SYNOPSIS

Project Title: Direction-Finding in Airborne Electronic Warfare Systems

1) **Background**: In a typical Airborne Electronic Warfare (EW) scenario, host combat aircrafts encounter various classes of threat radars, with widely varying signal characteristics and spread over a large geographical area. Host aircrafts have the task of achieving mission success, while ensuring safety of their formation. To achieve that, the aircrafts are equipped with onboard, real-time, threat warning systems like EW Receivers (EWRx) and offensive systems like Radar Jammers. Typically, an EW Receiver resolves uncertainties in Time, Frequency and Spatial domains by detection, estimation, classification, identification and tracking of each radar in a dense scenario comprising a large number of radars. Currently, EWRx are designed with Best-in-Class sensors, hardware, software, firmware and algorithms to achieve these complex functionalities.

2) **Project Objectives**:

   a) **Design & Analysis of Radar Signals:** This involves formulation of time, frequency and spatial domain properties of radar signals such as amplitude, frequency, signal-phase, inter-pulse & intra-pulse modulation parameters, waveform pattern etc. in the presence of AWGN. Generation & analysis of multi-emitter scenario involving multiple radars of dissimilar types shall be part of the project.

   b) **Study & Implementation of Direction-Finding (DF) methods for Airborne EW:** Here the objective is to address spatial domain uncertainties encountered by EW Systems. This involves understanding complexities of RF Direction-Finding in Airborne systems. Understanding & executing mathematical and signal processing methods towards developing unified solutions shall be part of the project.

3. **Domains**: Matrix Theory. Transforms. Signal Processing. RF & Microwave Systems.

4. **Software**: MATLAB (Simulations, Performance Evaluation, Data Analysis, Display)

5. **Approach**: The project shall comprise of the following components.

   a) **Studies**: Review of basic Engg concepts and programming in MATLAB. Overview of Radars & Electronic Warfare. Introduction to EW Receivers & EW Signal Processing. Assignments on basic concepts, Radar & EW.

   b) **Literature Survey**: Survey & Study of technical papers/books/publications related to Radar Signals and DF Methods for EW Systems. Assignments based on publications.

   c) **LAB Instruments**: Study of Signal Generation & Signal Analysis Instruments used in LAB. Case studies of Instruments from reputed manufacturers. Practical assignments.

   d) **Radar Signals:** Design & Analysis of Radar Signals in MATLAB. Generation & Analysis of Radar Signals using Lab Instruments. Programming assignments.

   e) **DF Methods**: Study and MATLAB implementation of DF methods used in Airborne EW. Comparative study on advantages & disadvantages of candidate DF methods. Practical demonstration in Connected/Radiation Mode in the LAB/ Test Facilities.