HINDUSTAN UNIVERSITY

HINDUSTAN INSTITUTE OF TECHNOLOGY & SCIENCE

Department of Aeronautical Engineering

M.Tech. Avionics with specialization in Unmanned Aerial Vehicle (UAV)

Curriculum & Syllabus
2014 Regulations

ACADEMIC REGULATIONS
(M.TECH./ M.B.A. / M.C.A.)
(Full - Time / Part – Time)
(Effective 2014-15)

1. Vision, Mission and Objectives

1.1 The Vision of the Institute is "To make every man a success and no man a failure".

In order to progress towards the vision, the Institute has identified itself with a mission to provide every individual with a conducive environment suitable to achieve his / her career goals, with a strong emphasis on personality development, and to offer quality education in all spheres of engineering, technology, applied sciences and management, without compromising on the quality and code of ethics.

1.2 Further, the institute always strives

- To train our students with the latest and the best in the rapidly changing fields of Engineering, Technology, Management, Science & Humanities.
- To develop the students with a global outlook possessing, state of the art skills, capable of taking up challenging responsibilities in the respective fields.
- To mould our students as citizens with moral, ethical and social values so as to fulfill their obligations to the nation and the society.
- To promote research in the field of science, Humanities, Engineering, Technology and allied branches.

1.3 Our aims and objectives are focused on

- Providing world class education in engineering, technology, applied science and management.
- Keeping pace with the ever changing technological scenario to help our students to gain proper direction to emerge as competent professionals fully aware of their commitment to the society and nation.
- To inculcate a flair for research, development and entrepreneurship.

2. Admission

2.1. The admission policy and procedure shall be decided from time to time by the Board of Management (BOM) of the Institute, following guidelines issued by Ministry of Human Resource Development (MHRD), Government of India. The number of seats in each branch of the (M.TECH / M.B.A. / M.C.A.) programme will be decided by BOM as per the directives from Ministry of Human Resource Development (MHRD), Government of India and taking into account the market demands. Some seats for Non Resident Indians and a few seats for foreign nationals shall be made available.

2.2. The selected candidates will be admitted to the (M.TECH / M.B.A. / M.C.A.) programme after he/she fulfills all the admission requirements set by the Institute and after payment of the prescribed fees.

2.3. Candidates for admission to the first semester of the Master's Degree Programme shall be required to have passed an appropriate Degree Examination recognized by Hindustan University.

2.4. In all matters relating to admission to the (M.TECH /M.B.A. / M.C.A.). Programme, the decision of the Institute and its interpretation given by the Chancellor of the Institute shall be final.

2.5. If at any time after admission, it is found that a candidate has not fulfilled

any of the requirements stipulated by the Institute, the Institute may revoke the admission of the candidate with information to the Academic Council.

3. Structure of the programme

3.1. The programme of instruction will have the following structure

i) Core courses of Engineering / Technology / Management.

ii) Elective courses for specialization in areas of student's choice.

3.2. The minimum durations of the programmes are as given below:

Program	No. of Semesters
M.Tech.(Full-Time)	4
M.Tech.(Part -Time)	6
M.B.A. (Full - Time)	4
M.B.A. (Part - Time)	6
M.C.A.(Full - Time)	6
M.C.A.(Part -Time)	8

Every (M.TECH / M.B.A. / M.C.A.) programme will have a curriculum and syllabi for the courses approved by the Academic Council.

3.3. Each course is normally assigned certain number of credits. The following norms will generally be followed in assigning credits for courses.

- One credit for each lecture hour per week per semester;
- One credit for each tutorial hour per week per semester;
- One credit for each laboratory practical (drawing) of three (two) hours per week per semester.
- One credit for 4 weeks of industrial training and
- One credit for 2 hours of project per week per semester.

3.4. For the award of degree, a student has to earn certain minimum total number of credits specified in the curriculum of the relevant branch of study. The curriculum of the different programs shall be so designed that the minimum prescribed credits required for the award of the degree shall be within the limits specified below.

Program	Minimum prescribed credit range
M.Tech. (Full time / Part time)	75 - 85
M.B.A. (Full time / Part time)	85 - 95
M.C.A (Full time / Part time)	115 - 125

3.5. The medium of instruction, examination and the language of the project reports will be English.

4. Faculty Advisor

4.1. To help the students in planning their courses of study and for getting general advice on the academic programme, the concerned Department will assign a certain number of students to a Faculty member who will be called their Faculty Advisor.

5. Class Committee

5.1 A Class Committee consisting of the following will be constituted by the Head of the Department for each class:

(i) A Chairman, who is not teaching the class.

(ii) All subject teachers of the class.

(iii) Two students nominated by the department in consultation with the class.

The Class Committee will meet as often as necessary, but not less than three times during a semester.

The functions of the Class Committee will include:

(i) Addressing problems experienced by students in the classroom and the laboratories.

(ii) Analyzing the performance of the students of the class after each test and finding ways and means of addressing problems, if any.

(iii) During the meetings, the student members shall express the opinions and suggestions of the class students to improve the teaching / learning process.

6. Grading

6.1 A grading system as below will be adhered to.

6.2 GPA & CGPA

Range of Marks	Letter Grade	Grade points
95-100	S	10
85 - 94	A	09
75- 84	B	08
65-74	C	07
55-64	D	06
50-54	E	05
< 50	U	00
	I (Incomplete)	--

GPA is the ratio of the sum of the product of the number of credits C_i of course "i " and the grade points P_i earned for that course taken over all courses "i" registered by the student to the sum of C_i for all "i ". That is,

$$GPA = \frac{\sum_i C_i P_i}{\sum_i C_i}$$

CGPA will be calculated in a similar manner, at any semester, considering all the courses enrolled from first semester onwards.

6.3. For the students with letter grade I in certain subjects, the same will not be included in the computation of GPA and CGPA until after those grades are converted to the regular grades.

6.4 Raw marks will be moderated by a moderation board appointed by the Vice Chancellor of the University. The final marks will be graded using an absolute grading system. The Constitution and composition of the moderation board will be dealt with separately.

7. Registration and Enrollment

7.1 Except for the first semester, registration and enrollment will be done in the beginning of the semester as per the schedule announced by the University.

7.2 A student will be eligible for enrollment only if he/she satisfies regulation 10 (maximum duration of the programme) and will be permitted to enroll if (i) he/she has cleared all dues in the Institute, Hostel & Library up to the end of the previous semester and (ii) he/she is not debarred from enrollment by a disciplinary action of the University.

7.3. Students are required to submit registration form duly filled in.

8. Registration requirement

8.1. (i) A Full time student shall not register for less than 16 credits or more than 26 credits in any given semester.

8.1. (ii) A part time student shall not register for less than 10 credits or more than 20 credits in any given semester.

8.2 If a student finds his/her load heavy in any semester, or for any other valid reason, he/she may withdraw from the courses within three weeks of the commencement of the semester with the written approval of his/her Faculty Advisor and HOD. However the student should ensure that the total number of credits registered for in any semester should enable him/her to earn the minimum number of credits per semester for the completed semesters.

9. Minimum requirement to continue the programme

9.1. For those students who have not earned the minimum required credit prescribed for that particular semester examination, a warning letter to the concerned student and also to his parents regarding the shortage of his credit will be sent by the HOD after the announcement of the results of the university examinations.

10. Maximum duration of the programme

The minimum and maximum period for the completion of various programs are given below.

Program	Min. No. of Semesters	Max. No. of Semesters
M.Tech (Full - time)	4	8
M.Tech (Part - time)	6	10
M.B.A. (Full Time)	4	8
M.B.A. (Part Time)	6	10
M.C.A. (Full - Time)	6	12
M.C.A (Part –Time)	8	14

11. Temporary discontinuation

11.1. A student may be permitted by the Director(Academic) to discontinue temporarily from the programme for a semester or a longer period for reasons of ill health or other valid reasons. Normally a student will be permitted to discontinue from the programme only for a maximum duration of two semesters.

12. Discipline

12.1. Every student is required to observe discipline and decorum both inside and outside the campus and not to indulge in any activity which will tend to bring down the prestige of the University.

