THE VISION OF THE DEPARTMENT OF AEROSPACE ENGINEERING
The Department of Aerospace Engineering shall strive to be a globally known department, committed for its academic excellence, professionalism and societal expectations. The Department aims to impart state of the art technical knowledge, practical skills, leadership qualities, team spirit, ethical values and entrepreneurial skill to make all the students capable of taking up any task relevant to the area of Aerospace Engineering.

THE MISSION OF THE DEPARTMENT OF AEROSPACE ENGINEERING
The Mission of the Department of Aerospace Engineering is to
- Prepare the students to have a very good fundamental knowledge to meet the present and future needs of industries.
- Improve the technical knowledge of the students in tune with the current requirements through collaboration with industries and research organization.
- Make the students gain enough knowledge in various aspects of system integration.
- Motivate the students to take up jobs in national laboratories and aerospace industries of our country.
- Take up inter and multidisciplinary research, sponsored and consultancy projects with industries and research establishments.
- Encourage the faculty members and students to do research and to update with the latest developments in the area of Aerospace Engineering.
ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
REGULATIONS - 2019
CHOICE BASED CREDIT SYSTEM
M.E. AVIONICS

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):
   I. PEO 1: Successful Moulding of Graduate into Avionics Professional: Graduates of the programme will acquire adequate knowledge both in practical and theoretical domains in the field of Avionics Engineering through rigorous post graduate education.
   II. PEO 2: Successful Career Development: Graduates of the programme will have successful technical and managerial career in Avionics industries and aviation engineering management.
   III. PEO 3: Contribution to Avionics Field: Graduates of the programme will have innovative ideas and potential to contribute for the development and current needs of the Aviation Industries.
   IV. PEO 4: Sustainable interest for Lifelong learning: Graduates of the programme will have sustained interest to learn and adapt new technology developments to meet the changing industrial scenarios.
   V. PEO 5: Motivation to pursue research in Avionics field: Graduates will have interest and strong desire to undertake research oriented jobs and responsibilities in Universities and Industries.

2. PROGRAMME OUTCOMES (POs)

On successful completion of the programme,

<table>
<thead>
<tr>
<th>PO #</th>
<th>Graduate Attribute</th>
<th>Programme outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Engineering knowledge</td>
<td>Postgraduate will be able to use the Engineering knowledge acquired from the basic courses offered in the programme to pursue either doctoral studies or a career as an academician / scientist or engineer.</td>
</tr>
<tr>
<td>2.</td>
<td>Problem analysis</td>
<td>Post Graduate will acquire the ability to design, analyze as well as to conduct experiments to interpret data in the field of Avionics.</td>
</tr>
<tr>
<td>3.</td>
<td>Design / Development of solutions</td>
<td>Postgraduate will have the ability to design a system or a component to meet the design requirements with constraints exclusively meant for Avionics.</td>
</tr>
<tr>
<td>4.</td>
<td>Conduct investigations of complex problems</td>
<td>Post Graduate will have a firm scientific, technological and communication base that helps him/her to conduct investigations of complex problems in the Aircraft industry and R &amp; D organizations related to Avionics and other professional fields.</td>
</tr>
<tr>
<td>5.</td>
<td>Modern tool usage</td>
<td>Post Graduate will become familiar with modern engineering tools and analyze the problems within the domains of Avionics as a member of multidisciplinary teams</td>
</tr>
</tbody>
</table>
6. The Engineer and society
   Postgraduate will be capable of doing research in inter and multidisciplinary areas which will result in more efficient and cheaper products that are beneficial to society.

7. Environment and sustainability
   Postgraduate will exhibit awareness of contemporary issues on environment focussing on the necessity to develop new system design and testing methods for the solution of problems related to avionics industry.

8. Ethics
   Post Graduate will acquire an understanding of professional and ethical responsibility with reference to their career in the field of Avionics and other professional fields.

9. Individual and team work
   Postgraduate will be trained towards developing and understanding the importance of design and development of avionics subsystems from system integration point of view which requires team work.

10. Communications
    Postgraduate will be able to communicate effectively both in verbal and nonverbal forms.

11. Project management and finance
    Postgraduate will show his ability for managerial skills in design or research teams and will be able to deliver cost effective solutions for products and services.

12. Life-long learning
    Postgraduate will be capable of understanding the value of life-long learning.

3. PROGRAMME SPECIFIC OUTCOMES

   **PSO1**: The postgraduate will become familiar with approach to analysis for avionics engineering problems and conversant with methods of solutions.

   **PSO2**: The post graduate will become well versed with usage of modern techniques and software tools to design and develop avionics subsystems and products.

   **PSO3**: The postgraduate will excel as an individual as well as team member in design and research teams in universities and avionics industries.

   **PSO4**: The postgraduate will become an enthusiast to learn new technologies and methods life long in the area of avionics engineering.

4. Mapping of PEOs with POs

<table>
<thead>
<tr>
<th>Programme Educational Objectives</th>
<th>Programme Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PO1</td>
</tr>
<tr>
<td>I</td>
<td>✓</td>
</tr>
<tr>
<td>II</td>
<td>✓</td>
</tr>
<tr>
<td>III</td>
<td>✓</td>
</tr>
<tr>
<td>IV</td>
<td>✓</td>
</tr>
<tr>
<td>V</td>
<td>✓</td>
</tr>
</tbody>
</table>
# MAPPING OF COURSE OUTCOME AND PROGRAMME OUTCOME

<table>
<thead>
<tr>
<th>PROGRAM CORE COURSES (PCC)</th>
<th>COURSE TITLE</th>
<th>PO 1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced applied Mathematics</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Digital Avionics</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Flight Instrumentation</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Bridge Core course</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Aerospace Engineering (For Non-Aero Students)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>(OR) Electronic Systems (For Aero Students)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Avionics Integration Laboratory</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>ADA Programming Laboratory</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Navigation Systems</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Aerospace Guidance and Control</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Rocketry and Space Mechanics</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Automatic Flight Control Systems Laboratory</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Navigation and Guidance Laboratory</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PROFESSIONAL ELECTIVE COURSES (PEC)</th>
<th>COURSE TITLE</th>
<th>PO 1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Elective –I</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Modern Control Theory and Applied Mathematics</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Electro Optic Systems for Avionics Engineers</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>System modeling and Simulation for Avionics Engineers</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Avionics System Engineering</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

*Attested*

Director
Centre for Academic Courses
Anna University, Chennai-600 025
<table>
<thead>
<tr>
<th>Program Elective – II</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Image Processing for Aerospace Applications</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Fault Tolerant Computing</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Real Time Embedded Systems and Applications</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Program Elective – III</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elements of Satellite Technology</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Electronic Warfare</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Microwaves and Radar</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>UAV System Design</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Program Elective - IV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digital Fly By Wire</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Missile Technology</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Industrial Avionics</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Program Elective – V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spacecraft Communication Systems</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Soft Computing for Avionics Engineers</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>S. No</td>
<td>COURSE CODE</td>
<td>COURSE TITLE</td>
<td>CATEGORY</td>
<td>PERIODS PER WEEK</td>
<td>TOTAL CONTACT PERIODS</td>
<td>CREDITS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
<td>--------------</td>
<td>----------</td>
<td>------------------</td>
<td>-----------------------</td>
<td>---------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>MA5159</td>
<td>Advanced Applied Mathematics</td>
<td>FC</td>
<td>3 1 0</td>
<td>4</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>AV5101</td>
<td>Digital Avionics</td>
<td>PCC</td>
<td>4 0 0</td>
<td>4</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>AV5151</td>
<td>Flight Instrumentation</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>AV5102</td>
<td>Bridge Core course</td>
<td>PCC</td>
<td>3 1 0</td>
<td>4</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>AV5103</td>
<td>Aerospace Engineering</td>
<td>PCC</td>
<td>3 1 0</td>
<td>4</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(For Non-Aero Students)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(OR) Electronic Systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(For Aero Students)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>RM5151</td>
<td>Research Methodology &amp; IPR</td>
<td>RMC</td>
<td>2 0 0</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>Audit Course-I *</td>
<td>AC</td>
<td>2 0 0</td>
<td>2</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td>Program Elective-I</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>AV5111</td>
<td>Avionics Integration Laboratory</td>
<td>PCC</td>
<td>0 0 4</td>
<td>4</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>AV5112</td>
<td>ADA Programming Laboratory</td>
<td>PCC</td>
<td>0 0 4</td>
<td>4</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL** 20 2 8 30 24

*Audit course is optional*
SEMESTER II

<table>
<thead>
<tr>
<th>S. No</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>AV5201</td>
<td>Navigation Systems</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>AV5251</td>
<td>Aerospace Guidance and Control</td>
<td>PCC</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>AL5076</td>
<td>Rocketry and Space Mechanics</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>Program Elective-II</td>
<td></td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>Program Elective-III</td>
<td></td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td>Audit Course-II*</td>
<td></td>
<td>AC</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>PRACTICALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>AV5211</td>
<td>Automatic Flight Control Systems</td>
<td>PCC</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>8.</td>
<td>AV5212</td>
<td>Navigation and Guidance Laboratory</td>
<td>PCC</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>9.</td>
<td>AV5213</td>
<td>Mini Project with Seminar</td>
<td>EEC</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td>17</td>
<td>1</td>
<td>12</td>
</tr>
</tbody>
</table>

*Audit course is optional

SEMESTER III

<table>
<thead>
<tr>
<th>S.No</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Program Elective-IV</td>
<td></td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>Program Elective-V</td>
<td></td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>Open Elective</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td><strong>PRACTICALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>AV5311</td>
<td>Dissertation-I</td>
<td>EEC</td>
<td>0</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td>9</td>
<td>0</td>
<td>12</td>
</tr>
</tbody>
</table>

