**List of Figures**

| Figure 1.1 | Sketch of a mesa and planer photodetector | 3 |
| Figure 1.2 | Photo excitation in semiconductors | 9 |
| Figure 2.1 | Photonic excitation and recombination in a semiconductor | 18 |
| Figure 2.2 | Types of photodetectors | 18 |
| Figure 2.3 | Equivalent circuit diagram of a photoconductor | 19 |
| Figure 2.4 | P-I-N Photodiode | 20 |
| Figure 2.5 | Schematic diagram of MOS diode with photogate used as CCD | 21 |
| Figure 2.6 | Structure of MOSFET with length of channel ‘L’ and width of channel ‘W’. | 23 |
| Figure 2.7 | Structure of HBT | 24 |
| Figure 2.8 | Cross section of a HEMT (The dotted line highlights the parasitic MESFET) | 27 |
| Figure 2.9 | Structure of a MESFET with gate length, $L$, and channel thickness, $d$. | 29 |
| Figure 3.1 | (a)The schematic diagrams for a non-self-aligned MESFET structure operated in the sub threshold region. (b) Penetration of the sidewall field into the gate-controlled region and the boundary conditions used. | 50 |
| Figure 3.2 | Cross sectional view of the MESFET with illumination | 56 |
| Figure 3.3 | Equivalent circuit for the illuminated MESFET | 57 |
| Figure 4.1 | Schematic of GaAs MESFET | 72 |
| Figure 4.2 | Comparison of Gaussian and new Gaussian like function curves | 83 |
| Figure 4.3 | Variation of channel potential along the channel length for dark and illuminated condition | 83 |
Figure 4.4 (a) Variation of channel potential along the channel length for different standard deviation ($\sigma=0.05 \mu m$) for dark and illuminated conditions (b) Variation of channel potential along the channel length for different standard deviation ($\sigma=0.05 \mu m$) for dark and illuminated conditions

Figure 4.5 Threshold voltage $V_{th}$ variations with gate length $L$ for dark and illuminated conditions

Figure 4.6 Variation of Threshold Voltages $V_{th}$ with incident optical power ($P_{in}$) for different gate length ($L$)

Figure 4.7 Variation of threshold voltage $V_{th}$ with gate length $L$ for different channel thickness

Figure 4.8 Schematic of GaAs MESFET

Figure 4.9 (a) Variation of external, internal photo voltage as a function of Optical Power

Figure 4.9 (b) Photoconductive Current as a function of Incident Optical Power

Figure 4.10 Characteristics of GaAs MESFET under optically controlled and backgating conditions

Figure 4.11 (a) Transconductance GaAs MESFET under dark, illuminated and backgating conditions Deviation in transconductance and output resistance without considering DLT (ideal case), with DLT (real case) is also depicted
(b) Output resistance of GaAs MESFET under dark illuminated and backgating conditions. (Deviation in transconductance and output resistance without considering DLT (ideal case), with DLT (real case) is also depicted)

Figure 4.12  
(a) Schematic cross section of an optically biased non-self aligned GaAs MESFET  
(b) Non-self-aligned device structure in the turn-on region  
(c) Schematic structure for optically biased self-aligned MESFET operated in turn-on region.

Figure 4.13 Id–Vd Characteristics for non-self-aligned MESFET in dark and illuminated conditions for Lg = 0.3 μm

Figure 4.14 (a) Id–Vd Characteristics for non-self-aligned MESFET in illuminated condition for Lg = 0.5 μm  
(b) Id–Vd Characteristics for non-self-aligned MESFET with Lg = 0.5 μm at different photon flux

Figure 4.15 Id–Vd characteristics for self-aligned MESFET in dark and illuminated conditions for Lg = 0.5 μm

Figure 4.16 Schematic of GaAs OPFET used for the modeling. ‘a’ is the thickness of active channel region, ‘L’ is the length of the schottky metal gate

Figure 4.17 Id–Vd Characteristics for non-self-aligned MESFET in dark and illuminated conditions for Lg 0.3 μm

Figure 4.18 Variation of transit-time with gate-length for different drain-source voltages

Figure 4.19 Variation of transit-time with gate-length for different gate-source voltages

Figure 4.20 Schematic of GaAs MESFET
Figure 4.21 (a) Schematic diagram of the shape of depletion region of GaAs MESFET in linear region.
(b) Schematic diagram of the shape of depletion region of GaAs MESFET in the saturation region.

Figure 4.22 Plot of $C_{gs}$ vs. $V_{gs}$ GaAs MESFET operated in the linear region for dark and illuminated condition

Figure 4.23 Plot of $C_{gd}$ vs. $V_{gs}$ GaAs MESFET operated in the linear region for dark and illuminated conditions

Figure 4.24 Plot of $C_{gs-sat}$ vs. $V_{gs}$ GaAs MESFET operated in the saturation region for dark and illuminated conditions

Figure 4.25 Plot of $C_{gd-sat}$ vs. $V_{gs}$ GaAs MESFET operated in the saturation region for dark and illuminated conditions.

Figure 4.26 Plot of the gate-source capacitance vs. $V_{ds}$ of GaAs MESFET under dark and illuminated conditions

Figure 4.27 Plot of the gate-drain capacitance vs. $V_{ds}$ of GaAs MESFET under dark and illuminated conditions

Figure 5.1 Physical structure of GaAs MESFET photodetectors

Figure 5.2 Id–Vd Characteristics for MESFET in dark and illuminated condition

Figure 5.3 Potential distribution in the channel under dark and illuminated condition

Figure 5.4 Variation of electric field profile under illuminated condition along the channel length and thickness.

Figure 5.5 Variation of electric field profile under illuminated condition along the width of the channel

Figure 5.6 Mobility distributions under illuminated condition along the channel length and thickness

Figure 5.7 Variation of drain current under illumination conditions

Figure 5.8 Transconductance in illumination condition