12.2. Any act of indiscipline of a student reported to the Director(Academic) will be referred to a Discipline Committee so constituted. The Committee will enquire into the charges and decide on suitable punishment if the charges are substantiated. The committee will also authorize the Director(Academic) to recommend to the Vice - Chancellor the implementation of the decision. The student concerned may appeal to the Vice Chancellor whose decision will be final. The Director(Academic) will report the action taken at the next meeting of the Council.

12.3. Ragging and harassment of women are strictly prohibited in the University campus and hostels.

13. Attendance

13.1. A student whose attendance is less than 75% is not eligible to appear for the end semester examination for that semester. The details of all students who have attendance less than 75% will be announced by the teacher in the class. These details will be sent to the concerned HODs and Dean.

13.2. Those who have less than 75% attendance will be considered for condonation of shortage of attendance. However a condonation of 10% in attendance will be given on medical reasons. Application for condonation recommended by the Faculty Advisor, concerned faculty member and the HOD is to be submitted to the Director(Academic) who, depending on the merits of the case, may permit the student to appear for the end semester examination. A student will be eligible for this concession at most in two semesters during the entire degree programme. Application for medical leave, supported by medical certificate with endorsement by a Registered Medical Officer, should reach the HOD within seven days after returning from leave or, on or before the last

instructional day of the semester, whichever is earlier.

13.3. As an incentive to those students who are involved in extra curricular activities such as representing the University in Sports and Games, Cultural Festivals, and Technical Festivals, NCC/ NSS events, a relaxation of up to 10% attendance will be given subject to the condition that these students take prior approval from the officer –in-charge. All such applications should be recommended by the concerned HOD and forwarded to Director(Academic) within seven instructional days after the programme/activity.

14. Assessment Procedure

14.1. The Academic Council will decide from time to time the system of tests and examinations in each subject in each semester.

14.2. For each theory course, the assessment will be done on a continuous basis as follows:

Test / Exam	Weightage	Duration of Test / Exam
First Periodical Test*	10%	2 Periods
Second Periodical Test*	10%	2 Periods
Model exam	20%	3 hours
Seminar/ Assignments/Quiz	20%	
End – semester examination	50%	3 Hours

*** Best out of the two tests will be considered.**

14.3. For practical courses, the assessment will be done by the subject teachers as below:

(i) Weekly assignment/Observation note book / lab records – weightage 60%.
(ii) End semester examination of 3 hours duration including viva – weightage 40%.

15. Make up Examination/model examination

15.1. Students who miss the end-semester examinations / model examination for valid reasons are eligible for make-up examination /model examination. Those who miss the end-semester examination / model examination should apply to the Head of the Department concerned within five days after he / she missed examination, giving reasons for absence.

15.2 Permission to appear for make-up examination / model exam will be given under exceptional circumstances such as admission to a hospital due to illness. Students should produce a medical certificate issued by a Registered Medical Practitioner certifying that he/she was admitted to hospital during the period of examination / model exam and the same should be duly endorsed by parent / guardian and also by a medical officer of the University within 5 days.

16. Project evaluation

16.1. For Project work, the assessment will be done on a continuous basis as follows:

Review / Examination	Weightage
First Review	10%
Second Review	20%
Third Review	20%
End semester Examination	50%

For end semester exam, the student will submit a Project Report in a format specified by the Director(Academic). The first three reviews will be conducted by a Committee constituted by the Head of the Department. The end – semester examination will be conducted by a Committee constituted by the Controller of Examinations. This will include an external expert.

17. Declaration of results

17.1 A candidate who secures not less than 50% of total marks prescribed for a course with a minimum of 50% of the marks prescribed for the end semester examination shall be declared to have passed the course and earned the specified credits for the course.

17.2 After the valuation of the answer scripts, the tabulated results are to be scrutinized by the Result Passing Boards of PG programmes constituted by the Vice-Chancellor. The recommendations of the Result Passing Boards will be placed before the Standing Sub Committee of the Academic Council constituted by the Chancellor for scrutiny. The minutes of the Standing Sub Committee along with the results are to be placed before the Vice-Chancellor for approval. After getting the approval of the Vice-Chancellor, the results will be published by the Controller of Examination/Registrar.

17.3 If a candidate fails to secure a pass in a course due to not satisfying the minimum requirement in the end semester examination, he/she shall register and re-appear for the end semester examination during the following semester. However, the sessional marks secured by the candidate will be retained for all such attempts.

17.4 If a candidate fails to secure a pass in a course due to insufficient sessional marks though meeting the minimum requirements of the end semester examination, wishes to improve on his/her sessional marks, he/she will have to register for the particular course and attend the course with permission of the HOD concerned and the Registrar. The sessional and external marks obtained by the candidate in this case will replace the earlier result.

17.5 A candidate can apply for the revaluation of his/her end semester examination answer paper in a theory course within 2 weeks from the declaration of the results, on payment of a prescribed fee through proper application to the Registrar/Controller of Examinations through the Head of the Department. The Registrar/ Controller of Examination will arrange for the revaluation and the results will be intimated to the candidate concerned through the Head of the Department. Revaluation is not permitted for practical courses and for project work.

18. Grade Card

18.1. After results are declared, grade sheet will be issued to each student, which will contain the following details:

(i) Program and branch for which the student has enrolled.
(ii) Semester of registration.
(iii) List of courses registered during the semester and the grade scored.
(iv) Semester Grade Point Average (GPA)
(v) Cumulative Grade Point Average (CGPA).

19. Class / Division

19.1 Classification is based on CGPA and is as follows:
CGPA≥8.0: **First Class with distinction**
6.5 ≤CGPA < 8.0: **First Class**
5.0 ≤CGPA < 6.5: **Second Class.**

19.2 (i) Further, the award of 'First class with distinction' is subject to the candidate becoming eligible for the award of the degree having passed the examination in all the courses in

his/her first appearance within the minimum duration of the programme.

(ii) The award of 'First Class' is further subject to the candidate becoming eligible to the award of the degree having passed the examination in all the courses within the below mentioned duration of the programme.

Program	No. of Semesters
M.Tech (Full - time)	5
M.Tech (Part - time)	7
M.B.A. (Full Time)	5
M.B.A. (Part Time)	7
M.C.A. (Full - Time)	7
M.C.A (Part –Time)	9

(iii) The period of authorized discontinuation of the programme (vide clause 11.1) will not be counted for the purpose of the above classification.

20. Transfer of credits

20.1. Within the broad framework of these regulations, the Academic Council, based on the recommendation of the transfer of credits committee so constituted by the Chancellor may permit students to earn part of the credit requirement in other approved institutions of repute and status in the country or abroad.

21. Eligibility for the award of (M.TECH / M.B.A. / M.C.A.) Degree

21.1. A student will be declared to be eligible for the award of the (M.TECH / M.B.A. / M.C.A.) Degree if he/she has

i) registered and successfully credited all the core courses,
ii) successfully acquired the credits in the different categories as specified in the curriculum corresponding to the discipline (branch) of his/her study within the stipulated time,
iii) has no dues to all sections of the Institute including Hostels, and
iv) has no disciplinary action pending against him/her.

The award of the degree must be recommended by the Academic Council and approved by the Board of Management of the University.

22. Power to modify

22.1. Notwithstanding all that has been stated above, the Academic Council has the right to modify any of the above regulations from time to time subject to approval by the Board of Management.