*Signed*

[Signature]

Director

Centre for Academic Courses
Anna University, Chennai-600 025
### SEMESTER IV

<table>
<thead>
<tr>
<th>S. No</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRACTICALS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>AV5411</td>
<td>Dissertation - II</td>
<td>EEC</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**TOTAL NO. OF CREDITS: 73**

### FOUNDATION COURSE (FC)

<table>
<thead>
<tr>
<th>S. No</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>THEORY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>MA5159</td>
<td>Advanced Applied Mathematics</td>
<td>FC</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

### PROGRAM CORE COURSES (PCC)

<table>
<thead>
<tr>
<th>S. No</th>
<th>CODE NO.</th>
<th>COURSE TITLE</th>
<th>PERIODS PER WEEK</th>
<th>CREDITS</th>
<th>SEMESTER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>1.</td>
<td>AV5101</td>
<td>Digital Avionics</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>AV5151</td>
<td>Flight Instrumentation</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>AV5102</td>
<td>Bridge Core course</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>AV5103</td>
<td>Aerospace Engineering</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(For Non-Aero Students)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(OR) Electronic Systems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(For Aero Students)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>AV5111</td>
<td>Avionics Integration Laboratory</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>5.</td>
<td>AV5112</td>
<td>ADA Programming Laboratory</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>6.</td>
<td>AV5201</td>
<td>Navigation Systems</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7.</td>
<td>AV5251</td>
<td>Aerospace Guidance and Control</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>8.</td>
<td>AL5076</td>
<td>Rocketry and Space Mechanics</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9.</td>
<td>AV5211</td>
<td>Automatic Flight Control Systems Laboratory</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>10.</td>
<td>AV5212</td>
<td>Navigation and Guidance Laboratory</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

**TOTAL CREDITS: 33**
# PROGRAM ELECTIVE COURSES (PEC)

## SEMESTER I
### ELECTIVE - I

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>AV5001</td>
<td>Modern Control Theory and Applied Mathematics</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>AV5002</td>
<td>Electro Optic Systems for Avionics Engineers</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>AV5003</td>
<td>System Modeling and Simulation for Avionics Engineers</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>AV5004</td>
<td>Avionics System Engineering</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

## SEMESTER II
### ELECTIVE - II

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>AV5005</td>
<td>Image Processing for Aerospace Applications</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>AV5006</td>
<td>Fault Tolerant Computing</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>AV5007</td>
<td>Real Time Embedded Systems and Applications</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

## SEMESTER II
### ELECTIVE - III

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>AS5072</td>
<td>Elements of Satellite Technology</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>AV5008</td>
<td>Electronic Warfare</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>NE5077</td>
<td>Microwaves and Radar</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>AV5009</td>
<td>UAV System Design</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
# Semester III
## Elective - IV

<table>
<thead>
<tr>
<th>SI. NO</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>AV5010</td>
<td>Digital Fly-By Wire Control</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>AV5011</td>
<td>Missile Technology</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>AV5012</td>
<td>Industrial Avionics</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

## Elective - V

<table>
<thead>
<tr>
<th>SI. NO</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>AV5013</td>
<td>Spacecraft Communication Systems</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>AV5014</td>
<td>Theory of Detection and Estimation of Digital Signals</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>AV5015</td>
<td>Soft Computing for Avionics Engineers</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

## Research Methodology and IPR Course (RMC)

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>CODE NO.</th>
<th>COURSE TITLE</th>
<th>PERIODS PER WEEK</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>RM5151</td>
<td>Research Methodology &amp; IPR</td>
<td>2 0 0</td>
<td>2</td>
</tr>
</tbody>
</table>

**TOTAL CREDITS:** 2

## Open Elective Courses (OEC)
*(out of 6 courses one course must be selected)*

<table>
<thead>
<tr>
<th>SI. NO</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>OE5091</td>
<td>Business Data Analytics</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>OE5092</td>
<td>Industrial Safety</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>OE5093</td>
<td>Operations Research</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>OE5094</td>
<td>Cost Management of Engineering Projects</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>OE5095</td>
<td>Composite Materials</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>OE5096</td>
<td>Waste to Energy</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
### AUDIT COURSES (AC)

Registration for any of these courses is optional to students.

<table>
<thead>
<tr>
<th>SL. NO</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>PERIODS PER WEEK</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lecture</td>
<td>Tutorial</td>
</tr>
<tr>
<td>1.</td>
<td>AX5091</td>
<td>English for Research Paper Writing</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>AX5092</td>
<td>Disaster Management</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>AX5093</td>
<td>Sanskrit for Technical Knowledge</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>AX5094</td>
<td>Value Education</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>AX5095</td>
<td>Constitution of India</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td>AX5096</td>
<td>Pedagogy Studies</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>7.</td>
<td>AX5097</td>
<td>Stress Management by Yoga</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>8.</td>
<td>AX5098</td>
<td>Personality Development Through Life Enlightenment Skills</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>9.</td>
<td>AX5099</td>
<td>Unnat Bharat Abhiyan</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

**Total Credits**: 0

### EMPLOYABILITY ENHANCEMENT COURSES (EEC)

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>CODE NO.</th>
<th>COURSE TITLE</th>
<th>PERIODS PER WEEK</th>
<th>CREDITS</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lecture</td>
<td>Tutorial</td>
<td>Practical</td>
</tr>
<tr>
<td>1.</td>
<td>AV5213</td>
<td>Mini Project with Seminar</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>2.</td>
<td>AV5311</td>
<td>Dissertation-I</td>
<td>0</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>3.</td>
<td>AV5411</td>
<td>Dissertation-II</td>
<td>0</td>
<td>0</td>
<td>24</td>
</tr>
</tbody>
</table>

**TOTAL CREDITS**: 20

### SUMMARY

<table>
<thead>
<tr>
<th>NAME OF THE PROGRAMME</th>
<th>SUBJECT AREA</th>
<th>CREDITS PER SEMESTER</th>
<th>CREDITS TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
<td>II</td>
<td>III</td>
</tr>
<tr>
<td>1. PCC</td>
<td>19</td>
<td>14</td>
<td>00</td>
</tr>
<tr>
<td>2. PEC</td>
<td>03</td>
<td>06</td>
<td>06</td>
</tr>
<tr>
<td>3. RMC</td>
<td>02</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>4. OEC</td>
<td>00</td>
<td>00</td>
<td>03</td>
</tr>
<tr>
<td>5. EEC</td>
<td>00</td>
<td>02</td>
<td>06</td>
</tr>
<tr>
<td>6. Non Credit/Audit Course</td>
<td>✓</td>
<td>✓</td>
<td>00</td>
</tr>
</tbody>
</table>

**TOTAL CREDIT**: 24 22 15 12 73
OBJECTIVES:
- To encourage students to develop a working knowledge of the central ideas of linear algebra.
- To enable students to understand the concepts of probability and random variables.
- To make students understand the notion of a Markov chain, and how simple ideas of conditional probability and matrices can be used to give a thorough and effective account of discrete-time Markov chains.
- To familiarize the students with the formulation and construction of a mathematical model for a linear programming problem in real life situation.
- To introduce the Fourier Transform as an extension of Fourier techniques on periodic functions and to solve partial differential equations.

UNIT I  LINEAR ALGEBRA  12

UNIT II  ONE DIMENSIONAL RANDOM VARIABLES  12

UNIT III  RANDOM PROCESSES  12
Classification – Auto correlation - Cross correlation - Stationary random process – Markov process — Markov chain - Poisson process – Gaussian process.

UNIT IV  LINEAR PROGRAMMING  12
Formulation – Graphical solution – Simplex method – Two phase method - Transportation and Assignment Models

UNIT V  FOURIER TRANSFORM FOR PARTIAL DIFFERENTIAL EQUATIONS  12

TOTAL: 45+15=60 PERIODS

OUTCOMES:
At the end of the course, students will be able to
- Apply the concepts of linear algebra to solve practical problems.
- Use the ideas of probability and random variables in solving engineering problems.
- Classify various random processes and solve problems involving stochastic processes.
- Formulate and construct mathematical models for linear programming problems and solve the transportation and assignment problems.
- Apply the Fourier transform methods of solving standard partial differential equations.
REFERENCES:

AV5101 DIGITAL AVIONICS L T P C 4 0 0 4

OBJECTIVES:
- To introduce role of avionics system and its architecture
- To understand the avionics system design development and integration using simulation tools
- To introduce different types of cockpit displays.
- To know modular avionics packaging and EMI/EMC requirements in avionics
- To study system assessment, validation, certification and maintenance of avionics system

UNIT I INTRODUCTION TO AVIONICS 12
Role for Avionics in Civil and Military Aircraft systems, Avionics sub-systems - design- Introduction to control surface actuation system, Fly-by-wire Actuators, defining avionics System/sub-system- Requirements & importance of ‘ilities’- Avionics system architectures – Integrated Modular Avionics - Guidance and Certification Considerations

UNIT II AVIONICS SYSTEM DATA BUSSES, DESIGN AND INTEGRATION 12

UNIT III AVIONICS SYSTEM ESSENTIALS: DISPLAYS, I/O DEVICES AND POWER 12
Trends in display technology, Civil and Military aircraft cockpits, MFDs, MFK, HUD, HDD, HMD, DVI, HOTAS, Synthetic and enhanced vision, situation awareness, Panoramic/big picture display, virtual cockpit-Civil and Military Electrical Power requirement standards, comparing the Military and Civil Requirements and Tips for Power System Design.

