Republic of the Philippines
OFFICE OF THE PRESIDENT
COMMISSION ON HIGHER EDUCATION

CHED MEMORANDUM ORDER (CMO)
No. 28
Series of 2007

SUBJECT : POLICIES AND STANDARDS (PS) FOR THE DEGREE OF BACHELOR OF SCIENCE IN AERONAUTICAL ENGINEERING (BSAeroE)

In accordance with the pertinent provisions of Republic Act (RA) No. 7722, otherwise known as the "Higher Education Act of 1994," and by virtue of Resolution No. 839-2006 of the Commission en banc dated December 4, 2006 and for the purpose of rationalizing the aeronautical engineering education in the country, the following policies and standards shall be hereby adopted and promulgated by the Commission.

ARTICLE I - INTRODUCTION

Section 1. Rationale and Background.

Aeronautical Engineering is a field of science that deals with the principles of flight and related engineering disciplines and their applications to research and development, planning, design, manufacture, operation, maintenance, repair, modification, and inspection of aircraft, spacecraft and their systems and components.

The herein Policies and Standards (PS) have been reviewed in accordance with recent approved CMOs, industry needs, latest trends and technology in the field of aeronautical engineering. This PS emerged as a result of consolidated effort of the academe, industry and other concerned agencies.

ARTICLE II - AUTHORITY TO OPERATE

Section 2. All private higher education institutions (PHEIs) intending to offer **Bachelor Of Science in Aeronautical Engineering** must first secure proper authority from the Commission in accordance with existing rules and regulations. State Universities and Colleges (SUCs), and Local Colleges and Universities (LCUs) should likewise strictly adhere to the provisions in these policies and standards.

ARTICLE III - PROGRAM SPECIFICATION

Section 3. Degree Name

The program herein shall be called **BACHELOR OF SCIENCE IN AERONAUTICAL ENGINEERING (BSAeroE).**

All baccalaureate degree programs in aerospace engineering shall be converted to aeronautical engineering considering that aeronautical engineering has been a government-regulated profession since 1982 pursuant to P.D. 1570, while aerospace engineering has never been a regulated profession whose curriculum is practically identical to the aeronautical engineering curriculum

Section 4. Program Description

4.1 Objectives

To prepare the students for professional aeronautical engineering career to assume leading roles in the technological and socio-economic development of both local and foreign Aviation Industry, particularly in the areas of aircraft research, development, manufacturing, maintenance, operation, and aviation education. Aside from their professional knowledge and skills, the graduates must also possess strong foundation in the physical and basic engineering sciences as well as in human relations to enable them to meet the challenges being brought about by the rapid technological progress in Aeronautics.

4.2 Program Outcomes

A graduate of the Bachelor of Science in Aeronautical Engineering (BSAeroE) program must attain:

a. An ability to apply knowledge of mathematics, physical sciences, engineering sciences to the practice of aeronautical engineering.
b. An ability to design and conduct experiments to test hypotheses and verify assumptions, as well as to analyze and interpret data and to simulate processes.
c. An ability to design, improve, innovate, and to supervise systems or processes to meet desired needs within realistic constraints.
d. An ability to work effectively in multi-disciplinary and multi-cultural teams in diverse fields of practice.
e. An ability to identify, formulate, and solve aeronautical engineering problems.
f. An understanding of the effects and impact of the aeronautical engineering profession on the environment and the society, as well as the social and ethical responsibilities of the profession.

g. The specialized knowledge in at least one field of aeronautical engineering practice, and the ability to apply such knowledge to provide solutions to actual problems.
h. An ability for effective oral and written communications particularly in the English language.
i. An ability to engage in life-long learning and to keep current of the development in a specific field of specialization.
j. An ability to use the appropriate techniques, skills and tools necessary for the practice of aeronautical engineering.
k. A knowledge of contemporary issues.
l. An ability to apply acquired aeronautical engineering knowledge and skills for national development

4.3 Specific Professions/ Careers/ Occupations or trades that the graduates may go into

4.3.1 Research and Development Engineer
4.3.2 Aircraft Structural Engineer
4.3.3 Aircraft Design Engineer
4.3.4 Aircraft Power Plant Engineer
4.3.5 Aircraft Manufacturing Engineer
4.3.6 Aircraft Engineer
4.3.7 Aircraft Maintenance Engineer
4.3.8 Aircraft Operation/ Performance Engineer
4.3.9 Aircraft Interior Engineer
4.3.10 Aircraft Systems Engineer
4.3.11 Aircraft Tooling Engineer
4.3.12 Aeronautical Engineering Consultant
4.3.13 Aeronautical Engineering Professor

Section 5. Allied Programs

5.1 Mechanical Engineering
5.2 Electronics and Communications Engineering
5.3 Electrical Engineering
5.4 Management
5.5 Other aviation-related programs

ARTICLE IV -COMPETENCY STANDARDS

Section 6. This section defines the Entry Level Competency Standards, knowledge, attitudes, values and skills applicable to the BSAeroE graduate are contained in **ANNEX I** of this Memorandum.

ARTICLE V- CURRICULUM

Section 7. Curriculum Description

7.1 The BS Aeronautical Engineering program has a total of 225 credit units. The program consist of the general education,

technical courses, allied courses, professional courses and technical elective courses and on-the-job-training.

7.2 The general education courses are in accordance with the requirements of the CHED Memorandum Order No. 59, s. 1996- The New General Education Curriculum (GEC)

7.3 The technical courses comprised of the Mathematics with a total of 26 units, the Physical Sciences with a total of 12 units and the Basic Engineering Sciences with a total of 21 units.

7.4 There must be at least 26 professional courses, 1 technical elective and OJT with a total of 104 units

7.5 The allied courses are comprised of Thermodynamics, Basic Electronics and Elementary Electrical Engineering with a total of 9 units.

