

# 17656

21415

3 Hours / 100 Marks

Seat No.

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- Instructions :** (1) All Questions are *compulsory*.  
(2) Illustrate your answers with neat sketches wherever necessary.  
(3) Figures to the right indicate full marks.  
(4) Assume suitable data, if necessary.  
(5) Use of Non-Programmable Electronic Pocket Calculator is permissible.  
(6) Preferably, write the answers in sequential order.

- |  | <b>Marks</b> |
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| <b>1. [A] Attempt any THREE :</b>  | <b>12</b>    |
| (a) State two advantages and two applications of circular waveguide.                             |              |
| (b) Draw labelled sketch of Reflex Klystron. List its two application.                           |              |
| (c) Define the term antenna scanning. State its types. Explain any one type of antenna scanning. |              |
| (d) Define the term 'orbit' w.r.t. satellite. List different types of orbits of satellite.       |              |
| <b>[B] Attempt any ONE :</b>   | <b>6</b>     |
| (a) Draw field pattern of $TE_{1,0}$ mode in rectangular waveguide.                              |              |
| (b) Draw a neat constructional diagram of IMPATT diode. Describe its working.                    |              |
| <b>2. Attempt any FOUR :</b>   | <b>16</b>    |
| (a) Compare waveguide and two wire transmission line. (Eight points)                             |              |
| (b) Write out specifications of each of the followings :   |              |
| (i) Two cavity Klystron  |              |
| (ii) Magnetron   |              |
| (c) List different display methods used in radar. Explain any one display method.                |              |
| (d) State four advantages of fiber optic communications.   |              |
| (e) Classify fiber optic cable on the basis of (i) modes (ii) refractive index profile.          |              |
| (f) State reason for difference in uplink and downlink frequency in satellite communication.     |              |

P.T.O.

- 3. Attempt any FOUR :** **16**
- (a) A rectangular waveguide is 5 cm by 2.5 cm. Calculate the cut-off frequency of dominant mode.
  - (b) With neat sketch, describe operation of tunnel diode.
  - (c) State four factors influencing maximum range of radar.
  - (d) State four advantages of Geostationary satellites.
  - (e) Differentiate satellite communication and fiber optic communication w.r.t. (i) Frequency range (ii) Electromagnetic interference (iii) Application (iv) Limitations.
- 4. [A] Attempt any THREE :** **12**
- (a) State function of following waveguide components :
    - (i) Isolator
    - (ii) Circulator
  - (b) Draw constructional diagram of PIN diode and describe its working.
  - (c) Explain Radar Beacon. State its two applications.
  - (d) Define following terms w.r.t. satellite :
    - (i) Look angle
    - (ii) Footprint
    - (iii) Station keeping
    - (iv) Elevation angle
- [B] Attempt any ONE :** **6**
- (a) A silica optical fiber with core diameter large enough to be considered by ray theory analysis has core refractive index of 1.50 and cladding refractive index of 1.47. Calculate (i) Critical angle (ii) NA of fiber (iii) Acceptance angle in air for fiber.
  - (b) Derive Radar range equation for noise free atmosphere.
- 5. Attempt any FOUR :** **16**
- (a) Draw and describe the working of E-plane tee.
  - (b) Draw constructional diagram of two cavity Klystron. List its two applications.
  - (c) Draw block diagram of OTDR and explain its working.
  - (d) Draw block diagram of satellite subsystem.
  - (e) Calculate critical angle of incidence between two substances with different refractive indices  $n_1 = 1.4$  and  $n_2 = 1.36$ .
  - (f) State splicing techniques used for optical fiber. Explain any one in detail.
- 6. Attempt any FOUR :** **16**
- (a) Explain the concept of dominant mode in waveguide.
  - (b) Compare LED and LASER. (8 points)
  - (c) What is intermodal and intramodal dispersion ?
  - (d) Compare step index and graded index fiber. (Any four points)
  - (e) Write uplink and downlink frequencies for C-band, X-band, Ku band and Ka band.
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15162

3 Hours / 100 Marks

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  - (3) Illustrate your answers with neat sketches wherever necessary.
  - (4) Figures to the right indicate full marks.
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  - (6) Use of Non-programmable Electronic Pocket Calculator is permissible.
  - (7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

**Marks**

1. (A) Attempt any THREE :

12

- (a) Define the terms w.r.t. waveguide :
  - (i) Cut-off frequency
  - (ii) Cut-off wavelength
- (b) Draw labelled sketched diagram of Reflex Klystron. Give any two applications.
- (c) Draw block diagram of Radar System and explain it.
- (d) Define following term w.r.t. to satellite :
  - (i) Footprint
  - (ii) Station keeping

**P.T.O.**

**(B) Attempt any ONE :****6**

- (a) Describe TE and TM modes in rectangular waveguide.
- (b) Sketch the construction of Gunn diode and give its operation.

**2. Attempt any FOUR :****16**

- (a) Differentiate between waveguide and two-wire transmission line.
- (b) Describe, how bunching is formed in Magnetron – with neat diagram.
- (c) Describe working of MTI radar with neat block diagram and waveforms.
- (d) State reason for differences in uplink and downlink frequency in satellite communications.
- (e) List advantages and disadvantages of fibre optic cable as compare to conventional cable. (2 points each).
- (f) Describe absorption loss and scattering loss occur in optical fibre.

**3. Attempt any FOUR :****16**

- (a) State the advantages and applications of circular waveguide (2 points each).
- (b) With neat sketch describe the operation of PIN diode.
- (c) Define Radar Beacons; give its typical usage.
- (d) Explain advantages of satellite communication (4 points).
- (e) Draw block diagram of Fiber Optic Communication System and describe the function of each block.

4. (A) Attempt any THREE : 12

- (a) Draw field pattern of circular waveguide.
- (b) Draw the construction of Tunnel diode and give its working as microwave component.
- (c) Describe a scope, PPI display method with its diagram.
- (d) Draw block diagram of satellite subsystem and explain working of any one subsystem.

(B) Attempt any ONE : 6

- (a) Explain horizontal, vertical, helical and spiral antenna scanning in radar system.
- (b) Draw frequency spectrum for optical communication with band name and its range.

5. Attempt any FOUR : 16

- (a) Describe working of directional coupler with neat diagram.
- (b) Describe working of two cavity Klystron Amplifier.
- (c) Differentiate between LED and LASER.
- (d) Describe working of communication subsystem of satellite.
- (e) Define with respect to fibre optic cable (a) numerical aperture (b) acceptance angle.
- (f) Describe fusion splicing, Vgroove splice and elastic tube splice with respect to fibre optic cable.