UNIT IV MAINTENANCE AND PACKAGING 12
UNIT V
SYSTEM ASSESSMENT, VALIDATION AND CERTIFICATION

Fault tolerant systems - Hardware and Software, Evaluating system design and Future architecture - Hardware assessment - FARs guide certification requirements - Fault Tree analysis – Failure mode and effects analysis – Criticality, damaging modes and effects analysis - Software development process models - Software Assessment and Validation - Civil and Military standards - Certification of Civil Avionics.

TOTAL: 60 PERIODS

OUTCOMES:
Students will be able to:

CO1: Enumerate the basic concepts of Avionics Systems to the engineers.
CO2: Explain the working of avionics systems in an aircraft.
CO3: Explain the topics such as Avionics system architecture, Avionics bus systems, integration, display systems and packaging.
CO4: Deploy these skills effectively in the understanding and analysis of avionics systems.
CO5: Perform documentation on hardware and software development for certification process.

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✔</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:

AV5151 FLIGHT INSTRUMENTATION

OBJECTIVES:
- To learn the concept of measurement, error estimation and classification of aircraft instrumentation and displays
- To study air data instruments and synchronous data transmissions systems
- To study gyroscope and its purposes, aircraft compass system and flight management system
- To study Data acquisition and handling systems
- To impart knowledge about the basic and advanced flight instruments, their construction, characteristics and their operation.

UNIT I MEASUREMENT SCIENCE AND DISPLAYS

UNIT II AIR DATA INSTRUMENTS AND SYNCHRO TRANSMISSION SYSTEMS 9
Air data instruments-airspeed, altitude, Vertical speed indicators, Altitude alerting systems, Machmeter, Mach Warning system, Static Air temperature, Angle of attack measurement, Stall Warning system, Synchronous data transmission system

UNIT III GYROSCOPIC AND ADVANCED FLIGHT INSTRUMENTS 9
Gyroscope and its properties, gyro system, Gyro horizon, Erection systems for Gyro Horizons-Direction gyro-direction indicator, Rate gyro-rate of turn and slip indicator, Turn coordinator, acceleration and turning errors, Standby Attitude Director Indicator, Gyro stabilized Direction Indicating Systems, Advanced Direction Indicators, Horizontal Situation Indicator.

UNIT IV AIRCRAFT COMPASS SYSTEMS & FLIGHT MANAGEMENT SYSTEM 9
Direct reading compass, magnetic heading reference system-detector element, monitored gyroscope system, DGU, RMI, deviation compensator. FMS- Flight planning-flight path optimization-operational modes-4D flight management

UNIT V POWER PLANT INSTRUMENTS & FLIGHT DATA RECORDING 9
Pressure measurement, temperature measurement, fuel quantity measurement, engine power and control instruments-measurement of RPM, manifold pressure, torque, exhaust gas temperature, EPR, Engine Fuel Indicators, engine vibration monitoring, Cockpit Voice Recorder and Flight Data Recorder.

OUTCOMES:
Students will be able to:
CO1: Design the error model and estimate the error in the aircraft instruments
CO2: Explain about the various air data systems and synchronous data transmissions systems
CO3: Apply the principle of gyroscope, DGU, RMI, FMS in 4D flight management in the Avionics domain requirements.
CO4: Classify the different sensors and select the appropriate one for the given requirements.
CO5: Explain the operation and importance of engine instruments and flight data recorder.

<table>
<thead>
<tr>
<th></th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
<th>CO5</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO1</td>
<td>✔</td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>PO2</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO3</td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO4</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO5</td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>PO7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>PO8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>PO9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>PO10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>PO11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>PO12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
</tr>
</tbody>
</table>

REFERENCES:
OBJECTIVES:
- To provide knowledge in the basic concepts of aerospace engineering including Aerodynamics, Aircraft performance, stability & control, Aircraft Structures and Propulsion.
- To provide exposure on the factors that influence aircraft design and limit aircraft performance
- To provide knowledge on analysis of longitudinal/lateral/directional motions.
- To provide knowledge to perform preliminary design computations to meet static stability and time requirements
- To provide exposure on dynamic flight conditions using the non-linear equations of motion

UNIT I  FUNDAMENTALS OF AERODYNAMICS  12

UNIT II  AIRPLANE PERFORMANCE  12
General equation of motion of an airplane. Steady level flight, Thrust required and Power required, Thrust available and Power available for propeller driven and jet powered aircraft, Effect of altitude, maximum level flight speed, conditions for minimum drag and minimum power required, Shallow and steep angles of climb, Rate of climb, Maximum Climb angle and Maximum Rate of climb- Absolute and service ceiling, Gliding flight, Glide hodograph, Range and Endurance of Propeller and Jet aircrafts. Effect of wind on range and endurance. Estimation of take-off and landing distances, level turn, minimum turn radius, maximum turn rate, bank angle and load factor. V-n diagram

UNIT III  STATIC STABILITY AND CONTROL  12
General concepts-Degrees of freedom of a rigid body, Static and dynamic stability, Criteria for longitudinal static stability, contribution to stability by wing, tail, fuselage, wing fuselage combination, Neutral point-Stick fixed and Stick free conditions, Free elevator factor, , elevator control power, elevator angle to trim, Directional stability-yaw and sideslip, Criterion of directional stability, contribution to static directional stability by wing, fuselage, tail, rudder requirements, Lateral stability-Dihedral effect, criterion for lateral stability, contribution of fuselage, wing, fuselage, tail.

UNIT IV  DYNAMIC STABILITY  12
Equations of motion, small disturbance theory, Different types of axes. Derivation of equations of motion for Estimation of longitudinal stability derivatives, Routh’s discriminant, solving the stability quartic, Phugoid motion, Factors affecting the period and damping. Characteristic modes of oscillation in stick fixed and stick free conditions, Response, Lateral dynamics. Dutch roll and spiral instability, Auto rotation and spin

UNIT V  AIRCRAFT STRUCTURES AND POWERPLANT SYSTEMS  12
Introduction to Aircraft structures -Loads-Types of construction- Design feature of Aircraft materials. Different types of load carrying members on Wing and Fuselage. Aircraft propulsion, Rocket propulsion, Construction and working of Turbo jet, Turbo prop, Turbo fan and Ram jet engines Types of propellants.

TOTAL: 60 PERIODS
OUTCOMES:
Students will be able to:
CO1: Gain knowledge of the different performance parameters such as level flight take-off, climb, cruise, turn, descent and landing performance.
CO2: Explain the factors influencing aircraft design that limit aircraft performance and different structural load carrying members of the airplane.
CO3: Apply the basic concepts of Aerospace, their power plants, the Mechanics of its flight, the dihedral effect, rolling power and control effectiveness of aileron in the appropriate domain.
CO4: Analyze the dynamic stability from various components of the airplane
CO5: Perform preliminary design computations to meet static stability and analyze dynamic flight conditions using the non-linear equations of motion

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES

AV5103 ELECTRONIC SYSTEMS L T P C
3104

OBJECTIVES
- To provide knowledge in the basic concepts and applications of electronics systems including Transistors, Operational Amplifiers, Digital Electronics, Microprocessors and Micro-Controllers.
- To introduce to analysis and design of feedback amplifiers, oscillatory circuits.
- To provide knowledge on design of DC power supplies.
- To provide knowledge on design of digital logic circuits using logic gates and flip-flops.
- To introduce to interfacing and control of peripherals with microcontrollers using assembly language programming.

UNIT I TRANSISTORS AND LINEAR IC’s 12
Introduction to electronic devices, BJT, modes of operation - classification of transistors-OP-AMP specifications, applications, voltage comparator, A/D and D/A converter, sample and hold circuit, timer, VCO, PLL, interfacing circuits, Introduction to analog computer.

UNIT II SIGNAL GENERATORS AND DC POWER SUPPLIES 12
UNIT III  DIGITAL SYSTEMS

Number system, Review of TTL, ECL, CMOS- Logic gates, Flip Flops, Shift Register, Counter, Multiplexer, Demultiplexer / Decoder, Encoder, Adder, Arithmetic functions, analysis and design of clocked sequential circuits, Asynchronous sequential circuits, Finite State Machines.

UNIT IV MICROPROCESSOR BASED SYSTEMS


UNIT V MICROCONTROLLER BASED SYSTEMS

AVR Micro controllers – Architecture – Assembly language Programming–Timer and Counter Programming – D/A and A/D interfacing – Multiple Interrupts – Analog interfacing and industrial control, Interfacing of LVDTs, Resolvers, Encoders, hall effect sensors, LCD panels, Stepper motor controller.

TOTAL: 60 PERIODS

OUTCOMES:

Students will be able to:

CO1: Explain the operation and applications of basic electronic devices and Linear IC’s

CO2: Design a signal generator and analog circuits using BJT and OP-AMP.

CO3: Design a digital circuit using Logic Gates and understand their implementation in microprocessor/microcontroller

CO4: Select and interface suitable peripherals to microprocessors/microcontroller.

CO5: Program and control the microprocessor/microcontroller using assembly language programming

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:

OBJECTIVES:
To impart knowledge and skills required for research and IPR:
- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

UNIT I RESEARCH PROBLEM FORMULATION 6
Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations.

UNIT II LITERATURE REVIEW 6
Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT III TECHNICALWRITING /PRESENTATION 6
Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT IV INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR) 6

UNIT V INTELLECTUAL PROPERTY RIGHTS (IPR) 6
Traditional knowledge Case Studies, IPR and IITs.

OUTCOMES:
1. Ability to formulate research problem
2. Ability to carry out research analysis
3. Ability to follow research ethics
4. Ability to understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
5. Ability to understand about IPR and filing patents in R & D.