7.6 The aeronautical engineering practice (OJT) will consist of 420 hours.

Section 8. Curriculum Outline

Classification/ Field / Course	Minimum No. of Hours		Minimum Credit Units
	Lecture	Laboratory	
I. TECHNICAL COURSES			
A. Mathematics			
College Algebra	3	0	3
Advanced Algebra	2	0	2
Plane and Spherical Trigonometry	3	0	3
Analytic Geometry	2	0	2
Solid Mensuration	2	0	2
Differential Calculus	4	0	4
Integral Calculus	4	0	4
Differential Equations	3	0	3
Probability and Statistics	3	0	3
Sub-Total	**26**	**0**	**26**
B. Natural/Physical Sciences			
General Chemistry	3	3	4
Physics 1	3	3	4

Classification/ Field / Course	Minimum No. of Hours		Minimum Credit Units
	Lecture	Laboratory	
Physics 2	3	3	4
Sub-Total:	**9**	**9**	**12**
C. Basic Engineering Sciences			
Engineering Drawing	0	3	1
Computer Fundamentals and Programming	0	6	2
Computer –Aided Drafting	0	3	1
Statics of Rigid Bodies	3	0	3
Dynamics of Rigid Bodies	2	0	2
Mechanics of Deformable Bodies	3	0	3
Engineering Economy	3	0	3
Engineering Management	3	0	3
Environmental Engineering	2	0	2
Safety Management	1	0	1
Sub-Total:	**17**	**12**	**21**
D. Allied Courses			
Thermodynamics	3	0	3
Elementary Electrical Engineering	3	0	3
Basic Electronics	3	0	3
Sub - Total	**9**	**0**	**9**
E. Professional Courses			
Advanced Engineering Mathematics for AeroE	3	0	3
Aircraft Materials and Processes	3	0	3
Airframe Construction and Repair	2	6	4
Fundamentals of Aerodynamics	5	0	5
Applied Subsonic Aerodynamics	5	0	5

Classification/ Field / Course	Minimum No. of Hours		Minimum Credit Units
	Lecture	Laboratory	
Applied Supersonic Aerodynamics	5	0	5
Research Methods and Applications	2	0	2
Aircraft Systems	4	0	4
Operations Engineering	4	0	4
Reliability Engineering	3	0	3
Aeronautical Laboratory	1	6	3
Aircraft Avionics	4	0	4
Air Laws and Regulations	3	0	3
Aircraft Maintenance and Inspection	3	3	4
Aviation Safety	2	0	2
Aerodrome Engineering and Management	3	0	3
Aircraft Structures 1	5	0	5
Aircraft Structures 2	5	0	5
Basic Helicopter and Propeller Design	3	0	3
Aircraft Design 1	3	6	5
Aircraft Design 2	3	6	5
Air Transport Economics and Management	3	0	3
Reciprocating Engines	4	3	5
Gas Turbine engines	4	3	5
CADD 1	2	3	3
CADD 2	2	3	3
Sub-Total:	**86**	**39**	**99**
F. Electives			
Technical Elective	2	0	2
Rocket Engines			

Classification/ Field / Course	Minimum No. of Hours		Minimum Credit Units
	Lecture	Laboratory	
Home-built Aircraft			
Project Feasibility Study			
Sub-Total:	**2**	**0**	**2**
G. Aeronautical Engineering Practice (OJT)			**3**
TOTAL PROFESSIONAL COURSES	**88**	**39**	**104**
II NON-TECHNICAL COURSES			
A. Social Sciences			
Social Science 1	3	0	3
Social Science 2	3	0	3
Social Science 3	3	0	3
Social Science 4	3	0	3
Sub-Total:	**12**	**0**	**12**
B. Humanities			
Humanities 1	3	0	3
Humanities 2	3	0	3
Humanities 3	3	0	3
Sub-Total:	**9**	**0**	**9**
C. Languages			
English 1	3	0	3
English 2	3	0	3
English 3 (Technical Communication)	3	0	3
Pilipino 1	3	0	3
Pilipino 2	3	0	3
Sub-Total:	**15**	**0**	**15**
D. Mandated Course			
Life and Works of Rizal	3	0	3
Sub-Total:	**3**	**0**	**3**
E. Physical Education			
P.E. 1,2,3,4			8
Sub-Total:			**8**

Classification/ Field / Course	Minimum No. of Hours		Minimum Credit Units
	Lecture	Laboratory	
F. National Service Training Program			
NSTP 1,2			6
Sub-Total:			**6**
GRAND TOTAL	**188**	**60**	**225**

SUMMARY OF THE BSAeroE CURRICULUM

Classification/ Field	Total No. of Hours		Total No. of Units
	Lecture	Laboratory	
I. TECHNICAL COURSES			
A. Mathematics	26	0	26
B. Natural/Physical Sciences	9	9	12
C. Basic Engineering Sciences	17	12	21
D. Allied Courses	9	0	9
E. Professional Course	88	39	104
Sub- Total	**149**	**60**	**172**
II. NON- TECHNICAL			
A. Social Sciences	12	0	12
B. Humanities	9	0	9
C. Languages	15	0	15
D. Life and Works of Rizal	3	0	3
E. Physical Education			8
F. NSTP			6
Sub- Total	**39**	**0**	**53**
GRAND TOTAL	**188**	**60**	**225**

Section 9. Relationship of the Courses to the Program Outcomes

The relationships of the identified courses in section 8 to the identified program outcomes in section 4-4.2 are contained in **ANNEX II** of this Memorandum.

Section 10. Sample/ Model program of study

The institution may enrich the sample/model program of study depending on the needs of the industry, provided that all prescribed courses required in the curriculum outlines are offered and pre-requisites are complied with

FIRST YEAR

1st Year-1st Semester

Subjects	No. of Hours		Total Units	Prerequisites
	Lecture	Laboratory		
College Algebra	3	0	3	None
Plane and Spherical Trigonometry	3	0	3	None
General Chemistry	3	3	4	None
Engineering Drawing	0	3	1	None
Pilipino 1	3	0	3	None
English 1	3	0	3	None
Social Science 1	3	0	3	None
PE 1			2	None
NSTP 1			3	None
TOTAL	**18**	**6**	**25**	

1st Year – 2nd Semester

Description of Subjects	No. of Hours		Total Units	Prerequisites
	Lecture	Laboratory		
Advanced Algebra	2	0	2	College Algebra
Analytic Geometry	2	0	2	College Algebra, Plane and Spherical Trigonometry
Solid Mensuration	2	0	2	College Algebra, Plane and Spherical Trigonometry
Physics 1	3	3	4	College Algebra, Plane and Spherical Trigonometry
Pilipino 2	3	0	3	
English 2	3	0	3	
Social Science 2	3	0	3	
PE 2			2	
NSTP 2			3	
TOTAL	**18**	**3**	**24**	

SECOND YEAR

2nd Year – 1st Semester

Subjects	No. of Hours		Total Units	Prerequisites
	Lecture	Laboratory		
Differential Calculus	4	0	4	Analytic Geometry, Solid Mensuration, Advanced Engineering
Physics 2	3	3	4	Physics 1
Computer Fundamentals and Programming	0	6	2	2nd year standing
English 3 -Technical Communication	3	0	3	English 2
Social Science 3	3	0	3	
Humanities 1	3	0	3	
PE 3			2	
TOTAL	**16**	**9**	**21**	