M.Tech. **Avionics with specialization in UAV**

SEMESTER – I

Code No.	Course Title	L	T	P	C	TCH
THEORY						
PMA 102	Applied Mathematics for Avionics Engineers	3	1	0	4	4
PAV 101	Digital Avionics & EMI/EMC	3	1	0	4	4
PAM 101*	Mechanics of Flights	3	1	0	4	4
PAM 103*	Civil Aviation Requirements -I	3	1	0	4	4
PEC 113	Electronic Devices & Circuits	3	1	0	4	4
PAV 102	Flight Instrumentation & Data Acquisition	3	1	0	4	4
PRACTICAL						
PAV 103	Integrated Avionics Laboratory	0	0	3	1	3
	TOTAL				**25**	**27**

*Common in M.Tech (Aircraft Maintenance)

SEMESTER – II

Code No.	Course Title	L	T	P	C	TCH
THEORY						
PAV 201	Aerospace Guidance and Control	3	1	0	4	4
PAV 202	Aircraft Navigation Systems	3	1	0	4	4
PAV 203	Rocketry & Space Mechanics	3	1	0	4	4
----	Elective - I	3	0	0	3	3
----	Elective - II	3	1	0	4	4
----	Elective – III	3	1	0	4	4
PRACTICAL						
PAV 204	Flight Control Laboratory	0	0	3	1	3
	TOTAL				**25**	**27**

SEMESTER – III

Code No.	Course Title	L	T	P	C	TCH
THEORY						
PAV 301	Digital Fly-By-Wire Control	3	0	0	3	3
----	Elective - IV	3	0	0	3	3
----	Elective - V	3	0	0	3	3
PRACTICAL						
PAV 302	Aircraft Systems Lab	0	0	3	1	3
PAV 303	Project Work – Phase I	0	0	12	6	12
	TOTAL				**16**	**24**

SEMESTER – IV

Code No.	Course Title	L	T	P	C	TCH
PRACTICAL						
PAE 401	Project Wok - Phase II	0	0	24	12	24
	TOTAL				**12**	**24**

Total No. of Credits: 78

SEMESTER – I

PMA 102	APPLIED MATHEMATICS FOR AVIONICS ENGINEERS	L T P C 3 1 0 4
GOAL	To create the awareness and comprehensive knowledge in applied engineering mathematics for avionics.	

OBJECTIVE	OUTCOME
The course should enable the student to: • To diagnolize a matrix which would render the special vectors and matrices • To determine nonlinear differential equations • To have sound knowledge of graphs path and cycles • To grasp the basics, solve random process and be able to analyze the response of random inputs to linear time invariant system. • To Find correlation by using different random process method	**The student should able to:** • To understand matrix decomposition • To solve nonlinear equations through Riccati's and lane emden methods • To solve Cubic spline, Hermite's, Gaussian interpolation methods. • To understand the graph isomorphism and Hamiltonian paths and cycles. • To understand markov, poisson , Gaussian and mrakov chain methods for random process.

UNIT I MATRIX THEORY 12

Special vectors and matrices, Matrix inversion lemma, Least square normal equation, The Choleski decomposition, singular value decomposition.

UNIT II NON-LINEAR ORDINARY DIFFERENTIAL EQUATION 12

Introduction, Equation, with separable variables, Equations reducible to linear form, Bernoullis equation, Riccati's equation, Special Forms of Riccati's equation, The Lane Emden equation, The nonlinear Pendulum, Duffing equation.

UNIT III NUMERICAL INTEGRATION 12

Cubic Spline interpolation, Hermite's Interpolation, Gaussian Qundraline, Cubature.

UNIT IV GRAPHS, PATHS AND CYCLES 12

Definitions and examples, sub graphs, Complements, Graph isomorphism, vertex degree: Euler trails and circuits, Planar graphs, Hamiltonian paths and cycles.

UNIT V RANDOM PROCESSES 12

Classification, Stationary random process, Markov process, Poisson process, Gaussian process, Mrakov chain, Auto correlation, Cross correlation.

TOTAL: 60

TEXT BOOKS

1. Froberg, C.E, "Numerical Mathematics", The Benjamin/Cummings Publishing Co., Inc., 1985.
2. Jain. M.K. Iyengar S.R.K., and Jain R.K. "Numerical Methods for Scientific & engineering Computation", Wiley Eastern Ltd., 1987.

REFERENCES

1. Bronson, R., "Matrix operations, Schaum's outline series", McGraw Hill, New York., 1989.
2. Stephenson, G. Radmore. P.M. "Advanced mathematical Methods for Engineering and science students", Cambridge university Press 1999.
3. Bondy.J.A. and Murthy, U.S.R., "Graph Theory with applications", Macmillan, 1977.
4. Medhi.J."Stochastic Processes", Wiley Eastern. Ltd., 1994.

PAV 101	DIGITAL AVIONICS & EMI/EMC	L T P C 3 1 0 4
GOAL	To introduce basic concepts of avionics system and its subsystem under various operating conditions and the fundamentals of design concepts	

OBJECTIVE	OUTCOME
The course should enable the student to: • To introduce role of avionics system and its architecture • To understand the trends in display technology • To understand the avionics system design development and integration using simulation tools • To know modular avionics packaging and EMI/EMC requirements in avionics • To study system assessment, validation, certification and maintenance of avionics system	**The student should able to:** To understand the systems and subsystems of avionics. To understand the trends in display technology To development and integration using simulation tools To understand life cycle costs for military and civil avionics To understand system assessment, validation, certification and maintenance of avionics system

UNIT I INTRODUCTION TO AVIONICS 9

Role for Avionics in Civil and Military Aircraft systems, Avionics sub-systems and design, defining avionics System/subsystem requirements-importance of 'ilities', Avionics system architectures

UNIT II AVIONICS SYSTEM ESSENTIALS: DISPLAYS, I/O DEVICES AND POWER 13

Trends in display technology, Alphanumeric displays, character displays etc., 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 III AVIONICS SYSTEM DATA BUSES, DESIGN AND INTEGRATION 13

MIL-STD-1553B, ARINC-429, ARINC-629, CSDB, AFDX and its Elements, Avionics system design, Development and integration-Use of simulation tools, stand alone and integrated Verification and Validation

UNIT IV PACKAGING AND EMI/EMC 12

Modular Avionics Packaging, Trade-off studies, ARINC and DOD types, system cooling, EMI/EMC requirements
BIT and CFDS, Automatic Test Equipment, Speeds maintenance, ATLAS, Remote diagnostics and maintenance support-Life Cycle Costs for Military and Civil Avionics, Cash flow analysis, Software costs, Establishing spares level

UNIT V SYSTEM ASSESSMENT, VALIDATION AND CERTIFICATION 13

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

TOTAL: 60

TEXT BOOKS

1. Spitzer, C.R. 'Digital Avionics Systems', Prentice Hall, Englewood Cliffs, N.J., U.S.A., 1987
2. Cary R .Spitzer, The Avionics Handbook, Crc Press, 2000

REFERENCES

1. Collinson R.P.G. 'Introduction to Avionics', Chapman and Hall, 1996
2. Middleton, D.H. 'Avionics Systems', Longman Scientific and Technical, Longman Group UK Ltd., England, 1989
3. Jim Curren, Trend in Advanced Avionics, IOWA State University, 1992.

PAM 101	MECHANICS OF FLIGHT	L T P C 3 1 0 4
GOAL	To introduce the basic concept of aeronautical engineering and the current development in the field.	

OBJECTIVE	OUTCOME
The course should enable the student to:	**The student should able to:**
• To understand how an airplane flies?	To understand components of an airplane and their functions , motions of airplane
• To understand the trends in principles of operation of propulsion devices.	To understand working of different types of engines and its area of applications.
• To understand the theory of flight in aerodynamics concepts and terms	To understand the Airfoils and streamlines bodies forces acting on an airplane lift, drag, speed and power
• To Introduce the stability and control of an aircraft	To understand static and dynamic stability dynamic instability and control concepts
• To study Aircraft structures and Design features of Aircraft materials.	To know the loads taken by aircraft and type of construction and also construction materials in them

UNIT I CONFIGURATION OF AIRPLANE AND ITS COMPONENTS 12

How an Airplane flies - components of an airplane and their functions - motions of a plane - Pitching, Rolling and Yawing-Banking, skidding and slipping - starting, taxying - Take-off - landing - stalling, spinning, spirals - cross wind take-offs and landings. Different types of flight vehicles.

UNIT II PROPULSION 12

Aircraft propulsion, Rocket propulsion, power plant classification, principles of operation, and Areas of their application.

UNIT III AERODYNAMICS 12

Airfoils and streamline bodies - forces acting on an airplane - lift and drag - speed and power – physical properties and structure of atmosphere - theory of flight.

UNIT IV STABILITY AND CONTROL 12

Introduction to stability and control, Concepts of static and dynamic stability and control, Dynamic instability and control, V-n diagram, Range and endurance.

