

CURRICULUM
OF
AERONAUTICAL ENGINEERING
FOR
B.S/M.S

(Revised 2004)



HIGHER EDUCATION COMMISSION
ISLAMABAD

CURRICULUM DIVISION, HEC

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PREFACE

Curriculum of a subject is said to be the throbbing pulse of a nation. By looking at the curriculum of a subject, one can judge the state of intellectual development and the state of progress of a nation. The world has turned into a global village, new ideas and information are pouring in a constant stream. It is, therefore, imperative to update our curricula by introducing the recent developments in the relevant fields of knowledge.

In exercise of the powers conferred by Sub-section (1) of Section 3 of the Federal Supervision of Curricula Textbooks and Maintenance of Standards of Education Act 1976, the Federal Government vide Notification No.D773/76-JEA (Cur.), dated December 4, 1976, appointed Higher Education Commission as the Competent Authority to look after the Curriculum Revision Work beyond Class XII at Bachelor level and onwards to all Degrees, Certificates and Diplomas awarded by Degree Colleges, Universities and other Institutions of higher education.

In pursuance of the above decisions and directives, the Commission is continually performing curriculum revision in collaboration with the Universities. According to the decision of the special meeting of Vice-Chancellors' Committee, curriculum of a subject must be reviewed after every 3 years. For the purpose, various Committees are constituted at the national level comprising senior teachers nominated by the Universities. Teachers from local degree colleges and experts from user organizations, where required, are also included in these Committees.

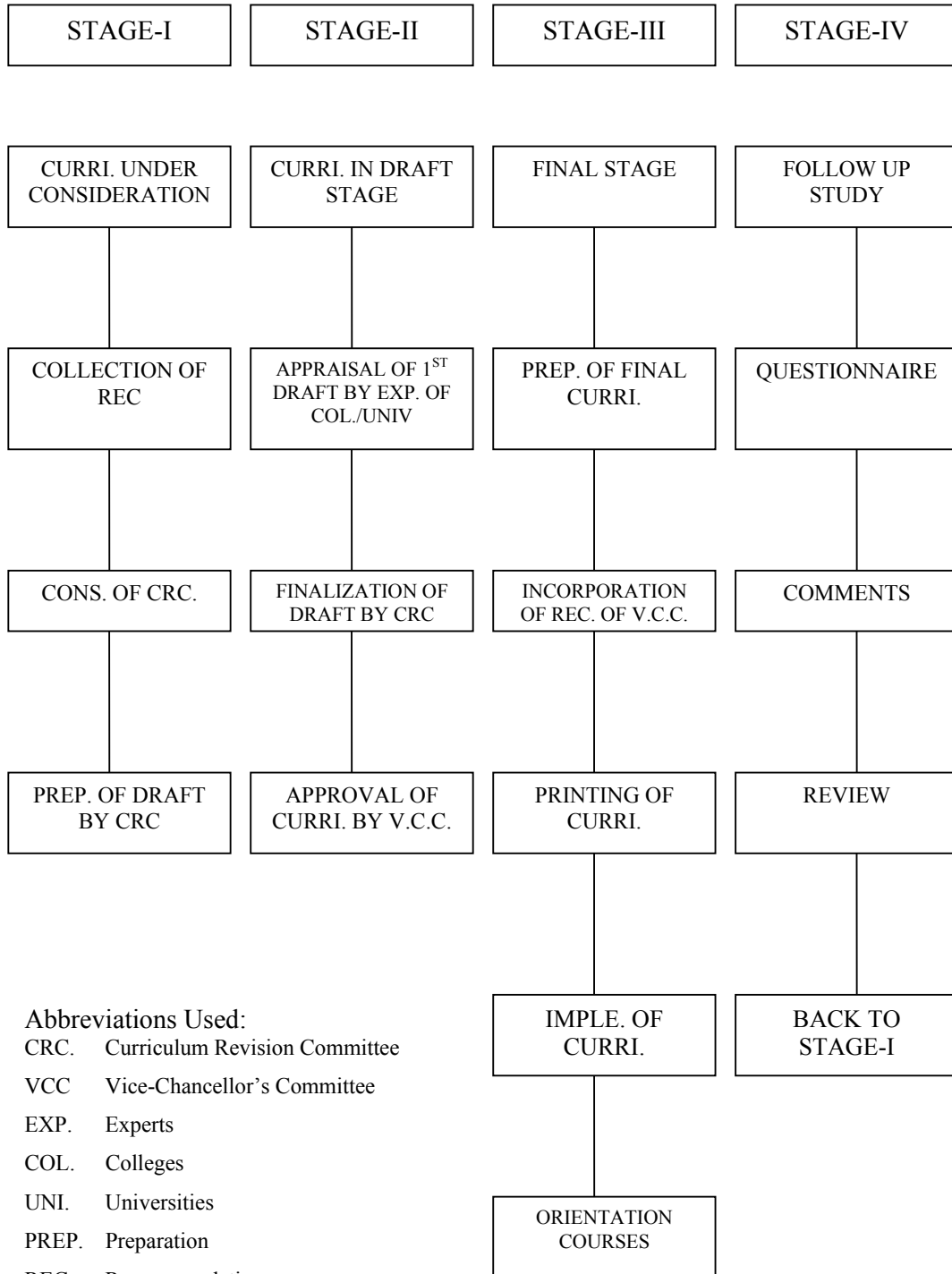
The National Curriculum Revision Committee on **Aeronautical Engineering** in its meeting held in May 2004 at the HEC Regional Centre, Peshawar finalized the draft curriculum after due consideration of the comments and suggestions received from the Universities and Colleges where the subject under consideration is taught.

The Final draft prepared by the Curriculum Revision Committee duly approved by the Competent Authority is being circulated for implementation by the Universities.

(PROF. DR. ALTAF ALI G. SHAIKH)
Adviser (HRD)

July 2004

CURRICULUM DEVELOPMENT



INTRODUCTION

A three-day meeting of the *National Curriculum Revision Committee for Aerospace and Avionics Engineering* (NCRC-Aerospace/Avionics Engineering) was held on 20-22 May, 2004 to finalize draft curricula for Aerospace and Avionics degree programmes drafted during an earlier meeting of the Committee held on 12-14 February, 2004 at Higher Education Commission, Regional Centre, Peshawar. The objective of the meeting was to finalize curricula for Aerospace & Avionics Engineering for various degree programmes in the public and private sector universities of Pakistan.

Participants of the Meeting

1. Dr. Khalid Parvez
Professor & Dean
Nominee Pakistan Engineering Council,
College of Aeronautical Engineering,
PAF Academy, Risalpur
Convener
2. Dr. Ahmed Ejaz Nadeem
Professor & Head
Industrial Engineering Department,
College of Aeronautical Engineering,
PAF Academy, Risalpur
Secretary
3. Wing Cdr. Dr. Jahanzeb Masood
Associate Professor,
Aerospace Engineering Department,
College of Aeronautical Engineering,
PAF Academy, Risalpur
Member
4. Engr. Aleem Arshad
Deputy Director (Aero Technologies),
National Development Complex,
National Engineering & Scientific
Commission # 586, Street # 28,
G-10/2, Islamabad
Member
(Attended 1st meeting only)
5. Mr. Ayaz Aziz
Director,
Institute of Space Technology
Islamabad
Member
6. Group Capt. Dr. Khahid Mahmood Tahir
Director Development and Senior Staff
Officer,
Pakistan Aeronautical Complex Board,
Kamra, Distt. Attock
Member
(Attended 2nd meeting only)
7. Engr. Professor Jamshed-ur-Rahman
Director Academic,
Khadim Ali Shah Bukhari Institute of
Technology, 84-B, SMCHS, Karachi
Member

- | | |
|--|--------|
| 8. Mr. Asif Israr,
Lecturer,
Institute of Space Technology
Islamabad | Member |
| 9. Mr. Arbab Mehmood Ahmad,
Senior Manager Academics,
Institute of Space Technology
Islamabad | Member |

General

In the final meeting Muhammad Tahir Ali Shah, Assistant Director (S&T) welcomed the participants. He expressed pleasure over the worthy participation of academia from around the country, representing both the public and private sector institutions.

The participants agreed to maintain Professor & Dean Dr. Khalid Parvez as the Convener and Professor Dr. Ahmed Ejaz Nadeem as the Secretary of the NCRC-Aerospace/Avionics Engineering.

Professor & Dean Dr. Khalid Parvez, Convener of the Committee, welcomed the participants and thanked HEC for their efforts and the following universities/organizations for sending their representatives to participate in the important national cause.

1. PAF College of Aeronautical Engineering, NUST, PAF Academy, Risalpur
2. Institute of Space Technology, Islamabad
3. Aero Technologies-NESCOM, Islamabad
4. Pakistan Aeronautical Complex Board, Kamra, Distt Attock
5. Khadim Ali Shah Bukhari Institute of Technology, 84-B SMCHS, Karachi

Since most of the work on curricula for under-graduate and post-graduate programmes in Aerospace and Avionics Engineering was completed in the previous meeting of NCRC-Aerospace/Avionics Engineering held on 12-14 February, 2004, the Convener invited the comments/remarks/suggestions from the participants on the report of the earlier meeting already circulated to all the participants for their review. Engr. Prof. Jamshed-ur-Rehman, Group Captain Dr. Khalid Mehmood Tahir, and Mr. Ayaz Aziz pointed out some typographical errors in the report. Mr. Ayaz proposed that some of the course titles in the undergraduate programme for Aerospace Engineering might be revised. The Committee after deliberations agreed to the proposal and necessary corrections/amendments were incorporated in the curriculum. The comments/suggestions from the foreign experts were also considered.

It was unanimously agreed that report of the earlier meeting after necessary corrections/amendments be treated as the final report of the NCRC-Aerospace/Avionics Engineering. The final report is as under:

Item No.1 Vision of Aerospace/Avionics Engineering Education

Dr. Khalid Parvez proposed to develop a clear vision of Aerospace/Avionics engineering to inspire and guide the task of curriculum development and define the scope of Aerospace/Avionics Engineering education. He stated that Aerospace/Avionics Engineering involves the application of Engineering concepts, techniques, and methods to the development of Aerospace/Avionics systems. An Aerospace/Avionics engineering programme should develop professionals who have a mastery of Aerospace/Avionics system development principles, theory, practice, and process.

Dr. Khalid Parvez said that Aerospace/Avionics Engineering like other engineering disciplines must lay an emphasis on issues of process, design, measurement, analysis and verification providing a strong foundation in engineering principles and practices as applied to Aerospace/Avionics system development.

Dr. Ahmad Ejaz Nadeem invited the attention of the participants to the following concept of the *ABET Engineering Criteria 2000* applied to Aerospace/Avionics Engineering:

“The curriculum must provide both breadth and depth across the range of engineering topics implied by the title and objective of the programme. The programme must demonstrate that graduates have: the ability to analyse, design, verify, validate, implement, apply, and maintain Aerospace/Avionics systems; the ability to appropriately apply mathematics, probability and statistics, and relevant topics in Engineering and management sciences to complex Aerospace/Avionics systems.”

The Committee held a detailed and extensive deliberation on the said issue. It was noted that the rapidly emerging and developing areas of Aerospace/Avionics engineering offer challenges and newer and exciting opportunities. The Committee agreed that the proposed curriculum should be geared towards exploring the subject at theoretical, practical, and application levels. It must address the need to establish concepts, knowledge and practical experience in all aspects of Aerospace/Avionics cycle — requirements, problem analysis, design, construction, testing, maintenance and project planning and control. The curriculum, it was felt, should also take into account the human aspect of the discipline in terms of human-machine interaction.

The Committee came up with the following Vision Statement for Aerospace/Avionics education in Pakistan:

“The Aerospace/Avionics education in Pakistan will focus on imparting to students the knowledge and training which should enable them to harmonize theory with practice, concept with application, and problem with solution. It will prepare them to ably apply engineering principles, processes and practices to aerospace and avionics systems, and their maintenance. The programme will also, in addition to students’ professional growth, attend to development of their personal and interpersonal skills. It will help students to enhance their ability in oral and written communication, and their adaptability to group-work environments. The program will inculcate among students a strong sense of civic, professional and ethical responsibility. The program will strive to develop in the professionals a capacity for innovation and a passion for life long learning.”

The meeting expressed confidence that the curricula thus developed will reflect the spirit as contained in the Vision Statement and when implemented it will satisfy the professional demands of industry and academia. The graduates thus produced will be adequately equipped to exploit the opportunities and answer the challenges offered by the modern world.

Item No.2 Knowledge Areas of Aerospace/Avionics Curriculum Development

The Chair suggested approaching the curriculum development systematically by identifying the major knowledge areas of Aerospace/Avionics Engineering education at the outset.

The following major areas were considered appropriate to design the curriculum of Aerospace/Avionics Engineering:

Aerospace Engineering

1. Aerodynamics
2. Structures
3. Thermodynamics/Propulsion
4. Mechanics
5. Supporting Areas (Mathematics, Basic Sciences, Electrical System, Engineering Management and Workshop Technology)
6. General Education.

Avionics Engineering

1. Electronics
2. Energy Conversion/Electro-Mechanical Systems/Power Electronics
3. Electromagnetism
4. Communications

5. Computer Systems
6. Controls
7. Guidance, Navigation and Control
8. Microwaves/Radar/Antenna
9. Supporting Areas (Mathematics, Basic sciences, Aerodynamics, Thermodynamics, Propulsion, Engineering Management and Workshop Technology)
10. General Education

The Committee discussed various international recommendations and standards presented to the participants. The meeting recognized that good curriculum should focus on building a solid foundation in the early stages of learning and gradually introducing and strengthening the core professional competencies and desired skill-sets. The main technical Aerospace and Avionics content should be covered during the second, third and fourth years. Laboratory component should inculcate among students an industrious approach and practice to problem solving. Good engineering practices must be nurtured all along the education programme. As the practice of Aerospace/Avionics Engineering is often in the context of multi-application domains, therefore, the graduates should be provided an opportunity of reasonably broad exposure to learn and demonstrate the application of Engineering practices. A final year design project should provide the opportunity to bring together all the knowledge gained in a wide variety of courses to solve realistic problems.