<table>
<thead>
<tr>
<th>CO1</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
REFERENCES:

AV5111 AVIONICS INTEGRATION LABORATORY

OBJECTIVES:
- To provide practical knowledge in the basic concepts of avionic system integration and operation of basic civil and military avionic data bus.
- To provide knowledge to install and Configure MIL-STD-1553B, ARINC 429 and AFDX data cards to transfer and receive data.
- To provide knowledge on IMU calibration.
- To provide the practical knowledge on sensor fusion.
- To provide practical knowledge on attitude estimation using IMU.

LIST OF EXPERIMENTS
1. Testing of installation of MIL-STD-1553, ARINC-429 and ARINC-629 card (Self test)
2. Configuring MIL-STD-1553 cards in transmitting and receiving mode.
3. Configuring ARINC-429 and ARINC-629 cards in transmitting and receiving mode.
4. Testing of installation and configuring of AFDX card in transmitting and receiving mode.
5. Using the interactive driver to transmit or receive the data
   - On a single PC by loop back connection.
   - PC to PC by connecting a shielded pair of wires.
6. Transmit and receive the messages
   - Using loop back connection with single card.
   - Using connector (shielded pair of wires).
7. Calibration of Inertial Measurement Unit (IMU)
8. Sensor data fusion using complementary filter
9. Development of Inertial Measurement Unit (IMU) based angle estimation based on Euler’s and Quaternion approach.

TOTAL: 60 PERIODS

OUTCOMES:
Students will be able to:
CO1: Integrate and operate avionic bus systems.
CO4: Extract data from IMU and to represent attitude in Euler and Quaternion form using data fusion.
CO5: Implement in Real time the sensor data over data buses to various terminals.
AV5112 ADA PROGRAMMING LABORATORY

OBJECTIVES:
- Be familiar with the basics of ADA programming language
- Be exposed to the concepts of ABSTRACT DATA TYPES
- To write, test, and debug simple ADA programs.
- To implement ADA programs with conditionals and loops.
- Learn to use Arrays, strings, functions, structures and unions for structuring ADA programs.
- Read and write data from/to files in ADA.

LIST OF PROGRAMS:
1. Search and Print passenger and flight details (Control statements, string operations).
2. 3x3 matrix multiplication in ADA (Arrays & looping statements).
3. Parameter passing to subprogram.
4. Swapping of 3 variables without temporary variable (functions).
5. Class definition and handling.
6. Exception handling.
7. Packages in ADA.
8. File handling 'statistics of character types in given file'.
9. A program to detect Bayes criterion to detect intended signal from a source.
10. A program to integrate INS and GPS flight data.

PLATFORM NEEDED gnat-community-interpreter for Windows.

OUTCOMES:
Students will be able to:
CO1: Conversant with the basics of ADA programming language
CO2: Capable of writing, testing, and debugging simple ADA programs
CO3: Use methods and classes using packages
CO4: Design file and exception handling
CO5: Implement engineering algorithms using ADA

TOTAL: 60 PERIODS
OBJECTIVES:
To impart knowledge on the concept of
- Different axis systems and co-ordinate transformation techniques
- Different radio navigation systems
- Inertial sensors and inertial navigation
- Various approach and landing aids of aircraft
- Satellite navigation & Hybrid navigation

UNIT I 
NAVIGATION SYSTEMS & INERTIAL SENSORS
Introduction to navigation – Categories of navigation- Evolution of Air navigation – Introduction to Inertial Sensors – Accelerometers – Gyroscopes- Mechanical Gyro - Ring Laser gyro- Fiber optic gyro – MEMS system

UNIT II 
INERTIAL NAVIGATION SYSTEMS

UNIT III 
RADIO NAVIGATION
Different types of radio navigation- ADF, VOR, DME - Doppler – Hyperbolic Navigations -LORAN, DECCA and Omega – TACAN, Enhanced LORAN- Future trends

UNIT IV 
LANDING SYSTEMS AND AIR TRAFFIC MANAGEMENT

UNIT V 
SATELLITE NAVIGATION & HYBRID NAVIGATION

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to:
CO1: Explain the need for different axis systems and select the suitable system for the given condition.
CO2: Derive the necessary mathematical knowledge that are needed in modelling the navigation process and methods.
CO4: Perform data fusion and sensor integration.
CO5: Deploy these skills effectively in the analysis and understanding of hybrid navigation systems in an aircraft.
<table>
<thead>
<tr>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
<th>CO5</th>
</tr>
</thead>
<tbody>
<tr>
<td>√</td>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>√</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:

AV5251 AEROSPACE GUIDANCE AND CONTROL  L T P C  3 1 0 4

OBJECTIVES:
- To learn about the aircraft equations of motion and method of linearization.
- To learn about the operating principle of guidance law
- To study about the augmentation systems
- To study longitudinal stability and to design the longitudinal autopilot
- To study lateral stability and to design the lateral autopilot

UNIT I INTRODUCTION  12
Introduction to Guidance and control - Definition, Historical background – Coordinate Frame - Equations of motion – Lineraization.

UNIT II AUGMENTATION SYSTEMS  12
Need for automatic flight control systems, Stability augmentation systems, control augmentation systems, Design of Limited authority and Full Authority Augmentation systems - Gain scheduling concepts.

UNIT III LONGITUDINAL AUTOPILOT  12
Displacement Autopilot -Pitch Orientation Control system, Acceleration Control System, Glide Slope Coupler and Automatic Flare Control and Flight path stabilization, Longitudinal control law design using back stepping algorithm.

UNIT IV LATERAL AUTOPILOT  12

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025
UNIT V  MISSILE AND LAUNCH VEHICLE GUIDANCE

Operating principles and design of guidance laws, homing guidance laws- short range, Medium range and BVR missiles, Launch Vehicle- Introduction, Mission requirements, Implicit guidance schemes, Explicit guidance, Q guidance schemes

TOTAL: 60 PERIODS

OUTCOMES:
Students will be able to:
CO1: Explain the equations governing the aircraft dynamics and the process of linearizing them.
CO2: Define the various guidance schemes and requirements for aircrafts and missiles.
CO3: Apply the principle of stability and control augmentation systems.
CO4: Analyse the oscillatory modes and methods of suppressing them
CO5: Design the controller for lateral, longitudinal and directional control of aircrafts.

REFERENCES:

AL5076  ROCKETRY AND SPACE MECHANICS  L T P C
3 0 0 3

COURSE OBJECTIVES:
1. This course presents the fundamental aspects of rocket motion along with detailed estimation of rocket trajectories.
2. This course also imparts knowledge on optimization of multistage rockets.
3. This course provides the basics of space mechanics required for an aeronautical student
4. This course helps students to provide with the basics of orbit transfer of satellites.
5. This course will help students to gain knowledge on various control methods of rockets.

Attested

DIOR
Centre for Academic Courses
Anna University, Chennai-600 025
UNIT I  ORBITAL MECHANICS  9

UNIT II  SATELLITE DYNAMICS  9

UNIT III  ROCKET MOTION  10
Principle of operation of rocket motor – thrust equation – one dimensional and two dimensional rocket motions in free space and homogeneous gravitational fields – Description of vertical, inclined and gravity turn trajectories – determinations of range and altitude – simple approximations to burnout velocity.

UNIT IV  ROCKET AERODYNAMICS  9

UNIT V  STAGING AND CONTROL OF ROCKET VEHICLES  9
Need for multi staging of rocket vehicles – multistage vehicle optimization – stage separation dynamics and separation techniques- aerodynamic and jet control methods of rocket vehicles – SITVC.

COURSE OUTCOMES:
Upon completion of this course, students will be able

CO1: To knowledge on the fundamental laws of orbital mechanics with particular emphasis on interplanetary trajectories.

CO2: To calculate orbital parameters and perform conceptual trajectory designs for geocentric or interplanetary missions.

CO3: To familiarize themselves with trajectory calculations for planar motion of rockets.

CO4: To determine forces and moments acting on airframe of a missile.

CO5: To acquire knowledge on the need for staging and stage separation dynamics of rocket vehicles.

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TOTAL: 45 PERIODS
REFERENCES:

AV5211 AUTOMATIC FLIGHT CONTROL SYSTEMS LABORATORY L T P C
0 0 4 2

OBJECTIVES:
- To introduce the advanced concepts of flight control and required mathematical knowledge.
- To provide exposure on Root locus, analysis of stability through Root locus plots, Bode plot, Lead Lag compensator.
- To provide exposure on PID controller tuning, controller and autopilot design.
- To provide exposure on data fusion and estimation using kalman filter.
- To provide exposure on hardware in loop simulation.

