2021

ELECTRONICS — HONOURS

Paper : DSE-B-1

(Biomedical Instrumentation)

Full Marks : 50

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer ***question no.* 1** and ***any four*** from the rest.

1. Answer ***any ten*** questions : 1×10

(a) Change in resonant frequency of QCM is proportional to

(i) mass accumulated in crystal. (ii) crystal used.

(iii) time of usage. (iv) charge accumulated in crystal.

(b) CT stands for

(i) Controlled Tomography (ii) Computerised Tomography

(iii) Converted Tomography (iv) Comparison Tomography.

(c) _____ and _____ type transducers are very common.

(i) Mechanical and chemical (ii) Peizo-electric and photoelectric

(iii) Electromagnetic and magnetic (iv) None of these.

(d) How many leads are normally used for ECG detection?

(i) 4 (ii) 8

(iii) 12 (iv) 14

(e) Process of changing resting potential to action potential is known as

(i) Polarization (ii) Re-polarization

(iii) Depolarization (iv) Unipolarization.

(f) Impedance Pneumography is an indirect technique for the measurement of _____ .

(i) Heart rate (ii) Pulse rate

(iii) Respiration rate (iv) Blood flow rate.

(g) Which of the following is used in tomography?

(i) X ray (ii) Gamma ray

(iii) UV ray (iv) IR radiation.

(h) For hydrogen nuclei in a typical 1.5T MRI field, the resonant frequency is approximately

(i) 64 MHz (ii) 68 MHz

(iii) 46 MHz (iv) 86 MHz.

(i) Which transducer is normally used for temperature measurement in a patient monitoring system?

(i) Thyristor (ii) Thermistor

(iii) Thermocouple (iv) Thermometer.

(j) Oximeter is used to measure _____ level of blood.

(i) HbO_2 (ii) SpO_2

(iii) SaO_2 (iv) H_2O_2

(k) What is the frequency of operation of solid-state diathermy machines?

(i) 250 kHz to 1 MHz (ii) 200 kHz to 2 MHz

(iii) 150 kHz to 250 kHz (iv) 250 Hz to 100 kHz.

(l) Which of the following have higher action potential propagation rate?

(i) Heart muscle (ii) Nerve cell

(iii) Thigh muscle (iv) All of these.

2. (a) Describe the origin of bioelectric signals.

(b) Draw a typical cell potential waveform, label it properly and explain the phenomena of depolarization and repolarization. 2+(2+2+2+2)

3. (a) Define a 'Photoelectric Transducer'.

(b) What are the types of photoelectric cells?

(c) Illustrate the principle of a photo-multiplier with the help of a diagram. 2+3+5

4. (a) Explain, in detail, the input circuit of a cardiac monitor.

(b) Describe the importance of the following features :

(i) Electrosurgery interference filter

(ii) Leads off detector

(iii) Quick recovery circuit. 4+(2+2+2)

5. (a) Describe the various scanning techniques used in computed tomography.

(b) What is helical scanning in computed tomography? What is its advantage?

(c) Explain the function of sliprings. 2+(2+2)+4

6. (a) What is the function of a safety analyser?

(b) Explain with the help of a block diagram the method for measurement of chassis leakage current. 3+(3+4)

7. (a) Explain the principle of heating using microwaves.

(b) Describe the working of microwave diathermy machine with the help of a block diagram. 4+(4+2)

8. (a) What is the function of a ventilator?

(b) How many types of ventilators are there? Explain with the help of diagrams. 3+(3+4)

———————

2021

ELECTRONICS — HONOURS

Paper : DSE-B-2

(Transmission Lines, Antenna and Microwave Devices)

Full Marks : 50

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Question no.* 1** is compulsory and answer ***any four from the rest.

1. Answer ***any ten*** questions : 1×10

(a) Indicate the false statement. The SWR on a transmission line is infinity; the line is terminated in

(i) a short circuit. (ii) a complex impedance.

(iii) an open circuit. (iv) a pure reactance.

(b) The velocity factor of a transmission line

(i) depends upon the dielectric constant of the material used.

(ii) increased the velocity along the transmission line.

(iii) is governed by the skin effect.

(iv) is higher for a solid dielectric than for air.