UNIT V. AIRCRAFT STRUCTURES 12

Introduction to Aircraft structures - Loads - Types of construction - Design feature Aircraft materials.

TOTAL: 60

TEXT BOOKS

1.Kermode, A.C, 'Mechanics of Flight' English Book Store, New Delhi, 1992
2.John.D.Anderson, Jr., 'Introduction to flight' TATA McGraw-Hill, 2006

REFERENCES

1.Van Sickle Neil, D 'Modern Airmanship' Van Nostrand Reinhol, New York, 1985.
2. Megson T.H. 'Aircraft Structures for Engineering Student's II Edition, Edward Arnold, Kent, U.S.A. 1990

PAM 103	CIVIL AVIATION REQUIRMENTS-1	L T P C 3 1 0 4
GOAL	To make the students to understand the Indian aviation rules 1937, relating to aviation and civil aviation requirement in India (DGCA).	
	OBJECTIVE	**OUTCOME**
The subject should enable the student : 1.To enhance the knowledge of aircraft act1934, and aircraft rules. 2.To understand the responsibility of owner/operator of a/c and objective of CAD. 3.To understand the procedure for the preparation of MEL, from MMEL. 4.Enhance the knowledge on the different types of maintenance programme their approval. 5.Understand the procedure for getting the approvals of organizations in different categories		**The student should able to:** 1.Describe the Indian aircraft rules and the related publications. 2.Know the procedure for keeping the aircraft in airworthiness conditions. 3.Describe the use of MEL, and the procedure for releasing the a/c under MEL. 4.Describe the different types of maintenance programme. 5.Understand the requirements for getting AO in different categories.

UNIT I

Indian aircraft rules 1937 and related publications **7**

Knowledge of aircraft act, 1934, aircraft rules, 1937 as far as they related to airworthiness and safety of aircraft. Knowledge of civil airworthiness requirements, aeronautical information circulars, aeronautical information publications- (relating to airworthiness), advisory circulars & A.M.E. notices (NOTAMS) by DGCA.

UNIT II

C.A.R. series A – procedure for issue of civil airworthiness requirements and responsibility of operators vis-à-vis air worthiness directorate

Responsibilities of operators/owners; procedure of CAR issue, amendments etc; objectives and targets of airworthiness directorate; airworthiness regulations and safety oversight of engineering activities of operations
C.A.R. series "B" – issue approval of cockpit check list, MEL, CDL: Deficiency list (MEL & CDL); preparation and use of cockpit check list and emergency check list.

UNIT III **11**

C**.A.R. series 'C' – defect recording, monitoring, investigation and reporting**

Defect recording, reporting, investigation, rectification and analysis; flight report, recording of in-flight instrument, reading and reporting of flight defects and rectification of defects observed on aircraft.

C.A.R. series 'D – and aircraft maintenance programmes

Reliability programmes (engines); aircraft maintenance programmes & their approval: on condition maintenance of reciprocating engines; TBO – revision programme.

UNIT IV **13**

C.A.R. Series E – approval of organizations

Approval of organizations in categories A, B, C, D, E, F, & G; requirements of infrastructure at stations other than parent base.

UNIT V **18**

C.A.R. Series "F" airworthiness and continued airworthiness

Procedure relating to registration of aircraft; procedure for issue / revalidation of type certification of aircraft and its engines / propellers; issue /revalidation and renewal of certificate of airworthiness; requirement for renewal of certificate of airworthiness. Suspensions of certificate of airworthiness and its subsequent revalidation. **TOTAL: 60**

TEXT BOOKS

1. Aircraft manual (India) volume – latest edition, the English book store, 17-l, Connaught circus, New Delhi.2000.
2. Civil aviation requirements with latest amendment (section 2 airworthiness) – published by DGCA, the English book store, 17-l, Connaught circus, New Delhi. Aeronautical information circulars (relating to airworthiness) from DGCA.2009.

   Advisory circulars from DGCA,2009.

PEC 113	ELECTRONIC DEVICES & CIRCUITS	L T P C 3 1 0 4
GOAL	To make the students to understand the principle and operations of electronic devices and circuits	
	OBJECTIVE	**OUTCOME**
	The subject should enable the student : • To enhance the knowledge of electronic devices and IC fabrication • To understand the working of integrated circuits. • The analysis and design of feedback amplifiers and oscillatory circuits • To understand the principle of digital electronics and its logic operation • The architecture of microprocessor 8085, assembly language programming, peripherals and interfacing	**The student should able to:** • The principle and operation of semi-conductor , diodes , transistors and IC fabrication • The circuits using linear integrated circuits and their applications • Design the feedback amplifiers consideration of phase and frequency parameters. • The learners will able to analysis and design of digital circuits • The learners will able write a program in microprocessor 8085.

UNIT I ELECTRONIC DEVICES 12

Introduction to semiconductor diodes, transistor circuits, transistor and integrated circuit fabrication, field effect transistors, MOSFET, MODFET, MESFET

UNIT II LINEAR INTEGRATED CIRCUITS 12

OP-AMP specification, applications, comparator, Integrater, Differentiator, A/D and D/A converter, sample and hold circuit, timer, VCO, PLL, interfacing circuitry.

UNIT III FEEDBACK AND OSCILLATOR CIRCUITS 12

Feedback amplifier-phase and frequency considerations, oscillator operation, phase shift oscillator, Wien bridge oscillator, Crystal oscillator.

UNIT IV DIGITAL ELECTRONICS 12

TTL, ECL, CMOS-CIRCUITS, Characteristics Functional description of typical digital ICs, Gates, FFs, Shift Register, Counter, Multiplexer, Demultiplexer/Decoder, Encoder, Adder, Arithmetic functions, analysis and design of clocked sequential circuits, Asynchronous sequential circuits.

UNIT V MICROPROCESSOR AND APPLICATIONS 12

Architecture of Microprocessor 8085, Address Mode Instruction set, assembly language programming, peripherals and Interfacing, applications.

TOTAL: 60

TEXT BOOKS

1. Milman & Halkias, "Integrated Electronics", McGraw Hill, 1999.
2. Malvino & Leach, "Digital Principles & Applications", McGraw Hill, 1986

REFERENCES

1. Metha.V.K.,"Principles of Electronics", S.Chand & Company Ltd., 1994.
2. David A. Bell, "Electronic Devices and Circuits", PHI New Delhi, 1998.
3. Mathur, A.P. "Introduction to Microprocessors", Tata McGraw-Hill, 1985.

PAV 102	FLIGHT INSTRUMENTATION & DATA ACQUISITION	L T P C 3 1 0 4
Goal	The goal of the programme is to provide a detail about the working of flight instrumentation and data acquisition and handling system	

Objectives	Outcome
• To learn the concept of measurement, error estimation and classification of aircraft instrumentation and displays	• The learners will able to measure the error and can find the error estimation in the aircraft instruments
• To study air data instruments and synchronous data transmissions systems	• The learners will be able know about the various air data systems and synchronous data transmissions systems
• To study gyroscope and its purposes	• The learners will be able to know the principle of gyroscope and its property.
• To study aircraft compass system and flight management system	• The learners will be able to know the principle of DGU,RMI , FMS and its operation mode in 4D flight management.
• To study Data acquisition and handling systems	• The learners will be able to know the principle and working of various power plant instruments and application of telemetry flight data testing in UAV and satellites.

UNIT I MEASUREMENT AND DISPLAYS 12

Instrumentation brief review-Concept of measurement-Errors and error estimation- Functional elements of an instrument system-System representation- Static and dynamic characteristics-calibration- Estimate of system performance-classification of aircraft instruments-Instrument displays panels and cockpit layout.

UNIT II AIR DATA INSTRUMENTS AND SYNCHRO TRANSMISSION SYSTEMS 12

Air data instruments-airspeed, altitude, Vertical speed indicators. Static Air temperature, Angle of attack measurement. Synchronous data transmission system

UNIT III GYROSCOPIC INSTRUMENTS 12

Gyroscope and its properties, gyro system, Vertical gyroscope-Horizon, Direction gyro-direction indicator, Rate gyro-rate of turn and slip indicator, acceleration and turning errors..