The meeting also discussed in depth the influence of the industry on the Aerospace/Avionic Engineering programmes. The meeting agreed on the proposals presented in the documents placed as appendices A thru F including eligibility criteria, programme structures, and programme requirements.

Item No.3 Discussion on B.E (Aerospace) curriculum of CAE and IST

Two institutions namely College of Aeronautical Engineering (CAE) and Institute of Space Technology (IST) offer B.E programme in Aerospace Engineering. Their B.E (Aerospace) Curricula were discussed and they were found to be similar and meeting the vision of education and the requirements outlined in the knowledge areas by the NCRC-Aerospace/Avionics Engineering.

Item No. 4, 5 & 6 Discussion on B.E (Avionics), M.S (Aerospace), M.S (Avionics) curricula of CAE

College of Aeronautical Engineering (CAE) is the only institution offering B.E (Avionics) M.S (Aerospace) and M.S (Avionics) programmes. Curricula of CAE for these programmes were discussed in light of the vision and the knowledge areas outlined by the NCRC — Aerospace/Avionics Engg. The curricula were found meeting the vision of the respective programmes adequately.

Item No.7 Nomenclature of Degree Programmes

The Committee emphasized that the nomenclature followed for Aerospace/Avionics Engineering programmes should correspond to international trends and standard. The following nomenclatures were thus agreed upon for various degrees:

B.S Aerospace Engineering	:	B.E (Aerospace)
B.E Avionics Engineering	:	B.E (Avionics)
M.S Aerospace Engineering	:	M.S (Aerospace)
M.S Avionics Engineering	:	M.S (Avionics)

Item No.8 Duration of Programmes

The BE Aerospace/Avionics Engineering Degree programmes would be minimum 4-year programmes spread over 8 semesters and M.S Aerospace/Avionics Engineering programmes would be minimum 1-½-year programmes spread over 3 semesters.

Item No.9 Admission Criteria

The eligibility criteria for B.E Aerospace/Avionics Engineering admission were discussed. It was proposed that candidates should have an intermediate with physics, mathematics and chemistry or equivalent qualifications; however, universities may define their own admission criteria.

The eligibility criterion for admission to M.S Aerospace/Avionics Engineering was unanimously agreed to be B.E/B.Sc Engineering in relevant field.

Item No.10 BE Aerospace/Avionics Engineering — Programme Structure

All participants agreed that the proposed programme in Aerospace/Avionics Engineering meets the needs of learning outcomes in terms of knowledge outcomes and ability outcomes with relevant skills. The development of curriculum is expected to enhance the theoretical and practical understanding of the field of Aerospace and Avionics Engineering.

Minimum credit hours earned by a student shall be 128 for the award of B.E degrees in Aerospace and Avionics Engineering. Overall distribution must conform to the criteria laid down by PEC. The distribution of total credit hours of each programme is as under:

1. For B.E (Aerospace), out of minimum 128 credit hours, 105 credit hours must be done as per the distribution given in Appendix-A. Description of courses for B.E Aerospace is given in Appendix-B. For the remaining 23 credit hours, universities may decide the distribution. However, the recommended courses for the remaining 23 credit hours are listed in Appendix-C.
2. For B.E (Avionics), out of minimum 128 credit hours, 110 credit hours must be done as per the distribution given in Appendix-D. Description of courses for B.E Avionics is given in Appendix-E. For the remaining 18 credit hours, universities may decide the distribution. However, the recommended courses for the remaining 18 credit hours are listed in Appendix-F.

Besides the curricula for B.E Aerospace/Avionics developed in conformity with the criteria laid down above, it was unanimously agreed that qualified and dedicated faculty along with standard laboratory facilities to support theoretical classroom instruction was the hallmark of quality education in the field of Aeronautical Engineering. HEC and PEC being two national bodies dealing with engineering education in country must ensure availability of qualified and dedicated faculty along with standard laboratory facilities at universities/institutes offering B.E Aerospace/Avionics programmes.

Item No. 11 Constitution of Sub-Committees

Sub committees were constituted on the proposal of participants to work in detail on various important issues of the agenda. Subsequently the following sub-committees were constituted:-

Sub-committee for B.E/M.S Aerospace Engineering

1. Dr. Jahanzeb Masud
 2. Mr. Ayaz Aziz
 3. Mr. Asif Israr
 4. Mr. Aleem Arshad
- Coordinator

Sub-committee for B.E/M.S Avionics Engineering

1. Dr. Ahmad Ejaz Nadeem
- Coordinator

2. Professor Jamshed-ur-Rehman
3. Mr. Aleem Arshad

Item No. 12 M.S Aerospace/Avionics Engineering — Programme Structure

The M.S Aerospace/Avionics Engineering programmes were also discussed and agreed upon in the meeting. It was noted that the MS Aerospace/Avionics programmes should be designed as a next higher degree in the profession for BE Aerospace/Avionics graduates.

For MS minimum credit hours earned by a student shall be 30. Following is the distribution of total credit hours.

Component	Credit Hours
Courses	15
Electives	09
Thesis	06
Total	30

Item No. 13 Development of Objectives and Contents for Courses

The objectives of MS Aerospace/Avionics Engineering programmes were discussed. It was unanimously agreed that the programme objectives formulated by the PAF College of Aeronautical Engineering for their M.S Aerospace/Avionics Engineering programmes vary comprehensive and should be adopted as such. Therefore, the objectives of M.S Aerospace/Avionics Engineering programmes should be to produce graduates, who:

1. Are well-educated, highly valued and successful professionals, technically well prepared for their subsequent assignments, duties and responsibilities as Aerospace/Avionics engineers in public as well as private sector organizations. (Such positions may range from requiring very detailed and advanced work in a specific discipline to broad responsibilities requiring interaction among many disciplines and technical organizations – interdisciplinary teamwork.)
2. Have been provided core education in Aerospace or Avionics Engineering.
3. Possess detailed understanding in one or two speciality areas.
4. Apply foundational scientific concepts and sound engineering principles to efficiently and effectively advance technological capabilities in the country.
5. Have experience in conducting and documenting an independent investigation of a problem pertaining to Aerospace or Avionics Engineering.

6. Professionally communicate technical solutions and results.
7. Continue to pursue lifelong multidisciplinary learning as professional engineers.

The curricula for M.S Aerospace and M.S Avionics being followed at the PAF College of Aeronautical Engineering, the only institution offering MS Aerospace and MS Avionics programmes were discussed and were found meeting the vision and the programme objectives agreed upon by the committee. Therefore, proposed curricula for M.S Aerospace and M.S Avionics should be as given in Appendices ‘G’ and ‘H’ respectively.

Contents/Description of courses to facilitate accomplishment of the programme objectives were deliberated in light of the M.S Aerospace and M.S Avionics programmes of the PAF College of Aeronautical Engineering and it was agreed that course contents being followed were comprehensive and should be recommended for the M.S Aerospace and M.S Avionics programmes. Contents/Description of courses for M.S Aerospace/Avionics Engineering programmes are given in Appendices ‘J’ and ‘K’ respectively.

Item No. 14 Ph.D Aerospace/Avionics Engineering — Programme Structure

The Ph.D programme in Aerospace and Avionics are not being offered in any institution in Pakistan at present. However, the programmes are under active discussion/consideration at PAF College of Aeronautical Engineering and National University of Sciences & Technology (NUST). In light of the above, it was recommended that the Ph.D programmes should have a minimum of 30 credit hours of higher level coursework and at least 30 credit hours of doctoral research/dissertation work. It was also recommended that Ph.D Programme in Aerospace and Avionics must be designed with the processes to meet the objectives similar to those recommended for M.S Aerospace/Avionics Engineering programmes and the overall vision must always remain aligned with the overall vision of Aerospace and Avionics education in Pakistan recommended by the NCRC — Aerospace/Avionics. It was also agreed that after finalization of the details/modalities for Ph.D Aerospace/Avionics at PAF College of Aeronautical Engineering and National University of Sciences & Technology (NUST), same should be deliberated at length by the NCRC — Aerospace/Avionics prior to adoption in Pakistan.

Item No. 15 Review of the Sub-Committees’ Proposals

The Convener consolidated all the submissions of the sub-committees and presented to the NCRC — Aerospace/Avionics for review and refinement. The committee thoroughly reviewed the recommendations for B.E, M.S and Ph.D programmes and approved the proposed recommendations. All members agreed on the laid down structure, procedures, and modalities of the B.E programme. It was also agreed that to prepare/recommend the Ph.D programme, subsequent meeting as

required should be convened by HEC in consultation and upon recommendations of the respective sub-committee coordinators.

Item No. 16 Conclusion

Finally, Mr. Tahir Ali Shah, Assistant Director (S&T), Curriculum Division, HEC, Islamabad thanked the participants for their valuable contribution to this national cause. Dr. Khalid Parvez, the Convener also thanked the participants for their willing and useful participation. He said that their efforts will go a long way in developing workable, useful and comprehensive degree programmes in Aerospace/Avionics Engineering. He said this entire exercise has not only been utilized by the HEC for developing Aerospace/Avionics degree programmes, but it also provided an opportunity to professionals and faculty from all around the country to interact for mutual benefit in professional development. He also expressed his profound gratitude to the HEC for providing an excellent opportunity to academicians of public and private sector universities from all over the country to contribute their time, knowledge, expertise, and experience to this important national cause.

The meeting authorized the Convener to submit the final draft of the Aerospace/Avionics Engineering curricula to the Higher Education Commission.

The meeting concluded with vote of thanks to the Chair.

SCHEME OF STUDIES FOR B.E AEROSPACE ENGINEERING

Minimum Credits Hours	=	128
Essential Credit Hours	=	105

Breakdown of 105

Subjects	Theory Credit Hours	Experimental Credit Hours
Aerodynamics	8	2
Thermodynamics/Propulsion	8	1
Structures	7	2
Aerospace Materials	3	-
Workshop Tech	0	3
Drawing	1	2
Air Vehicle Design	3	3
Stability and Control	3	-
Control System	3	-
Electronic/Electric	5	1
Engineering Management	3	-
Measurement/Inst	2	1
Physics	2	1
Chemistry	3	0
Tech Report Writing	3	-
Pakistan Studies	3	-
Mathematics	15	-
Islamic Studies	3	-
Engineering Mech	6	-
Programming Languages	1	2
Projects	6	0
Sub-total	87	18
Grand total	105	

**LIST OF R REMAINING 23 CREDIT HOURS RECOMMENDED COURSES
FOR B.E AEROSPACE ENGINEERING**

Minimum Credits Hours	=	128
Essential Credit Hours (Proposed courses listed in appendix A)	=	105
Remaining Credit Hours	=	23

Subjects	Credit Hours	
	Theory	Laboratory
Introduction to Aerospace Technology	3	0
Introduction to Space Technology	3	0
Rocket Propulsion	3	0
Propulsion II (Conceptual Components Design)	3	0
Turbo machinery	3	0
Flight Control System	3	0
Ethics in Engineering Practices	3	0
Introduction to FEM	2	0
Introduction to CFD	2	0
Space Flight Dynamics	3	0
Psychology	3	0
Human Relations	3	0
Introduction to Smart Materials	2	0
Communication Skills	1	0
Office Correspondence/Service Writing	1	0
Ethics/Character Building & Leadership/Individual & Society	3	0
International Relations	1	0
Aerospace & Air Operations	3	0
Decision Making & Time Management	1	0
Computer Science	1	0

DETIAL OF COURSES FOR B.E (AEROSPACE) ENGINEERING

AERODYNAMICS

AERO-2xx	Fundamentals of Incompressible Aerodynamics	2-1/2
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📖 *Fundamentals of Aerodynamics by John D Anderson, 3rd Ed, McGraw-Hill, 1988.*

This is the first course in Aerodynamics, which covers the fundamentals of fluid dynamics. It deals with the incompressible fluid flows only and comprises two major parts. The first part deals with the fluid statics and dynamics in which the fluid flows are analyzed and the mass flow rate, forces and energy flux are calculated. This part deals with the potential flows and their super position. Part two consists of the dimensional analysis, boundary layer theory and compares the ideal and real flows. This part mainly deals with airfoil characteristics, thin airfoil theory, high lift devices, wing characteristics, Prandtl's lifting line theory and drag on the aircraft.

AERO-3xx	High Speed Aerodynamics	2-1/2
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📖 *Gas Dynamics by James E A John, Allyn & Bacon, Boston, 1972.*

This is the second course in aerodynamics and explains the wave propagation in compressible media and gives basic equations of compressible fluid flow. Discussion includes the isentropic flow of a perfect gas. The analysis of normal, oblique and conical shock waves and Prandtl-Meyer flow is carried out along with their application to nozzle flows. The course also deals with flows with friction and heat transfer. Three dimensional flow equations are derived. Also the linearized flow theory, shock expansion theory and supersonic similarity parameters are discussed to explain the concepts of supersonic airfoil/wing design.

AERO-3xx	Aerospace Vehicle Performance	3-0
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📖 *Aircraft Performance, Stability and Control, Vol-I by James D Lang, USAF Academy, Dept of Aeronautics, 1974.*

The course introduces basic performance characteristics. It begins with an introduction to standard atmosphere and pilot/static system of an aircraft. The course then covers a steady-state analysis of performance parameters such as endurance, aircraft ceiling, range, climb, descent and glide, take of and landing performance. Accelerated performance parameters are then evaluated using Energy State Approximation and results are compared with exact solutions. The last part of the course deals with turning performance both instantaneous and sustained. Space: Newton law of gravity, two body problem, trajectory eqn, orbits, coordination.