**6. Attempt any FOUR :****16**

- (a) Distinguish microwave circulator and isolator with following parameters :
    - (i) Function
    - (ii) Construction
    - (iii) Application
    - (iv) Number of ports
  - (b) Describe scattering and dispersion losses in optical fibre.
  - (c) Distinguish between splicing and connectors of fibre optic cable.
  - (d) How power is generated in satellite ? Describe how it is distributed to other subsystem of satellite.
  - (e) Describe working and principle of avalanche photodiode with a neat sketch.
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3 Hours / 100 Marks

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- Instructions :**
- (1) All Questions are *compulsory*.
  - (2) Answer each next main Question on a new page.
  - (3) Illustrate your answers with neat sketches wherever necessary.
  - (4) Figures to the right indicate full marks.
  - (5) Assume suitable data, if necessary.
  - (6) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

**Marks**

1. (A) Attempt any THREE : 12
- (a) Define the terms w.r.t. waveguide :
    - (i) Cut-off frequency
    - (ii) Phase velocity
    - (iii) Group velocity
    - (iv) Guided wavelength of waveguide
  - (b) Draw labelled sketch of TWT. Give two applications.
  - (c) Describe the principle of Doppler effect used in Radar system.
  - (d) Define following terms w.r.t. satellite :
    - (i) Foot print
    - (ii) Azimuth angle

- (B) Attempt any ONE :** **6**
- (a) With neat diagram describe propagation of microwave through rectangular waveguide. In which condition it becomes dominant mode ?
  - (b) With neat sketch describe the operation of GUNN diode.
- 2. Attempt any FOUR :** **16**
- (a) Differentiate between waveguide and two wire transmission line.
  - (b) Describe working of reflex klystron amplifier with a neat diagram.
  - (c) Write RADAR range equation and state the factor affecting maximum range of RADAR.
  - (d) List uplink and downlink frequency for different bands used in satellite communication.
  - (e) Define the following with respect to optical fiber communication :
    - (i) Critical angle
    - (ii) Snell's lawwith suitable diagrams.
  - (f) Describe coupling losses occur in optical fiber communication with neat diagrams.
- 3. Attempt any FOUR :** **16**
- (a) Compare rectangular waveguide and circular on the basis of :
    - (i) Definition
    - (ii) Construction
    - (iii) Application
    - (iv) Field pattern



- (b) Sketch the construction of Tunnel diode and write its operation.
- (c) Explain A-scope Display Method with diagram, used in Radar System.
- (d) State four advantages of geo-stationary satellite.
- (e) Differentiate between satellite communication and fiber optic communication.  
(any four points)

**4. (A) Attempt any THREE : 12**

- (a) Sketch the construction of circulator and isolators. State two applications of each.
- (b) Draw the construction of PIN diode. Describe working principle.
- (c) Give the operation of pulsed radar to detect the object.
- (d) Describe the function of Altitude Control Subsystem in Satellite for keeping satellite in its orbit.

**(B) Attempt any ONE : 6**

- (a) Draw block diagram of Optical Fiber Communication System. Describe the function of different sensors used in optical communication system.
- (b) Draw the block diagram of MTI radar and describe its working with waveforms.

**5. Attempt any FOUR : 16**

- (a) Draw field pattern of circular waveguide.
- (b) Draw TWT and give its two applications.
- (c) State four limitations of LED as a source to optical fiber.

- (d) Draw block diagram of satellite subsystem and describe function of each sections.
- (e) A silica optical fiber with a core diameter large enough to be considered by ray theory analysis has a core reflective index of 1.50 and a cladding refractive index of 1.47. Calculate (i) Critical angle, (ii) NA of fiber, (iii) Acceptance angle in air for fiber.
- (f) Differentiate between single mode and multimode fiber.

**6. Attempt any FOUR :**

**16**

- (a) Describe function of hybrid Tee with neat diagram. (E – H plane or Magic Tee)
  - (b) List the different losses occur in optical fiber. Describe any one loss with diagram.
  - (c) List different types of splicing techniques. Describe any one method.
  - (d) Describe the function of telemetry and tracking in satellite communication system.
  - (e) Distinguish between LED and LASER. (4 points)
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**3 Hours / 100 Marks**

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- Instructions :**
- (1) All Questions are *compulsory*.
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  - (4) Assume suitable data, if necessary.
  - (5) Use of Non-programmable Electronic Pocket Calculator is permissible.

**Marks**

**1. (A) Attempt any THREE : 12**

- (a) Define the term w.r.t. wave guide (a) group velocity, (b) phase velocity.
- (b) With neat sketch, describe operations of tunnel diode.
- (c) List different display methods used in Radar. Explain any one display method.
- (d) Why is the uplink is more than downlink frequency in satellite communication ?

**(B) Attempt any ONE : 06**

- (a) Describe rectangular waveguide in TE and TM mode.
- (b) Sketch the construction of PIN diode and write its operation.

**2. Attempt any FOUR :****16**

- (a) Draw the construction of microwave circulator and isolator. List applications of each (any two).
- (b) Draw and explain the working of two cavity klystron amplifier.
- (c) Describe any one antenna used in RADAR.
- (d) Define with respect to fiber optic cable (i) Numerical Aperture, (ii) Acceptance angle.
- (e) Describe losses in optical fiber.
- (f) Explain advantages of Satellite communication (4 points).

**3. Attempt any FOUR :****16**

- (a) A rectangular waveguide is  $5 \text{ cm} \times 2.5 \text{ cm}$ . Calculate cutoff freq. of dominant mode.
- (b) Describe the bunching process in Magnetron with neat diagram.
- (c) How doppler effect can be used to measure speed ?
- (d) Illustrate how telemetry tracking and command system is used in satellite.
- (e) Draw frequency spectrum of optical communication with band name and its range.

## 4. (A) Attempt any THREE :

12

- (a) Write uplink and downlink frequencies for C-Band, X-Band, Kn-Band & Ka-Band.
- (b) State two advantages and two applications of continuous wave Radar.
- (c) Describe working of directional coupler with neat diagram.
- (d) Describe the working of TWT as an amplifier.

## (B) Attempt any ONE :

06

- (a) A glass clad fiber is made with core glass of refractive index 1.5 and the cladding is dopped to give fractional index difference of 0.0005. Find  
(i) The cladding index, (ii) The critical internal reflection angle,  
(iii) The Numerical aperture.
- (b) Explain the working of MTI radar with the help of block diagram and with suitable waveforms.