LIST OF EXPERIMENTS
1. Stability analysis using Root locus, Bode plot, Nyquist plot and Polar plot techniques
2. Development of Longitudinal and Lateral Equations of Motion
3. Performance Improvement of Aircraft Dynamics by pole placement technique
4. Design of PID and LQR algorithm for aircraft dynamics
5. Design of longitudinal autopilot – Displacement, Automatic Glide Slope Control System and Flare Control System
6. Design of Automatic Lateral beam guidance system
7. Design of Van-Guard Missile system
8. Implementation of Hardware-In-Loop Simulation (HILS) for fixed wing aircraft
9. Development of basic stabilization of rotary wing aircrafts

NOTE: Implementation using X-plane, Flight-Gear & Aerosim (Experiments from 5 to 9)

TOTAL: 60 PERIODS

OUTCOMES:
Students will be able to:

CO1: Perform stability analysis of a given aircraft transfer function using different analysis techniques.
CO2: Design a controller using PID and LQR methods
CO3: Design the controller for lateral, longitudinal and directional control of aircrafts.
CO4: Test the designed controller using flight simulator for fixed wing and rotary wing aircrafts.
CO5: Perform Hardware-In-Loop Simulation and modify design parameters to achieve desired results.
OBJECTIVES:
- To provide exposure on inertial sensors Calibration procedures and navigation algorithms
- To provide exposure to hybrid navigation systems
- To provide exposure on Camera Calibration, Optical Flow Estimation, Object detection and tracking methods
- To provide exposure on target coordinate estimation and control for aerial image
- To provide exposure on Kalman Filter design and UAV landing guidance

LIST OF EXPERIMENTS
1. Calibration of MEMS accelerometers
2. Calibration of MEMS gyroscopes
3. Sensor Data Fusion using Kalman filter
4. INS/GPS Integration
5. Simulation of Way Point Navigation using X-Plane
6. Camera calibration
7. Optical Flow Estimation
8. Object detection and tracking
9. Target coordinate estimation using UAV aerial image
10. Integration of Gimbal camera and control for aerial imaging and relative navigation
11. Integration of GPS, Range sensors and Altimeter for landing guidance
12. Simulation of UAV landing guidance using GPS, Range sensors and Altimeter data
13. Design of Kalman filter

TOTAL: 60 PERIODS

OUTCOMES:
Students will be able to:
CO1: Calibrate MEMS IMU and fuse the sensor data using Kalman Filter
CO2: Simulate the waypoint navigation system and integrate the INS/GPS navigation systems
CO3: Calibrate the camera and estimate the state using optical flow
CO4: Perform object detection, tracking, target coordinate estimation and integration of Gimbal camera for UAV aerial image
CO5: Integrate the GPS, Range sensor and Altimeter data for UAV landing guidance

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
OBJECTIVES:
- To understand classical control systems and to analyze the stability of them
- To understand the state space analysis and the design concepts
- To understand the nature of non-linear systems and to analyze the stability of such system
- To understand the non-linear systems and its stability analysis
- To understand the application of selected tools and design and development of optical control system.

UNIT I  INTRODUCTION

UNIT II  STATE SPACE ANALYSIS
Concept of state, state variables and state model, state modeling of linear systems - State space representation using physical variables, phase variables & canonical variables - Controllability and Observability - State Feedback - Pole Placement

UNIT III  NON-LINEAR SYSTEMS

UNIT IV  NONLINEAR SYSTEM ANALYSIS

UNIT V  OPTIMAL CONTROL

TOTAL: 45 PERIODS
OUTCOMES:
Students will be able to:
CO1: Apply mathematical knowledge and basics of science and engineering to develop model for non-linear system.
CO2: Analyze non-linear system based on the first principle model.
CO3: Analyze the solution for complex non-linear system.
CO4: Develop various control schemes for non-linear systems.
CO5: Linearize non-linear system for developing linear control

<table>
<thead>
<tr>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:

AV5002 ELECTRO OPTIC SYSTEMS FOR AVIONICS ENGINEERS L T P C 3 0 0 3

OBJECTIVES:
- To understand the basic concepts of Laws of Black body radiation
- To understand the advanced concepts of Laser systems
- To understand the advanced concepts of Laser systems
- To introduce the concepts of imaging devices and tracking systems
- To give exposure on basic of various Fiber optic systems and their application in avionics domain
UNIT I  INTRODUCTION
Electro Magnetic spectrum, Thermal radiation, Laws of Black body radiation, Emissivity and Kickoff’s
law, Black body sources, Atmospheric propagation characteristics: Scattering effect, Transmission
through rain, Scintillations.

UNIT II  LASER SYSTEMS
Theory of Laser operation, Optical resonators, Temporal and spatial coherence, Introduction to gas,
solid and semiconductor lasers Modulators: Electro Optic, Magneto optic and Acousto- Optic-
modulators, Q switching, Mode locking, Cavity dumping, Introduction to Holography, Ring Laser gyro,
Laser hazards and Safety measures.

UNIT III  INFRARED SYSTEMS
Infrared and thermal detectors, Description and design features of typical passive search and
detection, Infrared imaging, Forward looking Infra Red (FLIR) Tracking and Homing systems. Satellite
Radiometers.

UNIT IV  IMAGING DEVICES AND TRACKING SYSTEMS
Imaging tubes: Vidicon, Pyroelectric vidicon, Image intensifier tubes, CCD, Focal plane arrays (FPA),
Optical tracking, Sensor steering and stabilization, Servo Control. Opto mechanical design of camera
and systems. Description and design features of laser ranging and guidance system, LIDAR.

UNIT V  FIBER OPTIC SYSTEMS
Types of Fiber optic cables and their characteristics, fiber optic sources and detectors, Avionics fiber
optic data busses: IEEE std 1393, MIL STD 1773 etc. Multiplexing schemes for onboard avionics,
Fiber optic gyro.

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to:
CO1: Apply the concepts of Black body radiation, Black body sources.
CO2: Explain the working and applications of LASERs
CO3: Explain the working and applications of Infrared imaging devices
CO4: Explain the working and applications of imaging and tracking devices.
CO5: Analyze the fiber-optic systems, allowing the avionics engineers to deploy these skills
effectively in the design and development of optical systems in avionics engineering.

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:
1. Gupta, S.C. —Optoelectronic devices and Systems, Prentice Hall of India, New Delhi, 2nd
   2005.
   of India, New Delhi, 1998.
OBJECTIVES:
- To introduce the concepts of aircraft mathematical model and Aircraft Equations of Motion
- To introduce the probability concepts in simulation
- To impart practical knowledge on the simulation of aircraft systems.
- To introduce the knowledge about various types of flight simulators
- To introduce interfacing of Flight simulators with AeroSim and Aerospace Blockset

UNIT I SYSTEM MODELS AND SIMULATION
- Continuous and discrete systems, System modeling, Static models, Dynamic models, Principles used in modeling the techniques of simulation, Dynamic modeling of the Quadrotor - Aircraft mathematical model, Aircraft axis systems - Aircraft Equations of Motion – Aircraft force equations – Moment Equations – Longitudinal and Lateral Directional EOM- Kinematic Equations – Linearizing the EOM- Equations of longitudinal and lateral directional motion- Analytical modeling of aircraft wing loads, Bending moment model

UNIT II PROBABILITY, CONCEPTS IN SIMULATION
- Stochastic Variables, Discrete probability functions, continuous probability function, Measure of Probability functions, Continuous uniformly distributed random number, Congestion in systems, Arrival patterns, various types of distribution, Simulation of Queuing systems

UNIT III SYSTEM SIMULATION
- Discrete events, Representation of time, Generation of arrival patterns, Simulation Programming tasks, Gathering statistics, Counters and summary statistics, Simulation language. Continuous System models, Differential equation, Analog methods, digital analog simulators, Continuous system simulation language (CSSLs), Hybrid simulation, UAV and MAV simulation, Simulation of an autopilot, INS, autonomous landing systems, Interactive systems, AeroSim and Aerospace Blockset libraries for flight simulation

UNIT IV SYSTEM DYNAMICS AND MATHEMATICAL MODELS FOR FLIGHT SIMULATION
- Historical background growth and decay models, System dynamics diagrams, Multi – segment models. Representation of time delays, The Dynamo Language Elements of Mathematical models, Equation of motion, Representation of aerodynamics data, Aircraft systems, Structure and cockpit systems, Motion system, Visual system, Instructor’s facilities.

UNIT V FLIGHT SIMULATOR AS A TRAINING DEVICE AND RESEARCH TOOL
- Introduction, advantage of simulator, the effectiveness of Simulator, The user's role, Simulator Certification, Data sources, Validation, in- flight simulators - Interfacing Flight Gear Flight Simulator using AeroSim and Aerospace Blockset

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to:
CO1: Explain the equations governing the aircraft dynamics and the process of linearizing them.
CO2: Derive the equations of aircraft wing loads, bending moment model.
CO3: Explain the probability concepts in simulation and flight simulators.
CO4: Perform and compare the simulation on different flight simulators.
CO5: Demonstrate the concepts and working of a flight simulator.
OBJECTIVES:
- To provide exposure to basic concepts of Aircraft product system engineering and design
- To provide exposure to different fault and failure analysis methods in avionic systems.
- To provide exposure on systems engineering process, System Architecture and integration
- To provide exposure on the importance of Maintainability, reliability and availability of the product.
- To provide exposure importance of formal planning and documentation in systems engineering.

UNIT I  INTRODUCTION TO SYSTEMS ENGINEERING  9

UNIT II  THE AIRCRAFT SYSTEMS AND DESIGN  9

UNIT III  SYSTEM ARCHITECTURES AND INTEGRATION  9

REFERENCES:

AV5004 AVIONICS SYSTEM ENGINEERING  L T P C 3 0 0 3
UNIT IV  PRACTICAL CONSIDERATIONS AND CONFIGURATION CONTROL

UNIT V  SYSTEMS RELIABILITY AND MAINTAINABILITY

OUTCOMES:
Students will be able to:
CO1: Describe the importance of systems engineering process in product development
CO2: Categorize different aircraft systems and will be able to differentiate the avionics architectures
CO3: Analyze the different stages of product development and factors influencing in each stage
CO4: Design the different alternatives during design process
CO5: Plan, organize and document the task related to product design, development and testing.

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

REFERENCES:
OBJECTIVES:
- To introduce basics of image processing, imaging sensors and Geometric spatial transformations
- To introduce the concepts in image enhancement and camera calibration techniques
- To understand the image segmentation and feature extraction methods
- To introduce the detailed concepts on multi resolution analysis
- To expose students to the state of the art image processing algorithms for aerospace applications

UNIT I  FUNDAMENTALS OF IMAGE PROCESSING

UNIT II  IMAGE ENHANCEMENT AND CAMERA CALIBRATION

UNIT III  IMAGE SEGMENTATION AND FEATURE ANALYSIS

UNIT IV  MULTI RESOLUTION ANALYSIS

UNIT V  AEROSPACE APPLICATIONS

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to:
CO1: Explain the mathematics behind image processing, point operations and colour image enhancement and restoration.
CO2: Perform image processing using Feature Analysis, Feature Extraction and Template Matching methods.
CO4: Perform Image enhancement, Wavelet transforms, multi-resolution analysis.
CO5: Deploy these skills effectively in vision based navigation and control.
REFERENCES:

AV5006

FAULT TOLERANT COMPUTING

OBJECTIVES:
- To provide basic knowledge on the concept of fault tolerance and redundancy.
- To learn about the error detection and correction techniques.
- To study about the system architectures, integration, practical considerations and configuration.
- To provide knowledge on fault tolerance using software.
- To study system reliability and maintainability.