Sys. Kepler's laws, trajectory designs and simulation

AERO-3xx	Intro to Aerospace Engineering	3-0
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📖 *A History of Aerodynamics by John D Anderson, Jr, Cambridge University Press, Cambridge, 1998.*

Overview, Space environment, types of satellites and their components, types of satellite orbits, satellite orbit characteristics, types of airborne vehicles, components of airborne vehicles, types of rockets, rocket components, types of space launch vehicles, Introduction to endoatmospheric flight.

AERO-3xx	Wind Tunnel Testing	0-1
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📖 *Low Speed Wind Tunnel Testing by Pope & Harper, John Wiley, N.Y. 1966.*

The course consists of a series of experimental work on CAE Subsonic Wind Tunnel. It includes wind tunnel calibration, model testing and data reduction for obtaining important aerodynamic and stability parameters of an aircraft. The necessary tunnel boundary corrections and scale effects are also evaluated and applied to raw data.

STABILITY & CONTROL

AERO-3xx	Aerospace Vehicle Stability & Control	3-0
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📖 *Aircraft Performance Stability and Control, Vol-I by James D Lang, USAF Academy, Dept of Aeronautics, 1974*

📖 *Automatic Control of Aircraft by Blakelock, John Wiley, N.Y. 1965*

📖 *Dynamics of Flight (Stab & Control) by B. Etkin & Duff, 3rd Ed, John Wiley, NY 1996*

This is a major course, which gives a systematic account of aircraft stability and control. In first part of the course, the static longitudinal, directional and lateral stability with respect to aircraft axes system is studied. Effects of various major components on static stability, critical flight conditions and controls requirement are also included in this part. In second part of more complicated part of stability i.e. dynamic stability, the axes system (inertial, body and stability axes) and their transformations is studied. This part also gives treatment of aircraft equations of motion/linearization, Laplace transformation, stability derivatives, transfer functions, aircraft dynamic responses to external disturbances and controls. Space related topics i.e. Equation of motions, static stability and control, long & lateral dynamics, Stability Derivatives.

AEROSPACE VEHICLE DESIGN

AERO-4xx	Aerospace Vehicle Design	3-3
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📖 *Aircraft Design: A Conceptual Approach* by Raymer, 3rd Ed, AIAA Virginia, 1999

This deals with the conceptual design of various types and categories of aircraft. Conceptual design is basically new aircraft concept development process and consists of two major activities: design layout and design analysis. These two phases broadly cover aspects involving configuration layout, pay-load considerations, aerodynamics, propulsion, structures and loads, weights, stability and control, performance and finally trade studies. As a part of this course, the student is required to prepare and present a conceptual design of a complete aircraft based on certain specifications. Extensive use of computers would be made to refine the designed aircraft.

AERO-4xx	Space Flight Dynamics	3-0
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Text books:

📖 *Fundamental of Astrodynamics* by Bates

📖 *An Introduction to Astrodynamics* by Baker, RML, Academic Press, 1967

Reference books:

📖 *Space Flight dynamics*, by Wiesel E William, McGraw-Hill, NY, 1992

Introduction, Newton's law of gravitation, two body problem, trajectory equation, orbits, coordinates system, time of flight, the Kepler problem, conic trajectories, patched conic approximation.


ENGINEERING MECHANICS

MECH-1xx	Engineering Statics	3-0
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📖 *Engineering Mechanics (Statics)* by J L Mariani & L G Kraige, 4th Edition, John Wiley, NY, 1998

This is the first course in Mechanics, which concerns the general principles of statics and the equilibrium of bodies under the action of forces. The main topics included under the course are properties of forces, moments, couples and resultants; analysis of two and three-dimensional problems; and application of equilibrium principles to simple trusses, frames and machines. The course also covers special topics related to friction effects to beams and fluid statics.


MECH-2xx	Engineering Dynamics	3-0
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 *Engineering Mechanics (Dynamics) Vol II by J L Mariam & L G Kraige (S I Version 4th Edition), John Wiley, NY, 1998*

The primary purpose of this course is to help the students develop the ability to visualize physical configurations in terms of real materials, actual constraints and practical limitations that govern the behaviour of machines and structures. The course has been divided into four parts. The first part, Kinematics of Particles, deals with a number of ways in which the motion of a particle is generated. Part two, Kinetics of Particles, is concerned with the three basic methods, force-mass-acceleration, work-energy, and impulse-momentum. In the third part, Kinematics of Rigid Bodies, the equations of relative velocity and relative acceleration are encountered. Emphasis is placed jointly on solution by vector geometry and solution by vector algebra. Part four, Kinetics of Rigid Bodies, covers the basic equations, which govern all categories of plane motion.

AEROSPACE MATERIALS


MECH-3xx	Material Science	3-0
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 *Elements of Materials Science & Engineering by Van Vlack, 4th Ed, Addison Wisley, London, 1980*

The course mainly deals with properties of various materials being used in engineering applications in general and Aerospace applications in particular. The basic physical and chemical phenomena that govern these material properties are introduced and explained. Material like metals, metal alloys, polymers, ceramics and composites are discussed and relative advantages/disadvantages highlighted with respect to engineering applications. Material degradation and failure along with corrosion effects are introduced. A brief narration on electrical, magnetic and semi-conductor materials is included towards the end of the course.

DRAWING

DWG-1xx	Engineering Drawing-I	1-1
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 *Fundamental of Engineering Drawing by French & Vierck, 4th Ed, McGraw-Hill, NY 1978*

This course consists of a series of lectures and class room exercises designed at familiarizing the students with the basic concepts of engineering drawing. It includes a brief account of the various types of drawings with main emphasis on Orthographic

drawing. It also includes detailed exercises on graphical geometry topics like, principle views, auxiliary views and sectional views.

DWG-2xx	Engineering Drawing-II	0-1
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- 📖 *Inside AutoCAD Release 10 by D Racker & H.Rice, 5th Edition*
- 📖 *Advanced AutoCAD Release 12 by Robert M Thomas, 3rd Ed, BPB, New Delhi, 1993*

This is a course on Computer Aided Drafting (CAD), which covers the fundamentals of CAD. The course has been designed to provide students with a secure and sufficient background for understanding and using the computers to make 2-D and 3-D engineering drawings. It also prepares the students for more advanced uses of computers in CAD/CAM (computer aided manufacturing) operations. The course had been divided into three parts. In the first part, the students get introduced to the computers. The second part deals with enabling the students to make 2-D drawings. Students are familiarized with various 2-D drawing commands including the dimensioning commands and advanced editing techniques. Part three is concerned with the familiarization of 3-D drawings. Students are familiarized with basic concepts and techniques of 3-D drawing commands.

STRUCTURES

STRUC-2xx	Structural Mechanics	2-1/2
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- 📖 *Mechanics of Materials by Archie Higdon, 4th Edition, John Wiley, N Y 1985*

This is the first course in structures, which covers the fundamental concept required in aircraft structure courses. Forces under different loading conditions are analyzed and its effect on the resisting member is studied. The course has been divided into two parts; in the first part analysis of stress-strain concept and their inter-relationship is covered whereas the second part includes the behaviour under different loading.


STRUC-3xx	Structural Vibrations & Aeroelasticity	2-1/2
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- 📖 *Mechanical Vibration-Theory and Applications by Francis S Tse, Ivan E Morse and R T Hinkle, 2nd Ed, Allyn & Bacon, USA, 1978*

The course includes topics like study of elements of vibratory system, simple harmonic motion, theory and application of systems with one degree of freedom, writing of equation of motion of systems with different methods, determining solution of free and forced vibratory systems, transient vibration with impulse response and convolution integral, two degree of freedom systems with method of determining their natural frequencies, matrix methods, continuous systems, lateral vibration of beams,

introduction to aeroelasticity, concepts of divergence and control effectiveness and reversal.

STRUC-3xx	Aerospace Vehicle Loading & Structural Analysis	3-0
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 *Theory and Analysis of Flight Structures by R M Rivello, 1st Ed, McGraw-Hill, 1969.*

This is the third course in aircraft structures. The course is based on forming the equations for bending, torsion and shear in beams. The course also deals with deflection analysis of beams.


STRUC-3xx	Experimental Structural Analysis	0-1
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 *Lab Handouts*

This course consists of a series of experiments designed to cover the practical aspects of the basic concepts of Mechanics of Materials. It also familiarizes the students with the use of strain gauges and the strain measuring equipment.


THERMODYNAMICS/PROPULSION

ME-2xx	Thermodynamics-I	3-0
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 *An Introductory Engineering Thermodynamics by J B Jones/G A Hawkins, 2nd Edition, John Wiley, NY, 1986.*

This is the first course in Engineering Thermodynamics. It provides essential background and competence to the students to have basic know how and analyzing ability of the fundamental concept, Zeroth law and First law of Thermodynamics and its applications to various systems and physical properties of pure substances. Use of property tables, P-V-T relations, Equations of state for ideal gases, second law and its consequences, reversible and irreversible processes and cycles, entropy and its use. Study of the subject course is the pre-requisite for more advanced courses on Engineering Thermodynamics and Propulsion etc.

ME-2xx	Thermodynamics-II	2-1/2
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 *An Introductory Engineering Thermodynamics by J B Jones and G A Hawkins, 2nd Edition, John Wiley, NY, 1986*

This is the second course in Thermodynamics, which illustrates the application of the basic principles covered in the pre-requisite course ME-201. The course has been divided into five parts. In the first part, properties and mixing characteristics of ideal gases are discussed. The second part deals with the properties of atmospheric air

(mixture of ideal gases and vapours). In the third part of the course, mass and energy balance for a combustion reaction and adiabatic combustion temperature calculations is covered. Part four covers the power cycles (no phase change of working substance), such as Brayton, Otto and Diesel cycles. The last part of the course covers the phase change of working substance, Carnot cycle using steam, Rankine cycle, refrigeration, reverse Carnot cycle and Brayton cycle.

ME-3xx	Aerospace Propulsion	3-1/2
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📖 *Mechanics & Thermodynamics of Propulsion* by P D Hill & C.R. Peterson, 2nd Ed Addison, Wesley, NY, 1992

📖 *Rocket Propulsion Elements* by George P Sutton, Oscar Biblarz, 6th Ed. John Wiley, NY, 1992

The course mainly deals with air breathing engines which include ramjet, turbojet, turbo-fan, and turbo-prop. The course starts with the review of basic topics in thermodynamics, which predict the performance of propulsion devices. Next, the details of turbo engine components, especially compressor and turbine, and their matching are discussed. In the later part of the course rocket propulsion and rocket propellants, liquid & Solid Rocket Propulsion Systems, nozzle design, rocket performance. Relevant experiments at appropriate levels are also conducted during the semester.

ENGINEERING PROJECT

AE-4xx	Engineering Project	6-0
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Students are required to complete an engineering project based upon the knowledge they have gained during BE studies.

WORKSHOP TECHNOLOGY

IE-1xx	Workshop Technology-I	0-1
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📖 *Technology of Machine Tools* by Krar, Oswald and Amand, 4th Ed. McGraw-Hill, 1991

The first part of workshop technology is mostly concerned with the hand tools' familiarization and their working. The Sheet-metal working and other operations like Cutting, Shearing, Filing, Sawing and Contouring are discussed. Various Welding types and their practices are carried out. The familiarization with metal-sheets, stock Aluminium, Steel, Brass and Bronze is covered.

IE-1xx	Workshop Technology-II	0-2
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📖 Technology of Machine Tools by Krar, Oswald and Amand, 4th Ed. McGraw-Hill, 1991

The second part of workshop technology deals with various types of machine tools like lathe, milling, shaper, bending, grinding and contour-cutter machines. The operations like turning, tapering, boring, drilling, threading on lathe and gear cutting on milling machines are discussed in detail. The indexing operations and various types of indexing on milling machine are covered. An introduction to composite materials, plastics, ceramics, and adhesives is part of this course.

The brief discussion of NC and CNC-machining, Principles and their programming basics are covered. New age machining like EDM and ECM processes are also covered to introduce the students with space age machining.

CONTROL SYSTEMS

EENG-3xx	Fundamentals of Automatic Control of Linear Systems	3-0
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📖 *Feedback Control Systems by Phillips & Harbor, 3rd Ed, Prentice Hall, USA, 1993*

This course introduces the Aerospace majors to the fundamentals of linear control system. Initially the student is taught the mathematical modelling of physical systems, which include both electrical and mechanical systems. The Digital computer is introduced as a tool for solution of differential equations and linear systems, transient and steady state response. Classification of control systems and frequency response of feedback control system are taught during the later part of the course. Root locus, Routh's criterion and signal flow graphs are also covered. Digital computation on package CC and Matlab are used to put theory in practice.

ELECTRONICS/ ELECTRICAL ENGINEERING

EENG-2xx	Electric Circuits & Machines	2-1/2
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📖 *Circuits, Devices and Systems by Ralph J Smith & Richard C darf, 5th Ed, John Wiley, NY, 1989*

📖 *Direct and Alternating Current Machinery by Rosenblatt and Friedman, 1st Ed, McGraw-Hill, 1963*

The course covers theory and applications of electric circuits and machines for Aerospace majors. Topics included are: concepts of impedance, admittance and transient; use of phasor notation in solutions of AC circuits' use of circuit laws network theorems and concepts of resonance, power and energy. The student is then introduced to DC machines (DC generator and DC motor), alternator, transforms etc.

EENG-2xx	Fundamentals of Electronics	3-1/2
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📖 *Electronic Circuits Discrete and Integrated by Schilling and Belove, 3rd Edition, McGraw-Hill, NY, 1989*

📖 *Fundamentals of Digital Computer by Bartee, 4th Ed, Prentice Hall, USA, 1977*

This course introduces the Aerospace major to electric circuits and digital computer fundamentals. The student is introduced to semiconductor theory during the earlier part of the course. This is followed by an introduction to function of diode and its application, transistor and its terminal characteristics. The biasing of transistor circuits and the concept of DC and AC load lines is also given, which is followed by the analysis of various transistor amplifier configurations. The later part of the course introduces the student to fundamentals of digital computer design.