UNIT IV AIRCRAFT COMPASS SYSTEMS AND FLIGHT MANAGEMENT SYSTEM 12

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 12

Pressure measurement, temperature measurement, fuel quantity measurement, engine power and control instruments-measurement of RPM, manifold pressure, torque, exhaust gas temperature, EPR, fuel flow, engine vibration, monitoring. Data acquisition and Handling systems: Introduction-signal conditioners-Instrumentation amplifiers-filters. Data conversion - multiplexers-A/D-D/A conversion. Telemetry-Airborne and ground system-PC based telemetry system. Introduction to telemetry flight data testing. Application of telemetry in UAVs and Satellites.

TOTAL: 60

TEXT BOOKS

1. Pallet, E.H.J. 'Aircraft Instruments & Integrated systems', Longman Scientific and Technical, McGraw-Hill, 1992.
2. Murthy, D.V.S., 'Transducers and Measurements', McGraw-Hill, 1995

REFERENCES

1. Doeblin.E.O, 'Measurement Systems Application and Design', McGraw-Hill, NewYork, 1986.
2. HarryL.Stilz, 'Aerospace Telemetry', Vol I to IV.

PAV 103	INTEGRATED AVIONICS LABORATORY	L T P C 0 0 3 1
Goal	To implement testing and configuration of data buses MIL STD 1553, ARNIC 629 and ARNIC 429, Pitot-static system, ILS, VOR, Marker beacon and VHF/UHF communications avionics systems	

Objectives	Outcome
• To learn the Testing and installation of MIL-STD-1553B	• The learners will able to Test and install the MIL-STD-1553B
• To Configuring MIL-STD-1553B, cards	• The learners will able to Configure MIL-STD-1553B, cards in transmitting And receiving mode.
• To learn the Testing and installation of ARINC 429 & ARINC 629 card	• The learners will able to Test and install the ARINC 429 & ARINC 629 card
• To Configuring ARINC 429 and ARINC 629 cards	• The learners will able to Configure ARINC 429 and ARINC 629 cards in transmitting and receiving mode
• To learn the Testing and Calibration of Airspeed indicator using pitot static tester	• The learners will able to Test and Calibrate the Airspeed indicator using pitot static tester
• To learn the Testing and calibration of altimeter using Pitot-static tester	• The learners will able to Test and Calibrate the altimeter using Pitot-static tester
• To learn the Testing and calibration of vertical speed indicator using pitot static tester	• The learners will able to Test and Calibrate the vertical speed indicator using pitot static tester
• To learn the Testing of localizer, Glide-slope, VOR using IFR 4000	• The learners will able to Test the localizer, Glide-slope, VOR using IFR 4000
• To learn the Testing of ATC Transponder, DME, TCAS using IFR 6000	• The learners will able to Test the ATC Transponder, DME, TCAS using IFR 6000
• To learn the Testing of VHF/UHF using IFR 4000 & IFR 6000	• The learners will able to Test the VHF/UHF using IFR 4000 & IFR 6000

TOTAL: 60

SEMESTER II

PAV 201	AEROSPACE GUIDANCE AND CONTROL	L T P C 3 1 0 4
Goal	The goal of the programme is to provide operating principles and design of guidance of missile and launch vehicles	

Objectives	Outcome
• To learn the concept of navigation systems	• The learners will able to understand the definition and terms in navigation systems
• To learn about the operating principle of guidance law	• The learners will be able know about the various guidance schemes and missile type requirements
• To study about the augmentation systems	• The learners will be able to know the principle of stability and control augmentation systems
• To study longitudinal stability and to design the longitudinal autopilot	• The learners will be able to know about the Displacement, Pitch Orientation Control system Glide Slope Coupler and Automatic Flare Control systems.
• To study lateral stability and to design the lateral autopilot	• The learners will be able to know the Damping of dutchroll methods of Obtaining Coordination, Yaw Orientation Control system, turn compensation and Automatic lateral Beam Guidance.

UNIT I INTRODUCTION 10

Introduction to navigation, Guidance and control - definition, Historical background.

UNIT II MISSILE AND LAUNCH VEHICLE GUIDANCE 12

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

UNIT III AUGMENTATION SYSTEMS 12

Need for automatic flight control systems, Stability augmentation systems, control augmentation systems, Gain scheduling concepts.

UNIT IV LONGITUDINAL AUTOPILOT 14

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 V LATERAL AUTO PILOT 12

Damping of the Dutch Roll, Methods of Obtaining Coordination, Yaw Orientation Control system, turn compensation, Automatic lateral Beam Guidance. Introduction to Fly-by-wire flight control systems, Lateral control law design using back stepping algorithm.

TOTAL: 60

TEXT BOOKS

1. Blakelock, J.H 'Automatic control of Aircraft and missiles ', John Wiley Sons, NewYork, 1990
2. Stevens B.L & Lewis F.L, 'Aircraft control & simulation', John Wiley Sons, NewYork, 1992

REFERENCES

1. Collinson R.P.G, 'Introduction to Avionics', Chapman and Hall, India, 1996.
2. Garnel.P. & East.D.J, 'Guided Weapon control systems', Pergamon Press, Oxford, 1977.
3. Nelson R.C 'Flight stability & Automatic Control', McGraw Hill, 1989
4. Bernad Etikin,'Dynamic of flight stability and control', John Wiley, 1972

PAV 202	AIRCRAFT NAVIGATION SYSTEMS	L T P C 3 1 0 4
Goal	To study the different types and techniques of navigation systems	

Objectives	Outcome
• To learn the concept of radio navigation systems	The learners will able to understand the Different types of navigation
• To learn about the approach and landing aids	The learners will be able know about the Ground controlled approach system
• To study about the inertial sensors	The learners will be able to know Gyroscopes,Laser gyro,fibre optic gyro and accelerometers
• To study longitudinal stability and to design the longitudinal autopilot	The learners will be able to know the INS components, transfer function and errors-The earth in inertial space, the coriolis effect-Mechanisation
• To study satellite navigation & Hybrid navigation	The learners will be able to know the GPS, DGPS,Kalman filtering and INS and GPS integration

UNIT I RADIO NAVIGATION 12

Different types of radio navigation- ADF, VOR/DME- Doppler -LORAN and Omega

UNIT II APPROACH AND LANDING AIDS 12

ILS, MLS, GLS - Ground controlled approach system - surveillance systems-radio altimeter

UNIT III INERTIAL SENSORS 12

Gyroscopes-Mechanical-electromechanical-Ring Laser gyro- Fibre optic gyro, Accelerometers.

UNIT IV INERTIAL NAVIGATION SYSTEMS 12

INS components: transfer function and errors-The earth in inertial space, the coriolis effect-Mechanisation. Platform and Strap down, INS system block diagram, Different co-ordinate systems, Schuler loop, compensation errors, Cross coupling, Gimbal lock, Alignment.

UNIT V SATELLITE NAVIGATION & HYBRID NAVIGATION 12

Introduction to GPS -system description -basic principles -position and velocity determination-signal structure-DGPS, Introduction to Kalman filtering-Estimation and mixed mode navigation-Integration of GPS and INS-utilization of navigation systems in aircraft

TOTAL: 60

TEXT BOOKS

1. Nagaraja, N.S. “Elements of Electronic Navigation”, Tata McGraw-Hill Pub. Co., New Delhi, 1975.
2. Slater, J.M. Donnel, C.F.O and others, “Inertial Navigation Analysis and Design”, McGraw-Hill Book Company, New York, 1964.
3. Sen, A.K. & Bhattacharya, A.B. “Radar System and Radar Aids to Navigation”, Khanna Publishers, 1988.

REFERENCES

1. Albert Helfrick, ‘Practical Aircraft Electronic Systems’, Prentice Hall Education, Career & Technology, 1995
2. Albert D. Helfrick, ‘Modern Aviation Electronics’, Second Edition, Prentice Hall Career & Technology, 1994
3. George M Siouris, ‘Aerospace Avionics System; A Modern Synthesis’, Academic Press Inc., 1993
4. Myron Kyton, Walfred Fried, ‘Avionics Navigation Systems’, John Wiley & Sons, 1997.

