CONTENTS

STATEMENT ........................................ i
ACKNOWLEDGEMENTS ................................ iv
CONTENTS .......................................... viii

CHAPTER I INTRODUCTION .......................... 1

CHAPTER II GENERATION MECHANISMS OF
IRREGULARITIES .................................. 47

CHAPTER III LANGMUIR PROBE, INSTRUMENTATION
AND DATA ANALYSIS .............................. 72

CHAPTER IV RESULTS DURING PERIODS OF
NORMAL ELECTROJET .............................. 117

CHAPTER V RESULTS DURING PERIODS OF
COUNTER ELECTROJET ............................ 143

CHAPTER VI DISCUSSION AND CONCLUSIONS .... 153

REFERENCES ....................................... 179
CHAPTER I  INTRODUCTION  1-46

1.1 Equatorial Electrojet  3
  1.1.1 Conductivities in the Ionosphere  5
  1.1.2 Models of the Equatorial Electrojet  9

1.2 Counter Electrojet  17

1.3 D and E-region Irregularities  23
  1.3.1 Observational Results of Ionization Irregularities from Ground Based Studies  23
    1.3.1.1 Studies with Ionosonde  23
    1.3.1.2 Studies with V.H.F. Forward and Backscatter Radar  25
      a) Electrojet Irregularities  25
      b) Irregularities due to Neutral Turbulence  34
  1.3.2 Observational Results of Ionization Irregularities from Rocket Borne Studies  36

CHAPTER II  GENERATION MECHANISMS OF IRREGULARITIES  47-71

2.1 Theories of Cross-field Instability  47
  2.1.1 Linear Theories  47
  2.1.2 Non-linear Theories  54

2.2 Neutral Turbulence  61
  2.2.1 General Nature of Turbulence  61
  2.2.2 Regions of Turbulence in the Ionosphere  66
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2.3</td>
<td>Electron Density Fluctuations Due to Fluctuations in Neutral Density</td>
<td>68</td>
</tr>
<tr>
<td>2.2.4</td>
<td>Electron Density Fluctuations Due to Turbulent Mixing</td>
<td>69</td>
</tr>
<tr>
<td>CHAPTER III</td>
<td><strong>LANGMUIR PROBE, INSTRUMENTATION AND DATA ANALYSIS</strong></td>
<td>72-116</td>
</tr>
<tr>
<td>3.1</td>
<td>Basic Principle of Langmuir Probe</td>
<td>72</td>
</tr>
<tr>
<td>3.1.1</td>
<td>Behaviour of Probe at Different Potentials</td>
<td>73</td>
</tr>
<tr>
<td>3.1.2</td>
<td>Different Versions of Langmuir Probe Used by Various Workers</td>
<td>78</td>
</tr>
<tr>
<td>3.1.3</td>
<td>Regions of Applicability</td>
<td>81</td>
</tr>
<tr>
<td>3.1.4</td>
<td>Sensor of the Langmuir Probe</td>
<td>82</td>
</tr>
<tr>
<td>3.1.5</td>
<td>Reference Electrode</td>
<td>83</td>
</tr>
<tr>
<td>3.1.6</td>
<td>Floating Potential</td>
<td>84</td>
</tr>
<tr>
<td>3.2</td>
<td>Proportionality Between the Probe Current and Electron Density</td>
<td>85</td>
</tr>
<tr>
<td>3.3</td>
<td>Irregularity Measurements with Langmuir Probe</td>
<td>87</td>
</tr>
<tr>
<td>3.4</td>
<td>Instrumentation</td>
<td>88</td>
</tr>
<tr>
<td>3.4.1</td>
<td>Power Supply Regulator</td>
<td>91</td>
</tr>
<tr>
<td>3.4.2</td>
<td>Electrometer Amplifier</td>
<td>93</td>
</tr>
<tr>
<td>3.4.3</td>
<td>Sweep Circuit</td>
<td>98</td>
</tr>
<tr>
<td>3.4.4</td>
<td>High Frequency Noise Amplifier</td>
<td>101</td>
</tr>
<tr>
<td>3.4.5</td>
<td>Duct Amplifier</td>
<td>102</td>
</tr>
<tr>
<td>3.5</td>
<td>Data Analysis</td>
<td>105</td>
</tr>
</tbody>
</table>
### 3.5.1 Determination of Electron Density

- Analysis of 30-300 Meter Scalesizes
  - a) Fourier Transform Technique
  - b) Zero Crossing Technique for Most Prominent Scalesize

### 3.5.2 Analysis of 30-300 Meter Scalesizes

### 3.5.3 Analysis of 1-15 Meter Scalesizes

---

### CHAPTER IV

#### RESULTS DURING PERIODS OF NORMAL ELECTROJET

- **4.1** General Nature of Electron Density Profile During Different Times of the Day
- **4.2** General Nature of Electron Density Gradients During Different Times of the Day
- **4.3** Ionization Irregularities Produced Through Cross-field Instability Mechanism
  - **4.3.1** Irregularities in 30-300 Meter Scalesize Range
    - a) Region of Occurrence
    - b) Shape of Irregularities
    - c) Spectrum of Irregularities
    - d) Amplitude of Typical Scalesizes
    - e) Variation of Scale-size with Altitude
  - **4.3.2** Irregularities in 1-15 Meter Scalesize Range
CHAPTER V RESULTS DURING PERIODS OF COUNTER ELECTROJET

5.1 Experimental Results During Counter Electrojet

5.1.1 Electron Density and its Gradient

5.1.2 Irregularities Due to Cross-field Instability

5.1.3 Irregularities Due to Neutral Turbulence

5.1.4 Irregularities Due to Streaming Instability

5.1.5 Irregularities Due to Unknown Mechanism

CHAPTER VI DISCUSSION AND CONCLUSIONS

6.1 Irregularities Due to Cross-field Mechanism

6.1.1 30-300 Meter CF Irregularities During Normal Electrojet

6.1.2 30-300 Meter CF Irregularities During Counter Electrojet
6.1.3 1-15 Meter GF Irregularities During Normal Electrojet 162

6.2 Irregularities Produced by Neutral Turbulence Mechanism 169

6.3 Irregularities Produced by Unknown Mechanism 172

6.4 Conclusions 173

REFERENCES ... 179-186