ENGINEERING MANAGEMENT

IE-2xx	Production Planning and Control	3-0
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📖 *Operations Management by James B Dilworth, 2nd Ed, McGraw-Hill, 1996*

This course presents some of the basic principles of production planning and indicates the way it is interrelated with other functions in the framework of production management. In this course, students are familiarized with the functions of production planning and control with an overview of different types of manufacturing systems. Factors affiliated with different fields of production including product characteristics and economic analysis is covered. Methods of sales forecasting, types of plant layout and procedure generally followed for evaluation of materials and processes are discussed. Advantages due to different types of scheduling of jobs on processors and methods employed are discussed. Finally, types of information systems are summarized describing the benefits gained due to it, at different management levels. Some advanced topics may also be included in this course. Few educational videos may be shown. Cadets submit a PPC Project report.

MEASUREMENT/INSTRUMENTATION

IE-2xx	Test & Measurement	2-1
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📖 *Mechanical Measurements by Thomas G Beckwith, Roy D Marangoni & John H Lienhard V, 5th Ed, Addison Wesley, NY 1993*

Measurement and correct interpretation there of are necessary parts of any engineering research and development programme. Naturally, the measurements must supply reliable information and their meanings must be correctly comprehended and interpreted. This course is meant for student engineers shows have to deal with various types of test and measurement equipment at various stages of their life. It includes topics related to process of measurement standards and dimensional units of measurement, sensors, counters, displacement and dimensional measurements, and stress & strain measurement analysis, fluid flow measurement, temperature measurement and motion measurement. Experimental portion includes use of measuring instruments like autocollimator, screw pitch measuring machine, tolerator, horizontal metro scope, interference microscope, interferometer, surface roundness testing machine and Mechanical & Electronic comparators.

PHYSICS

PHYS-1xx	Engineering Physics-I	2-1
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📖 *University Physics by Sears & Zemansky, 4th Ed, Addison Wesley, London, 1973*

Dimensional analysis, experimental errors; force and torque, general conditions of equilibrium work, energy and power angular motion and moment of inertia. Electric field intensity, current and resistance; Kirchhoff's laws for electrical circuits, electromagnetism, thermoelectricity. Simple Harmonic Motion (SHM), composition of SHM, Damped SHM, Lissajous figures, beats, doppler effect, loudness and intensity.

Fundamental concepts in geometrical optics, wave theories of light, dual nature of radiation and matter, interference, diffraction, polarization, double refraction and its application to optical stress analysis.

CHEMISTRY

CHEM-1xx	Chemistry	3-0
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📖 *Chemistry by Sienko, 5th Ed, McGraw-Hill 1976*

📖 *Physical Chemistry by Danial, 2nd Ed, John Wiley, NY*

Thermo-chemistry, chemical equilibrium, ionic equilibria and solubility product; Electro-chemistry; light metals: Beryllium, Aluminium, Magnesium and Titanium. Heavy metals: Copper, Iron and Steel. Corrosion, nuclear chemistry, polymers.




TECHNICAL REPORT WRITING

ENGL-2xx	Technical Report Writing	3-0
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The course is meant for 3rd Semester students. It includes lectures on Technical Report Writing and methods of effective writing. It also consists of an exercise by cadets on technical report writing and its evaluation by instructor. Additional lectures on presentation methods and library research are also delivered.

PAKISTAN STUDIES



PS-1xx	Pakistan Studies	3-0
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-  *Muslim Community of Indo-Pakistan Sub-Continent by Dr I H Qureshi, Monton, Netherlands, Moaref, 1977*
-  *A Short History of Pakistan, Book-IV by W Zaman and A Hamid*
-  *Elements of Economics and the Pakistan Economy by Adil, 4, National Book Foundation, Karachi, 1976*

The ideological background of Pakistan, the role of personalities from Mujaddid Alf Sani to Quaid-i-Azam in the Muslim renaissance and educational reforms; political struggle for Pakistan, Independence and its early problems; efforts to establish Islamic order and achievements in constitutional, social and economical fields. Geographical characteristics and people of Pakistan; natural resources, agriculture, industry, commerce and manpower.

MATHEMATICS



MATH-1xx	Elements of Applied Algebra and Calculus-I	4-0
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-  *Integrated Algebra and Trigonometry by Fisher and Zeibur, Prentice Hall, New Jersey, 1972*
-  *Calculus and Analytic Geometry by Thomas, 9th Ed, Addison Wesley, England, 1996*

Complex numbers and De Moivre's theorem determinants, matrices, product, inversion, rank, system of equations and Cramer's rule, synthetic division, remainder and factor theorem, roots of polynomial equations, graphical method and transcendental equations. Limit, continuity and differentiation involving algebraic, trigonometric, hyperbolic, implicit and composite functions; application to rates and small corrections, simple Cartesian, parametric and polar curves; tangent, normal,


maxima and minima, Taylor and Maclaurin series; curvature. Integration as inverse of differentiation, by substitution, by parts and partial fraction; definite integrals (Wallis formula); integral as limit for a sum, area and arc length of plane figures, volumes and surfaces of solids of revolution.

MATH-1xx	Calculus-II and Differential Equations	4-0
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-  *Calculus and Analytic Geometry by Thomas, 9th Ed, Addison Wesley, England, 1996*
 *Advanced Engineering Mathematics by Kreyszig, 8th Ed, John Wiley Singapore, 1999*

Introduction to infinite series integral and P-test, ratio test, comparison test, absolute convergence and simple power series. Analytic solid geometry of planes, lines, solids and curves, Vectors in two and three dimensions, scalar and vector products and differentiation. Introduction to partial differentiation, partial derivatives, physical and geometrical interpretations, chain rule, total differential and small corrections tangent plane normal line, maxima and minima in two variables. Multiple integration, application to area, volume, surface, centroid, moment of inertia theorems. Introduction to differential equations, simple first order differential equations, physical applications and orthogonal trajectories. Ordinary linear differential equations with constant coefficients, complementary, particular and complete solutions method of undetermined coefficients, variation of parameters, Cauchy-Euler Equation power series. Fourier series; periodic, even and odd functions, half range sine and cosine series, complex series; Fourier Integrals.

MATH-2xx	Advanced Engineering Mathematics	4-0
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-  *Advanced Engineering Mathematics by Kreyszig, 8th Ed, John Wiley Singapore, 1999*

Laplace Transformation: Functions, derivatives, integral and basic theorems, inversion by partial fraction and convolution, linear differential equations with constant coefficients, system of equations, unit step and periodic functions. Introduction to partial differential equations, separation of variables, operator methods, wave, heat and Laplace equations with application to boundary value problems. Review of vector algebra; scalar and vector fields, Del-operator, gradient, divergence, curl and Laplacian in Cartesian and orthogonal curvilinear coordinates Gauss and Stokes theorems. Complex Variables: Analytic functions, Cauchy-Riemann equations and harmonic functions; complex integration, Cauchy integral theorem, integral formula, Taylor and Maclaurin series; poles, residues, residue theorem, application to contour and improper integrals.


MATH-2xx	Probability and Statistics	3-0
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 *Introduction to Statistics by Ronald E Walpole, 3rd Ed, Macmillan, 1990*


Representation of statistical data, measures of central tendency, variation, skewness and Kurtosis. Fundamentals of probability, discrete and continuous probability distributions i.e. binomial, Poisson, negative exponential, normal and Weibull; Sampling of mean and standard deviation by normal, Chi-square and F distributions, testing of hypothesis. Linear correlation by moments and by rank experimental verification of laws of statistics and probability.

ISLAMIC STUDIES

IS-1xx	Islamic Studies	3-0
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 *Islamiyat Compulsory: Allama Iqbal Open University Islamabad*

 *Islamic Ideology by Prof Khurshid Ahmad, Shoaba Tasneef Wa Taleef Wa Tarjuma, Karachi University, 1988*

 *Lectures on Islam, Part 1&2 by Prof Abdul Qayyum, NUST Rawalpindi, 1996*

Virtues of the Holy Quran, text and translation of Al-Hujurat and Al-Furqan; Importance of Sunnah, Twenty Selected Ahadith; oneness of Allah, Prophethood, Last Day of Judgment, Prayer, Fasting, Zakat, Pilgrimage, Jihad and its importance in the light of the Quran and Hadith. Life of the Holy Prophet Muhammad (SAW): Life in Makkah and his way of preaching Islam; Life in Madina; Fraternization, Charter of Madina, Conquest of Makkah, the last pilgrimage. Character building, truthfulness, piety, fulfilment of promise, respect of parents and elders, wisdom and foresight; characteristics of Islamic society, honest earning, human dignity, tolerance, broad mindedness, social justice and mutual consultation, Islamic concept of Allah, universe, man, society and state; incentives of rational thinking, contribution of Muslims in the fields of Mathematics, Science and Engineering. Rise and Fall of Muslim Civilization. Pakistan, the Muslim world and renaissance in the modern age.

PROGRAMMING LANGUAGES

MATH-3xx	Fortran Programming and Numerical Methods	1-2
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 **ICL EPC Fortran 77 Reference Manual**

Introduction to digital computers, main components and functions; elements of programming, flow charts, high level languages and Fortran 77; practical training in Fortran programming. Introduction to numerical methods; polynomial, transcendental and linear systems of equations; finite differences, interpolation, curve fitting, differentiation, integration and ordinary differential equations; errors of approximation. Practical training in application to scientific and engineering problems.

SHEME OF STUDIES FOR B.E AVIONICS ENGINEERING

Minimum Credits Hours = 128
 Essential Credit Hours = 110

Subjects	Credit Hours	
	Theory	Laboratory
Electronics	10	2
Energy Conversion/Electro-Mechanical Systems	2	0.5
Electromagnetic	6	0.5
Communications	3	0.5
Computer Systems	6	1.5
Controls	2	0.5
Signals & Systems	2	0.5
Guidance, Navigation & Control	2	0
Microwave Devices	2	0.5
Radar Systems	2	0.5
Antenna Engineering	1	0.5
Engineering Project	0	6
Aviation Technology	2	1
Aerodynamics	3	0.5
Thermodynamics of Propulsion	3	0
Test & Measurement	1	0.5
Engineering Management	3	0
Programming Languages	1	2
Mathematics	15	0
Pakistan Studies	2	0
Islamic Studies	2	0
Engineering Drawing	1	1
Tech Report Writing	2	0
Workshop Technology	0	3
Physics	5	1
Chemistry	3	0.5
Mechanics	5	0
Computer Science	0	1
Sub-total	86	24
Grand total	110	

LIST OF RECOMMENDED COURSES FOR REMAINING 18 CREDIT HOURS

Subjects	Credit Hours	
	Theory	Laboratory
Fundamentals of Artificial Intelligence	3	0.5
Introduction to Robotics	3	0.5
Introduction to Fuzzy/Neuro Systems	3	0.5
Industrial Control Systems – Signal Processing & Conversion	3	0.5
Fundamentals of Digital Signal Processing	3	0.5
Embedded System Design	3	0.5

Communications-II	2	0
Operational Amplifier Circuit Design	2	0.5
Instrumentation System Fundamentals Controls	2	0.5
Microwave Engineering	2	0.5
Advanced Aviation Technology	1	2
Engineering Economy	2	0
Test & Measurement	1	0.5
Production, Planning & Control	2	0.5
Product Design & Development	1	1
Statistical Quality & Control	2	0
English	2	0
Communication Skill	1	0
Office Correspondence/Service Writing	1	0
Ethics/Character Building & Leadership/Individual & Society	3	0
International Relations	1	0
Avionics & Air Operations	1	0
Decision Making & Time Management	1	0
Psychology	3	0
Human Relations	3	0
Computer Science	0	1

DETAIL OF COURSES OF B.E (AVIONICS)

BASIC ELECTRONICS

EENG-1xx	Engineering Circuit Analysis – I	2-1/2
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Text Book:

📖 *Engineering Circuit Analysis by William Hayt & Kemmerly, 5th Ed, McGraw-Hill, NY, 1993*

Reference Books:

📖 *Introduction to Electric Circuits by Richard C Dorf, John Wiley, USA, 1989*

This is the first course in Electrical Engineering and forms the basis of all subsequent courses in Avionics Engineering. The students are introduced to the fundamental quantities and components of electricity. Nodal and Mesh analysis methods are also covered. Basic electricity laws and network theorems i.e. Kirchoff's laws, voltage/current division rules, source transformation, linearity superposition and maximum power transfer theorems are covered for resistive circuits. Theory of Inductors and Capacitors along with their response is also covered. The students also perform laboratory experiments to augment their theoretical knowledge.

EENG-2xx	Engineering Circuit Analysis-II	2-1/2
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Text Book:

📖 *Engineering Circuit Analysis by William H Hayt Jr & Jack E Kemmerly, 5th Ed, McGraw-Hill, NY, 1993*

Reference Book:

📖 *Introduction to Electric Circuits by Richard C Dorf, John Wiley, USA, 1989*

Analysis of linear RLC circuits excited by time-varying voltage and currents are fully covered in this course, supported by several exercise problems and laboratory experiments. Fundamental laws and theorems are applied to obtain differential equations representing RLC circuits, which are further solved to obtain complete response by classical, phasor and Laplace transform techniques. Mutual inductance, Power and resonance are discussed. Phasor diagrams and two-port network theory are also covered.