PAV 203	Rocketry and space mechanics	L T P C 3 1 0 4
Goal	To introduce basic concepts of design and trajectory estimation of rocket , missiles and basic concepts of orbital Mechanics	
OBJECTIVES	**OUTCOMES**	
Impart the students To enable orbital mechanics and satellite dynamics To enable the motion of rockets To enable knowledge on rocket aerodynamics To enrich the knowledge on materials for space craft and missiles To give knowledge on satellite injection and its perturbations	The student will Be able to understand solar system, Keplers, Newton's law of motion, escape velocity, Geosynchronous , geostationary satellites Be able to understand principle of rocket and its stages, thrust equation, one and two dimensional rocket motions Understand the loads, drag, performances at different altitudes, types of nozzles and launching problems Be able to understand materials used and special coatings and ablative materials Be able to understand Satellite injections, orbit transfer, orbit deviation due to injection error, general perturbation approach	

UNIT I ORBITAL MECHANICS AND SATELLITE DYNAMICS 15

Description of solar system – Keplers Laws of planetary motion – Newton's Law of Universal gravitation – Two body and Three-body problems – Jacobis Integral, Librations points - Estimatur of orbital and escape velocities – geosynchronous and geostationary satellites life time – satellite perturbations – Hohmann orbits – calculation of orbit parameters.

UNIT II ROCKET MOTION 15

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 – staging of rockets.

UNIT III ROCKET AERODYNAMICS 12

Description of various loads experienced by a rocket passing through atmosphere – drag estimation – wave drag, skin friction drag, foron drag and base pressure drag – Boat-tailing in missiles – performance at various altitudes – conical and bell shaped nozzles – adapted nozzles – rocket dispersion – launching problems.

UNIT IV MATERIALS FOR SPACECRAFT AND MISSILES 5

Selections of materials for spacecraft and missiles – special requirements of materials to perform under adverse conditions – ablative materials.

UNIT V SATELLITE INJECTION AND SATELLITE ORBIT PERTURBATIONS 13

General Aspects of satellite Injections – Satellite Orbit Transfer –Various Cases – Orbit Deviations Due to Injection Errors – Special and General Perturbations – Cowell's Method – Encke's Method – Method of vibrations of Orbital Elements – General Perturbations Approach.

TOTAL: 60

REFERENCES

1. G.P. Sutton, "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 5th Edition, 1986.
2. J.W. Cornelisse, "Rocket Propulsion and Space Dynamics", J.W. Freeman & Co., Ltd., London, 1982.

PAV 204	FLIGHT CONTROL LABORATARY	L T P C 0 0 3 1
Goal	To implement stability analysis and design using X-plane, flight gyro and aerosim	

Objectives	Outcome
The subject should enable the students to • Stability analysis using Root locus, Bode plot, Nyquist plot and Polar plot techniques • Design of lead, lag and lead-lag compensator for aircraft dynamics • Performance Improvement Of Aircraft Dynamics By pole placement technique • Development Of Longitudinal Equations Of Motion • Design of displacement longitudinal autopilot • Design Of Automatic Glide Slope Control System And Flare Control System • Development Of Lateral Equations Of Motion • Design of Lateral Autopilot • Design of Turn Co-ordination system • Design of Automatic Lateral beam guidance system • Design of Van-Guard Missile system • Design of Observers • Design of Kalman filters	The learners will able to do the • Stability analysis using Root locus, Bode plot, Nyquist plot and Polar plot techniques • Design of lead, lag and lead-lag compensator for aircraft dynamics • Performance Improvement Of Aircraft Dynamics By pole placement technique • Development Of Longitudinal Equations Of Motion • Design of displacement longitudinal autopilot • Design Of Automatic Glide Slope Control System And Flare Control System • Development Of Lateral Equations Of Motion • Design of Lateral Autopilot • Design of Turn Co-ordination system • Design of Automatic Lateral beam guidance system • Design of Van-Guard Missile system • Design of Observers • Design of Kalman filters

NOTE: Implementation using X-plane, Flight-Gear & Aerosim

TOTAL:60

SEMESTER III

PAV 301	DIGITAL FLY-BY-WIRE CONTROL	L T P C 3 0 0 3
Goal	The goal of the programme is to provide principles and architecture digital fly by wire control and hardware and software design and advance concepts in DFBW system design	

Objectives	Outcome
• To learn the concept of digital fly by wire	• The learners will able to understand the Rectangular and cylindrical wave guides and operation of Passive waveguide components.
• To learn about the theory and operating characteristics of microwave measurements	• The learners will be able know about the Reflex klystrons, Two cavity Klystrons, Magnetrons, and TWTS.
• To study about the radar equations and its principles	• The learners will be able to know the block diagram of a simple pulse radar and description of the various blocks
• To study about the different types of radars	• The learners will be able to know about the CW and FMCW radars, Tracking radars, MTI radars and Synthetic Aperture radar.
• To apply pulsed Doppler radar principle and to understand tracking radars through pulsed wave form	• The learners will be able to know the Principles of Pulsed Doppler Radar, Spectral Charities of a Pulsed Waveform.

UNIT I INTRODUCTION TO DIGITAL FLY-BY-WIRE CONTROL 6

Need for DFBW 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 8

Description of various elements of DFBW systems - Concept of redundancy and reliability, Fault coverage and redundant architecture.

UNIT III DFBW ARCHITECTURES 8

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 SOME REQUIREMENTS FOR DFBW SYSTEM DESIGN 8

Survivable Flight control System programs, ADP Phases-Simplex package Evaluation -FBW without Mechanical Backup-Survivable Stabilator Actuator package, Reliability requirements and their relevance to DFBW system design, redundant power supply requirements, Environmental and weight, volume constraints.

UNIT V DESIGN ISSUES IN DFBW SYSTEM DESIGN 15

Fault tolerant processor hardware design, EMI/EMC and thermal consideration, Built-in-test features, reliable software development, Redundancy management (voting, monitoring), Failure and maintenance philosophies, Implementation, Issues of digital control laws, Generic failures in Hardware and software. Advanced concepts in DFBW System Design.

TOTAL: 45

TEXT BOOKS

1. Vernon R Schmitt, James W Morris and Gavin D Jenny, 'Fly By Wire-A Historical Perspective', SAE International, 1998.

REFERENCES

1. AGARD-CP-137, 'Advances in Control systems', (Chap.10, 17,21, 22, 23, 24), 1985.
2. AGARD-CP-384, Active Control Systems Review, Evaluations and Projections, 1988.
3. AGARD-CP-260, 'Stability and Control' (Chap.15), 1985
4. 'Modern Air Combat', Salamander Books Ltd, 1989

PAV 302	AIRCRAT SYSTEM LABORATORY	L T P C 0 0 3 1
GOAL	To get the practical knowledge and "On-HAND" experience in maintenance of various aircraft systems and common snags rectification procedure un various aircraft system	

OBJECTIVE	**OUTCOME**
The subject should enable the students to	The students should be able to
1. Understand the aircraft jacking up procedure and its precaution.	1. Carry out aircraft jacking safely without any damage to men equipment.
2. Understand the various methods of aircraft levelling and its procedure.	2. Carry out aircraft levelling as per procedure. .
3. Understand the various check to be carried out to ensure the alignment of control surfaces.	3. Describe the various checks to be carry out to ensure the alignment of control surfaces.
4. Know the procedure and precaution of aircraft symmetry check.	4. Carryout aircraft symmetry check, as per procedure.
5. Understand the various test carried out on hydraulic system components to assess leakage and blockage.	5. Carryout flow test, and pressure test on hydraulic system.
6. Know the procedure for carrying out the landing gear retraction test.	6. Describe the procedure for landing gear retraction test and various precautions to be undertaken before carrying out the test.
7. Understand the various common snags in aircraft hydraulic and fuel systems and its rectification procedure.	7. Carry out rectification of common snags in aircraft hydraulic system as per procedure.