## 5. Attempt any FOUR :

16

- (a) Draw the field patterns of circular waveguide for its dominant mode.
- (b) With neat sketch describe the operation of IMPATT diode.
- (c) Draw block diagram of OTDR and explain its working.
- (d) Define geostationary orbit and the geostationary satellite.
- (e) Calculate critical angle of incidence between two substances with different refractive indices  $n_1 = 1.5$  and  $n_2 = 1.46$ .
- (f) Differentiate between LED and LASCR (any eight points).

P.T.O.

**6. Attempt any FOUR :****16**

- (a) Differentiate between waveguide and two wire transmission line.
  - (b) Describe working and principle of avalanche photodiode with neat sketch.
  - (c) A step index fiber has a numerical aperture of 0.16, a core refractive index of 1.45 and core diameter of 90  $\mu\text{m}$ , calculate
    - (i) The acceptance angle  $\theta_a$ .
    - (ii) the refractive index of cladding.
  - (d) Draw the diagram of fusion splice and rigid alignment tube splice.
  - (e) How power is generated in satellite ? Describe how it is distributed to other subsystem of satellite.
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3 Hours / 100 Marks

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**Marks**

1. (A) Attempt any THREE : 12

- (a) State the advantages of waveguide over two wire transmission line.  
(any 4)
- (b) Draw construction and explain working of Reflex Klystron.
- (c) Write RADAR range equation and state the factor affecting maximum range of RADAR.
- (d) Define the following terms w.r.t. Satellite.
  - (i) Foot print
  - (ii) Station keeping
  - (iii) Azimuth angle
  - (iv) Elevation angle

[1 of 4]

P.T.O.

- (B) Attempt any ONE :** **6**
- (a) Draw different types of waveguide. What is dominant mode ? Explain wave propagation in rectangular waveguide.
  - (b) With neat sketch describe the operation of the GUNN Diode & list it's applications.
- 2. Attempt any FOUR :** **16**
- (a) Differentiate between TE mode & TM mode in rectangular wave guide.
  - (b) Write the effect of magnetic and electric fields in Magnetron.
  - (c) Write the operation of pulsed radar to detect the object.
  - (d) Draw block diagram of Satellite earth station and explain function of each block.
  - (e) Define (1) Critical angle, (2) Snell's Law, (3) Numerical aperture, (4) Acceptance angle.
  - (f) Give classification of optical fiber.
- 3. Attempt any FOUR :** **16**
- (a) State any two advantages and application of circular waveguide.
  - (b) With neat sketch describe the operation of PIN diode.
  - (c) Draw neat labelled block diagram of CW Doppler Radar & explain its working.
  - (d) Define the term orbit w.r.t. Satellite. List different types of orbits of Satellite.
  - (e) State & explain advantages of fiber optical communication. (any 4)



4. (A) Attempt any THREE : 12

- (a) Draw field pattern of circular waveguide.
- (b) Draw construction of tunnel diode and describe its working principle.
- (c) Define antenna scanning & its type used in a radar.
- (d) Write working of Telemetry and tracking control sub-system in Satellite communication.

(B) Attempt any ONE : 6

- (a) With neat sketch draw block diagram of MTI radar system and explain working.
- (b) Draw block diagram of fiber optic communication system & list out optical sources and detectors suitable for fiber optic communication.

5. Attempt any FOUR : 16

- (a) Draw constructional diagram of Isolator and explain its working.
- (b) Describe with waveform, how signal grow in TWT.
- (c) Draw constructional diagram of Edge Light emitter diode and explain its working.
- (d) Draw block diagram of Satellite power sub-system.
- (e) A silica optical fiber with core diameter large enough to be considered by ray theory analysis has core refractive index of 1.50 & cladding refractive index of 1.47. Calculate (1) Critical angle, (2) NA of fiber, (3) Acceptance angle.
- (f) State the need of splicing & list different techniques used for optical fiber. Explain any one in detail.

**6. Attempt any FOUR :****16**

- (a) Draw constructional diagram of two hole directional coupler & explain its working.
  - (b) Describe absorption and dispersion losses in optical fiber.
  - (c) Draw block diagram of OTDR and explain its working principle.
  - (d) Differentiate satellite communication and fiber optic communication w.r.t.
    - (i) Frequency range
    - (ii) Electro Magnetic Interference
    - (iii) Application
    - (iv) Limitation
  - (e) Draw the constructional diagram of PIN photo diode and explain its working.
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# 17656

15116

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**Marks**

1. a) Attempt any THREE of the following: 12
- (i) Define the terms w.r.t. waveguide
    - 1) Cutoff frequency of a waveguide
    - 2) Guide wavelength
  - (ii) Draw labelled sketch of Reflex Klystron. State its applications.
  - (iii) Write RADAR range equation and state the factors affecting maximum range of RADAR.
  - (iv) Define geostationary orbit and geostationary satellite.
- b) Attempt any ONE of the following: 06
- (i) Sketch the construction of Gunndiode and write its operation.
  - (ii) What is waveguide? With neat sketch explain its operation.

P.T.O.

- 2. Attempt any FOUR of the following:** **16**
- a) Differentiate between circular and rectangular waveguide.
  - b) Draw the construction of two cavity Klystron amplifier and describe its working principle.
  - c) How doppler effect can be used to measure speed?
  - d) State the reason for difference in uplink and downlink frequency in satellite communication.
  - e) Describe scattering and dispersion losses in optical fiber.
  - f) Draw frequency spectrum for optical communication with band name and its range.
- 3. Attempt any FOUR of the following:** **16**
- a) State advantages and applications of circular waveguide.
  - b) Sketch the construction of tunnel diode and write its operation.
  - c) Describe a scope display method of radar with its diagram.
  - d) State the advantages and disadvantages of fiber optic communication.
  - e) Define with respect to satellite communication
    - (i) Orbit
    - (ii) Footprint
- 4. a) Attempt any THREE of the following:** **12**
- (i) Draw field pattern of circular waveguide. State its applications.
  - (ii) Draw the construction of PIN diode and describe with its working principle.
  - (iii) State two advantages and two applications of CW radar.
  - (iv) Illustrate the block diagram of communication channel subsystem used in satellite communication.

**b) Attempt any ONE of the following:****06**

- (i) Explain the working of MTI radar with the help of block diagram and with suitable waveforms.
- (ii) Draw the block diagram of fiber optic communication system and list out the detectors and light source for it.