ELECTRICAL MACHINES

EENG-2xx	Electro-Mechanical Systems	2-1/2
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Text Books:

- 📖 *Electric Machinery Fundamentals* by Stephen J Chapman, 3rd Ed, Mc-Graw-Hill, 1989
- 📖 *Electric Machines: Theory, Operation, Applications, Adjustment, and Control* by Charles I Hubert, Merrill, Prentice Hall New Jersey, 1991

Reference Books:

- 📖 *Circuit Devices and Systems* by Ralph J Smith, 5th Ed, John Wiley, NY, 1992
- 📖 *Direct & Alternating Current Machinery* by Rosenblatt and Friedman, New York City Community College, 1963

This course is designed to give the student an understanding of theory and application of rotating electrical machines and transformers. The topic included are: Principles of electromagnetic energy conversion, introduction and operation of DC motors and their characteristics, commutation and speed control, transformers for single and polyphase circuits. Principle of operation of AC generators and their characteristics, efficiency and losses, construction operation and characteristics of polyphase induction motors, synchronous AC motors & Universal motors. Fault location in machines and selection of machines. The students perform ten laboratory experiments on Universal machines and transformers.

ELECTRONICS

ELECT - 2xx	Electronics-I	3-1/2
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Text Book:

- 📖 *Microelectronic Circuits* by Adel S Sedra & Kenneth C Smith, 4th Ed, Oxford University Press, 1998

This is the first course in electronics and forms part of a sequence of two courses, which together are intended to develop the ability to analyze and design electronic circuits, analogue and digital, discrete and integrated. The prime objective of this course is to provide insight into the analysis and design of electronic circuits. The course begins with some electronic system examples and introduces the idea of a signal as an information container to provide motivation and to place the study of electronic circuits in its proper perspective. During this course not only a qualitative description of the physical operation of on junction diodes, bipolar junction transistors and field effect transistors is given, but many interesting and practical circuit applications of these active devices are also presented. By the end of this course a student would be thoroughly familiar and intimately comfortable with the active

devices covered and would have also learnt about the basic building blocks of electronic circuits.

ELECT-3xx	Electronics – II	3-1/2
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Text Book:

📖 *Microelectronic Circuits by Adel S. Sedra & Kenneth C Smith, 4th Ed, Oxford University Press, 1998*

Reference Book:

📖 *Analysis and Design of Analogue Integrated Circuits by Grey and Meyer, 3rd Ed, John Wiley, NY, 1995*

This is the second course in the sequence of two courses on electronic circuits. The objective of this course is to provide the students an insight into analysis and design of the electronic circuits that find extensive application in such fields as computers, control systems, digital instrumentation, communications, radar etc. This course is devoted to the study of analogue circuits emphasizing amplifiers. The course begins with differential amplifiers, in both its bipolar and FET forms followed by various output stages. Frequency response of amplifiers, feedback analysis with focus on practical circuit applications of negative feedback and stability problems in feedback amplifiers are also presented. This course also introduces both bipolar and MOS analogue integrated circuits. Design of filters, tuned amplifiers, and oscillators are also covered in this course.

ELECTROMAGNETICS

COMM-2xx	Electro-Magnetic Field Theory	3-0
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Text Book:

📖 *Elements of Electromagnetics by Matthew N O Sadiku, 2nd Edition, Oxford University Press, 1995*

Reference Books:

📖 *Field and Wave Electromagnetic, David K. Cheng, 2nd Edition, Addison Wesley, USA, 1989*

📖 *Engineering Electromagnetics by William H Hayt, 5th Edition, McGraw-Hill, NY 1989*

📖 *Electronic Communication Systems by George Kennedy, 4th Edition, Macmillan, NY 1993*

📖 *Electromagnetic Waves and Radiating Systems by Jerdan, E C, Prentice Hall, 1968*

This is the first course in Electromagnetics (EM), which covers the fundamentals of EM fields. The course has been designed to provide students with a secure and

sufficient background for understanding and analyzing electromagnetic phenomena, as well as prepare them for more advanced subjects in EM theory. The course has been divided into three parts. In Part-I, vector algebra, coordinate systems, and transformations, and vector calculus has been reviewed. The second part deals with the electrostatics covering static electric fields, electric fields in material spaces, and electrostatics boundary value problems. Part-III covers steady magnetic field (magnostatics), magnetic forces, materials, devices. The application of the Maxwell's equations to wave propagation, transmission lines, wave guides and antennas are covered in later courses on electromagnetics.

COMM-3xx	Transmission Lines & Waveguides	3-1/2
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Text Book:

📖 *Elements of Electromagnetics by Matthew N O Sadiku, 2nd Ed, Oxford University Press, 1995*

Reference Books:

📖 *Field and Wave Electromagnetic, David K Cheng, 2nd Ed, Addison Wesley, USA, 1989*

📖 *Engineering Electromagnetics by William H Hayt, 5th Ed, McGraw-Hill, NY 1989*

📖 *Electronic Communication Systems by George Kennedy, 4th Ed, Macmillan, NY 1993*


📖 *Electromagnetic Waves and Radiating Systems by Jerdan, E C, Prentice Hall, 1968*

This is the second course in Electromagnetics. The course provides background for understanding and analyzing electromagnetic phenomena, as well as prepares the student for advanced subjects on Microwave Devices and Antenna Engineering. The course has been divided into four parts. In Part-I, a comprehensive coverage of Maxwell's Equations is included leading to time-harmonic fields, thus preparing the foundation for the next part i.e. EM Wave Propagation. Part-II deals with the EM Wave Propagation covering the basic concept of waves in general leading to plane waves in free space, good conductors, and loss as well as lossless dielectric. Poynting Theorem followed by the reflection and refraction of waves is also covered in Part-II. Part-III covers transmission lines, Smith Chart and some applications of the transmission lines. In Part-IV, fundamentals of waveguides are covered leading to modes of propagation, power transmission & attenuation and the modes of excitation of a waveguide.


ANTENNA ENGINEERING

COMM-3xx	Antenna Engineering	1-1/2
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Text Book:

 *Antenna Theory Analysis and Design* by C A Balanis, John Wiley & Sons, 2nd Ed, New York, 1997

Reference Book:


 *Fields and Waves Electromagnetics* by David K Cheng, 2nd Ed, Addison Wesley, USA, 1989

The course of Antenna Engineering is designed to meet the need of Avionics Engineering at the undergraduate level. The course presumes that the students have the knowledge of basic electromagnetic theory, Maxwell's equations, the wave equation and calculus. The main objective of the course is to introduce, in a unified manner, the fundamental principles of antenna theory and to apply them to the antenna analysis and measurement. The course begins with the physical principle of radiation mechanism which is followed by the study of the radiation properties of a wire antenna. To illustrate the applications of fundamental theory, the course includes the study of different types of antenna, these are: linear wire antenna, loop antenna, arrays and reflector antennas. The antenna measurement techniques are also discussed in the course.


COMPUTER SYSTEMS

DGTL- 3xx	Digital System-I	3-1/2
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Text Book:

 Digital Design 3rd Ed, by Morris Mano. This title is re-named as Logic & Computer Design Fundamentals, 2nd Ed, Pearson Education NJ/Singapore, 2001

Reference Book:

 *Introduction to Switching Theory and Logic Design* by Hill and Patterson, John Wiley, 1968

This course explores and imparts the knowledge about the fundamental concepts of digital systems fundamentals through course work and corresponding laboratory exercises. The course introduces basic principles and design concepts from representation and digital logic to computer organization. The hands-on laboratory exercises comprise of both hardware and software based problems. Verilog Hardware Description Language (VHDL) is used to demonstrate the concepts of digital systems design at a suitable level for beginning students who are learning circuits for the first time.

DGTL-3xx	Digital Systems-II	3-0
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Text Books:

- 📖 *The Intel Microprocessors, 8086/8088/80186, 80386, 80486 Architecture, Programming and Interfacing* by Barry B Bray, 3rd Ed, Merrill/Macmillan, New York, 1994
- 📖 *The 8051 Microcontroller* by L Scott Mackenzie, 1st Ed, Macmillan, USA, 1992

Reference Books:

- 📖 *Microprocessors, Principles and Applications* by Charles M Gilmore, McGraw-Hill, 1995
- 📖 *Micro and Interfacing, Programming and Hardware* by Douglas V Hall, 2nd Ed, McGraw-Hill, 1992
- 📖 *A Product-Development Laboratory Process*, Maxwell-Macmillan, 1992

This course is intended to impart basic knowledge about the fundamental concepts of Microprocessor and Microcontroller based systems. The course has two distinct subdivisions. The first subdivision pertains to the microprocessor fundamentals, which include description of functioning, internal architecture, and microprocessor based system design techniques. The second subdivision deals with microcontroller fundamentals. This subdivision is intended to impart the knowledge about highlighting the differences and similarities between a microprocessor and a Microcontroller, introducing the compact architecture of a Microcontroller and its potential applications, and system design based on Microcontroller. Hands-on hardware and software experiments supplement the concepts of Microprocessor and Microcontroller.

DGTL-3xx	Digital Systems-II Laboratory	0-1
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Text Book:

- 📖 *Assembly Language for The IBM-PC*, Macmillan, 1990 by Kip R Irvin, Macmillan, NY 1997

Reference Books:


- 📖 *Assembly Language Primer* by Robert Lafore, Plume/Waite, 1984
- 📖 *Programming and Interfacing the 8086/8088 Microprocessor, A Product-Development Laboratory Process* by Roy goody, Maxwell-Macmillan, 1992.

This course is intended to enhance the theoretical knowledge gained by the students during the course work in the digital systems design through the use of the hardware and software based laboratory experiments. The main tools that are used in this course include specialized digital semiconductors ICs for hardware design and assembly language based software tools for software related experiments.


SIGNALS AND SYSTEMS

SYS- 3xx	Signals and Systems	2-1/2
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Text Book:

 *Introduction to Signals & Systems by Oppenheim, 1st Ed, Prentice Hall, NY 1997*

Reference Book:


 *Signals and Systems: An Introduction by Leslie Balmer, Prentice Hall, NY 1991*

SYS-321 is intended to provide the fundamentals of signals and systems. After introduction of signals and systems, the students are familiarized with signal representation and basic system properties. Then LTI systems, both continuous time (CT) and discrete time (DT) are studied, in which convolution sum/integral, causality and stability are addressed. Fourier Series (FS), Fourier Transform (FT), Laplace Transform (LT) and Z-Transform are also discussed towards the end of the course. The students are familiarized with sampling, filters and Amplitude Modulation (AM) as well.


CONTROLS


CONT-3xx	Modern Control Systems	2-1/2
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Text Book:

 *Feedback Control Systems by Phillips and Harbor, 3rd Ed, Prentice Hall, NY 1993*

Reference Books:

 *Modern Control Systems by Richard C Dorf, 8th Ed, Addison Wesley, California, 1998*

 *User's Guide for The Student Edition of MATLAB by Duane Hanselman & Bruce Littlefield, Prentice Hall, NJ, 1997*

This course is aimed to build a comprehensive foundation in the analysis and design of control systems using classical and modern techniques. The course covers system modelling, system responses, control system characteristics, stability analysis, root-locus analysis and design, frequency response analysis and design, modern control design. The lab content for the course includes control systems analysis and design on digital computers using Programme CC and Matlab softwares.

CONT-3xx	Guidance Navigation & Control	2-0
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Text Book:

📖 *Avionics Navigation Systems 2nd Ed, by Myron Kayton*

This course presents an advanced coverage of navigation technology used by moving platforms to navigate around the globe. The student is introduced to navigation requirements, avionics architecture, navigation equations and system errors. Multi-sensor fusion incorporating inertial, GPS, Doppler, stellar and baro inputs is presented with practical considerations. The course covers in detail radio, air data and inertial navigation systems along with their applications in civil and military environments.

COMMUNICATION

COMM-3xx	Communication Systems	3-1
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Text Book:

📖 *Modern Digital and Analogue Communication Systems, 3rd Ed, by B P Lathi, Hart Rinehart & Winston, NY 1997*

Reference Books:

- 📖 *Introduction to Communication System by Ferral G Stremmer, 2nd Ed, Addison Wesley, 1982*
- 📖 *Analogue and Distal Communication Systems by Martin S Roden, 3rd Ed, Prentice Hall, NY 1991*
- 📖 *Principles of Communication Systems by Herbert Taub and Donald L Schilling, 2nd Ed, McGraw-Hill, NY 1987*
- 📖 *Communication System by Simon Hyakin, 2nd Ed, John Wiley, NY 1983*

This course familiarizes the students with the principles of communication systems and consists of two portions: Analogue and Digital Communications. In the analogue communication portion various techniques of modulation and demodulation of analogue signals are discussed. Signal-to-noise-ratio (SNR) in analogue AM and FM systems are also covered. The second portion deals with digital transmission methods for analogue signals. Discrete pulse and carrier wave modulation schemes are also discussed. Bit error rate performances of various digital communication systems are also included. Finally, a brief introduction to the relatively new concept of fibre optic communication is also included.

COMM-3xx	Data Communication & Networks	2-0
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Text Books:

📖 *Data and Computer Communications, 5th Ed, by William Stallings, Prentice Hall, NY 1977*

📖 *Computer Networks, 2nd Ed by Larry Peterson and Bruce Davie*

This course is to provide a unified overview of the broad field of data and computer communications. The course emphasizes on the basic principles and topics of fundamental importance concerning the technology and architecture of the field of data and computer communications. In essence, this course deals with data communication over a transmission link, wide area networks, local area networks and protocol architecture.

MICROWAVE DEVICES

RADAR-3xx	Microwave Devices	2-1/2
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Text Book:

📖 *Microwave Devices & Circuits by Samuel Y Liao, 3rd Ed, Prentice Hall, NY 1990*

Reference Book:

📖 *Electronic Communication Systems by George Kennedy. 4th Ed, McGraw-Hill, Singapore, 1993*

This course introduces the student to microwaves devices as applicable to radar and Communication systems. A study of passive and active microwave devices is carried out. Klystron, Magnetron, TWT and Twystrons are discussed as Microwave Oscillators and amplifiers. Microwave solid-state devices make a significant portion of the course.

