

GEORGIA INSTITUTE OF TECHNOLOGY
SCHOOL OF AEROSPACE ENGINEERING

AE- 4803A SPRING SEMESTER (T - TH, 3 - 4:30PM)

TITLE: *AVIONICS FOR UNMANNED AERIAL VEHICLES*

CREDIT: 3 CREDIT HOURS (GRADUATE STUDENTS AND GRADUATING SENIORS ONLY)

PREREQUISITES: BASIC ELECTRONICS FUNDAMENTALS (EE 3710, OR EQUIVALENT KNOWLEDGE)

DATES/TIMES: SPRING SEMESTER, TUESDAYS AND THURSDAYS FROM 3:00 TO 4:30 PM

COURSE NUMBER: AE 4803A

GRADES BASED ON: 1 PRE-DROP DATE QUIZ, 15% 1 DESIGN PAPER, 35%

1 MID-TERM QUIZ, 25% 1 FINAL EXAM 25%

TEACHER: *ROBERT C. MICHELSON*, • ADJUNCT ASSOCIATE PROFESSOR, SCHOOL OF A.E. (RET),

• PRINCIPAL RESEARCH ENGINEER *EMERITUS*, GEORGIA TECH RESEARCH INSTITUTE,

• PAST PRESIDENT OF THE ASSOCIATION FOR UNMANNED VEHICLE SYSTEMS, INTL.,

• ORIGINATOR OF THE INTERNATIONAL AERIAL ROBOTICS COMPETITION,

• DIRECTOR OF THE INSTITUTE'S "ENTOMOPTER" (MICRO AIR VEHICLE) PROGRAM.

• WINNER OF THE PIRELLI TOP AWARD FOR WORK ON BIOLOGICALLY-

""INSPIRED MAVS FOR PLANETARY EXPLORATION.

• WINNER OF THE PIONEER AWARD (HIGHEST LEVEL OF RECOGNITION WITHIN

""THE UNMANNED SYSTEMS INDUSTRY FOR TECHNICAL CONTRIBUTIONS TO

""ADVANCE THE STATE-OF-THE-ART)

OPTIONAL REFERENCE (≈ \$50)

DIGITAL AVIONICS SYSTEMS PRINCIPALS AND PRACTICE, CARY SPITZER, MCGRAW-HILL, SECOND EDITION

REQUIRED (≈ \$30)

INTRODUCTION TO UAV SYSTEMS, PAUL FAHLSTROM, THOMAS GLEASON, UAV SYSTEMS, INC.

REQUIRED (≈ \$20)

AVIONICS FUNDAMENTALS, IAP, INC. TRAINING MANUAL #0-89100-293-6

AVIONICS FOR UNMANNED AERIAL VEHICLES

AS AIRCRAFT BECOME MORE SOPHISTICATED, THEY RELY TO A GREATER DEGREE ON AVIONICS TO PERFORM THEIR FLIGHT FUNCTIONS. EVENTUALLY THE PILOT MAY BECOME OBSOLETE AS ONBOARD INTELLIGENCE DEMONSTRATES A GREATER CAPABILITY THAN THE HUMAN TO MAINTAIN DIFFICULT AND EXACTING FLIGHT REGIMES FOR AERODYNAMICALLY UNSTABLE AIRCRAFT CONFIGURATIONS OR DURING MANEUVERS THAT GO BEYOND HUMAN BODY TOLERANCE. IN MANY CASES, THE PRESENCE OF A HUMAN PILOT SIGNIFICANTLY REDUCES THE PERFORMANCE ATTAINABLE FROM HIGH-PERFORMANCE AIRCRAFT. AT OTHER TIMES, MISSIONS CAN NOT BE PERFORMED BECAUSE THEY ARE TOO DANGEROUS FOR THE HUMAN PILOT.

THIS SPECIAL COURSE OFFERING WILL TEACH THE STUDENT THE FUNDAMENTALS OF AIRCRAFT AVIONICS. DISCUSSION WILL CENTER ON AIRCRAFT AVIONICS REQUIREMENTS, DESIGN, AND OPERATION. TO FULLY EXPLORE THE LIMITS OF AIRCRAFT AVIONICS WHEN UNFETTERED BY THE RESTRICTIONS OF A HUMAN PILOT, THE COURSE

WILL CONCENTRATE SPECIFICALLY ON UNMANNED AERIAL VEHICLES (UAV) RANGING FROM REMOTELY PILOTED VEHICLES (RPV) TO COMPLETELY AUTONOMOUS UAVs, AND WILL ALSO CONSIDER THE SPECIAL NEEDS OF MICRO AIR VEHICLES.

THIS 3-CREDIT HOUR CLASS REQUIRES A BASIC KNOWLEDGE OF ELECTRONICS (PREREQUISITE EE 3710, OR EQUIVALENT) BUT WILL *NOT* BE AN ELECTRONICS CLASS. STUDENTS FROM ALL DISCIPLINES ARE ENCOURAGED TO ATTEND, ESPECIALLY THOSE WISHING TO BE INVOLVED IN AERIAL ROBOTICS OR HAVING AEROSPACE, ELECTRONICS, OR COMPUTER ENGINEERING INTERESTS AND BACKGROUNDS. THE CLASS IS INTENDED TO GIVE THE STUDENT A PRACTICAL WORKING KNOWLEDGE OF AVIONICS DESIGN CRITERIA, LIMITATIONS, AND THE ENABLING TECHNOLOGY.

TOPICAL OUTLINE

1. AVIONICS REQUIREMENTS

- A. "PAYLOADS" VS. "AVIONICS"**
- B. MANNED AIRCRAFT**
- C. UNMANNED AIRCRAFT**
- D. LEVELS OF AUTONOMY**

2. AVIONICS SYSTEMS ESSENTIALS

- A. INTELLIGENCE**
- B. SENSORS**
- C. ACTUATORS**
- D. DATA BUSES**
- E. STABILITY AND CONTROL**
- F. NAVIGATION**
- G. POWER**

3. INTERFACES

- A. ONBOARD INTELLIGENCE-TO-AIR VEHICLE**
- B. ONBOARD INTELLIGENCE-TO-PAYLOAD**
- C. ONBOARD INTELLIGENCE-TO-GROUND**

4. LINKS

- A. LINK TYPES AND ATTRIBUTES**
- B. ANTI-JAM LINKS**
- C. PROPAGATION/LINK RANGE**
- D. DATA RATES**

5. LAUNCH AND RECOVERY ISSUES

- A. AUTOMATIC LANDING SYSTEMS**
- B. LOST LINK**

6. MISSION PLANNING AND CONTROL STATIONS

7. FAULT TOLERANCE

- A. REDUNDANCY**
- A. ERROR DETECTION/CORRECTION**
- B. RESOURCE REALLOCATION**

8. MAINTAINABILITY AND RELIABILITY

9. ARCHITECTURES

10. PACKAGING AVIONICS INTO THE AIRCRAFT

11. FIGURING THE COSTS OF AVIONICS