**5. Attempt any FOUR of the following:****16**

- a) Distinguish microwave circulator and isolator with following parameters:
  - (i) Function
  - (ii) Construction
  - (iii) Application
  - (iv) Number of ports
- b) Show how TWT can be used as an amplifier.
- c) A step index fiber has a numerical aperture of 0.16, a core refractive index of 1.45 and core diameter of 90 mm. Calculate:
  - (i) The acceptance angle  $\theta_a$
  - (ii) The refractive index of cladding
- d) Describe the antenna used in satellite.
- e) Describe edge emitter LED construction and working principle.
- f) Draw and explain the block diagram of OTDR.

**6. Attempt any FOUR of the following:****16**

- a) Draw diagram of twists and corners. State its applications.
  - b) Describe the Intrinsic and Extrinsic absorption losses in optical fiber.
  - c) Draw the diagram of fusion splicing and rigid alignment tube splice.
  - d) Illustrate how telemetry tracking and command system is used in satellite.
  - e) Draw structure of avalanche photodiode and describe its working principle.
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**Marks**

1. a) Attempt any THREE of the following: 12
- (i) Define the terms w.r.t. waveguide
    - (1) Cutoff frequency
    - (2) Group velocity
  - (ii) Draw well labeled constructional diagram of TWT. State any two specifications.
  - (iii) Write radar range equation. State factors influencing maximum range of radar.
  - (iv) Define following terms w.r.t. satellite -
    - (i) Azimuth angle
    - (ii) Elevation angle.

P.T.O.

b) **Attempt any ONE of the following:****6**

- (i) Justify  $TE_{110}$  mode in rectangular waveguide is the dominant mode. Draw the field pattern for  $TE_{110}$  and  $TE_{210}$  mode.
- (ii) With suitable. Sketch and waveforms, explain the working of IMPATT diode.

**2. Attempt any FOUR of the following:****16**

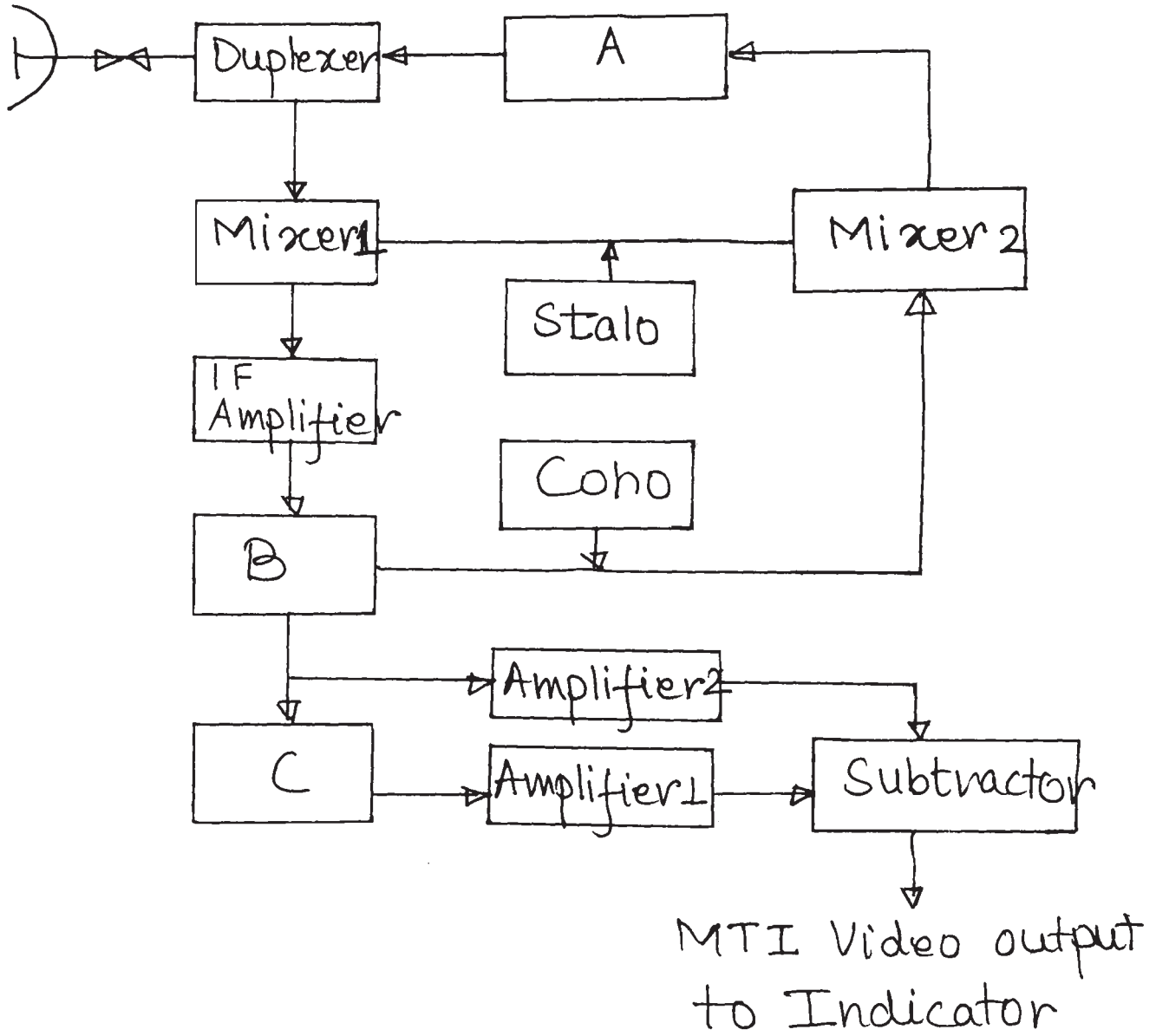
- a) A rectangular waveguide measures  $3 \times 4.5$  cm internally and has a 9 GHz signal propagated in it. Calculate the cut off wave length, the guide wavelength, phase velocity and the characteristic wave impedance for  $TE_{110}$  mode.
- b) Why do practical Klystron amplifiers generally have more than two cavities ? How can broad band operation be achieved in multicavity Klystrons.
- c) Write the operation of pulsed radar to detect the object.
- d) What is uplink and downlink frequency. Give reason for difference in uplink and downlink frequency.
- e) Draw the frequency for optical communication with band name and its range.
- f) Compare SMSI and MMGI fibers based on
  - (i) Mode
  - (ii) Refractive index profile
  - (iii) Data rate
  - (iv) Application