RADAR

RADAR-4xx	Radar System Engineering	2-1/2
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Text Book:

📖 *Introduction to Radar System, 2nd Ed, by M I Skolnik, McGraw-Hill, London, 1980*

Reference Book:

📖 *Understanding Radar Systems by Simon Kigsley and Shaun Quegan, McGraw Hill, Singapore, 1992*

The purpose of this course is to provide through understanding of the fundamental of radar at graduate level. This course introduces the techniques, which have been extensively used in modern radar systems. It is a system-oriented course; hence it integrates and applies the basic concepts found in other Avionics Engineering courses.

The course is divided into four parts. The first part forms an easy guide to the basic of what radar is all about, and what it can do. It includes the understanding of basic radar equation and important factors, which influence range performance of a pulse radar. The basic concepts of probability are used to analyse the performance of any radar. The second part includes the principle and applications of CW and FMCW radar. It also covers the basic concept of analogue and digital MTI and pulse Doppler radar. The third part of the course deals with the understanding of various tracking techniques. The last part of the course is about principles and applications of 3-D and phased array radars.

ENGINEERING PROJECT

AV-4xx	Engineering Project	0-4
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Students are required to complete an engineering project based upon the knowledge they have gained during BE studies.

AEROSPACE TECHNOLOGY

AE-2xx	Aerospace Technology	2-1
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This is an introductory course of Aerospace Technology aimed at giving practical understanding of aircraft and its systems to the engineering students. It encompasses the aspects of flight controls, aircraft construction, principles of jet reaction, flight instruments, electrical systems and armament.

Flight control studies deal with aerodynamics and aircraft control surfaces. Aircraft construction includes basic structure of aircraft, landing gears, hydraulic, pneumatic and fuel systems and also the maintenance inspections. The topic ‘principle of jet reaction’ includes thrust and power, factors effecting thrust, compressors and jet propulsion devices. The study of aircraft instruments includes flight, engine auxiliary instruments. The electrical system deals with power supply, power generation and electrical components. Armament systems study deals with aircraft ejection systems, fundamentals of bombs and firearms, principal and construction of ammunition and explosives. In addition to the text, a few videos and visits of aircraft maintenance facilities are included to help understanding course contents.

AERODYNAMICS

AERO – 2xx	Applied Aerodynamics	3-1/2
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Text Book:

📖 *Introduction to Flight by J D Anderson, Jr, 4th Ed, McGraw-Hill Singapore, 2000*

Reference Books:

📖 *Gas Dynamics by E A Johan, Allyn & Bacon, 1969*

📖 *Fundamental of Aerodynamics by J D Anderson, Jr (3rd Ed), McGraw-Hill, NY, 1988*

📖 *Aircraft Performance, Stability and Control Vol-I by James D Lang, USAF Academy, Dept of Aeronautics, 1974*

To introduce the senior avionics engineering students to the aerospace subject of aerodynamics. The course is divided into four parts. The first part deals with the basic hydrostatic equation and the understanding of standard atmosphere. The second part deals with fluid flow, both incompressible and compressible. It includes Continuity/Momentum/Energy equations; low and high-speed wind tunnel, high lift devices and brief description to transonic aerodynamics. The third part deals with the evaluation of aircraft performance which includes rate of climb, gliding flight, absolute ceiling, range, endurance and take off performance. The last part gives an introduction to aircraft stability, which includes longitudinal static stability, neutral point, static margin and moments of the airplane.

MECHANICS

MECH – 1xx	Engineering Statics	2-0
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Text Book:

📖 *Engineering Mechanics by J L Meriam, 4th Ed, John Wiley, NY, 1998*

Reference Books:

📖 *Engineering Mechanics by Irving Shames, Dynamics, 4th Ed, Prentice Hall, NJ 1997*

📖 *Engineering Mechanics by Irving Shames, Statics, 4th Ed, Prentice Hall, NJ 1997*

This is the first course in Mechanics, which covers the general principles of statics and the equilibrium of bodies under the action of forces. In chapter 2, the properties of forces, moments, couples and resultants are developed. In both Chapter 2 and 3, analyses of two dimensional problems are treated. Chapter 4 deals with the application of equilibrium principles to simple trusses and to frames and machines. Chapter 5 includes the special topics of beams and fluid statics. Chapter 6 is concerted with friction and selected machines application.

MECH – 2xx	Engineering Dynamics	2-1/2
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Text Book:

📖 *Engineering Mechanics (Dynamics) by J L Meriem and L G Kraige (SI Version 4th Ed) John Wiley, NY 1998*

Reference Books:

📖 *Engineering Mechanics (Dynamics) by R C Hibbeler. 6th, Macmillan, NY 1992*
 📖 *Engineering Mechanics by Higdon and Stiles. Prentice Hall, 1968*

The primary purpose of this course is to help the students develop the ability to visualize physical configurations in terms of real materials, actual constraints and practical limitations that govern the behaviour of machines and structures. The course has been divided into four parts. The first part (Kinematics of particles) deals with a number of ways in which the motion of a particle is generated. Part two (Kinetics of Particles) is concerned with the three basic methods, force-mass-acceleration, work-relative velocity and relative acceleration are encountered; emphasis is placed jointly on solution by vector geometry and solution by vector algebra. Part four (Kinetics of Rigid Bodie) covers the basic equations, which govern all categories of plane motion.

THERMODYNAMICS

ME- 2xx	Thermodynamics of Propulsion	3-0
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Text Book:

📖 *Engineering Thermodynamics, An Introductory Textbook by J B Jones/G A Hawkins, 2nd Ed, John Wiley & Sons Inc, 1986*

Reference Books:


📖 *Thermodynamics by Kenneth Wark, 6th Ed, McGraw-Hill, Singapore, 1999*
 📖 *Applied Thermodynamics by T D Estop/McMonkey, 5th Ed, Pearson, Delhi 1993*

It provides the students with essential background and competence for know how and analysis on Fundamental concepts, Zeroth Law, First law of thermodynamics and its applications. Concepts of reversible and irreversible processes and cycles. Entropy and its uses. Study of subject course is pre requisite for more advance courses on Engineering Thermodynamics and propulsion etc.

ENGINEERING DRAWING

DWG-1xx	Engineering Drawing	1-1
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Text Book:

 *Fundamentals of Engineering Drawing by French and Vierck. 4th Ed, McGraw-Hill, NY*

This course consists of a series of lectures and classroom exercises designed at familiarizing the students with the basic concepts of engineering drawing. It includes a brief account of the various types of drawings with main emphasis on Orthographic drawings, which are the most widely used mode of technical communication. It includes detailed exercises on graphical geometry and then continuous with progressive practice in making and understanding various types of Orthographic drawings. The topics covered include principle views auxiliary views and sectional views.



ENGINEERING MANAGEMENT

IE-2xx	Production Planning and Control	3-0
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Text Book:

 *Operations Management by James B Dilworth, 2nd Ed, McGraw-Hill, 1986*

Reference Books:

 *Electronics Communication Systems by G Kennedy, 4th Ed, McGraw-Hill, 1993*
 *Aircraft, Electricity & Electronics by Thomas K Eismen, 5th Ed, McGraw-Hill, 1994*

This course presents some of the basic principles of production planning and indicates the way it is interrelated with other functions in the framework of production management. In this course, students are familiarized with the functions of production planning and control with an overview of different types of manufacturing systems. Factors affiliated with different fields of production including product characteristics and economic analysis is covered. Methods of sales forecasting, types of plant layout and procedure generally followed for evaluation of materials and processes are discussed. Advantages due to different types of scheduling of jobs on processors and methods employed are discussed. Finally, types of information systems are summarized describing the benefits gained due to it, at different management levels. Some advanced topics may also be included in this course. Few educational videos may be shown. Cadets submit a PPC Project report.

MEASUREMENT/INSTRUMENTATION

IE-2xx	Test & Measurement	1-1/2
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Text Book:

- 📖 Mechanical Measurements by Thomas G Beckwith, Roy D Marangoni & John H Lienhard V 5th Ed, Addison Wesley, 1993

Measurement and correct interpretation there of are necessary parts of any engineering research and development programme. Naturally, the measurements must supply reliable information and their meanings must be correctly comprehended and interpreted. This course is meant for student engineers how to deal with various types of test and measurement equipment at various stages of their life. It includes topics related to process of measurement standards and dimensional units of measurement, sensors, counters, displacement and dimensional measurements, and stress & strain measurement analysis, fluid flow measurement, temperature measurement and motion measurement. Experimental portion includes use of measuring instruments like autocollimator, screw pitch measuring machine, tolerance, horizontal metro scope, interference microscope, interferometer, surface roundness testing machine and Mechanical & Electronic comparators.

WORKSHOP TECHNOLOGY

IE-1xx	Workshop Technology – I	0-1
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Text Books:

- 📖 *Introduction to Technology of Machine Tools* by S F Krar & W Oswald. 4th Ed, McGraw-Hill, 1991
- 📖 *Modern Welding* by Althouse, Turnquist & Bowditch, Good Heart Wilcox, Holland, 1976

Reference Books:

- 📖 *Machine Shop Training* by S F Krar & St Amand, McGraw-Hill, 1977
- 📖 *General Shop Metal Work* by Dragoo & Reed, McKnight, 1947

This is the first course in Industrial Engineering Department. This Workshop Technology-I is part of the sequence of two courses which together cover the field of measuring, layout, and cutting tools. Also in practical class they will do practical exercises in wood shop, metal shop and riveting shop. Besides, drill press, its use and different operations, are covered in this course. Finally, the students will study different types of welding and they will be given welding practice in the welding shops. About 19 Lab classes are reserved for the practical training in the above shops.

IE-1xx	Workshop Technology – II	0-2
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Text Book:

📖 *Technology of Machine Tools by S F Krar 3rd & 4th Ed, McGraw-Hill, 1998*

Reference Books:

📖 *Machine Shop by Wagener and Arthur, Nestrland, 1950*

This is the second course in Workshop technology. This course is mainly concerned with use and applications of machine tools in manufacturing engineering. The Objective of this course is to familiarize the students thoroughly with the working capabilities and construction of main machine tools. The most common machine tools in this course are the Lathe machine, Shaper machine and Milling machine. The computer age machining techniques are also taught in this course. The idea of CAD/CAM on CNC milling machine is explained in this subject. Proper selection of cutting speeds, feeds and depth of cut on all these machines is taught to the students. Moreover, the calculation of various cutting speeds on different materials is also taught to the students. Tool's signature for various operations is also covered in this course. Projects are made on these machine tools to get the expertise in handling these machine tools. About 18 long periods (Lab periods) are reserved for these projects.

PHYSICS

PHYS-1xx	Engineering Physics–I	2-1/2
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Text Book:

📖 *University Physics by Sears & Zemansky, 4th Ed, Addison Wesley, London, 1973*

This is the first course on physics mainly concerned with dimensional analysis, experimental errors; force and torque, general conditions of equilibrium work, energy and power angular motion and moment of inertia. Electric field intensity, current and resistance; kirchhoff's laws for electrical circuits, electromagnetism, thermoelectricity are also covered in this course. Simple Harmonic Motion (SHM), composition of SHM, Damped SHM, Lissajous figures, beats, doppler effect, loudness and intensity and fundamental concepts in geometrical optics, wave theories of light, dual nature of radiation and matter, interference, diffraction, polarization, double refraction and its application to optical stress analysis also form part of this course.

PHYS-1xx	Engineering Physics – II	3-1/2
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Text Books:

- 📖 *University Physics by Sears & Zemansky, 4th Ed, Addison Wesley, London, 1973*
- 📖 *Perspectives of Modern Physics by A Beiser, McGraw-Hill, 1987*
- 📖 *Solid State Electronic Devices by Ben G Streetman, 4th Ed, 4th Ed, McGraw-Hill, 1995*

Reference Book:

- 📖 *Introduction to Semi-Conductor Physics by Adler, Smith & Longini, John Wiley, 1964*

The objective of this course is to cover special theory of relativity, relativistic mechanics, Rutherford & Boh'r theories of atom, Schrodinger equation and applications of quantum mechanics. Classical and quantum mechanical models of electron, crystal properties and structure and band models are also introduced in this course. To provide pre-requisite knowledge for the later courses, electrons and holes in semiconductors, doped semiconductors, temperature effects in semiconductors, methods of fabrication of PN junctions and contact potentials at PN junction are also covered. Later part of the course addresses the Zener breakdown and avalanche effect, fundamentals of BJT, lasers and semiconductor materials.

CHEMISTRY

CHEM-1xx	Chemistry	3-1/2
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Text Book:

- 📖 *Chemistry by Sienko and Plane, 5th Ed., McGraw-Hill, 1976*
- 📖 *Physical Chemistry by Danial, 2nd Ed, John Wiley, NY*

This course covers thermo-chemistry, chemical equilibrium, ionic equilibria & solubility product; Electro-chemistry; light metals: Beryllium, Aluminium, and Magnesium & Titanium. Heavy metals: Copper, Iron and Steel, Corrosion, nuclear chemistry, and polymers.

TECHNICAL REPORT WRITING

ENGL-2xx	Technical Report Writing	2-0
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The course is meant for 3rd Semester students. It includes lectures on Technical Report Writing and methods of effective writing. It also consists of an exercise by cadets on technical report writing and its evaluation by instructor. Additional lectures on presentation methods and library research are also delivered.

PAKISTAN STUDIES

PS-1xx	Pakistan Studies	2-0
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Text Books:

- 📖 *Muslim Community of Indo-Pakistan Sub-Continent* by Dr I H Qureshi, Monton, Netherlands, Maaref, 1977
- 📖 *A Short History of Pakistan, Book-IV* by W Zaman and A Hamid
- 📖 *Elements of Economics and the Pakistan Economy* by A. Adil, National Book Foundation, Karachi, 1976

The ideological background of Pakistan, the role of personalities from Mujaddid Alf Sani to Quaid-i-Azam in the Muslim renaissance and educational reforms; political struggle for Pakistan, Independence and its early problems; efforts to establish Islamic order and achievements in constitutional, social and economical fields. Geographical characteristics and people of Pakistan; natural resources, agriculture, industry, commerce and manpower.