2nd Year- 2nd Semester

Subjects	No. of Hours		Total Units	Prerequisites
	Lecture	Laboratory		
Integral Calculus	4	0	4	Differential Calculus
Probability and Statistics	3	0	3	College Algebra
Elementary Electrical Engineering	3	0	3	Physics 2 (Service course to be offered by Electrical Engineering)
Aircraft Materials and Processes	3	0	3	Physics 2, General Chemistry
Social Science 4	3	0	3	
Humanities 2	3	0	3	
Life and Works of Rizal	3	0	3	
PE 4			2	
TOTAL	**22**	**0**	**24**	

THIRD YEAR

3rd Year – 1st Semester

Subjects	No. of Hours		Total Units	Prerequisites
	Lecture	Laboratory		
Differential Equations	3	0	3	Integral Calculus
Statics of Rigid Bodies	3	0	3	Physics 1, Integral Calculus
Thermodynamics	3	0	3	Integral Calculus, Physics 2 (Service course to be offered by Mechanical Engineering)
Engineering Economy	3	0	3	3rd year standing
Computer Aided Drafting	0	3	1	3rd year standing
Basic Electronics	3	0	3	Elementary Electrical Engineering (Service course to be offered by Electronics and Communications Engineering)
Environmental Engineering	2	0	2	General Chemistry, 3rd year standing
Safety Management	1	0	1	
Humanities 3 (Literature)	3	0	3	
TOTAL	**21**	**3**	**22**	

3rd Year – 2nd Semester

Subjects	No. of Hours		Total Units	Prerequisites
	Lecture	Laboratory		
Reciprocating Engines	4	3	5	Thermodynamics, Aircraft Materials and Processes
Fundamentals of Aerodynamics	5	0	5	Physics 2, Integral Calculus
Airframe Construction and Repair	2	6	4	Aircraft Materials and Processes
Advanced Engineering Mathematics for Aero E	3	0	3	Differential Equations
Dynamics of Rigid Bodies	2	0	2	Statics of Rigid Bodies
Mechanics of Deformable Bodies	3	0	3	Statics of Rigid Bodies
TOTAL	**19**	**9**	**22**	

FOURTH YEAR

4th Year – 1st Semester

Subjects	No. of Hours		Total Units	Prerequisites
	Lecture	Laboratory		
Aeronautical Laboratory	1	6	3	Fundamentals of Aerodynamics
Applied Subsonic Aerodynamics	5	0	5	Fundamentals of Aerodynamics
Aircraft Systems	4	0	4	Basic Electronics, Elementary Electrical Engineering
Air Laws, and Regulations	3	0	3	None
Engineering Management	3	0	3	4th year standing
Computer Aided Drafting and Design (CADD) 1	2	3	3	Computer Fundamentals and Programming, Computer Aided Drafting
TOTAL	**18**	**9**	**21**	

4th Year - 2nd Semester

Subjects	No. of Hours		Total Units	Prerequisites
	Lecture	Laboratory		
Aircraft Maintenance and Inspection	3	3	4	Aircraft Materials and Processes
Applied Supersonic Aerodynamics	5	0	5	Applied Subsonic Aerodynamics
Aircraft Structure 1	5	0	5	Mechanics of Deformable Bodies, Airframe Construction and Repair, Advanced Engineering Mathematics
Computer Aided Drafting and Design (CADD) 2	2	3	3	Computer Aided Drafting and Design (CADD) 1
Gas Turbine Engines	4	3	5	Thermodynamics
TOTAL	**19**	**9**	**22**	

Summer:

Aeronautical Engineering Practice (OJT) **420 Hours 3 units**

FIFTH YEAR

5th Year – 1st Semester

Subjects	No. of Hours		Total Units	Prerequisites
	Lecture	Laboratory		
Basic Helicopter and Propeller Design	3	0	3	Applied Supersonic Aerodynamics, Reciprocating Engines, Aircraft Systems, Gas Turbine
Aircraft Avionics	4	0	4	Aircraft Systems
Research Methods and Applications	2	0	2	Technical Communications, Probability and Statistics
Aircraft Design 1	3	6	5	Applied Supersonic Aerodynamics, Aircraft Systems, Reciprocating Engines, Gas Turbine Engines
Aircraft Structure 2	5	0	5	Aircraft Structure 1
Aerodrome Engineering and Management	3	0	3	Engineering Management, Air Laws and Regulations
TOTAL	**20**	**6**	**22**	

5th Year – 2nd Semester

Subjects	No. of Hours		Total Units	Prerequisites
	Lecture	Laboratory		
Aviation Safety	2	0	2	Environmental Engineering, Safety Management
Aircraft Design 2	3	6	5	Aircraft Design 1, Aircraft Structure 2
Air Transport Economics and Management	3	0	3	Engineering Economy, Engineering Management, Air Laws and Regulations
Reliability Engineering	3	0	3	Advance Engineering Mathematics, Probability and Statistics, Research Methods & Application
Operations Engineering	4	0	4	Applied Subsonic Aerodynamics, Aerodrome Engineering and Management
Technical Elective	2	0	2	
TOTAL	**17**	**6**	**19**	

Section 11. On-the-job-training or practicum requirements

The 3-units OJT with a total of 420 hours is required to be taken by the student with 4th year standing. The student shall report to their OJT coordinator or adviser twice a week

ARTICLE VI - COURSE SPECIFICATION

Section 12. The course specifications for the BS Aeronautical Engineering program are contained in **ANNEX III** of this Memorandum, **ANNEX IV** shall contain the summary of the Laboratory requirements.

1. Course Name
2. Course Description
3. Number of units for lecture and laboratory
4. Number of contact hours per week
5. Prerequisite
6. Course Objectives
7. Course Outlines
8. Equipment
9. References

ARTICLE VII – GENERAL REQUIREMENTS

Section 13. The general requirements for the BS Aeronautical Engineering Program are contained in **"CMO 25, S. 2005 – Revised PSG for Engineering Education."**, a separate Memorandum issued by the Commission.

The following are hereby required to comply with the policies in the following areas:

1. Instructional Program Quality
2. Research
3. Community Involvement
4. Administration and Support

Article VIII - TRANSITORY PROVISION

Section 14. HEIs that have been granted permit or recognition for Bachelor of Science in Aeronautical Engineering program are given a non-extendable period of three (3) years from the date of effectivity hereof to fully comply with all the requirements in this CMO.