- 3. Attempt any FOUR of the following:** **16**
- a) State any three advantages and one disadvantage of circular waveguide.
  - b) With neat diagram, illustrate the working of the Quenn diode.
  - c) With the aid of a sketch, explain the PPI Radar indicator.
  - d) Compare Non synchronous and synchronous satellite based on
    - (i) Orbit
    - (ii) Visibility
    - (iii) Altitude
    - (iv) Footprint
  - e) State any six advantages and two disadvantages of fiber optics cable.
- 4. a) Attempt any THREE of the following:** **12**
- (i) Calculate the cut off wavelength, guide wavelength, characteristic wave impedance of a wave guide whose internal diameter is 4cm for a 12 GHz signal propagated in it in the  $TE_{111}$  mode.
  - (ii) Sketch the construction of tunnel diode and write its operation.
  - (iii) What is doppler effect. How doppler effect is used to calculate the relative velocity.
  - (iv) Illustrate how telemetry tracking and command system used in satellite communication.

b) Attempt any ONE of the following:

- (i) Identify the given diagram, label the block A, B and C and illustrate why those blocks are needed.



- (ii) Draw the block diagram of fiber optics communication system and illustrate the function of each block.

**5. Attempt any FOUR of the following:****16**

- a) Draw the constructional diagram of Isolator and illustrate its operation.
- b) With the aid of neat diagram, illustrate phase focussing effect in the cavity magnetron.
- c) How amplification takes place in Avalanche photodiode (APD) used as optical detectors ?
- d) Draw and explain the block diagram of transponder/communication channel subsystem.
- e) Calculate critical angle of incidence between two material with different refractive indices  $n_1 = 1.4$  and  $n_2 = 1.36$ . Also calculate numerical aperture and acceptance cone angle.
- f) When the optical power launched into an 8km length of fiber is  $120 \mu\text{W}$ , the mean optical power at the fiber output is  $3 \mu\text{W}$ . Determine -
  - (i) the overall signal attenuation or loss, in decibels through the fiber assuming there is no connector or splicer.
  - (ii) The signal attenuation per kilometer for the fibers.

**6. Attempt any FOUR of the following:****16**

- a) Draw the neat sketch of hybrid junction, illustrate its properties.
  - b) Illustrate modal dispersion loss. Where it occurs and how it can be controlled ?
  - c) Illustrate elastic tube splicing with neat diagram.
  - d) How power is generated in satellite. Describe how it is distributed to other subsystem of satellite.
  - e) Distinguish between LED and LASER diode on the basis of -
    - (i) Operating principle
    - (ii) Switching time
    - (iii) Spectral width
    - (iv) Life
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17656

11718

3 Hours / 100 Marks

Seat No.

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- Instructions :**
- (1) All Questions are *compulsory*.
  - (2) Answer each next main Question on a new page.
  - (3) Illustrate your answers with neat sketches wherever necessary.
  - (4) Figures to the right indicate full marks.
  - (5) Assume suitable data, if necessary.
  - (6) Use of Non-programmable Electronic Pocket Calculator is permissible.
  - (7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

- |   | <b>Marks</b> |
|---|--------------|
| <b>1. (A) Attempt any THREE :</b>   | <b>12</b>    |
| (a) Draw the microwave spectrum and designate the appropriate band in it.                             |              |
| (b) Sketch the constructional details of TWT and explain its working.                                 |              |
| (c) Define Radar beacons and state their uses.  |              |
| (d) Define and explain the terms :  |              |
| (i) Uplink frequency  |              |
| (ii) Downlink frequency   |              |
| <b>(B) Attempt any ONE :</b>  | <b>6</b>     |
| (a) Differentiate between TE $m, n$ and TM $m, n$ modes. (6 points)                                   |              |
| (b) Draw a constructional diagram of tunnel diode. Describe it's working.<br>State it's applications. |              |

**2. Attempt any FOUR:****16**

- (a) Explain the dominant mode of wave propagation through a rectangular waveguide.
- (b) List the specifications of two cavity klystron amplifier and give its applications.
- (c) Draw block diagram of basic radar system and describe its working.
- (d) List the types of orbits used in satellite system and describe them.
- (e) Define :
  - (i) Reflection
  - (ii) Refraction
  - (iii) Absorption in scattering w.r.t. light theory.
- (f) List any four types of losses in optical fibers.

**3. Attempt any FOUR :****16**

- (a) State the advantages of circular waveguide and list its applications.
- (b) Draw the construction of Gunn diode and describe its working.
- (c) List the antenna tracking methods used in radar system. Explain any one of them.
- (d) Explain the following terms w.r.t. satellite :
  - (i) Elevation,
  - (ii) Altitude
- (e) Define : Critical angle. State Snell's law.

**4. (A) Attempt any THREE :****12**

- (a) Draw the field patterns of circular waveguide.
- (b) State the two applications of each :
  - (i) IMPATT diode
  - (ii) PIN diode
- (c) Compare between A-scope and PPI display methods.
- (d) Draw the block diagram of telemetry tracking and command subsystem and state its principle of operation.

**(B) Attempt any ONE :****6**

- (a) Derive the Radar range equations and describe the factors affecting the maximum range of radar.
- (b) Draw and explain the block diagram of fiber optic communication system. List its advantages and disadvantages.

**5. Attempt any FOUR :****16**

- (a) Describe the function of following w.r.t. waveguide :
  - (i) Isolators
  - (ii) Circulators.
- (b) Draw the construction of magnetron. Describe its working.
- (c) Compare between edge emitter and surface emitter LED's.
- (d) Draw the block diagram of communication channel subsystem and state its principle of operation.

**P.T.O.**

- (e) Classify the optical fibers based on bands and specify their operating frequency range.
- (f) List and explain the properties of splicing.

**6. Attempt any FOUR :**

**16**

- (a) Describe the function of following junctions :
    - (i) E – plane junction
    - (ii) H-plane junction in microwave transmission.
  - (b) State and explain the characteristics of optical fibers.
  - (c) Differentiate between fusion splice and V-groove splice.
  - (d) Describe the antenna subsystem of satellite.
  - (e) Draw the construction of avalanche photodiode. State it's working principle.
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17656

11819

3 Hours / 100 Marks

Seat No.

