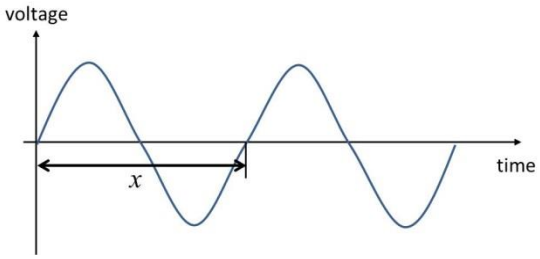
Communications and Sensors

student number: _____

Assessed test 1
Open Book. One hour

Introduction and fundamentals

1. In the diagram, what does the quantity x represent ?



(a) wavelength ☐ (b) amplitude ☐ (c) period ☐ (d) phase ☐

2. A 10 W transmitter is connected to an antenna via a cable which has a loss of 6 dB. How much power reaches the antenna ?

(a) 2.5 W ☐ (b) 1 W ☐ (c) 0.1 W ☐ (d) 5 W ☐

3. A power amplifier in a beacon transmitter has a gain of 16 dB and is fed with an input signal of 10 mW. The output power is:

(a) 20 mW ☐ (b) 40 mW ☐ (c) 200 mW ☐ (d) 400 mW ☐

4. Which has the shortest wavelength ?

(a) VHF ☐ (b) infra-red ☐ (c) visible light ☐ (d) microwave ☐

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(a) VHF ☐ (b) infra-red ☐ (c) visible light ☐ (d) microwave ☐

6. The spectrum of a radio signal would be measured using a

(a) spectrum analyser ☐ (b) slotted line ☐ (c) oscilloscope ☐ (d) wavemeter ☐

7. The 1.3 GHz amateur radio band corresponds to a wavelength of:

(a) 230 m ☐ (b) 23 m ☐ (c) 2.3 mm ☐ (d) 23 cm ☐

8. A radar signal has a mean frequency of 10 GHz and a bandwidth of 300 MHz. The fractional bandwidth is:

(a) 0.3 % ☐ (b) 10 % ☐ (c) 30 % ☐ (d) 3 % ☐

9. A signal power level of +33 dBm is equivalent to:

(a) 2 mW ☐ (b) 33 W ☐ (c) 0.2 W ☐ (d) 2 W ☐

10. Four 1 kΩ resistors connected in parallel give a resistance of:

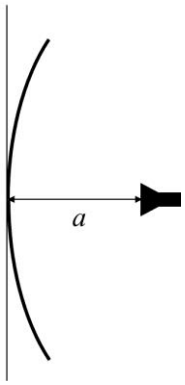
(a) 4 kΩ ☐ (b) 1 kΩ ☐ (c) 250 Ω ☐ (d) 0.25 Ω ☐

Antennas and propagation

11. An antenna that is 10 wavelengths wide has a beamwidth of approximately:

(a) 6° ☐ (b) 10 milliradians ☐ (c) 60° ☐ (d) 20° ☐

12. The diagram shows a parabolic dish. What does a represent?

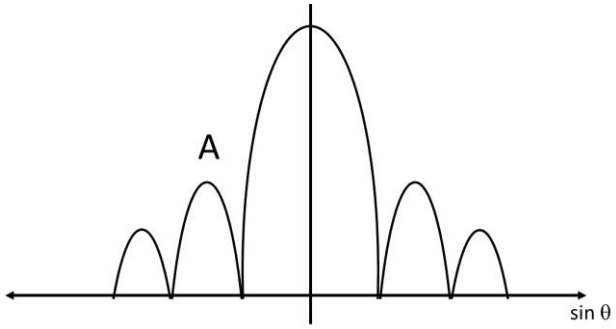


(a) focal length ☐ (b) f/D ratio ☐ (c) diameter ☐ (d) depth ☐

13. A 50 Ω resistive load is connected to the end of a transmission line whose characteristic impedance is 50 Ω. The reflection coefficient is:

(a) 1 ☐ (b) 0 ☐ (c) infinity ☐ (d) −1 ☐

14. The figure shows an antenna radiation pattern. The feature marked A is a:

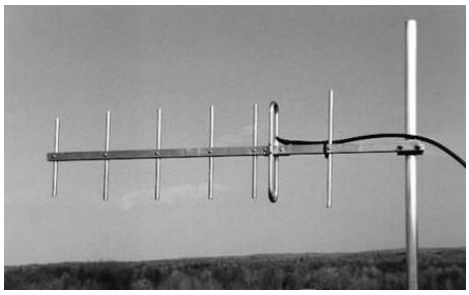


(a) null ☐ (b) ambiguity ☐ (c) sidelobe ☐ (d) backlobe ☐

15. A technique to lower the sidelobes of an antenna is to:

(a) use a higher frequency ☐ (b) increase the size of the antenna ☐ (c) use an amplitude taper ☐ (d) use circular polarisation ☐

16. The antenna in the picture is a



(a) yagi ☐ (b) log spiral ☐ (c) loop ☐ (d) monopole ☐

17. … and its polarisation is

(a) horizontal ☐ (b) vertical ☐ (c) circular ☐ (d) elliptical ☐

18.… and if the length of the dipole elements is 0.35 m, its frequency of operation is approximately:

(a) 30 MHz ☐ (b) 215 MHz ☐ (c) 860 MHz ☐ (d) 430 MHz ☐

19. A technique to reduce the beamwidth of an antenna is to:

(a) use a lower frequency ☐ (b) increase the size of the antenna ☐ (c) use an amplitude taper ☐ (d) use circular polarisation ☐

20. The height of the F-layer of the ionosphere above the Earth's surface is approximately:

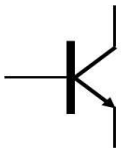
(a) 30 km ☐ (b) 50 km ☐ (c) 300 km ☐ (d) 2000 km ☐

Analogue electronics

21. Which of the following is not a semiconductor ?

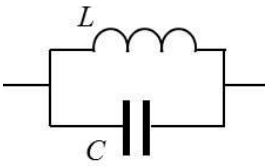
(a) Gallium Arsenide ☐ (b) Germanium ☐ (c) Sulphur ☐ (d) Silicon ☐

22. The diagram shows the circuit symbol for a



(a) diode ☐ (b) FET ☐ (c) triode ☐ (d) junction transistor ☐

23. The diagram shows a capacitor C = 10 pF and an inductor L = 0.1 µH forming a parallel tuned circuit. The resonant frequency is:



(a) 159 MHz ☐ (b) 318 MHz ☐ (c) 15.9 MHz ☐ (d) 159 kHz ☐

24. A current of 10 mA flows through a 100 Ω resistor. The voltage across the resistor is:

(a) 10 mV ☐ (b) 1 mV ☐ (c) 1 V ☐ (d) 0.1 V ☐

25. … and the power dissipated in the resistor is:

(a) 10 mW ☐ (b) 1 mW ☐ (c) 0.1 mW ☐ (d) 100 mW ☐

26. A Field Effect Transistor is fabricated using features 40 nm wide. Approximately how many atoms would this comprise ?

(a) 400 ☐ (b) 200 ☐ (c) 4000 ☐ (d) 20 ☐

27. The Noise Figure of a receiver is:

(a) a measure of the noise power added by a receiver ☐ (b) the noise power per unit bandwidth ☐ (c) the gain of the first the first stage of the receiver ☐ (d) the noise power at the receiver output ☐

28. Dynamic range is

(a) the largest signal that a circuit can detect ☐

(b) the smallest signal that a circuit can detect ☐

(c) the signal-to-noise ratio ☐

(d) the range of signal levels that a circuit can cope with ☐

29. A 1.5 V battery is rated at 1500 mAH. It powers a circuit that consumes 1.5 mW. Approximately how long will the battery last ?

(a) 2 days ☐

(b) 2 weeks ☐

(c) 2 months ☐

(d) 2 years ☐

30. A 1.5 V battery is rated at 1500 mAH. When fully charged, the stored energy is

(a) 5400 J ☐

(b) 8100 J ☐

(c) 3.375 J ☐

(d) 2.25 J ☐

Digital electronics

31. What is the decimal number 76 expressed in binary ?

(a) 11001000 ☐

(b) 01101001 ☐

(c) 11011000 ☐

(d) 01001100 ☐

32. What is the result of the binary addition:

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  0 1 1 1 0 1 0 1
+ 0 1 0 1 0 0 1 1
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(a) 11001000 ☐

(b) 01101001 ☐

(c) 11011000 ☐

(d) 01001100 ☐

33. The logical function represented by the truth table is

A	B	F
0	0	1
0	1	0
1	0	0
1	1	1

(a) $F = A + B$ ☐ (b) $F = A \oplus B$ ☐ (c) $F = \overline{A \oplus B}$ ☐ (d) $F = \overline{A} + \overline{B}$ ☐

34. An audio signal has a bandwidth from 300 Hz to 6 kHz. What is the minimum sampling frequency to ensure correct sampling ?

(a) 5.7 kHz ☐ (b) 6 kHz ☐ (c) 11.4 kHz ☐ (d) 12 kHz ☐

35. The purpose of an anti-aliasing filter is

(a) to remove harmonic frequencies ☐ (b) to remove low frequencies ☐ (c) to remove frequencies that would be incorrectly sampled ☐ (d) to remove unwanted noise ☐

36. A digital processor requires a dynamic range of at least 60 dB. The analogue-to-digital converter that digitises the signal should have at least

(a) 6 bits ☐ (b) 10 bits ☐ (c) 12 bits ☐ (d) 16 bits ☐

37. The output signal from a sensor is digitised by a 10-bit analogue-to-digital converter at a sample rate of 10 kHz. The volume of data generated per hour is:

(a) 100 kbits ☐ (b) 6 Mbits ☐ (c) 60 Mbits ☐ (d) 360 Mbits ☐

38. A memory that stores a fixed set of digital information is called a

(a) FPGA ☐ (b) ROM ☐ (c) HDD ☐ (d) ASIC ☐

39. Digital processing is

(a) reproducible ☐ (b) programmable ☐ (c) miniaturisable ☐ (d) all of these ☐

40. A sample-and-hold is a

(a) type of shift register ☐ (b) type of flip-flop ☐ (c) demultiplexer ☐ (d) circuit used in front of an ADC ☐