A student currently enrolled in the BSAeroE program shall be allowed to graduate under the old curriculum. However, students enrolling for the abovementioned program beginning school year 2008-2009 shall be covered by this CMO.

ARTICLE IX- REPEALING CLAUSE

Section 15. All issuances, including but not limited to CMO No. 49, s. 1997 and/ or any part thereof inconsistent herewith, are deemed repealed or modified accordingly.

ARTICLE X - EFFECTIVITY CLAUSE

Section 16. This CMO shall take effect starting 1st semester of SY 2008-2009, after publication in an official gazette or in a newspaper of general circulation.

Section 17. An educational institution applying to offer new BSAeroE program shall likewise comply with all the provisions of this CMO. (see Article II – Authority to Operate of this Memorandum)

Pasig City, Philippines May 2, 2007 .

For the Commission:

CARLITO S. PUNO, DPA
Chairman

ANNEX I

COMPETENCY STANDARDS

PROFILE OF DUTIES AND COMPETENCIES OF AN AERONAUTICAL ENGINEERING GRADUATE

General Duties	Specific (Sub) Duties	Competencies/ Skills/ Tasks						
		1	2	3	4	5	6	7
Research and Development	1. Understand the problem and objectives	Understand the principles of mathematics, physical, natural and applied sciences	Understand the research process	Write a research proposal	Collect data through surveys, use of internet or other information system			
	2. Collect, evaluate, assess, transform data into meaningful and useful information	Understand the principles of mathematics, physical, natural and applied sciences	Apply probability and statistical tools	Interpret statistical results	Demonstrate presentation skills	Prepare technical reports		
	3. Design and conduct experiments, analyze and interpret data, document and disseminate	Explain design of experiment	Undertake an experiment	Test hypothesis	Analyze and validate data	Write technical reports		

* Research and Development general duties and competencies were adopted from the basic engineering competencies approved by the TPETA

PROFILE OF DUTIES AND COMPETENCIES OF AN AERONAUTICAL ENGINEERING GRADUATE

General Duties	Specific (Sub) Duties	Competencies/ Skills/ Tasks						
		1	2	3	4	5	6	7
Design and Manufacture	1. Identify products and process	Understand the principles of mathematics, natural, physical and applied sciences	Determine appropriate engineering principles and technique application to the concept design	Develop proficiency in computational and multi-dimensional modeling/simulation skills in the defined knowledge areas	Develop the ability to use techniques, skills and medium tools such as computer softwares necessary for engineering practice			
	2. Design , Plan, and Implement machines, products and services	Understand engineering concepts & invention applied in the course	Should know Design subjects, product development, kinematics, strength of materials and engineering mechanics	Able to explain existing engineering plans	Acquire in-depth understanding of the principles and needs of engineering design			
	3. Generate (adapt) technical specification and standards	Conduct research for the international application to the conceptual design being developed	Familiar with engineering standards	Able to translate custom desired needs into engineering solution terms				

PROFILE OF DUTIES AND COMPETENCIES OF AN AERONAUTICAL ENGINEERING GRADUATE

General Duties	Specific (Sub) Duties	Competencies/ Skills/ Tasks						
		1	2	3	4	5	6	7
Design and Manufacture	4. Adapt standards & technical specifications for the aircraft design	Conduct research for international and local application to the design	Familiar with the engineering standards	Identify deviations to international standards and initiate change				
	5. Identify aircraft materials, tools & equipments including inspection and manufacturing process	Provide information on the physical and chemical properties of aircraft materials	Know the process involve in the heat treatment of metals and other metallurgical processes	Know the operation of tools and equipment	Conduct testing and inspection of materials			
	6. Provide appropriate engineering drawing.	Understand the principles in engineering drawing	Prepare drawing based on specified standards	Produce hardcopy using computer software				
	7. Supervise the development and manufacture of the design	Know the requirements in aviation product manufacture	Know the procedures in setting up an aviation development and manufacturing capability	Develop knowledge and proficiency in the preparation of technical report				

PROFILE OF DUTIES AND COMPETENCIES OF AN AERONAUTICAL ENGINEERING GRADUATE

General Duties	Specific (Sub) Duties	Competencies/ Skills/ Tasks						
		1	2	3	4	5	6	7
Design and Manufacture	8. Test and evaluate the product and correct discrepancies.	Create prototype	Understand aircraft engineering principles and testing procedure	Perform component testing	Analyze and interpret results			
Operation	1. Prepare basic and aircraft operations manuals	Understand rules and regulations pertaining to aircraft operation	Be familiar with aircraft system and procedures	Understand aircraft operations management structure and functions	Knowledgeable on interrelationship between government agencies and the organization	Familiar with emergency system and procedures		
	2. Develop and issue weight and balance data	Familiar with center of gravity envelope	Familiar on aircraft compartment capacity and load distribution	Familiar on loading chart/table presentation	Knowledgeable on actual aircraft loading procedures	Monitor of loading system procedures in airport		
	3. Develop and issue aircraft performance data	Knowledgeable on aircraft performance and stability and control	Familiarity with aircraft performance graphs and table					
	4. Develop and issue flight planning data	Knowledgeable on flight rules and regulations	Familiar with data presentation required by flight crew	Familiar with airport data and characteristics				

PROFILE OF DUTIES AND COMPETENCIES OF AN AERONAUTICAL ENGINEERING GRADUATE

General Duties	Specific (Sub) Duties	Competencies/ Skills/ Tasks						
		1	2	3	4	5	6	7
Operation	5. Develop and issue aircraft operating limitations	Familiar with aircraft operating systems	Familiar with manufacturers recommended limitations	Thorough knowledge on airworthiness regulations	Thorough knowledge on the requirements of route structure			
	6. Participate in aerodrome design and development program	Full understanding of the international standards on airport design	Thorough Knowledge on aircraft take-off and landing characteristics	Familiar in aircraft service equipments	Thorough knowledge in surveying			
	7. Conduct aircraft performance check	Thorough knowledge in aircraft performance characteristics	Familiar with crew functions and responsibilities	Thorough knowledge on aircraft stability and control	Thorough knowledge in government regulatory requirements			
	8. Participate in aircraft evaluation and acceptance	Thorough knowledge on navigation, metreology and aircraft design	Familiar in data gathering i.e. CVR/ FDR interpretation	Thorough Knowledge on aircraft operating characteristics	Skill in data presentation			
	9. Participate in aircraft incident and accident investigation	Thorough knowledge on navigation, metreology and aircraft design	Familiar in data gathering i.e CVR/FDR interpretation	Thorough knowledge on aircraft operating characteristics	Skill in data presentation			