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- Instructions :**
- (1) All Questions are *compulsory*.
  - (2) Answer each next main Question on a new page.
  - (3) Illustrate your answers with neat sketches wherever necessary.
  - (4) Figures to the right indicate full marks.
  - (5) Assume suitable data, if necessary.
  - (6) Use of Non-programmable Electronic Pocket Calculator is permissible.
  - (7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

**Marks**

1. (A) Attempt any THREE : 12

- (a) Define the term cut-off frequency and cut-off wavelength. State their mathematical formulae.
- (b) State significance of two cavities in multicavity Klystron. State its effect on Bandwidth.
- (c) State advantages and disadvantages of continuous wave Radar. (Two each)
- (d) Define the term Geostationary satellite. State its advantages.

(B) Attempt any ONE : 6

- (a) Compare waveguide and transmission line on the basis of definition, operating mode, construction, frequency range, applications and limitations.



- (b) State the name of microwave diode suitable for following each application :
- (i) Microwave oscillator
  - (ii) Replacing TWT Transmitter
  - (iii) Microwave Power Switching
  - (iv) Airborne Radar
  - (v) Logic operations
  - (vi) Pulse modulation

**2. Attempt any FOUR :**

**16**

- (a) For a rectangular waveguide with a wall separation of 4 cm and a desired frequency of operation is 8 GHz, determine :
- (i) Cut-off frequency
  - (ii) The Phase Velocity
- (b) With neat cross sectional constructional details, write effect of magnetic and electric field in magnetron.
- (c) State RADAR range equation and write factor influencing maximum range.
- (d) Sketch block diagram of satellite earth station and state functions of each block.
- (e) State any four advantages and four disadvantages of fibre optic communication.
- (f) Define the term multimode fiber, step Index fiber, Graded Index fiber and single mode fiber.

**3. Attempt any FOUR :****16**

- (a) Sketch field pattern for  $TE_{11}$  mode of Rectangular waveguide. State its any two advantages.
- (b) Sketch constructional diagram of Tunnel diode and state any four feature.
- (c) Explain Pulse Radar with neat block diagram.
- (d) State frequency range for up link and down link for C band and Kv band for satellite.
- (e) Define the term Numerical aperture, Acceptance Angle & Critical Angle for optical fiber cable.

**4. (A) Attempt any THREE :****12**

- (a) Compare :
  - (i) TE Mode & TM Mode
  - (ii) Circular wave guide & Rectangular wave guide
- (b) Sketch schematic diagram of IMPATT diode and write its working principle.
- (c) State the meaning and sketch antenna scanning pattern for Horizontal scan, Helical scan, Spiral scan and Nodding Scan.
- (d) Why altitude control is essential for satellite ? Hence write the role of altitude control subsystem for satellite.

**(B) Attempt any ONE :****6**

- (a) State the concept of continuous wave RADAR. Sketch its block diagram. State its any two applications.
- (b) A optical fiber with a core diameter large enough, has a core refractive index of 1.70 and a cladding refractive index of 1.65. Calculate critical angle, numerical aperture and acceptance angle.

**P.T.O.**

**5. Attempt any FOUR :****16**

- (a) Explain Hybrid Tee with neat sketch.
- (b) Velocity modulation occurs in two cavity Klystron amplifier. Justify with neat sketch.
- (c) Compare LED with LASER on the basis of principle of operation, spectral width, data rate, compatible fibers.
- (d) Draw the block diagram of satellite sub-system & explain power subsystem.
- (e) A step index fiber has a numerical aperture of 0.14 a core refractive index of 1.50 and core diameter 80 mm. Calculate acceptance angle and refractive index of cladding.
- (f) Explain OTDR with neat diagram & give its advantages.

**6. Attempt any FOUR :****16**

- (a) Explain Reflex Klystron with neat sketch & define Transit Time. Give two application of it.
  - (b) Define the term absorption loss. State types of absorption losses. How these losses occurs ?
  - (c) List out any four essential properties of fiber connector.
  - (d) State the functions of telemetry and trucking sub-system of satellite.
  - (e) Compare PIN photo diode with avalanche photo diode. (any four factors)
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22535

12223

3 Hours / 70 Marks

Seat No.

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- Instructions :**
- (1) All Questions are *compulsory*.
  - (2) Illustrate your answers with neat sketches wherever necessary.
  - (3) Figures to the right indicate full marks.
  - (4) Assume suitable data, if necessary.
  - (5) Use of Non-programmable Electronic Pocket Calculator is permissible.
  - (6) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

**Marks**

**1. Attempt any FIVE of the following :**

**10**

- (a) Define the following term :
  - (i) Group Velocity (ii) Phase Velocity
- (b) Draw the microwave spectrum and designate the appropriate band in it.
- (c) List application of two-hole directional coupler.
- (d) Draw the construction diagram of E-plane and H-plane junction.
- (e) List applications of tunnel diode.
- (f) Define the term antenna scanning. Write its types.
- (g) Write the factors that affect the RADAR range.

**2. Attempt any THREE of the following :**

**12**

- (a) Differentiate Between waveguide and two wire transmission line.
- (b) Explain the working principle of two hole directional coupler.
- (c) Draw the construction and explain working principle of IMPATT diode.
- (d) Explain the working of basic RADAR system with neat block diagram.



- 3. Attempt any THREE of the following : 12**
- (a) Draw and Explain the field pattern of circular waveguide for its dominant mode.
  - (b) Explain working MTI RADAR with neat block diagram.
  - (c) Explain the working principle of a cassegrain antenna with neat sketch.
  - (d) Describe working principle of TWT (Travelling wavetube) with neat diagram.
- 4. Attempt any THREE of the following : 12**
- (a) Explain the Principle of operation of two cavity Klystron amplifier with neat diagram.
  - (b) Explain working of isolator.
  - (c) Explain effect of magnetic field and electric field in magnetron.
  - (d) List the types of display methods used in RADAR. Explain any one display method.
  - (e) Draw the block diagram of frequency modulated (FM) CW RADAR system and explain its operation.
- 5. Attempt any TWO of the following : 12**
- (a) For Rectangular waveguide with wall separation of 4 cm and desired frequency of operation is 8 GHz, determine group velocity, Phase velocity. Write the advantages of Rectangular waveguide.
  - (b) Explain the working principle of Horn antenna with neat sketch. Write the performance parameters of antenna.
  - (c) Describe the operation of PIN diode with neat sketch. List the applications of PIN diode.

