Approval: 5th Senate Meeting

Course Title	: Stealth Technology: Infrared Signatures
Course Code	: ME-618
Course Instructor	: Prof. Shripad P. Mahulikar
Course Creditsstructure	: Lectures/Tutorials/Total: 2 lecture hours & 1 tutorial hour per week (Total 3 hrs. per week)
Students Intendedfor	: UG (ME final year) /MS (ME) /PhD (ME) can Credit this course [all other student categories can Audit this course (must at least pass in course to qualify as Audit)]
Prerequisite	: Heat Transfer (for those who Credit this course / no Pre-requisite for those who Audit this course)
Elective or Compulsory	: Elective

Preamble: The course will begin with an insight in to the basics of stealth technology (for susceptibility reduction i.e. survivability enhancement of aircraft / helicopter), followed by definitions and classifications of signatures. Thereafter, fundamentals and details [prediction and suppression (& its penalties on performance of aircraft / helicopter)] of passive infrared (IR) detection / signature from aircraft and helicopters will be introduced. Prediction methodology for internal and external sources of IR signature will be derived and elaborated as tools for IR signature management (suppression and countermeasures). The link between IR-signature, lock-on range, and aircraft / helicopter susceptibility will be studied for air-to-air combat.

Course Outline & Breakup:

Principles of Stealth Technology – camouflage, conceal, deceive, active vs. passive detection (2 hrs.)

Introduction to Signatures – radar (RCS & its reduction), infrared, visual, aural (3 hrs.)

Principles of Thermal / Infrared Radiation – basic laws (Planck's, Wien's Displacement, Kirchhoff's), grey body spectrum (6 hrs.)

Estimation of Infrared Signature (IR) from Internal Sources – engine heated casing, engine exhaust plume, aerodynamic heating of airframe (6 hrs.)

Estimation of Infrared Signature from External Sources – reflection of earthshine, sunshine, &skyshine (6 hrs.)

Role of Atmosphere – attenuation of IR-signature by intervening atmosphere & atmospheric background radiance (3 hrs.)

Relation between IR-Signature and Target Susceptibility – lock-on envelope & lethal envelop for air-to-air combat in horizontal plane (6 hrs.)

IR-Signature Suppression (& its Penalties) – optical blocking, cooling, emissivity optimization

IR Countermeasures – decoys / flares (2 hrs.)

Textbooks:

1. Hudson Jr., R.D., Infrared System Engineering, Wiley Series in Pure and Applied Optics, 2006.
2. Hackforth, H.L., Infrared Radiation, McGraw Hill, 1960.

3. Jones, J., Stealth Technology: The Art of Black Magic (ed. Thurber, M.), McGraw-Hill Co. 1989.

References:

(1) Mahulikar, S.P., Sonawane, H.R., &Rao, G.A., 2007, Infrared signature studies of aerospace vehicles, Progress in Aerospace Sciences, Vol. 43, Nos. 7-8, pp. 218-245.
(2) Rao, G.A., &Mahulikar, S.P., 2002 (Dec), Integrated review of stealth technology and its role in airpower, Aeronautical Journal, Vol. 106, No. 1066, pp. 629-641.
(3) Howe D. Introduction to the basic technology of stealth aircraft: Part 1 - basic considerations and aircraft self emitted signals (passive considerations). ASME Journal of Engineering for Gas Turbines& Power, 1991, Vol. 113, No. 75, pp. 75-79.