PROFILE OF DUTIES AND COMPETENCIES OF AN AERONAUTICAL ENGINEERING GRADUATE

General Duties	Specific (Sub) Duties	Competencies/ Skills/ Tasks						
		1	2	3	4	5	6	7
Maintenance	1. Provide maintenance program for aircraft	Recognize aircraft maintenance requirements and their interrelationship	Analyze and validate data	Develop planning framework	Knowledgeable with aircraft manufacturer's maintenance planning document	Knowledgeable with aircraft operation specification	Manifest methodological (sequential) thinking	Prepare monitoring and evaluation plan
	2. Conduct development program for aircraft systems and components	Knowledgeable on basic aircraft system operation and application	Diagnose product system failure or deficiency characteristics	Establish feedback and benchmarking mechanism	Familiar with OEM manuals /publications	Prepare project development and evaluation plan		
	3. Conduct structural repair and modification	Understand principles of mathematics, mechanics of forces, structural loadings and stress analysis	Identify the types of aircraft structural defects and categorize to interim, temporary or permanent error	Evaluate compliance with the regulatory requirements and manufacturer repair schemes	Evaluate defect as compared to the manufacturer's structural repair manual	Develop repair scheme and procedures	Recommend supplementary inspection procedures to maintain repair structural integrity	Perform weight and balance and symmetry and alignment
		Reassess repairs to maintain structural integrity	Recommend aircraft material substitution					

PROFILE OF DUTIES AND COMPETENCIES OF AN AERONAUTICAL ENGINEERING GRADUATE

General Duties	Specific (Sub) Duties	Competencies/ Skills/ Tasks						
		1	2	3	4	5	6	7
Maintenance	4. Improve reliability of aircraft system and components	Review systems performance parameters for changes, with bench markings	Knowledgeable on aircraft OEM manuals and publications	Knowledgeable on aircraft maintenance program and operating specifications	Collect data through surveys in the industry and apply statistical tools	Analyze data using probability statistics and other appropriate analytical tools	Prepare monitoring and evaluation plan for system performance check	Implement changes in systems performance parameters and establish feedback mechanism
	5. Develop aircraft cabin interiors	Identify standard chemicals and materials used in cabin interior	Determine the basic loading capability of the cabin interior	Knowledgeable on regulatory requirements	Familiar on emergency exits system ad emergency equipments	Knowledgeable on passenger and crew comfort, safety and in-flight service requirements	Familiar on door systems, galleys and equipments	
	6. Perform weight and balance of aircraft	Understand principles of mathematics for distances and moments (mechanics)	Identify requirements per the aircraft airworthiness circular when to conduct weight and balance	Knowledgeable on the use of aircraft weight and balance equipment and its operation				
	7. Conduct aircraft accident investigation	Conduct mathematical failure analysis	Apply maintenance standards and practice	Identify the work accomplishment records and documents of the aircraft	Knowledgeable on the human factor and environmental aspect	Knowledgeable on the regulatory policies and standards		

PROFILE OF DUTIES AND COMPETENCIES OF AN AERONAUTICAL ENGINEERING GRADUATE

General Duties	Specific (Sub) Duties	Competencies/ Skills/ Tasks						
		1	2	3	4	5	6	7
Maintenance	8. Evaluate, develop and recommend aircraft tools and support equipment.	Familiar with aircraft tooling and ground support	Knowledgeable on aircraft system operation and its application	Knowledgeable on basic material process (metallurgy)	Knowledgeable on equipment application and operation	Adopt engineering inter-disciplinary requirements and prototype		
Education	Provide technical knowledge and advice	Demonstrate values and ethical standards of the profession	Conduct trainings and seminars	Pursue advance studies and development on the field of aviation				

ANNEX II

Relationship of Courses to Program Outcomes

RELATIONSHIP OF THE COURSES TO THE PROGRAM OUTCOMES

I. TECHNICAL COURSES

A. Mathematics

Courses	Relationship to Program Outcomes											
	a	b	c	d	e	f	g	h	i	j	k	l
College Algebra	x	x	x		x		x		x	x		
Advanced Algebra	x	x	x		x		x		x	x		
Plane and Spherical Trigonometry	x	x	x		x		x		x	x		
Analytic Geometry	x	x	x		x		x		x	x		
Solid Mensuration	x	x	x		x		x		x	x		
Differential Calculus	x	x	x		x		x		x	x		
Integral Calculus	x	x	x		x		x		x	x		
Differential Equations	x	x	x		x		x		x	x		
Probability and Statistics	x	x	x		x		x		x	x		

B. Natural/Physical Sciences

Courses	Relationship to Program Outcomes											
	a	b	c	d	e	f	g	h	i	j	k	l
General Chemistry	x	x	x		x		x		x	x		
Physics 1,2	x	x	x		x		x		x	x		

C. Basic Engineering Sciences

Courses	Relationship to Program Outcomes											
	a	b	c	d	e	f	g	h	i	j	k	l
Engineering Drawing	x	x	x		x		x			x		
Computer Fundamentals and Programming	x	x	x		x		x		x	x		
Computer –Aided Drafting	x	x	x		x		x			x		
Statics of Rigid Bodies	x		x		x		x			x		
Dynamics of Rigid Bodies	x		x		x		x			x		

Courses	Relationship to Program Outcomes											
	a	b	c	d	e	f	g	h	i	j	k	l
Mechanics of Deformable Bodies	x		x		x		x			x		
Engineering Economy	x		x	x	x	x	x	x	x	x	x	
Engineering Management			x	x	x	x	x	x	x	x	x	
Environmental Engineering			x	x	x	x	x	x	x	x	x	
Safety Management			x	x			x	x	x	x	x	

D. Allied Courses

Courses	Relationship to Program Outcomes											
	a	b	c	d	e	f	g	h	i	j	k	l
Thermodynamics	x	x	x		x		x		x	x		
Elementary Electrical Engineering		x	x	x	x		x			x		
Basic Electronics		x	x	x	x		x			x		