**6. Attempt any TWO of the following :****12**

- (a) Write the name of microwave diode suitable for following each application :
- (i) Microwave Oscillator
  - (ii) Replacing TWT Transmitter
  - (iii) Microwave power switching
  - (iv) Airborne Radar
  - (v) Logic operation
  - (vi) Pulse modulation
- (b) Calculate the maximum range of RADAR for the following specification :
- (i) Operating Frequency = 10 GHz
  - (ii) Peak power transmitted by RADAR = 400 kW
  - (iii) Effective aperture of the receiving antenna = 5 m<sup>2</sup>
  - (iv) RADAR cross section of the target = 30 m<sup>2</sup>
  - (v) Power of minimum detectable signal =  $10^{-10}$  W
- (c) In MTI RADAR the pulse repetition frequency is 200 Hz and the carrier transmission frequency is 100 Hz. Find its first, second and third blind speed.
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22535

21222

3 Hours / 70 Marks

Seat No.

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15 minutes extra for each hour

- Instructions :**
- (1) All Questions are *compulsory*.
  - (2) Answer each next main Question on a new page.
  - (3) Illustrate your answers with neat sketches wherever necessary.
  - (4) Figures to the right indicate full marks.
  - (5) Assume suitable data, if necessary.
  - (6) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.
  - (7) Preferably, write the answers in sequential order.

**Marks**

1. Attempt any FIVE of the following :

10

- (a) List two applications of IMPATT diode.
- (b) Define cut-off wavelength of a waveguide.
- (c) State principle of operation of cassegrain feed antenna.
- (d) Draw construction details of Gunn diode and label it.
- (e) State the frequency range for following bands : (i) UHF band (ii) Ku band (iii) X band (iv) S band
- (f) List two advantages and two disadvantages of Pulse RADAR system.
- (g) Draw neat sketches of Magic Tee and label it.



- 2. Attempt any THREE of the following :** **12**
- (a) Compare waveguide with transmission line on the basis of (i) construction (ii) propagation with respect to cut-off frequency (iii) field / circuit theory (iv) application.
  - (b) Explain application of Tunnel diode as an amplifier with neat diagram.
  - (c) State working principle of sonar system and list four applications.
  - (d) Draw neat sketches and give one use of following Waveguide Accessories :
    - (i) Bends
    - (ii) Corners
- 3. Attempt any THREE of the following :** **12**
- (a) Draw construction diagram of Magnetron and label it. Give two applications.
  - (b) For rectangular waveguides define : TE & TM modes.  
Sketch field pattern for  $TE_{2,0}$  mode.
  - (c) Discuss the use of RADAR tracking antennas and explain any one type of tracking antenna.
  - (d) Draw block diagram of MTI RADAR and relate it, to explain detection of moving target.
- 4. Attempt any THREE of the following :** **12**
- (a) State the working principle of Reflex Klystron and illustrate setting up of oscillations in the tube using Applegate diagram.
  - (b) State the need of Radar antenna scanning and explain spiral scanning.
  - (c) Describe operating principle of Directional Coupler and give two applications.
  - (d) Define doppler effect. Draw block diagram and explain principle and operation of CW Doppler RADAR.

**5. Attempt any TWO of the following :****12**

- (a) Calculate the maximum range of a radar system (in km and nautical miles), which operates at 3 cm with a peak pulse power of 600 kW, if its antenna is  $5 \text{ m}^2$ , minimum detectable signal is  $10^{-13} \text{ W}$  and the radar cross-sectional area of the target is  $20 \text{ m}^2$ .
- (b) Compare with neat sketches the actions of gyrators, isolators and circulators using ferrites. Mention their typical application.
- (c) Draw construction details and state principle of operation of PIN diode. Explain any one application circuit of PIN diode with suitable schematic diagram.

**6. Attempt any TWO of the following :****12**

- (a) Draw block diagram of FM CW RADAR. Explain its operation and use as altimeter in aircrafts.
  - (b) A rectangular waveguide has  $a = 4 \text{ cms}$ ;  $b = 3 \text{ cms}$  as its sectional dimensions. Find all the modes which will propagate at 5000 MHz.
  - (c) With physical construction diagram, explain working principle of a TWT. State 02 performance characteristics and 02 applications of TWT.
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22535

11920

3 Hours / 70 Marks

Seat No.

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- Instructions :**
- (1) All Questions are *compulsory*.
  - (2) Answer each next main Question on a new page.
  - (3) Illustrate your answers with neat sketches wherever necessary.
  - (4) Figures to the right indicate full marks.
  - (5) Assume suitable data, if necessary.
  - (6) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

**Marks**

**1. Attempt any FIVE of the following :**

**10**

- (a) State the frequency range for following bands :
  - (i) C Band
  - (ii) X Band
  - (iii) K Band
  - (iv)  $K_u$  Band
- (b) State different types of waveguides.
- (c) State the name of Tee Joint used as Duplexer and Mixer.
- (d) Draw neat sketch of bends.
- (e) List any two applications of PIN diode.
- (f) List the two advantages and two disadvantages of CW RADAR.
- (g) Give the applications of RADAR.

**2. Attempt any THREE of the following :**

**12**

- (a) Compare waveguide and two wire transmission line (4 points).
- (b) State the working principle of circulator with neat sketch and state its two applications.
- (c) Draw equivalent circuit and VI characteristics of Tunnel diode.
- (d) Describe with relevant sketch the working principle of the 'A' type of display used in RADAR system.

- 3. Attempt any THREE of the following :** **12**
- (a) Sketch the field pattern of  $TE_{10}$  and  $TE_{11}$  modes of rectangular waveguide.
  - (b) Draw the block diagram of pulsed RADAR system. Explain its operation with applications.
  - (c) Explain with relevant sketch the scanning methods used for RADAR.
  - (d) Describe the working principle of TWT and state its two applications.
- 4. Attempt any THREE of the following :** **12**
- (a) Describe the operation with construction diagram. IMPATT Diode. State its two applications.
  - (b) Explain the working principle of Horn Antenna with neat sketch.
  - (c) Draw the block diagram of MTI RADAR. Explain its operation.
  - (d) Describe the working principle of magnetron with the help of constructional diagram.
  - (e) Explain Doppler effect and draw block diagram of CW Doppler RADAR.
- 5. Attempt any TWO of the following :** **12**
- (a) Draw the construction of GUNN diode and describe the applications of it.
  - (b) Determine Cut Off wavelength for the dominant mode in rectangular waveguide of breadth 10 cm for 2.5 GHz signal propagates in this waveguide in the dominant mode. Calculate Cut Off wavelength and group velocity.
  - (c) Explain working principle of two hole directional coupler and state its applications.
- 6. Attempt any TWO of the following :** **12**
- (a) Describe the bunching process of two cavity klystron with help of Apple gate diagram and state its two applications.
  - (b) Calculate the maximum range of guided missile tracking RADAR operate at 5 GHz with a 1 M Watt peak power output. If the antenna diameter is 3 m and the receiver has a bandwidth of 2 MHz with 10 dB noise figure. The target cross-section is  $2 \text{ m}^2$ .
  - (c) Explain blind speed of RADAR. Write step by step procedure to calculate blind speed.
-