PAV 303 & PAV 401	Project work (Phase I & II)	L T P C 0 0 36 18
Goal	To train the students "ON HAND" experience in maintenance of various air frame systems in aircraft and rectification of common snags.	
OBJECTIVES	**OUTCOMES**	
Impart the students The objective of the project work is to enable the students on a project involving theoretical and experimental studies related to the branch of study. Every project work shall have a guide who is the member of the faculty of the institution. Full semester shall be allotted and this time shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project.	The student will Be able to understand various procedures in identifying the project and literature survey, reference of journals, experiments and theoretical work	

SEMESTER – II (Electives)

PEC 701	MICROWAVE AND RADAR	L T P C 3 0 0 3
Goal	The goal of the programme is to provide operating principles of microwave components and radar	

Objectives	Outcome
• To learn the concept of various wave guides components	• The learners will able to understand the Rectangular and cylindrical wave guides and operation of Passive waveguide components.
• To learn about the theory and operating characteristics of microwave measurements	• The learners will be able know about the Reflex klystrons, Two cavity Klystrons, Magnetrons, and TWTS.
• To study about the radar equations and its principles	• The learners will be able to know the block diagram of a simple pulse radar and description of the various blocks
• To study about the different types of radars	• The learners will be able to know about the CW and FMCW radars, Tracking radars,MTI radars and Synthetic Aperture radar.
• To apply pulsed Doppler radar principle and to understand tracking radars through pulsed wave form	• The learners will be able to know the Principles of Pulsed Doppler Radar, Spectral Charities of a Pulsed Waveform.

UNIT I WAVE GUIDES 9

Rectangular and cylindrical wave guides, Passive waveguide components, Microstrip line structure and components.

UNIT II MICROWAVE SOURCE & MEASUREMENTS 10

Simple theory and operating characteristics of Reflex klystrons, Two cavity Klystrons, Magnetrons, and TWTS - solid state source - TEDS, IMPATTS, GaAs FETs and Tunnel diodes - Elements of microwave measurements.

UNIT III RADAR PRINCIPLES 12

The Radar Equation, Detection and False alarm probabilities - Pulse integration, the block diagram of a simple pulse radar and description of the various blocks - transmitter, antenna, duplexer, mixer and detector, receiver front end, displays.

UNIT IV TYPES OF RADARS 8

CW and FMCW radars-Tracking radars-MTI radars block diagram and principles of coherent MTI radars - Digital MTI, Synthetic Aperture radar.

UNIT V AIRBORNE PULSED DOPPLER RADAR 6

Principles of Pulsed Doppler Radar, Spectral Charities of a Pulsed Waveform, Low-, High-, and medium-PRF Mode

TOTAL: 45

TEXT BOOKS

1. S.Y. Liao, Microwave Devices and Circuits, Prentice Hall, 1980.
2. M.I. Skolnik, Introduction to Radar System (Second Edition) McGraw Hill, 1980.
3. M.I. Skolnik, Radar Hand book (Second Edition) McGraw Hill, 1990.

REFERENCES

1. E. C. Jordan and K. G. Balmain, Electromagnetic waves and Radiating Systems, Prentice Hall, 1971.
2. K. C. Gupta, Microwaves, Wiley Eastern, 1979.
3. Guy V. Morris, Linda L. Harkness, Airborne Pulsed Doppler Radar, Second Edition, Artech House Publishers, 1996.

PAU 701	AERODYNAMICS FOR UAV	L T P C 3 0 0 3
GOAL	To introduce basic concepts of aerodynamics for UAV application and its Numerical Solutions of Equations.	

OBJECTIVE	OUTCOME
The course should enable the student to: • To introduce different methods of Numerical Solutions and its operation. • To study the finite difference scheme, approximating derivatives . • To know the finite volume method for a rectangular 2D grid . • To know characteristics of turbulence, eddy and energy transfer • To study the Linear Eddy viscosity models, general eddy viscosity models, mixing length hypothesis.	**The student should able to:** • To understand the Direct iteration methods, Bisection method, the Secant Method, under relaxation, convergence criteria and the Newton Raphsons method • To understand the finite difference scheme, approximating derivatives • To understand the First order upwind scheme, central difference scheme, QUICK scheme and convection scheme • To understand characteristics of turbulence, eddy and energy transfer. • To understand Linear Eddy viscosity models, general eddy viscosity models, mixing length hypothesis

UNIT I INTRODUCTION

Introduction to aerodynamics for UAV application, Numerical Solutions of Equations- Direct iteration methods, Bisection method, the Secant Method, under relaxation, convergence criteria and the Newton Raphsons method

UNIT II FINITE DIFFERENCE METHOD

Introduction to finite difference scheme, approximating derivatives, Taylor series approximation, order of approximation, polynomial approximation, approximating higher-order derivatives, non-uniform grids, the convection diffusion problem, upwinding, numerical diffusion, boundary conditions, extension to multiple dimensions.

UNIT III FINITE VOLUME METHOD

Introduction, basic finite volume method, finite volume method for a rectangular 2D grid, First order upwind scheme, central difference scheme, QUICK scheme, convection scheme performance, boundary condition treatment, numerical flow solver strategy

UNIT IV TURBULENCE MODELING

Transition to turbulence, turbulence in engineering, characteristics of turbulence, eddy and energy transfer, turbulent kinetic energy spectrum, Kolmogorov hypothesis, Turbulent kinetic energy and rate of dissipation, integral length scale, Kolmogorov length scale, inertial sub range and Taylor length scale, local equilibrium of turbulent motion, range of length scales - turbulence bandwidth, numerical approaches to resolving and solving turbulence- DNS, LES, RANS, Hybrid Methods.

UNIT V SIMPLE & INDUSTRIAL TURBULENCE MODELS

Analysis of 2D boundary layers, Y-momentum equation in a boundary layer, total shear across a boundary layer, mean flow kinetic energy balance, turbulent kinetic energy balance, energy transfer process near a wall, Linear Eddy viscosity models, general eddy viscosity models, mixing length hypothesis, the Log layer, near wall damping in viscous layer, one-equation models, length scales in non-trivial flows, two equation models, log law region of an equilibrium boundary layer, decaying grid turbulence, the Shear Stress Transport(SST) model, near wall modeling, high Reynolds number modeling and wall functions, low Reynolds number models, channel flow example.

REFERENCE:

[1] J. Ferziger, M. Peric, Computational Methods for Fluid Dynamics, Springer; 3rd edition (November 6, 2001)

[2] H.K. Versteeg, W. Malalasekara, An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Prentice Hall; 2 edition (February 26, 2007)

[3] S.V. Patankar, Numerical Heat Transfer and Fluid Flow, Taylor & Francis Group (1980)

[4] Brian Launder, Modelling Turbulence in Engineering and the Environment: Second-Moment Routes to Closure, Cambridge University Press (2011)

[5] Progress in Wall Turbulence: Understanding and Modeling: Proceedings of the WALLTURB International Workshop Held in Lille, France, April 21-23, 2009, Springer (2010)

3. Van de Kamp, “Elements of astromechanics”, Pitman Publishing Co., Ltd., London, 1980.
4. E.R. Parker, “Materials for Missiles and Spacecraft”, McGraw-Hill Book Co., Inc., 1982.

PAU 702	PAYLOAD AND SENSORS FOR UAVS	L T P C 3 1 0 4
GOAL	To introduce basic concepts of Unmanned aerial system and its payload under various operating conditions and the fundamentals of design concepts	

OBJECTIVE	OUTCOME
The course should enable the student to: • To introduce different types of payloads of unmanned aerial vehicle and its architecture. • To study the trends in Data fusion applications to multiple sensor systems. • To estimation and tracking algorithms for data fusion in different process. • To know the Applications of artificial neural networks in avionics • To study Conditions under which fuzzy logic provides an appropriate solution .	**The student should able to:** • To understand the Non dispensable Payloads and dispensable Payloads • To understand the Data fusion applications to multiple sensor systems. • To development algorithms for data fusion in different process and integration using simulation tools • To understand Applications of artificial neural networks in avionics • To understand fuzzy logic provides an appropriate solution

UNIT I: Payload for UAV

Introduction – Types - Nondispensable Payloads - Electro-optic Payload Systems - Electro-optic Systems Integration - Radar Imaging Payloads - Other Nondispensable Payloads - Dispensable Payloads - Payload Development.