E. Professional Courses

Courses	Relationship to Program Outcomes											
	a	b	c	d	e	f	g	h	i	j	k	l
Advanced Engineering Mathematics for AeroE	x	x	x		x		x		x	x		
Aircraft Materials and Processes	x	x	x		x		x			x		
Airframe Construction and Repair	x		x		x		x			x		
Fundamentals of Aerodynamics	x	x	x		x		x			x		
Applied Subsonic Aerodynamics	x	x	x		x		x			x		
Applied Supersonic Aerodynamics	x	x	x		x		x			x		
Research Methods and Applications	x	x	x	x	x	x	x	x	x	x	x	X
Aircraft Systems	x	x	x		x		x	x	x	x	x	
Operations Engineering	x	x	x		x		x	x	x	x	x	
Reliability Engineering	x	x	x	x	x		x	x	x	x	x	
Aeronautical Laboratory	x	x	x	x	x	x	x	x	x	x	x	X

Courses	Relationship to Program Outcomes											
	a	b	c	d	e	f	g	h	i	j	k	l
Aircraft Avionics	x	x	x		x		x	x	x	x	x	
Air Laws and Regulation		x		x	x	x	x	x	x		x	X
Aircraft Maintenance and Inspection	x	x	x	x	x	x	x	x	x	x	x	
Aviation Safety	x	x	x	x	x	x	x	x	x	x	x	X
Aerodrome Engineering and Management	x	x	x	x	x	x	x	x	x	x	x	X
Aircraft structures 1	x	x	x		x		x	x	x	x	x	
Aircraft structures 2	x	x	x		x		x	x	x	x	x	
Basic Helicopter and Propeller Design	x	x	x	x	x	x	x	x	x	x	x	x
Aircraft Design 1	x	x	x	x	x	x	x	x	x	x	x	x
Aircraft Design 2	x	x	x	x	x	x	x	x	x	x	x	x
Air Transport Economics and Management	x			x	x			x	x		x	x
Reciprocating Engines	x	x	x		x		x	x	x	x	x	
Gas Turbine engines	x	x	x		x		x	x	x	x	x	
CADD 1,2	x	x	x									

F. Electives

Courses	Relationship to Program Outcomes											
	a	b	c	d	e	f	g	h	i	j	k	l
Technical Elective												
Rocket Engines	x	x	x		x		x	x	x	x	x	
Home-built Aircraft	x	x	x	x	x	x	x	x	x	x	x	x
Project Feasibility Study	x	x	x	x	x	x	x	x	x	x	x	x

G. Aeronautical Engineering Practice

Courses	Relationship to Program Outcomes											
	a	b	c	d	e	f	g	h	i	j	k	l
Aeronautical Engineering Practice (OJT)	x	x	x	x	x		x	x	x	x	x	

II NON-TECHNICAL COURSES

Courses	Relationship to Program Outcomes											
	a	b	c	d	e	f	g	h	i	j	k	l
Social Science 1,2,3,4				x		x		x	x		x	x
Humanities 1,2,3				x		x		x	x		x	x
English 1,2,3				x		x		x	x		x	
Pilipino 1,2				x		x		x			x	
Life and Works of Rizal				x				x			x	
P.E. 1,2,3,4				x							x	
NSTP 1,2				x							x	

Key: [ ] Very little or no emphasis [x] Some, moderate, or substantial emphasis

ANNEX III

COURSE SPECIFICATIONS

ANNEX III - COURSE SPECIFICATIONS
TABLE OF CONTENTS

COURSE SPECIFICATION
Bachelor of Science in Aeronautical Engineering

I. TECHNICAL COURSES

A. MATHEMATICS

Course Name	**COLLEGE ALGEBRA**
Course Description	Algebraic expressions and equations; solution sets of algebraic equations in one variable: linear, quadratic, polynomial of degree *n*, fractional, radical equations, quadratic in form, exponential and logarithmic equations; decomposition of fractions into partial fractions; solution sets of systems of linear equations involving up to three variables.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	None
Course Objectives	After completing this course, the student must be able to: 1. Operate and simplify algebraic expressions; 2. Determine the solution sets of all types of algebraic equations, exponential and logarithmic equations; and inequalities; 3. Use the manipulative and analytical skills acquired in Objectives 1 to 2 to solve word problems; and 4. Identify the domain and range of a given relation/function.
Course Outline	1. The Set of Real Numbers 1.1. Integer Exponents 1.2. Polynomials, Operations, Special Products 1.3. Binomial Expansion (Binomial Theorem) 1.4. Factoring Polynomials 2. Rational Expressions 2.1. Rules of Exponents; Simplification of Rational Expressions; Operations on Rational Expressions 2.2. Properties of Radicals; Simplification of Radicals 2.3. Operations on Radicals 2.4. Complex Numbers 3. Equations in One Variable 3.1. Linear Equations; Literal Equations 3.2. Quadratic Equations in One Variable 3.3. Word Problems 3.4. Other Equations in One Variable: Radical, Fractional, Quadratic in Form 3.5. Polynomial Equation of Degree *n* 4. Functions 4.1. Inverse Functions 4.2. Exponential and Logarithmic Functions 4.3. Exponential and Logarithmic Equations 5. Systems of Linear Equations (by Elimination Methods) 6. Decomposition of Rational Expressions into Partial Fractions
Laboratory Equipment	None
Suggested References	Dugopolski, Mark. *College Algebra*, 3rd ed. Addison-Wesley, 2002. Leithold, Louis. *College Algebra and Trigonometry*. Massachusetts: Addison-Wesley, 1989. Mijares, Catalina. *College Algebra*. Swokowski, Earl W. and Jeffrey A. Cole. *Algebra and Trigonometry with Analytic Geometry*, 10th ed. Brooks/Cole Publishing Co., 2001.