(c) A distortionless line is one in which the attenuation constant α is independent of

(i) Frequency of operation (ii) Length of line

(iii) Material of the line (iv) Conductivity.

(d) An evanescent mode occurs when

(i) a wave is attenuated rather than propagated.

(ii) the propagation constant is purely imaginary.

(iii) m = 0 = n so that all field components vanish.

(iv) the wave frequency is the same as the cut-off frequency.

(e) When a particular mode is excited in a waveguide there appears an extra electric field component in the direction of propagation. The resulting mode is

(i) Transverse-Electric (ii) Transverse-Magnetic

(iii) Longitudinal (iv) Transverse-Electromagnetic.

(f) The wavelength of a wave in a waveguide is

(i) greater than that in free space.

(ii) dependent on the waveguide dimensions and the free space wavelength.

(iii) inversely proportional to the phase velocity.

(iv) directly proportional to the group velocity.

(g) Which of the following is not an omnidirectional antenna?

(i) Half wave antenna (ii) Log – periodic

(iii) Discone (iv) Marconi.

(h) Which of the following antenna is best excited from a waveguide?

(i) Bi-conical (ii) Horn

(iii) Helical (iv) Discone.

(i) Frequencies in the UHF range normally propagate by means of

(i) Ground waves (ii) Sky waves

(iii) Surface waves (iv) Space waves.

(j) Tropospheric scatter is used with frequencies in the following range :

(i) HF (ii) VHF

(iii) UHF (iv) VLF.

(k) The multicavity klystron

(i) is not a good low-level amplifier because of noise.

(ii) has a high repeller voltage to ensure a rapid transit time.

(iii) is not suitable for pulsed operation.

(iv) needs a long transit time through the buncher cavity to ensure current modulation.

(l) The attenuator is used in the travelling wave tube (TWT) to

(i) help bunching. (ii) prevent oscillation.

(iii) prevent saturation. (iv) increase gain.

2. (a) Define characteristic impedance of a transmission line. When the input impedance of a transmission line is equal to its characteristic impedance?

(b) Briefly describe the three different types of losses present in transmission lines.

(c) What are the characteristics of TEM waves? (2+2)+3+3

3. (a) Define the term standing – wave – ratio. What is the formula for it if the load is purely resistive? Why is a high value of SWR often undesirable?

(b) What do you understand by impedance transformation in a transmission line? Write down formula for impedance transformation for an open transmission line.

(c) What is the characteristic impedance of an air-filled coaxial cable having inner and outer diameters 0.25 cm and 0.75 cm respectively?

(d) What is radiation resistance? (1+1+1)+(2+1)+3+1

4. (a) The smaller dimension of a rectangular waveguide is half of the larger dimension. Why?

(b) A rectangular waveguide acts as a filter — Explain. Define degenerate and non-degenerate modes in waveguide.

(c) Show that in a rectangular waveguide operating in TE_{10} mode, the cut-off frequency is given by $f_c = c / 2a\sqrt{\varepsilon_r}$, where ε_r is relative permittivity of the medium. 2+(3+2)+3

5. (a) Define the terms bandwidth, beamwidth and polarization in connection to an antenna.

(b) A half wave dipole antenna is capable of radiating 1 KW and has a 2.15 dB gain over an isotropic antenna. How much power must be delivered to the isotropic (omnidirectional) antenna, to match the field strength of directional antenna? (2+2+2)+4

6. (a) Define the radiation resistance of an antenna. What is the significance of this quantity?

(b) Define field intensity of an antenna. On what factors does it depend?

(c) A dipole antenna ($l = \lambda / 8$) operating at 400 MHz is used to send a message to a satellite in space. Find the radiation resistance of the antenna. (2+2)+(2+1)+3

7. (a) Briefly describe the following terms connected with sky wave propagation :

virtual height, critical frequency, fading.

(b) Briefly describe ground wave propagation. What is the angle of tilt? (2+2+2)+(3+1)

8. (a) Briefly explain the operation of a reflex klystron oscillator. Why is the transit time so important in this device?

(b) Write short note (***any one***) :

(i) Magnetron

(ii) Gunn diode

(iii) Travelling Wave tube. (4+2)+4
