. (c)

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