MATHEMATICS

MATH-1xx	Elements of Applied Algebra and Calculus-I	4-0
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Text Books:

- 📖 *Integrated Algebra and Trigonometry* by Fisher and Zeibur, 1st Ed, Prentice Hall, New Jersey, 1972
- 📖 *Calculus and Analytic Geometry* by Thomas, 9th Ed, Addison Wesley, England, 1996

Complex numbers and De Moivre's theorem determinants, matrices, product, inversion, rank, system of equations and Cramer's rule, synthetic division, remainder and factor theorem, roots of polynomial equations, graphical method and transcendental equations. Limit, continuity and differentiation involving algebraic, trigonometric, hyperbolic, implicit and composite functions; application to rates and small corrections, simple Cartesian, parametric and polar curves; tangent, normal, maxima and minima, Taylor and Maclaurin series; curvature. Integration as inverse of differentiation, by substitution, by parts and partial fraction; definite integrals (Wallis formula); integral as limit for a sum, area and arc length of plane figures, volumes and surfaces of solids of revolution.

MATH-1xx	Calculus-II and Differential Equations	4-0
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Text Books:

- 📖 *Calculus and Analytic Geometry* by Thomas, 1st Ed, Prentice Hall, New Jersey, 1972
- 📖 *Advanced Engineering Mathematics* by Kreyszig, 8th Ed, John Wiley, Singapore, 1999

Introduction to infinite series integral and P-test, ratio test, comparison test, absolute convergence and simple power series. Analytic solid geometry of planes, lines, solids and curves, Vectors in two and three dimensions, scalar and vector products and differentiation. Introduction to partial differentiation, partial derivatives, physical and geometrical interpretations, chain rule, total differential and small corrections tangent plane normal line, maxima and minima in two variables. Multiple integration, application to area, volume, surface, centroid, moment of inertia and Pappus theorems. Introduction to differential equations, simple first order differential equations, physical applications and orthogonal trajectories. Ordinary linear differential equations with constant coefficients, complementary, particular and complete solutions method of undetermined coefficients, variation of parameters, Cauchy-Euler Equation power series. Fourier series; periodic, even and odd functions, half range sine and cosine series, complex series; Fourier Integrals.

MATH-2xx	Advanced Engineering Mathematics	4-0
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Text Book:

 *Advanced Engineering Mathematics by Kreyszig, 8th Ed, John Wiley, Singapore, 1999*

Laplace Transformation: Functions, derivatives, integral and basic theorems, inversion by partial fraction and convolution, linear differential equations with constant coefficients, system of equations, unit step and periodic functions. Introduction to partial differential equations, separation of variables, operator methods, wave, heat and Laplace equations with application to boundary value problems. Review of vector algebra; scalar and vector fields, Del-operator, gradient, divergence, curl and Laplacian in Cartesian and orthogonal curvilinear coordinates Gauss and Stokes theorems. Complex Variables: Analytic functions, Cauchy-Riemann equations and harmonic functions; complex integration, Cauchy integral theorem, integral formula, Taylor and Maclaurin series; poles, residues, residue theorem, application to contour and improper integrals.

MATH-2xx	Probability and Statistics	3-0
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Text Book:

 *Introduction to Statistics by Ronald E Walpole, 3rd Ed, Macmillan, NY 1990*

Representation of statistical data, measures of central tendency, variation, skewness and Kurtosis. Fundamentals of probability, discrete and continuous probability distributions i.e. binomial, Poisson, negative exponential, normal and Weibull; Sampling of mean and standard deviation by normal, Chi-square and F distributions, testing of hypothesis. Linear correlation by moments and by rank experimental verification of laws of statistics and probability.

ISLAMIC STUDIES

IS-1xx	Islamic Studies	2-0
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Text Books:

📖 *Islamiyat Compulsory: Allama Iqbal Open University Islamabad*

❖ *Lectures on Islam Part I & II by Prof Abdul Qayyum, NUST, Rawalpindi, 1996*

Virtues of the Holy Quran, text and translation of Al-Hujurat and Al-Furqan; Importance of Sunnah, Twenty Selected Ahadith; oneness of Allah, Prophethood, Last Day of judgment, Prayer, Fasting, Zakat, Pilgrimage, Jihad and its importance in the light of the Quran and Hadith. Life of the Holy Prophet Muhammad (SAW): Life in Makkah and his way of preaching Islam; Life in Madina; Fraternization, Charter of Madina, Conquest of Makkah, the last pilgrimage. Character building, truthfulness, piety, fulfilment of promise, respect of parents and elders, wisdom and foresight; characteristics of Islamic society, honest earning, human dignity, tolerance, broad mindedness, social justice and mutual consultation, Islamic concept of Allah, universe, man, society and state; incentives of rational thinking, contribution of Muslims in the fields of Mathematics, Science and Engineering. Rise and Fall of Muslim civilization. Pakistan, the Muslim World and renaissance in the modern age.

PROGRAMMING LANGUAGES

MATH-3xx	C Programming and Numerical Methods	1-2
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Text Books:

📖 *The Waite Group's C Programming using Turbo C by Robert Lafore, 2nd Ed, Waite Granges, ND, 1993*

Introduction to digital computers, main components and functions; elements of programming, flow charts, high level languages and Fortran 77; practical training in Fortran programming. Introduction to numerical methods; polynomial, transcendental and linear systems of equations; finite differences, interpolation, curve fitting, differentiation, integration and ordinary differential equations; errors of approximation. Practical training in application to scientific and engineering problems.

SCHEME OF STUDIES FOR M.S (AEROSPACE ENGINEERING)

Minimum Credits Hours	=	30
Essential Credit Hours	=	21

Breakdown of 21

Subjects	Credit Hours
Aerodynamics Major:	
Mathematics	3
Aerodynamics related subjects	12
Thesis	6
Structures Major:	
Mathematics	3
Structures related subjects	12
Thesis	6
Propulsion Major:	
Mathematics	3
Propulsion related subjects	12
Thesis	6
Guidance & Control Major:	
Mathematics	3
Guidance & Control related subjects	12
Thesis	6
Respective Major Total	21

DETAIL OF COURSES FOR M.S (AEROSPACE ENGINEERING)

AERODYNAMICS

AE-5xx	Advanced Aerodynamics-I: Incompressible Flows	3-0
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📖 *Incompressible Flow 2nd Ed, by Panton, John Wiley, NY, 1996*

📖 *Viscous Flow 2nd Ed, by White, McGraw-Hill, NY, 1974*

This graduate level course is first in the sequence of two advanced aerodynamics courses. The main focus of this course is on incompressible flows. Incompressible flows form a major part of aerodynamics and their analysis is broadly classified under “inviscid” and “viscous” flows. In viscous incompressible flows, further subdivisions are made on the basis of flow Reynolds number (Re) i.e. Laminar boundary layer (High Re), Stokes flow (low Re) and turbulent flow (Very high Re). The basic governing equations of fluid/aerodynamics i.e. Navier Stokes equations are introduced and their various analytical solution techniques are explained in detail. Two-dimensional incompressible and inviscid flows are solved using complex analysis treatment.

AE-5xx	Advanced Aerodynamics-II: Compressible Flows	3-0
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📖 *Modern Compressible Flow 2nd Ed, by Anderson, McGraw-Hill, Singapore, 1990*

📖 *Viscous Flow 2nd Ed, by White, McGraw-Hill, NY, 1974*

This graduate level course is second in the sequence of two advanced aerodynamics courses. The main focus of this course is on compressible flow. Compressible flows form a major part of aerodynamics and their analysis is broadly classified under “inviscid” and “viscous” flows. Inviscid compressible flows include analysis of properties across shocks/expansion waves, variable area flows, linearized 2-D flow, part of hypersonic flow and unsteady wave motion. Viscous compressible flows involve solution of the complete system of governing equations including Navier-Stokes equations. Various examples of viscous compressible flow are illustrated

AE-5xx	Computational Fluid Fluidynamics-1	3-0
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📖 *Computational Fluid Mechanics and Heat Transfer by Anderson, Tanehill, & Pletcher, Hemisphere Pub, NY 1984*

This is the first course in Computational Fluid Dynamics (CFD). This includes introduction to finite difference and finite volume methods used in modern engineering. Basic concepts of discretization, consistency and stability are also introduced. Applications of numerical methods to selected model partial differential equations are carried out.

AE-5xx	Advanced Heat Transfer	3-0
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- 📖 *Heat Conduction by Ozisik*
- 📖 *Convective Heat Transfer 2nd Ed, by Cebeci Tuncer, Springer Germany, 2002*
- 📖 *Thermal Radiation Heat Transfer 2nd Ed, by Siegel & Howell, McGraw-Hill, 1972*

This graduate level course in heat transfer is designed to cover material beyond the undergraduate level. Different modes of heat transfer, i.e. Conduction, Convection and Radiation are broadly discussed. The main focus of this course is on Conduction and Convection with some introductory material on Radiation towards the end of the course. In Conduction 2-D steady and 1-D unsteady problems are introduced and their solution methods discussed. In Convection the equations of motion, energy and mass conservation are reviewed and problems involving forced and free convection are discussed with reference to various flow regimes.

STRUCTURES

AE-5xx	Theory of Elasticity	3-0
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- 📖 *Theory of Elasticity by Timoshenko & Goodier, 3rd Ed, McGraw-Hill, 1970, NY*

This is the first course in Structures, which in its broad aspect deals with the study of elastic bodies. When the elementary methods of strength of materials are inadequate to furnish satisfactory information regarding stress distribution in engineering structures, then a resort is made to the more powerful methods of theory of elasticity. Basic equations of the theory of elasticity in different co-ordinate system, solution to plane stress and plane strain problems, Fourier transformation method and St. Venant's principle is also introduced in the course. Solution to plates of various profiles and end conditions along with the most commonly used numerical energy methods are explained to strengthen the concepts of student to undertake the advanced courses in structures in the future semesters.

AE-5xx	Advanced Theory of Vibrations	3-0
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- 📖 *Mechanical Vibrations by Singiresu S Rao, 3rd Ed, Addison-Wesley, Massachusetts, 1995*

The purpose of this course is to cover comprehensive fundamental principles of vibration theory. It begins with an introduction to some basic concepts, discussion about spring, mass and damper elements, and introduction to harmonic motion and its analysis. The course then covers Free and Forced vibration of single degree of freedom (SDOF) system, damped and un-damped system. After thoroughly covering SDOF system two and multi-degrees of freedom system are covered. Special additional topics are covered at the end of the course.

AE-5xx	Finite Element Methods-I	3-0
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📖 *An Introduction to the Finite Element Method* by J N Reddy, 2nd Ed, McGraw-Hill, NY, 1993

The course provides an introduction to the Finite Element Method as applied to one & two-dimensional problems of structures, heat transfer & fluid flow. One-dimensional and two-dimensional, static & dynamic problems are solved by using FEM.

AE-5xx	Mechanics of Composite Materials	3-0
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📖 *Analysis and Performance of Fibre Composites*, by Agarwal and Broutman, 2nd Ed, John Wiley, NY, 1980

The objective of this course is to introduce composite materials to graduate students. It begins with an introduction to the composite material and their constituents. The course then covers unidirectional composites, in which various mechanical properties are of unidirectional composite are discussed. The course then covers behaviour of laminated composite plates under various loading conditions; in that classical lamination theory is used. Special additional topics are covered at the end of the course.

AERODYNAMICS & PROPULSION

AE-5xx	Advanced Aerodynamics-I: Incompressible Flows	3-0
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📖 *Modern Compressible Flow* 2nd Ed. by Anderson, McGraw-Hill, Singapore, 1990
 📖 *Viscous Flow* 2nd Ed, by White, McGraw-Hill, NY, 1974

This graduate level course is first in the sequence of two advanced aerodynamics courses. The main focus of this course is on incompressible flows. Incompressible flows form a major part of aerodynamics and their analysis is broadly classified under “inviscid” and “viscous” flows. In viscous incompressible flows, further subdivisions are made on the basis of flow Reynolds number (Re) i.e. Laminar boundary layer (High Re), Stokes flow (low Re) and turbulent flow (Very high Re). The basic governing equations of fluid/aerodynamics i.e. Navier Stokes equations are introduced and their various analytical solution techniques are explained in detail. Two-dimensional incompressible and inviscid flows are solved using complex analysis treatment.

AE-5xx	Advanced Aerodynamics-II: Compressible Flows	3-0
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This graduate level course is second in the sequence of two advanced aerodynamics courses. The main focus of this course is on compressible flow. Compressible flows form a major part of aerodynamics and their analysis is broadly classified under “inviscid” and “viscous” flows. Inviscid compressible flows include analysis of

properties across shocks/expansion waves, variable area flows, linearized 2-D flow, part of hypersonic flow and unsteady wave motion. Viscous compressible flows involve solution of the complete system of governing equations including Navier-Stokes equations. Various examples of viscous compressible flow are illustrated

AE-5xx	Turbomachinery	3-0
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📖 *Fluid Mechanics, Thermodynamics of Turbomachinery* by S L Dixon, Pergamon Press, 1966

This course includes the theories of cascades, performance analysis of axial and radial flow compressor, pumps and turbines at design and off-design conditions.

AE-5xx	Advanced Aerospace Propulsion	3-0
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📖 *Rocket Propulsion Elements 6th Ed*, by Sutton, John Wiley, NY, 1992

This course includes the theory of rocket propulsion, flight dynamics of rocket, solid rocket, liquid rocket, heat transfer in rocket motor, and component design.