UNIT II: Sensor

Data fusion applications to multiple sensor systems - Selection of sensors - Benefits of multiple sensor systems - Influence of wavelength on atmospheric attenuation - Fog characterization - Effects of operating frequency on MMW sensor performance - Absorption of MMW energy in rain and fog - Backscatter of MMW energy from rain - Effects of operating wavelength on IR sensor performance - Visibility metrics - Visibility - Meteorological range - Attenuation of IR energy by rain - Extinction coefficient values - Summary of attributes of electromagnetic sensors - Atmospheric and sensor system computer simulation models

UNIT III: Data Fusion Algorithms and Architectures

Definition of data fusion - Level 1 processing - Detection, classification, and identification algorithms for data fusion - State estimation and tracking algorithms for data fusion - Level 2, 3, and 4 processing - Data fusion processor functions - Definition of an architecture - Data fusion architectures - Sensor-level fusion - Central-level fusion - Hybrid fusion - Pixel-level fusion - level fusion-Decision-level fusion - Sensor footprint registration and size considerations - Dempster-Shafer Evidential Theory- Summary

UNIT IV: Artificial Neural Networks

Applications of artificial neural networks - Adaptive linear combiner - Linear classifiers - Capacity of linear classifiers - Nonlinear classifiers - Madaline - Feedforward network - Capacity of nonlinear classifiers - Supervised and unsupervised learning - Supervised learning rules - Voting Logic Fusion

UNIT V : Fuzzy Logic and Fuzzy Neural Networks

Conditions under which fuzzy logic provides an appropriate solution - Illustration of fuzzy logic in an automobile antilock braking system - Basic elements of a fuzzy system - Fuzzy logic processing - Fuzzy centroid calculation

Reference:

1. UNMANNED AIRCRAFT SYSTEMS UAVS DESIGN, DEVELOPMENT AND DEPLOYMENT Reg Austin Aeronautical Consultant, A John Wiley and Sons, Ltd., Publication
2. Mathematical Techniques in Multisensor Data Fusion (Artech House Information Warfare Library) [Hardcover] David L. Hall, Sonya A. H. McMullen ,
3. Handbook of Multisensor Data Fusion: Theory and Practice, Second Edition (Electrical Engineering & Applied Signal Processing Series) Martin Liggins II David Hall, James
4. Sensor and Data Fusion: A Tool for Information Assessment and Decision Making, Second Edition (SPIE Press Monograph PM222) Lawrence A. Klein .
5. Multi-Sensor Data Fusion with MATLAB by Jitendra R. Raol

SEMESTER – III (Electives)

PAU 703	MODELING AND SIMULATION OF DYNAMIC SYSTEMS	L T P C 3 0 0 3
GOAL	To introduce basic concepts of system dynamics and mathematical models for flight simulation and the fundamentals of design concepts	

OBJECTIVE	OUTCOME
The course should enable the student to:	**The student should able to:**
• To introduce Principles used in modeling the techniques of simulation	• To understand the , System modeling, in Static models, Dynamic models .
• To study the Discrete probability functions and continuous probability function	• To understand the Discrete probability functions and continuous probability function
• To know about Gathering statistics, Counters and summary statistics in different process.	• To understand the Simulation programming tasks
• To know the Dynamo Language Elements of Mathematical models and Representation of aerodynamics data	• To understand the system dynamics and mathematical models for flight simulation .
• To study advantage of simulator and the effectiveness of Simulator	• To understand advantage of simulator and the effectiveness of Simulator

UNIT I SYSTEM MODELS AND SIMULATION 10

Continuous and discrete systems, System modeling, Static models, Dynamic models, Principles used in modeling the techniques of simulation, Numerical computation techniques for models, Distributed lag models, Cobweb models.

UNIT II PROBABILITY, CONCEPTS IN SIMULATION 10

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.

UNIT III SYSTEM SIMULATION 10

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, Simulation of an autopilot, Interactive systems.

UNIT IV SYSTEM DYNAMICS AND MATHEMATICAL MODELS FOR FLIGHT SIMULATION 10

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 5

Introduction, advantage of simulator, the effectiveness of Simulator, The user's role, Simulator Certification, Data sources, Validation, in- flight simulators

REFERENCES:

1. Gordon. G., "System Simulation" , Prentice – Hall Inc., 1992.
2. Stables, K.J. and Rolfe, J.M. "Flight Simulation", Cambridge University Press, 198

PAU 704	UAV – OPERATIONAL AND INDUSTRIAL ASPECTS	L T P C 3 0 0 3
GOAL	• To study advanced terminology, models and prototypes of operational aspects of UAV system • To learn the UAV system in term of Robotics, Devices Simulation and Operational Regimes	

OBJECTIVE	OUTCOME
The course should enable the student to:	**The student should able to:**
• To introduce Military robotics history operations and Civil robotics history Civil robotics history. • To study the Categories/Classification FCS plan and overview – FCS current situation. • To know the Automatic control functionality, Advanced AI Applications and Intelligent Control Techniques • To do the case study and operational system design considerations • To study the Health monitoring , Safety module , Remote maintenance Adaptation and Learning.	• To understand Military robotics history operations and Civil robotics history • To understand the Categories/Classification FCS plan and overview – FCS current situation. • To understand Automatic control functionality, Advanced AI Applications and Intelligent Control Techniques To understand operational system design considerations of UAV sensor. • To understand the Health monitoring, Safety module , Remote maintenance Adaptation and Learning

UNIT - I INTRODUCTION **8**

General group – Military robotics history – Military robotics history operations– Civil robotics history – Civil robotics history operations – Design Considerations - Acquisition & Life Cycle Costs – UGV Architecture - UGV Components – Ground Vehicle concepts – Payloads and sensors.

UNIT - II TYPES AND ROLES **8**

Categories/Classification – Small size UGV – Large UGV – Law Enforcement Usage – Future Combat System (FCS) – FCS plan and overview – FCS current situation

UNIT- III SENSORS AND CHARACTERISTICS **15**

Sensor Acquisition - Optical (EO) - Infrared (IR) - Multi Spectral Imaging (MSI) - Hyper Spectral Imaging (HSI) - Laser Detection & Ranging (LIDAR) - Synthetic Aperture Radar (SAR) - UGV Perception concept - Environmental and Weather Effects - Sensor integration - Future Sensor Trends Control Definitions - Low Level Control (LLC) - High Level Control (HLC) - Vision and sensing - Automatic control functionality - Autonomous control functionality - Advanced AI Applications - Intelligent Control Techniques

UNIT - IV CASE STUDY AND OPERATIONAL SYSTEM DESIGN CONSIDERATIONS ` 20

The Need for Alternative Propulsion - Alternative Power Trends & Forecast - Energy Storage Methods & Density - Fuel Cell Basics & UGV Integration - Fuel Cells Used in Current UGVs - Hybrid Power train - Future UGV power train Designs - UGV Design Considerations - Platform Design Process - Navigation and Control - Propulsion Considerations - Communication issues - Manoeuvrability and Stability - Ground Control Station - Support / peripheral equipment - Mobility and Transportability - Current State of Communication - Future Needs of Communication - Line of Sight Fundamentals - Beyond Line of Sight

UNIT – V HUMAN MACHINE INTERFACE **9**

Human Factors Engineering - Human Machine Interface - Voice Recognition & Control - Brain Computer Interface -Health and Maintenance - Diagnostics - Recovery methods - Health monitoring - Safety module - Remote maintenance Adaptation and Learning - Adaptation - Learning - Programming - Optimization Special Features

Total: 60

Text Books:

1. Handbook of Military Industrial Engineering, Adedeji B. Badiru, Marlin U. Thomas – 2009*: ISBN 1420066293*.
2. Human-robot Interactions in Future Military Operations, Michael Barnes, Florian Jentsch – 2010 *: ISBN 1409486354.*
3. Computer Safety, Reliability, and Security, Erwin Schoitsch – 2010 *: ISBN 3642156509.*