**Scheme – I**  
**Sample Question Paper**

**Program Name** : **Diploma in Digital Electronics /Electronics Engineering**  
**Programme Group**  
**Program Code** : **DE/EJ/ET/EN/EX/EQ**  
**Semester** : **Fifth**  
**Course Title** : **Microwave and RADAR**  
**Marks** : **70**

22535

**Time: 3 Hrs.**

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**Instructions:**

- (1) All questions are compulsory.
- (2) Illustrate your answers with neat sketches wherever necessary.
- (3) Figures to the right indicate full marks.
- (4) Assume suitable data if necessary.
- (5) Preferably, write the answers in sequential order.

**Q.1) Attempt any FIVE of the following.**

**10 Marks**

- (a) State the frequency range for following bands :  
i) C Band ii) X Band iii) K Band iv) Ku Band
- (b) State the advantages of wave guide over transmission line
- (c) State the name of Tee Joint used as Duplexer and mixer
- (d) Draw neat sketch of Tapper and Twist
- (e) List applications of IMPATT diode
- (f) List the two advantages and two disadvantages of CW RADAR.
- (g) Give the factors that affect the RADAR range .

**Q.2) Attempt any THREE of the following.**

**12 Marks**

- (a) Compare rectangular waveguide and circular waveguide on the basis of : i) Definition  
ii) Construction iii) Disadvantage iv) Applications.
- (b) Explain the working principle of isolator with neat sketch and state it's two applications
- (c) Draw equivalent circuit and VI characteristics of Tunnel diode.
- (d) Define a RADAR Beacon. Explain its operation. Give typical usage.

**Q.3) Attempt any THREE of the following.**

**12 Marks**

- (a) Sketch the field pattern of  $TE_{10}$  ,  $TE_{11}$  Modes of rectangular wave guide

- (b) Draw the block diagram and explain operation of CW Doppler RADAR.
- (c) Classify different antenna patterns in Doppler Radar. Explain any one.
- (d) Describe the working principle of TWT and state its two applications

**Q.4) Attempt any THREE of the following.**

**12 Marks**

- (a) Describe the operating principle of PIN diode and state its two applications
- (b) Explain the working principle of Horn Antenna with neat sketch
- (c) Describe the working principle of magnetron with the help of constructional diagram
- (d) Distinguish between stationary target and moving target. Explain principle of MTI RADAR.
- (e) Define a pulsed RADAR. Give the effects of transmitting a long pulse? Explain all the stages of a pulsed RADAR.

**Q.5) Attempt any TWO of the following.**

**12 Marks**

- (a) Determine cutoff wavelength for the dominant mode in rectangular waveguide of breadth 10 cm for 2.5 GHz signal propagates in this waveguide in the dominant mode calculate guide wavelength and group velocity
- (b) Describe the working principle of directional coupler with neat sketch and state its two applications
- (c) Draw the construction of GUNN diode and describe the application of GUNN diode as an oscillator

**Q.6) Attempt any TWO of the following.**

**12 Marks**

- (a) Describe the bunching process of Two cavity Klystron with help of Apple gate diagram and state its two applications.
- (b) Calculate the maximum range of a guided missile tracking RADAR operate at 5GHz with a 1 Mwatt peak power output. If the antenna diameter is 3m and the receiver has a bandwidth of 2MHz with 10 dB noise figure. The target cross section is  $2\text{m}^2$ .
- (c) An MTI RADAR operates at 8 GHz with a prf of 3500 pps. Calculate the lowest three blind speeds of this RADAR.

**Scheme – I**  
**Sample Test Paper - I**

**Program Name** : Diploma in Digital Electronics /Electronics Engineering  
**Programme Group**  
**Program Code** : DE/EJ/ET/EN/EX/EQ  
**Semester** : Fifth  
**Course Title** : Microwave and RADAR  
**Marks** : 20

22535

**Time: 1 Hour.**

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**Instructions:**

- (1) All questions are compulsory.
- (2) Illustrate your answers with neat sketches wherever necessary.
- (3) Figures to the right indicate full marks.
- (4) Assume suitable data if necessary.
- (5) Preferably, write the answers in sequential order.

**Q.1 Attempt any FOUR.**

**08 Marks**

- (a) Define i) Cut off frequency ii) Cut off wavelength
- (b) Draw the constructions of E plane
- (c) List the applications of Microwave in various fields
- (d) State the device used for measurement of incident power and SWR
- (e) State the device used as power output tube in communication satellite

**Q.2 Attempt any THREE.**

**12 Marks**

- (a) Draw constructional diagram of reflex Klystron and state its two applications
- (b) Differentiate between wave guide & two transmission lines
- (c) State two advantages & two applications of circular waveguide
- (d) Draw neat sketch of Gyrotator and describe its working principle



**Scheme – I**  
**Sample Test Paper - II**

**Program Name** : Diploma in Digital Electronics /Electronics Engineering  
**Programme Group**  
**Program Code** : DE/EJ/ET/EN/EX/EQ  
**Semester** : Fifth  
**Course Title** : Microwave and RADAR  
**Marks** : 20

22535

**Time: 1 Hour.**

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**Instructions:**

- (1) All questions are compulsory.
- (2) Illustrate your answers with neat sketches wherever necessary.
- (3) Figures to the right indicate full marks.
- (4) Assume suitable data if necessary.
- (5) Preferably, write the answers in sequential order.

**Q.1 Attempt any FOUR.**

**08 Marks**

- (a) State 2 advantages and disadvantages of CW RADAR.
- (b) Give the typical usage of RADAR Beacon.
- (c) Show the use of Doppler effect to calculate the relative velocity.
- (d) State the factors affecting maximum RADAR range.
- (e) State the name of the transferred electron device used in fast combinational and sequential logic circuit

**Q.2 Attempt any THREE.**

**12 Marks**

- (a) Explain the working of IMPATT diode with the help of neat diagram and state it's two applications.
- (b) List the different antenna scanning pattern in RADAR. Explain any one.
- (c) Draw the block diagram of Pulsed RADAR explain it.
- (d) Describe the working of Tunnel diode as an oscillator with the help of neat diagram