UNIT I FAULT TOLERANCE

UNIT II ERROR DETECTION

UNIT III ERROR RECOVERY
UNIT IV SOFTWARE FAULT TOLERANCE

The recovery block scheme – Implementation of recovery block – Acceptance – tests – run-time Overheads.

UNIT V SYSTEMS STRUCTURE AND RELIABILITY


TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1: Explain the advanced concepts of Fault Tolerance
CO2: Derive the necessary mathematical knowledge that are needed in understanding the necessary procedures involved.
CO3: Design Redundancy system, Fault Tolerant system architecture, error handling and recovery
CO4: Deploy these skills effectively in the solution of problems in avionics engineering.
CO5: Design the software fault tolerant documents based on the pertaining tests and standards

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:


AV5007 REAL TIME EMBEDDED SYSTEMS AND APPLICATIONS

OBJECTIVES:

To understand the basics of embedded system, architecture of PIC microcontroller and ARM processor.
- To understand the RTOS concepts like scheduling and memory management related to the embedded system.
- To learn the protocols of embedded wired and wireless application.
- To understand the concepts of software abstraction and peripheral interfacing.
- To understand concepts involved in the design of hardware and software components for an embedded system.
UNIT I  EMBEDDED SYSTEM ARCHITECTURE

UNIT II  CONNECTIVITY

UNIT III  EMBEDDED/REAL TIME OPERATING SYSTEM

UNIT IV  SOFTWARE DEVELOPMENT FOR EMBEDDED APPLIATIONS

UNIT V  CASE STUDIES WITH EMBEDDED CONTROLLER

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to:
CO1: Explain the concepts of typical embedded systems.
CO2: Analyse a suitable choice of embedded processor for a given application.
CO3: Design the hardware and software for the embedded system.
CO4: Develop the real time kernel/operating system functions, task control block structure and analyze different task states.
CO5: Implement different types of inter task communication and synchronization techniques.

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:

AS5072 ELEMENTS OF SATELLITE TECHNOLOGY L T P C
3 0 0 3

COURSE OBJECTIVES:
This course will make students
1. To learn the satellite mission and configurations,
2. To have an basic idea on power system of satellites
3. To learn the attitude and orbit control systems of satellites.
4. To gain knowledge on basic of propulsion systems, structures, and thermal controls involved in satellites.
5. To learn the basic aspects of telemetry systems.

UNIT I SATELLITE MISSION AND CONFIGURATION 9

UNIT II POWER SYSTEM 8

UNIT III ATTITUDE AND ORBIT CONTROL SYSTEM (AOCS) 9
Coordinate system –AOCS requirements–Environment effects – Attitude stabilization – Attitude sensors –Actuators–Design of control algorithms.

UNIT IV PROPULSION SYSTEMS, STRUCTURES AND THERMAL CONTROL 10

UNIT V TELEMETRY SYSTEMS 9
Base Band Telemetry system– Modulation– TT & CRF system–Telecommand system–Ground Control Systems

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon completion of this course, Students will
CO1: Be able to describe the main components of a satellite and its importance.
CO2: Compare the merits and demerits of various power systems used.
CO3: Be able to learn the dynamics of the satellite.
CO4: Be able to study the design of propulsion systems, structures needed for satellites.
CO5: Acquire knowledge on satellite orbit control and telemetry systems.

<table>
<thead>
<tr>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td></td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td></td>
<td>☑</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>☑</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>☑</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:

AV5008 ELECTRONIC WARFARE

OBJECTIVES:
- To introduce principles of electronic warfare, electronic support measure and electronic counter measures
- To understand the Radar Warning Receivers trends in display technology
- To understand the Radar detection performance low RCS aircraft
- To know EM sensor subsystem, Mile parameter tracking
- To study electronic counter - counter measures (ECCM)

UNIT I ELECTRONIC WARFARE (EW) PRINCIPLES AND RADAR
Electronic Warfare taxonomy-EW Mission and scenarios – Basic principles of Radar – Radar Equations - Types

UNIT II ELECTRONIC SUPPORT MEASURE (ESM) RECEIVERS - ELECTRONIC COUNTER MEASURES (ECM)
Radar Warning Receivers (RWR) - Passive direction finding and emitter - location - noise jamming-Deception Electronic Counter Measures (DECM) - Modern ECM systems.
UNIT III  RADAR AND ECM PERFORMANCE ANALYSIS
Radar detection performance low RCS aircraft - ECM - Jamming equations - EW receiver sensitivity

UNIT IV  EW SIGNAL PROCESSING
Signal environment - EM sensor subsystem - The receiver subsystem - The pre-processor the data servo loop - Mile parameter tracking - Advanced pulley power - Managed Jamming.

UNIT V  ELECTRONIC COUNTER - COUNTER MEASURES (ECCM)
Radar applications in weapon systems - Radar types and characteristics, EW Technology and Future Trends - Antenna Technology - ECM transmitter power source technology - EW receiver technology - EW at millimeter Wavelength - Low Observability EW technology.

OUTCOMES:
Students will be able to:
CO1: Explain the importance and advantages of electronic warfare
CO2: Explain the electronic support measure and electronic counter measures
CO3: Do the performance analysis of Radar detection
CO4: Demonstrate the receiver subsystem, the pre-processor and the data servo loop - Mile parameter tracking
CO5: Explain system assessment, counter measures (ECCM)

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:

NE5077  MICROWAVES AND RADAR  L T P C  3 0 0 3

OBJECTIVES:
- To provide knowledge on the electronic devices and their implementation in generating RADAR signal
- To study the principles of operation and types of RADAR.
- To understand the theoretical principles underlying microwave sources for RADAR.
- To provide knowledge on signal processing involved in RADAR
- To learn about RADAR tracking.
UNIT I  MICROWAVESOURCES
Passive waveguide components, Microstrip line structure and components, Simple theory and operating characteristics of Reflex klystrons, Two cavity Klystrons, Magnetrons, and TWTS - solid state source - TEDS, IMPATTs, TRAPATT, GaAs FETs and Tunnel diode.

UNIT II  RADAR PRINCIPLES

UNIT III  TYPES OF RADARS

UNIT IV  RADAR SIGNAL PROCESSING

UNIT V  TRACKING RADAR
Tracking with radar – Monopulse Tracking – conical scan and sequential lobing –limitations to tracking Accuracy- Kalman Tracker -Fundamentals of Airborne radar

OUTCOMES:
Students will be able to:
CO1: To understand the concepts of radar
CO2: To derive a radar equations
CO3: To design a radar system.
CO4: To design and implement radar tracking algorithms.
CO5: To review the types of microwave sources

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:
OBJECTIVES:
- To introduce basic concepts of UAV
- To understand the basics of airframe
- To understand the avionics hardware
- To know communication payloads and controls and design considerations.
- To study path planning, Micro Aerial Vehicles and UAV certification standards.

UNIT I  INTRODUCTION TO UAV
History of UAV – classification –basic terminology-models and prototypes –applications

UNIT II  BASICS OF AIRFRAME

UNIT III  AVIONICS HARDWARE
Autopilot –AGL-pressure sensors-servos-accelerometer – gyro’s-actuators – power supply processor, integration, installation, configuration, and testing

UNIT IV  COMMUNICATION PAYLOADS AND CONTROLS
Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range –SAS- flight director-commands and videos-elements of control loops-flight computer sensor-displays-parameter settings-modems-memory system-simulation-ground test-analysis troubleshooting.

UNIT V  PATH PLANNING AND MAV
Waypoints navigation-ground control software-Recent trends in UAV-Case Studies.

OUTCOMES:
Students will be able to:
CO1: Categorize UAV based on its physical dimension and weight.
CO2: Design a suitable airframe according to the application requirements.
CO3: Select the proper hardware, payload and communication method for the UAV.
CO4: Design an UAV using the skills learned to satisfy the requirements.
CO5: Explain the UAV terminologies and different certification standards.

REFERENCES:
OBJECTIVES:
- To impart the knowledge on the concepts of digital fly-by-wire controls and their importance in understanding modern aircraft control strategies.
- To introduce different DFBW architectures, redundancy and reliability.
- To provide knowledge on active control technology, design issues and generic failures.
- To introduce recent trends in DFBW.
- To introduce DFBW system design requirements

UNIT I  INTRODUCTION TO FLY-BY-WIRE CONTROL
Need for FBW systems, Historical perspectives in design Programs-Douglas Long Beach Programs, WPAFB B 47 In House Program, LTV IAP, Sperry Phoenix Programs, CAS and SAS, CCV and ACT concepts.

UNIT II  ELEMENTS OF DFBW CONTROL
Description of various elements of DFBW systems - Concept of redundancy and reliability, Fault coverage and redrecontundant architecture.

UNIT III  DFBW ARCHITECTURES
Need for redundant architecture, discussion on triplex vs. quadruplex architecture for DFBW system, Concept of cross-strapping, Actuator command voting and servo force voting etc.

