SET A

M.Sc. PHYSICS
FOURTH SEMESTER
ELECTRONICS & COMMUNICATION TECHNOLOGY-II
MSP - 402B

[USE OMR FOR OBJECTIVE PART]

Duration: 3 hrs. **Full Marks: 70**

Objective

Time: 30 min. **Marks: 20**

Choose the correct answer from the following: ***1X20=20***

1. The length of a short monopole antenna element is
   a. $\lambda/2$ b. Less than $\lambda/8$
   c. $\lambda/4$ d. Less than $\lambda/2$

2. A Hertzian dipole consists of two _____ and _____ charges separated by a very short distance.
   a. unequal, opposite b. equal, same
   c. equal, opposite d. unequal, same

3. The induction and radiation fields are equal at a distance of _____
   a. $\lambda/4$ b. $\lambda/8$
   c. $\lambda/2$ d. $\lambda/6$

4. The ratio of radiation intensity in a given direction from antenna to the radiation intensity over all directions is called as _____
   a. Directivity b. Radiation power density
   c. Gain of antenna d. Array factor

5. Which of the following field varies inversely with r^2?
   a. Far Field b. Electrostatic Field
   c. Near Field d. Radiation Field

6. The radiation lobe containing the direction of maximum radiation is called as _____
   a. Back lobe b. Side lobe
   c. Minor lobe d. Major lobe

7. An ideal source in which the power is radiated equally in all directions is called as _____ radiator.
   a. Isotropic b. Omni-directional
   c. Directional d. Transducer

8. _____ is a single cavity klystron tube that operates as on oscillator by using a reflector electrode after the cavity.
   a. Backward wave oscillator b. Reflex klystron
   c. Travelling wave tube d. Magnetrons

9. Theoretical efficiency of a two-cavity klystron amplifier is
   a. 10-15% b. 20-30%
   c. 40-50% d. 50-60%

10. Microwave tubes are grouped into two categories depending on the type of:
   a. Electron beam field interaction b. Amplification method
   c. Power gain achieved d. Construction methods

11. The power gain of a TWT amplifier is
   a. up to 60 dB b. up to 50 dB
   c. up to 40 dB d. up to 30 dB

12. In a Microwave Klystron tube, the RF signal is usually given to
   a. Catcher Cavity b. Drift space
   c. Buncher Cavity d. None

13. Which of the following microwave tubes uses helix as a slow wave structure?
   a. Two-cavity Klystron b. Magnetron
   c. Travelling wave tube d. Reflex Klystron

14. Why are pulse Doppler radars operated with a pulse repetition frequency (PRF)?
   a. To reduce the existence of probability distribution function b. To generate high duty cycle
   c. To obtain range ambiguities d. To generate false alarm

15. Which electromagnetic wave is commonly used in radar systems?
   a. Microwaves b. Ultraviolet
   c. Infrared d. Radio

16. What does MTI stand for in radar technology?
   a. Magnetic Target Interceptor b. Mobile Tracking Instrument
   c. Moving Target Indicator d. Multi-Target Identification

17. In the maximum radar range equation, minimum detectable signal is represented by _____
   a. σ b. D_{min}
   c. M_{min} d. S_{min}

18. The absorption of photons in a photodiode is dependent on _____
   a. Absorption Coefficient b. Properties of material
   c. Charge carrier at junction d. Amount of light

19. _____ always leads to the generation of a hole and an electron.
   a. Repulsion b. Dispersion
   c. Absorption d. Attenuation

20. The excess density of electrons Δn and holes Δpin an LED is _____
   a. Equal b. $\Delta p > \Delta n$
   c. $\Delta n > \Delta p$ d. Does not affects the LED

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Descriptive

Time : 2 hrs. 30 min. **Marks : 50**

[Answer question no.1 & any four (4) from the rest]

1. **a.** Describe the optical absorption process in semiconductors. **2+6+2 =10**

   b. Discuss the photon absorption coefficient in a semiconductor and sketch the general shape of the optical absorption coefficient in asemiconductor as afunction of distance for two absorption coefficients.

   c. When does the absorption coefficient becomes maximum and minimum?

2. Find the expression for the power radiated by a hertzian dipole and calculate the radiation resistance. **10**

3. **a.** Find the current required to radiate a power of 100W at 100 MHz from a 0.01m hertzian dipole. **3+3+4 =10**

   b. The radiation resistance of an antenna is 72 Ω and loss resistance is 8 Ω. What is the directivity if the power gain is 30?

   c. Consider two similar dipoles having length of 3 cm used as transmitting and receiving antennas. Find the power received by the receiving antenna if it is placed at a distance of 10 m from the transmitting antenna which is radiating 15 W average power at 1 GHz.

4. Describe the mathematical analysis of Cavity magnetron and find the expression for Hull cut-off magnetic field and cut-off voltage. **10**

5. **a.** Define velocity modulation. Explain the methods of producing velocity modulation of electrons. **4+4+2 =10**

   b. Draw the Applegate diagram and explain the principle of operation of Reflex Klystron.

c. The operating frequency of Reflex klystron is 2 GHz. Calculate the change in frequency for a 2% change in Repeller voltage. Given that: Repeller voltage = 2000V and Accelerating voltage = 500V. Space between exit of the gap and repeller electrode = 2 cm (Assume n=1).

6. Sketch the energy band diagram and explain the operation of a homojunction LED and heterojunction high intensity LED. **10**

7. **a.** Explain the basic principle of operation of a RADAR system. **2+6+2 =10**

b. Derive the expression for radar range equation.

c. Calculate the maximum range of a radar system which operates at 3 cm wavelength with a peak power of 500 kW, if its S_{min} is 10^{-2} W, the capture area of its antenna is 5 m^2 and radar cross section area of target is 20 m^2.

8. **a.** Explain the various factors affecting radar performance. **7+3=10**

b. Discuss the Doppler effect due to relative motion between the radar and the target and calculate the Doppler shift.

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