MATHEMATICS

MA-5xx	Advanced Engineering Mathematics	3-0
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📖 *Introductory Linear Algebra with Applications 6th Ed*, by Bernard Kolman, Printice Hall, USA, 1997

📖 *Partial Differential Equations for Scientists and Engineers*, by Tune Myint-U & Lokenath Debnath, 3rd Ed, PTR Prentice Hall N J

📖 *Advanced Engineering Mathematics* by Erwin Kreysig, 8th Ed, John Wiley Singapore, 1999

📖 *Advanced Engineering Mathematics* by C Roy Wylie, 5th Ed, McGraw-Hill, London, 1982

📖 *Calculus of Variations* by Robert Weinstock, McGraw Hill, 1952

The course includes Vector Calculus, Tensors, Kronecker tensor, Livi-Civita tensor, differential operators in tensor form, Calculus of Variations, Brachistochrone problem, Euler-Lagrange Equations for several variables, optimization, Fibonacci Procedure, method of Lagrange multipliers, kulrn-Tucker Conditions.

MS THESIS

AE-6xx	MS Thesis	6-0
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Students are required to work on a research topic for their MS thesis.

SCHEME OF STUDIES FOR M.S (AVIONICS ENGINEERING)

Minimum Credits Hours	=	30
Essential Credit Hours	=	21

Breakdown of 21

Subjects	Credit Hours
Microwave Engineering Major:	
Mathematics	3
Microwave Engineering related subjects	12
Thesis	6
Controls Major:	
Mathematics	3
Controls related subjects	12
Thesis	6
Respective Major Total	
	21

DETAIL OF COURSES FOR M.S (AVIONICS)

MICROWAVE ENGINEERING

EE-5xx	Electromagnetics	3-0
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Text Book:

📖 *Electromagnetic Fields by Roald K Wangness, 2nd Ed, John Wiley, NY, 1986*

Reference Books:

- 📖 *Field and Wave Electromagnetic by David K Cheng, 2nd Ed, Addison Wesley, 1989*
- 📖 *Elements of Electromagnetics by Matthew N O Sadiku, 2nd Ed, Aaunders College, NY, 1995*
- 📖 *Engineering Electromagnetics by William H Hayt, 3rd Edition, McGraw-Hill Tokyo, 1974*
- 📖 *Electromagnetic Fields and Relativistic Particles by E J Konopinski, McGraw-Hill, New York, 1981*
- 📖 *Electromagnetic Fields: Sources and Media by A M Portis, Wiley, New York, 1978*

This is the first course in Electromagnetics (EM) and forms part of a sequence of two courses, which together are intended to develop the ability to analyze and apply the fundamentals of EM fields. The prime objective of this course is to provide an insight into the electromagnetic phenomena, as well as prepare for more advanced subjects in EM theory.

EE-5xx	Transmission Lines and Waveguides	3-0
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Text Book:

📖 *Electromagnetic Fields by Roald K Wangness, 2nd Ed, John Wiley, NY, 1986*

Reference Books:

- 📖 *Field and Wave Electromagnetic by David K Cheng, 2nd Ed, Addison Wesley, 1989*
- 📖 *Elements of Electromagnetics by Matthew N O Sadiku, 2nd Ed, Aaunders College, NY, 1995*
- 📖 *Antenna Theory Analysis and Design by Constantine A Balanis John Wiley & Sons, NY, 1997*
- 📖 *Electromagnetic Fields and Relativistic Particles by E J Konopinski, McGraw-Hill, New York, 1981*
- 📖 *Electromagnetic Fields: Sources and Media by A M Portis, Wiley, New York, 1978*

This is the second course in Electromagnetics (EM) and forms part of a sequence of two courses, which together are intended to develop the ability to analyze and apply

the fundamentals of EM fields. The prime objective of this course is to provide an insight into wave propagation, reflection and reflection. Transmission Lines & wave-guides as well as radiation are covered in sufficient details in this course.

EE-5xx	Microwave Engineering	3-0
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Text Books:

- 📖 *David Pozar, Microwave Engineering, Addison Wesley, 1990 ISBN 0201-50418-9*
- 📖 *Omp P Gandhi, Microwave Engineering and Applications, Pergamon Paress, 1989 ISBN 0-02-94165*

To introduce students to Wave propagation in unbounded media, Transmission Line and matching techniques, Microwave waveguides and model analysis and Microwave Network analysis and component.

EE-5xx	RF and Microwave Circuit Design	3-0
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Text Book:

- 📖 *Microwave Engineering by David M Pozar, Addison Wesley Publishing Company, 1990*

Reference Books:

- 📖 *Microwave Engineering and Applications by Om P Gandhi, Pergamon Press, 1989*
- 📖 *Microwave Devices & Circuits by Sammuel Y Liao, 3rd Ed, Prentice Hall, 1990*
- 📖 *Electromagnetic Fields by Roald K Wangness, 2nd Ed, John Wiley, NY, 1986*
- 📖 *Field and Wave Electromagnetic by David K Cheng, 2nd Edition, Addison Wesley, 1989*
- 📖 *Electromagnetic Fields and Relativistic Particles by E J Konopinski, McGraw-Hill, New York, 1981*
- 📖 *Electromagnetic Fields: Sources and Media by A M Portis, Wiley, New York, 1978*

This course is intended to develop the ability to apply the concepts and phenomenon on of EM fields with a focus on Maxwell’s equations, wave propagation, transmission lines & wave-guides, and network theory to modern microwave engineering. The primary objective of this course is to provide an insight into basic design ideas and motivations and to develop an understanding of the process of applying the fundamental principals to realize a useful, practical, and creative design.

CONTROLS

EE-5xx	Modern Control Systems	3-0
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Text Books:

- 📖 *Feedback Control System by Charles L Phillips & Royce D Harbor, 3rd Ed, Prentice Hall, 1993*
- 📖 *Linear Systems by Chen, 3rd Ed, Oxford University Press, 1999*
- 📖 *Signal and Systems by Oppenheim and Scheiflar, 2nd Ed, Prentice Hall, UK, 1997*

Reference Book:

- 📖 *Modern Control Systems by Richard C Dorf, 8th Ed, Wesley, California, 1988*

This is the course in modern feedback control systems taught to graduate students. The course is aimed at building a comprehensive foundation in the analysis and design of control systems using classical and modern techniques. The mathematical models of common components that appear in control systems are developed. The course covers in detail the analysis and design of linear control systems which includes the study of control system characteristics along with important concepts of system stability, sensitivity and steady-state accuracy. Later part of the course covers the analysis and design of control systems by root locus procedures and through various other frequency response methods. An introduction to modern control techniques using the state-space approach rounds off this course.

EE-5xx	Linear Systems Theory	3-0
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Text Book:

- 📖 *Linear System Theory by Chi-Tsong Chen, 3rd Ed, Oxford University Press, 1999*

Reference Books:

- 📖 *Linear System Theory by Wilson J Rugh, 2nd Ed, Prentice Hall, 1996*
- 📖 *Feedback Control Systems by Phillips and Harbor, 3rd Ed, 3rd Ed, Prentice Hall, 1993*
- 📖 *Modern Control Systems by Richard C Dorf, 8th Ed, Wesley, California, 1998*
- 📖 *User's Guide for the Student Edition of MATLAB by Duane Hanselman & Bruce Littlefield., Prentice Hall, NJ, 1997*

It is a Linear control systems course taught to MS Control System class to Avionics Engineering students. This course is aimed at building a comprehensive foundation for the analysis and design of linear control systems using linear modern control techniques i.e. linear state equations. The course covers system modelling, system responses, control system characteristics, stability analysis. The core material is the theory of time-varying linear systems, in both continuous-and discrete-time.

EE-5xx	Intelligent Adaptive Control Systems	3-0
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Text Books:

- 📖 *Neural Fuzzy systems—A Neuro-Fuzzy Synergism to Intelligent Systems* by C T Lin, and C S G Lee, Prentice Hall, New York, 1996
- 📖 *Fuzzy Control* by Kevin M Passino and Stephen Yurkovich, Addison Wesley Longman, Menlo Park, CA, 1998
- 📖 *An Introduction to Intelligent and Autonomous Control* by Antsaklis P J, Passino K M, eds, Kluwer Academic Publishers, Norwell, MA, 1993

Reference Book:

- 📖 *Instructor's lecture notes and selected papers*

The aim of this course is to give students an overview of the intelligent adaptive control systems techniques. Specifically a student will be able to learn the functional operation of a variety of intelligent control techniques. Also, this course will emphasize on the understanding of control-theoretic foundations of intelligent control systems. Also, the computers will be utilized for simulation and evaluation of intelligent control systems. Overall this course is intended to give the students a "hands-on" working knowledge of several of the main techniques of intelligent control.

COMMUNICATION

EE-5xx	Wireless Communication	3-0
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Text Book:

- 📖 *Wireless Communications Principles and Practice* by Theodore S Rappaport, 2nd Ed, Prentice Hall, NJ, 2002

The objective of this course is to introduce Mobile Radio Communication to graduate students. It begins with an introduction to the cellular concepts. The course then covers the large-scale path loss and small-scale Fading and multi-path effects in mobile radio propagation. The topics of equalization, diversity, channel coding and speech coding are then covered. In addition, various multiple access techniques for wireless communication and wireless networking are covered. Some of the wireless systems and standards are then taught. In the end, network design and optimization is covered.

DIGITAL SIGNAL PROCESSING

EE-5xx	Digital Signal Processing	3-0
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Text Books:

- 📖 *Discrete – Time Signal Processing*, Oppenheim and Schaffer, Prentice Hall Inc, 1997, ISBN 0-13-216292-x, Prentice Hall, NJ, 1989

📖 *Two-Dimensional Signal and Image Processing, Jae S Lim, Prentice Hall, 1997, ISBN 0-13-935322-4, Prentice Hall, NJ, 1990*

The students are familiarized with phase issues and optical FIR filter design. The concept of time dependent Fourier transmission is discussed which is followed with cepstral analysis. Then the students are introduced to two dimensional DSP. The parametric signal modelling is then discussed. They are then introduced with concepts of image enhancement, restoration and coding techniques.

POWER ELECTRONICS

EE-5xx	Power Electronics	3-0
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Text Books:

- 📖 *Fundamental of Power Electronics by R W Erickson, Chapman & Hall, NY 1997*
- 📖 *Power Electronics Converters, Application and Design By N Mohan, T M Undeland and W P Robbins, 3rd Ed, John Wiley, NJ 2003*
- 📖 *Power Electronics by Rashid, 2rd Ed, Prentice Hall London, 1988*

EE-565 is a graduate level course thought to MS Avionics Engineering student. The core material is the theory and analysis of power conversion using power Electronics devices. The course introduces from and functions of modern power electronic converters resonant converters and ac/ac converters. The students are exposed to the problems of modelling and controlling modelling and controlling power electronic systems. Steady state and transient thermal behaviour of power electronic systems/ devices and their application are considered.

MATHEMATICS

MA-5xx	Advanced Engineering Mathematics	3-0
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Text Book:

- 📖 *Numerical Analysis by Richard Burden and J Douglas Faries, 6th Ed, Brooks/ Cole, 1997*

Reference Book:

- 📖 *Advanced Engineering Mathematics by Erwin Kreyszig, 8th Ed, John Wiley Singapore, 1999*

System of linear equations: Gauss elimination method, decomposition methods, Jacobi and Gauss Siedal Method. Eigen values and eigen vectors. Linearly dependent and independent vectors. Orthogonal vectors. Determination of eigen values and eigen vectors. Numerical solutions of non-linear system of equations. Numerical solutions of ordinary differential equations including finite difference methods for linear and non-linear problems Numerical solutions of partial differential equations including elliptic, parabolic and hyperbolic equations.

M.S THESIS

EE-6xx	MS Thesis Research	6-0
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Students are required to work on a research topic for their M.S thesis.

RECOMMENDATIONS:

The NCRC discussed at length different aspects of the curricula of Aerospace/Avionics Engineering and agreed upon the recommendations given hereunder:-

1. The core courses be made compulsory in all Universities of Pakistan and a set of electives may be chosen to fulfil the complete curriculum requirement. The electives proposed by the committee may not be considered as mandatory. Universities may introduce additional electives to meet their own peculiar requirements on the recommendations of their own Board of Studies. Similarly the text books proposed, are also meant as a guideline only.
2. At most of the public sector universities/colleges, laboratories need improvements. The education in the field of engineering, particularly in Aerospace/Avionics Engineering cannot be imparted without practical experiments and hands-on practices. Special attention and additional funds may be provided to equip the laboratories. For core subjects, laboratory work is deemed absolutely essential.
3. There is an urgent need to commence a Teachers Training Programme to assimilate modern technologies and for the enhancement of instructional methodologies.
4. Trained and qualified manpower may be inducted on emergency basis to overcome the faculty shortage.
5. Special incentives may be devised for good teachers and students for their encouragement.
6. Engineering universities/colleges may be connected through LAN & WAN so that teachers and students may use Internet facility for R&D widely. This connectivity would result in useful interaction between the students, researchers and the faculty.
7. Use and application of simulation software tools may be introduced to students for the research/development work at appropriate levels.
8. For Mini Projects and Final Year Projects, laboratories should be well equipped with components, devices and equipment of common use.
9. Final year projects should involve analysis, design and practical work. The examination for the project should include an open-house formal presentation by the students. Efforts may also be made to invite representatives from the local industry.

10. The Committee is fully cognizant of the need for very strong interaction amongst the universities on academic matters. Therefore, all universities are requested to disseminate any changes in their curricula to others as well.
11. All engineering institutions should encourage internship training, spanning 4 to 6 weeks for their students in the local industry. The Committee strongly opines that in order to ensure participation of our industry, a legal framework needs to be evolved at the provincial and Federal Government levels.
12. Subject to availability of teaching faculty, engineering institution may also offer humanities courses in Philosophy, Logic and Human Resource Development also.
13. The teaching faculty may be encouraged to attend short courses, seminars and workshops in country and abroad.