UNIT IV  REQUIREMENTS FOR DFBW SYSTEM DESIGN
Survivable Flight control System programs, ADP Phases-Simplex package Evaluation -FBW without Mechanical Backup-Survivable Stablilator Actuator package, Reliability requirements and their relevance to DFBW system design, redundant power supply requirements, Environmental and weight, volume constraints, Built-in-test features, Software development, Redundancy management, Issues of digital control laws

UNIT V  RECENT TRENDS IN DFBW

TOTAL: 45 PERIODS
OUTCOMES:
Students will be able to:

CO1: Explain the basic concepts of Fly-by-wire and provide the necessary mathematical knowledge that are needed in understanding modern aircraft control strategies.

CO2: Explain the advanced concepts of Fly-by-wire

CO3: Explain on various topics such as evolution of FBW, Elements, architecture, design and design issues of DFBW.

CO4: Deploy these skills effectively in the analysis and understanding of modern control methods.

CO5: Design the control law for lateral and longitudinal axis with the necessary mathematical knowledge that are needed in creating modern aircraft control strategies.

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

REFERENCES:


AV5011 MISSILE TECHNOLOGY L T P C 3 0 0 3

OBJECTIVES:
- To introduce history and classifications of Missile systems and basics of trajectories
- To have a clear view about Aerodynamic characteristics of missiles and performance of missiles under testing
- To know about principles of Rocket and jet propulsion and nozzle characteristic parameter.
- To study the types of navigation used in missiles and their characteristics
- To compute trajectory calculations for ballistic missiles

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025
UNIT I     MISSILE SYSTEM
Introduction - history - classification - missile system elements, missile ground systems - radars – launchers, coordinate frames, basics of trajectory dynamics.

UNIT II    AERODYNAMICS
Missile aerodynamics- design methodology, aerodynamic prediction method, aerodynamic loads & performance analysis, wind tunnel and flight testing of missile models and missile prototypes.

UNIT III   PROPULSION
Principles of jet propulsion and rocketry, nozzle theory and performance parameters of solid rockets and ramjet and compound jet engines – evaluation of flight performance - forces acting on vehicle - basic relations of motion - multi stage vehicles

UNIT IV    NAVIGATION, GUIDANCE & CONTROL

UNIT V     MISSILE TRAJECTORY CALCULATIONS
Vertical, inclined and gravity turn trajectories – determination of range and altitude- numerical computation of ballistic trajectories.

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to:
CO1: Demonstrate the working of a Missile system and launchers in co-ordinate frames.
CO2: Discuss about design methodology of missiles and detailed view about aerodynamic loads and experimental methods.
CO3: Explain about propulsion principles and staging of vehicles in space.
CO4: Differentiate the types of navigation systems and their pros and cons.
CO5: Perform calculation of ballistic missile trajectories.

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:
OBJECTIVES:
- To introduce the basic knowledge on avionics system engineering, avionic subsystems and aircraft electrical systems
- To introduce to the avionic software standards & requirements and safety issues.
- To have a clear view about safety of complex systems
- To introduce to on board Navigation and Communication systems
- To get knowledge about FMS and HMI.

UNIT I  SYSTEM ENGINEERING AND AIRCRAFT ELECTRICAL SYSTEMS
System engineering overview, system engineering contract process, Technical process, H/w & S/w life cycle, Avionics systems includes FMS, BITE, Air traffic management systems, cockpit display system, Navigation, Mission management system, TCAS- Electric power generation, regulation and distribution systems, Industrial Power electronics, power supply, Battery charging systems, Engine electronics , Air-conditioning and lighting systems, wiring and cabling, Power supply Standards, and wiring and cabling standards

UNIT II  ON BOARD SOFTWARE
Introduction to FAR, JAR.25-1309 regulations & DO-178 standards. System aspects and software levels. Software development requirements, verification requirements, software configuration management requirements, software quality assurance requirements according to levels- case study.

UNIT III  SAFETY OF COMPLEX SYSTEMS
Introduction & objectives-Definition of basic concepts, certification regulations, analysis methods, Dependability techniques and tools- FMEA, FTA, combined failures, Reliability of systems, standards, methods of reliability analysis, certificate of Airworthiness, Risk management concepts-case study.

UNIT IV  ON BOARD NAVIGATION AND COMMUNICATION SYSTEMS
Over view of navigational aids, Flight planning, Area navigation, required time of arrival, RNAV architecture, Performance aspects, approach and landing challenges, regulatory and safety aspects, GPS and GNSS characteristics, Receiver autonomous integrity monitoring (RAIM)- Cockpit Instruments instrument errors and calibration, Data acquisition systems, ATEs, Display systems, Actuation a systems, Redundancy management. Reliability engineering System Maintenance

UNIT V  FMS & HUMAN MACHINE INTERFACE
Introduction, ARINC 424, Aircraft Performance, Aircraft Guidance, Flight plan, Trajectory and prediction, Position determination, VNAV, Flight Management Computer, control display unit, control display page function, flight management function, Navigation display system, Tactical display, FMS Graphical Flight Planning display, cockpit display system, aircraft display control panel.

TOTAL : 45 PERIODS
OUTCOMES:
Students will be able to:
CO1: Be able to interpret avionic software standards & requirements and safety issues.
CO2: Be able to explain the need for onboard Navigation systems, FMS and HMI.
CO3: Be able to explain the advanced concepts of Industrial avionics to the engineers and provide the necessary knowledge that are needed in understanding relevant processes.
CO4: Have an exposure on various topics such as System Engineering, on-board software, safety of complex systems, FMS, ARINC 424 and Human interface
CO5: Be able to deploy these skills effectively in the solution of problems in Avionics Engineering.

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:

AV5013  SPACERCRAFT COMMUNICATION SYSTEMS  L T P C
        3 0 0 3

OBJECTIVES:
- To introduce basics of orbital mechanics and various performance parameters
- To know about spacecraft subsystems and payload operations
- To get knowledge about multiple access systems and Network aspects in existing & planned sub systems
- To know about various mobile and fixed services feasible in satellite and classification of various satellites based on platforms
- To introduce to the concepts of telemetry tracking and telecommand.

UNIT I  ELEMENTS OF SATELLITE COMMUNICATIONS
UNIT II  TRANSMISSION, MULTIPLEXING, MULTIPLE ACCESS AND CODING

Different modulation and Multiplexing Schemes, Multiple Access Techniques FDMA, TDMA, CDMA, and DAMA, Coding Schemes, Satellite Packet Communications.

UNIT III  SATELLITE LINK DESIGN

Basic link analysis, Interference analysis, Rain induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequency reuse.

UNIT IV  SATELLITE TELEMETRY, TRACKING AND TELECOMMAND

Introduction to telemetry systems - Aerospace transducer - signal conditioning – multiplexing methods - Analog and digital telemetry - Command line and remote control system - Application of telemetry in spacecraft systems - Base Band Telemetry system - Computer command & Data handling, Satellite command system-Issues.

UNIT V  APPLICATIONS

VSAT-VSAT Technologies, Networks MSS-AMSS, MMSS

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to:

CO1: Explain the advanced concepts of Spacecraft communication systems to the engineers

CO2: Derive the necessary mathematical equations that are needed in understanding the physical processes.

CO3: Explain Orbital mechanics, elements of satellite communication system, links and multiplexing, multiple access, telemetry, tracking and telecommand

CO4: Review the communication codes schemes

CO5: Deploy these skills effectively in the solution of problems in avionics engineering.

<table>
<thead>
<tr>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:

OBJECTIVES

- To understand the concepts of detection and estimation.
- To learn the basics of multi-user detection theory.
- To understand the theory behind various estimation techniques.
- To understand Wiener filter and Kalman filter in detail.
- To understand the application specific implementation of different estimation methods.

UNIT I  REVIEW OF PROBABILITY AND STOCHASTIC PROCESS  9

UNIT II  SINGLE AND MULTIPLE SAMPLE DETECTION  9
Hypothesis Testing and the MAP Criterion, Bayes Criterion, Minimax Criterion, Neyman-Pearson Criterion, Sequential Detection, The Optimum Digital Detector in Additive Gaussian Noise, Performance of Binary Receivers in AWGN.

UNIT III  FUNDAMENTALS OF ESTIMATION THEORY  9

UNIT IV  WIENER AND KALMAN FILTERS  9

UNIT V  APPLICATIONS  9
Detector Structures in Non-Gaussian Noise, Examples of Noise Models, Receiver Structures, and Error-Rate Performance, Estimation of Non-Gaussian Noise Parameters Fading Multipath Channel Models, Receiver Structures with Known Channel Parameters, Receiver Structures without Knowledge of Phase, Receiver Structures without Knowledge of Amplitude or Phase, Receiver Structures and Performance with No Channel Knowledge.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1: Explain the concepts of detection, estimation and multi-user detection theory.
CO2: Apply the theory behind various estimation techniques.
CO3: Analyze detection and estimation theory to solve communication problems.
CO4: Apply probability and stochastic process concepts in detection and estimation.
CO5: Design Wiener and Kalman filters to solve linear estimation problems.
<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:

AV5015 SOFT COMPUTING FOR AVIONICS ENGINEERS  
L T P C 3 0 0 3

OBJECTIVES:
- To familiarize with soft computing concepts.
- To introduce the ideas of Neural Networks and use of heuristics based on human experience.
- To introduce Fuzzy set theory and different fuzzy models for controller design.
- To introduce the concepts of Genetic algorithm and its applications to soft computing using some applications.
- To introduce to neuro-fuzzy modelling.