Course Name	ADVANCED ALGEBRA
Course Description	Matrices and determinants; arithmetic and geometric series; solution sets of different types of inequalities and systems involving quadratics; solution of linear equations using determinants and matrices.
Number of Units for Lecture and Laboratory	2 units lecture
Number of Contact Hours per Week	2 hours lecture
Prerequisites	College Algebra
Course Objectives	After completing this course, the student must be able to: 1. Determine the solution sets of inequalities; 2. Determine the solution sets of systems involving quadratics; 3. Use the manipulative and analytical skills acquired in Objective 2 to solve word problems; 4. Operate and manipulate matrices and determinants; 5. Solve systems of linear equations using matrices and determinants; and 6. Determine the indicated sum of the elements in an arithmetic and geometric sequence.
Course Outline	1. Inequalities 1.1. Linear, Quadratic, and Polynomial Inequality 1.2. Linear Inequalities with Absolute Value 2. Ratio, Proportion, and Variation 3. Determinants 3.1. Expansion by Minors 3.2. Solution of Linear Systems by Cramer's Rule 4. Matrices 4.1. Identity Matrix 4.2. Cofactor Matrix 4.3. Transpose of a Matrix 4.4. Adjoint Matrix 4.5. Inverse of a Matrix 4.6. Algebra on Matrices (Sum and Difference, Scalar Multiplication, Matrix Multiplication) 4.7. Solution of Linear Systems Using Matrices 5. Sequence and Series 5.1. Arithmetic and Geometric Means 5.2. Arithmetic and Geometric Sequences 5.3. Arithmetic and Geometric Series 5.4. Infinite Series 6. Combinatorial Mathematics 6.1. Sequences 6.2. The Factorial of a Number 6.3. Fundamental Principles of Counting, Permutation, and Combination 6.4. Binomial Theorem 6.5. Mathematical Induction
Laboratory Equipment	None
Suggested References	Dugopolski, Mark. *College Algebra*, 3rd ed. Addison-Wesley, 2002. Leithold, Louis. *College Algebra and Trigonometry.* Massachusetts: Addison-Wesley, 1989. Swokowski, Earl W. and Jeffrey A. Cole. *Algebra and Trigonometry with Analytic Geometry*, 10th ed. Brooks/Cole Publishing Co., 2001.

Course Name	**PLANE AND SPHERICAL TRIGONOMETRY**
Course Description	Trigonometric functions; identities and equations; solutions of triangles; law of sines; law of cosines; inverse trigonometric functions; spherical trigonometry
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	None
Course Objectives	After completing this course, the student must be able to: 1. Define angles and how they are measured; 2. Define and evaluate each of the six trigonometric functions; 3. Prove trigonometric functions; 4. Define and evaluate inverse trigonometric functions; 5. Solve trigonometric equations; 6. Solve problems involving right triangles using trigonometric function definitions for acute angles; and 7. Solve problems involving oblique triangles by the use of the sine and cosine laws.
Course Outline	1. Trigonometric Functions 1.1. Angles and Measurement 1.2. Trigonometric Functions of Angles 1.3. Trigonometric Function Values 1.4. The Sine and Cosine of Real Numbers 1.5. Graphs of the Sine and Cosine and Other Sine Waves 1.6. Solutions of Right Triangle 2. Analytic Trigonometry 2.1. The Eight Fundamental Identities 2.2. Proving Trigonometric Identities 2.3. Sum and Difference Identities 2.4. Double-Measure and Half-Measure Identities 2.5. Inverse Trigonometric Functions 2.6. Trigonometric Equations 2.7. Identities for the Product, Sum, and Difference of Sine and Cosine 3. Application of Trigonometry 3.1. The Law of Sines 3.2. The Law of Cosines 4. Spherical Trigonometry 4.1. Fundamental Formulas 4.2. Spherical Triangles
Laboratory Equipment	None
Suggested References	Dilley, et al. Algebra 2 with Trigonometry. D.C. Heath & Co., 1990. Leithold, Louis. College Algebra and Trigonometry. Addison-Wesley, 1992. Sobel, Max A. and Norbert Lerner. Algebra and Trigonometry, 4th ed. New Jersey: Prentice Hall, Inc., 1995.

Course Name	**ANALYTIC GEOMETRY**
Course Description	Equations of lines and conic sections; curve tracing in both rectangular and polar coordinates in two-dimensional space.
Number of Units for Lecture and Laboratory	2 units lecture
Number of Contact Hours per Week	2 hours lecture
Prerequisites	College Algebra Plane and Spherical Trigonometry
Course Objectives	After completing this course, the student must be able to: 1. Set up equations given enough properties of lines and conics; 2. Draw the graph of the given equation of the line and the equation of the conic section; and 3. Analyze and trace completely the curve, given their equations in both rectangular and polar coordinates, in two-dimensional space.
Course Outline	1. Plane Analytic Geometry 1.1. The Cartesian Planes 1.2. Distance Formula 1.3. Point-of-Division Formulas 1.4. Inclination and Slope 1.5. Parallel and Perpendicular Lines 1.6. Angle from One Line to Another 1.7. An Equation of a Locus 2. The Line 2.1. Point-Slope and Two-Point Forms 2.2. Slope-Intercept and Intercept Forms 2.3. Distance from a Point to a Line 2.4. Normal Form 3. The Circle 3.1. The Standard Form for an Equation of a Circle 3.2. Conditions to Determine a Circle 4. Conic Sections 4.1. Introduction 4.2. The Parabola 4.3. The Ellipse 4.4. The Hyperbola 5. Transformation of Coordinates 5.1. Translation of Conic Sections 6. Curve Sketching 6.1. Symmetry and Intercepts 6.2. Sketching Polynomial Equations 6.3. Asymptotes (Except Slant Asymptotes) 6.4. Sketching Rational Functions 7. Polar Coordinates 7.1. Polar Coordinates 7.2. Graphs in Polar Coordinates 7.3. Relationships Between Rectangular and Polar Coordinates
Laboratory Equipment	None
Suggested References	Fuller, Gordon and Dalton Tarwater. *Analytic Geometry*, 7th ed. Addison-Wesley, 1993. Protter, Murray H. and Philip E. Protter. *Calculus with Analytic Geometry*, 4th ed. Quirino and Mijares. *Plane and Analytic Geometry*, 2nd ed. Riddle, Douglas F. *Analytic Geometry*, 6th ed. Swokowski, Earl W. and Jeffrey A. Cole. *Algebra and Trigonometry with Analytic Geometry*, 10th ed. Brooks/Cole Publishing Co., 2001.

Course Name	**SOLID MENSURATION**
Course Description	Concept of lines and planes; Cavalieri's and Volume theorems; formulas for areas of plane figures, volumes for solids; volumes and surfaces areas for spheres, pyramids, and cones; zone, sector and segment of a sphere; theorems of Pappus.
Number of Units for Lecture and Laboratory	2 units lecture
Number of Contact Hours per Week	2 hours lecture
Prerequisite	College Algebra, Plane and Spherical Trigonometry
Course Objectives	After completing this course, the student must be able to: 1. Compute for the area of plane figures; 2. Compute for the surface areas and volumes of different types of solids; and 3. Determine the volumes and surface areas of solids using other methods such as the theorems of Pappus.
Course Outline	1. Plane Figures 1.1. Mensuration of Plane Figures 2. Lines and Planes in Space 2.1. Typical Proofs of Solid Geometry 2.2. Angles 3. Solids for which V = Bh 3.1. Solid Sections 3.2. Cubes 3.3. Rectangular Parallelopiped 3.4. Cavalieri's Theorem 3.5. Volume Theorem 3.6. Prism 3.7. Cylindrical Surface 3.8. Cylinder (Circular and Right Circular) 4. Solids for which V = ⅓Bh 4.1. Pyramids 4.2. Similar Figures 4.3. Cones 4.4. Frustum of Regular Pyramid 4.5. Frustum of Right Circular Cone 5. Sphere 5.1. Surface Area and Volume 5.2. Zone 5.3. Segment 5.4. Sector 6. Theorems of Pappus
Laboratory Equipment	None
Suggested Reference	Kern, Willis F. and James R. Bland. *Solid Mensuration*, 2nd ed. New York: John Wiley & Sons, Inc.