UNIT I NEURAL NETWORKS

UNIT II FUZZY SET THEORY

UNIT III OPTIMIZATION METHODS

UNIT IV NEURAL AND FUZZY CONTROL SCHEMES
Direct and Indirect Neuro Control Schemes – Fuzzy Logic Controller – Familiarization of Neural Network and Fuzzy Logic Toolbox - Case Studies.
UNIT V  NEURO FUZZY MODELLING

TOTAL:45 PERIODS

OUTCOMES:
Students will be able to:
CO1: Explain the advanced concepts of Soft-computing
CO2: Provide the necessary mathematical knowledge that are needed in modeling the related processes.
CO3: Select a suitable soft-computing technique to solve the given problem effectively
CO4: Design a controller based on Neural Networks, Fuzzy logic and Neuro-fuzzy modeling.
CO5: Deploy the skills effectively in the solution to problems in avionics engineering.

<table>
<thead>
<tr>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

REFERENCES:

OE5091  BUSINESS DATA ANALYTICS
L T P C
3 0 0 3

OBJECTIVES:
- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modelling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.
UNIT I   OVERVIEW OF BUSINESS ANALYTICS


Suggested Activities:
- Case studies on applications involving business analytics.
- Converting real time decision making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:
- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT II   ESSENTIALS OF BUSINESS ANALYTICS


Suggested Activities:
- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:
- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

UNIT III   MODELING UNCERTAINTY AND STATISTICAL INFERENCE


Suggested Activities:
- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.
- Converting real time decision making problems into hypothesis.

Suggested Evaluation Methods:
- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.

UNIT IV   ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK

Suggested Activities:
- Practical – Install and configure Hadoop.
- Practical – Use web based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:
- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

UNIT V  OTHER DATA ANALYTICAL FRAMEWORKS

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

Suggested Activities:
- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:
- Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the student will be able to:
- Identify the real world business problems and model with analytical solutions.
- Solve analytical problem with relevant mathematics background knowledge.
- Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
- Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce
- Use open source frameworks for modelling and storing data.
- Apply suitable visualization technique using R for visualizing voluminous data.

REFERENCES:
OBJECTIVES:
- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

UNIT I INTRODUCTION
Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II FUNDAMENTALS OF MAINTENANCE ENGINEERING
Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III WEAR AND CORROSION AND THEIR PREVENTION

UNIT IV FAULT TRACING
Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment’s like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.
UNIT V  PERIODIC AND PREVENTIVE MAINTENANCE
Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

OUTCOMES:
Students will be able to:
CO1: Ability to summarize basics of industrial safety
CO2: Ability to describe fundamentals of maintenance engineering
CO3: Ability to explain wear and corrosion
CO4: Ability to illustrate fault tracing
CO5: Ability to identify preventive and periodic maintenance

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:

OE5093  OPERATIONS RESEARCH
L T P C
3 0 0 3

OBJECTIVES:
- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation, assignment problems
- Solve project management problems
- Solve scheduling problems

UNIT I  LINEAR PROGRAMMING
Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method
UNIT II  ADVANCES IN LINEAR PROGRAMMING  
Solutions to LPP using simplex algorithm - Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis

UNIT III  NETWORK ANALYSIS – I  
Transportation problems -Northwest corner rule, least cost method, Voges’s approximation method - Assignment problem -Hungarian algorithm

UNIT IV  NETWORK ANALYSIS – II  
Shortest path problem: Dijkstra’s algorithms, Floyds algorithm, systematic method -CPM/PERT

UNIT V  NETWORK ANALYSIS – III  
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to:
CO1: To formulate linear programming problem and solve using graphical method.
CO2: To solve LPP using simplex method
CO3: To formulate and solve transportation, assignment problems
CO4: To solve project management problems
CO5: To solve scheduling problems

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:
OBJECTIVES:
- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT I    INTRODUCTION TO COSTING CONCEPTS  9
Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT II    INTRODUCTION TO PROJECT MANAGEMENT  9
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts.

UNIT III   PROJECT EXECUTION AND COSTING CONCEPTS  9
Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV    COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL  9
Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V     QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT  9
Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to:
CO1 – Understand the costing concepts and their role in decision making
CO2–Understand the project management concepts and their various aspects in selection
CO3–Interpret costing concepts with project execution
CO4–Gain knowledge of costing techniques in service sector and various budgetary control techniques
CO5 - Become familiar with quantitative techniques in cost management
REFERENCES:
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988

OE5095 COMPOSITE MATERIALS  L T P C  3 0 0 3

OBJECTIVES:
- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identify the various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials.

UNIT I INTRODUCTION  9
Definition – Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II REINFORCEMENTS  9
Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.

UNIT III MANUFACTURING OF METAL MATRIX COMPOSITES  9

UNIT IV MANUFACTURING OF POLYMER MATRIX COMPOSITES  9

UNIT V STRENGTH  9
Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL: 45 PERIODS

Attested

[Signature]

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025
OUTCOMES:
Students will be able to:
CO1: Know the characteristics of composite materials and effect of reinforcement in composite materials.
CO2: Know the various reinforcements used in composite materials.
CO3: Understand the manufacturing processes of metal matrix composites.
CO4: Understand the manufacturing processes of polymer matrix composites.
CO5: Analyze the strength of composite materials.

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

REFERENCES:

OE5096 WASTE TO ENERGY L T P C 3 0 0 3

OBJECTIVES:
- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

UNIT I INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE 9
Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II BIOMASS PYROLYSIS 9
Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.
UNIT III  BIOMASS GASIFICATION

UNIT IV  BIOMASS COMBUSTION
Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V  BIO ENERGY
Properties of biogas (Calorific value and composition). Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to:
CO1 – Understand the various types of wastes from which energy can be generated
CO2 – Gain knowledge on biomass pyrolysis process and its applications
CO3 – Develop knowledge on various types of biomass gasifiers and their operations
CO4 – Gain knowledge on biomass combustors and its applications on generating energy
CO5 – Understand the principles of bio-energy systems and their features

<table>
<thead>
<tr>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

REFERENCES:
AUDIT COURSES (AC)

AX5091 ENGLISH FOR RESEARCH PAPER WRITING L T P C 2 0 0 0

OBJECTIVES
- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING 6
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS 6

UNIT III TITLE WRITING SKILLS 6
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS 6
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS 6
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

TOTAL: 30 PERIODS

OUTCOMES
CO1 – Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES
OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS


UNIT III DISASTER PRONE AREAS IN INDIA

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People’s Participation in Risk Assessment. Strategies for Survival

TOTAL: 30 PERIODS

OUTCOMES

CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
REFERENCES

AX5093              SANSKRIT FOR TECHNICAL KNOWLEDGE                     L T P C
                                                                          2 0 0 0

OBJECTIVES
- Illustrate the basic Sanskrit language.
- Recognize Sanskrit, the scientific language in the world.
- Appraise learning of Sanskrit to improve brain functioning.
- Relate Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT I     ALPHABETS
Alphabets in Sanskrit

UNIT II    TENSES AND SENTENCES
Past/Present/Future Tense - Simple Sentences

UNIT III   ORDER AND ROOTS
Order - Introduction of roots

UNIT IV    SANSKRIT LITERATURE
Technical information about Sanskrit Literature

UNIT V     TECHNICAL CONCEPTS OF ENGINEERING
Technical concepts of Engineering - Electrical, Mechanical, Architecture, Mathematics

TOTAL: 30 PERIODS

OUTCOMES
- CO1 - Understanding basic Sanskrit language.
- CO2 - Write sentences.
- CO3 - Know the order and roots of Sanskrit.
- CO4 - Know about technical information about Sanskrit literature.
- CO5 - Understand the technical concepts of Engineering.

<table>
<thead>
<tr>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
REFERENCES
1. “Abhyaspustakam” – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication

AX5094 VALUE EDUCATION

OBJECTIVES
Students will be able to
- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT I

UNIT II

UNIT III

UNIT IV

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to
- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the overall personality.

SUGGESTED READING
OBJECTIVES
Students will be able to:
- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional role and entitlement to civil and economic rights as well as the emergence of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT I  HISTORY OF MAKING OF THE INDIAN CONSTITUTION:
History, Drafting Committee, (Composition & Working)

UNIT II  PHILOSOPHY OF THE INDIAN CONSTITUTION:
Preamble, Salient Features

UNIT III  CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES:

UNIT IV  ORGANs OF GOVERNANCE:
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V  LOCAL ADMINISTRATION:

UNIT VI  ELECTION COMMISSION:
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to:
- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.
SUGGESTED READING
1. The Constitution of India, 1950 (Bare Act), Government Publication.

AX5096 PEDAGOGY STUDIES

OBJECTIVES
Students will be able to:
- Review existing evidence on there view topic to inform programme design and policy
- Making under taken by the DIID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT I INTRODUCTION AND METHODOLOGY:
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT II THEMATIC OVERVIEW
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES
Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV PROFESSIONAL DEVELOPMENT
Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 30 PERIODS
OUTCOMES
Students will be able to understand:
- What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

SUGGESTED READING

AX5097  
STRESS MANAGEMENT BY YOGA  

OBJECTIVES
- To achieve overall health of body and mind
- To overcome stress

UNIT I
Definitions of Eight parts of yoga (Ashtanga)

UNIT II
Yam and Niyam - Do’s and Don’ts in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT III
Asan and Pranayam - Various yoga poses and their benefits for mind & body - Regularization of breathing techniques and its effects - Types of pranayam

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to:
- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency
SUGGESTED READING
1. “Yogic Asanas for Group Tarining-Part-I”: Janardan Swami Yoga bhyasi Mandal, Nagpur
2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

AX5098 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

OBJECTIVES
- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT I
Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont’s) - Verses- 71,73,75,78 (do’s)

UNIT II
Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III
Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 - Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimad bhagwad geeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

OUTCOMES
Students will be able to
- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neet is hatakam will help in developing versatile personality of students.

SUGGESTED READING
1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bharthrihari’s Three Satakam, Niti-sringar-vairagya, New Delhi,2010