Course Name	**DIFFERENTIAL CALCULUS**
Course Description	Basic concepts of calculus such as limits, continuity and differentiability of functions; differentiation of algebraic and transcendental functions involving one or more variables; applications of differential calculus to problems on optimization, rates of change, related rates, tangents and normals, and approximations; partial differentiation and transcendental curve tracing.
Number of Units for Lecture and Laboratory	4 units lecture
Number of Contact Hours per Week	4 hours lecture
Prerequisites	Advanced Algebra Analytic Geometry Solid Mensuration
Course Objectives	After completing this course, the student must be able to: 1. Have a working knowledge of the basic concepts of functions and limits; 2. Differentiate algebraic and transcendental functions with ease; 3. Apply the concept of differentiation in solving word problems involving optimization, related rates, and approximation; and 4. Analyze and trace transcendental curves.
Course Outline	1. Functions 1.1. Definitions 1.2. Classification of Functions 1.3. Domain and Range of a Function 1.4. Graph of a Function 1.5. Functional Notation 1.6. Evaluation of a Function 1.7. Combinations of Functions 1.8. One-Valued and Many-Valued Functions 1.9. Odd and Even Functions 1.10. Special Function Types 1.11. Functions as Mathematical Models 2. Continuity 2.1. Definition 2.2. Properties of Continuous Functions 3. Limits 3.1. Notion of a Limit 3.2. Definition 3.3. Properties of Limits 3.4. Operations with Limits 3.5. Evaluation of Limits 3.6. One-Sided Limits 3.7. Unbounded Functions 4. The Derivative 4.1. Notion of the Derivative 4.2. Definition 4.3. Determination of the Derivative by Increments 4.4. Differentiation Rules 5. The Slope 5.1. Definition of Slope as the Derivative of a Function 5.2. Determination of the Slope of a Curve at a Given Point 6. Rate of Change 6.1. Average Rate of Change 6.2. Instantaneous Rate of Change 7. The Chain Rule and the General Power Rule 8. Implicit Differentiation 9. Higher-Order Derivatives 10. Polynomial Curves

	10.1. Generalities About Straight Lines 10.2. Tangents and Normal to Curves 10.3. Extrema and the First Derivative Test 10.4. Concavity and the Second Derivative Test 10.5. Points of Inflection 10.6. Sketching Polynomial Curves 11. Applications of the Derivative: Optimization Problems 12. Applications of the Derivative: Related Rates 13. The Differential 13.1. Definition 13.2. Applications of the Differential—Comparison of Δx and dx 13.3. Error Propagation 13.4. Approximate Formulas 14. Derivatives of Trigonometric Functions 14.1. Elementary Properties 14.2. Definition 14.3. Graphs of Trigonometric Functions 14.4. Applications 15. Derivatives of Inverse Trigonometric Functions 15.1. Elementary Properties 15.2. Definition 15.3. Graphs of Inverse Trigonometric Functions 15.4. Applications 16. Derivatives of Logarithmic and Exponential Functions 16.1. Elementary Properties 16.2. Definition 16.3. Graphs of Logarithmic and Exponential Functions 16.4. Applications 17. Derivatives of Hyperbolic Functions 17.1. Elementary Properties 17.2. Definition 17.3. Graphs of Hyperbolic Functions 17.4. Applications 18. Solution of Equations 18.1. Newton's Method of Approximation 18.2. Newton-Raphson Law 19. Transcendental Curve Tracing 19.1. Logarithmic and Exponential Functions 20. Parametric Equations 21. Partial Differentiation
Laboratory Equipment	None
Suggested References	Anton, Howard. *Multivariable Calculus*, 4th ed. New York: John Wiley & Sons, Inc., 1992. Berkey, Dennis D. *Calculus for Management and Social Sciences*, 2nd ed. Saunders College Publishing, 1990 Cozzens, Margaret B. and Richard D. Porter. *Mathematics with Calculus*. D.C. Heath & Co., 1987 Ellis, Robert and Benny Gulick. *Calculus with Analytic Geometry*. Harcourt Brace Jovanovich, 1990. Farlow, Stanley J. *Calculus and Its Application*. McGraw-Hill Publishing, 1990. Goldstein, Larry J., David C. Lay and David I. Schneider. *Calculus and Its Application*, 6th ed. Prentice Hall, Inc., 1993. Harsbarger, Ronald J. and James J. Reynolds. *Calculus with Applications*. D.C. Heath & Co., 1990. Hoffman, Laurence D. *Calculus for Business, Economics and the Social and Life Sciences*, 3rd ed. McGraw-Hill Book Co., 1989. Holder, Leonard L. *A Primer for Calculus*, 4th ed. Wadsworth Publishing Co., 1987. Larson, Roland E. and Bruce H. Edwards. *Finite Mathematics with Calculus*. D.C. Heath & Co., 1987.

	Leithold, Louis. *The Calculus*, 7th ed. Addison-Wesley, 2001. Lial, Margaret L. and Charles D. Miller. *Finite Mathematics and Calculus with Application*, 3rd ed. Scott, Foresman and Company, 1989. Protter, Murray H. *Calculus with Analytic Geometry.* James & Barlett, 1988. Swokowski, Earl W. *Calculus*, 5th ed. PWS-Kent Publishing, 1991. Zill, Dennis G. *Calculus with Analytic Geometry.* PWS-Kent Publishing, 1988. Zitarelli, David E. and Raymond F. Coughlin. *Finite Mathematics with Calculus: An Applied Approach.* Sanders College Publishing, 1989.

Course Name	**INTEGRAL CALCULUS**
Course Description	Concept of integration and its application to physical problems such as evaluation of areas, volumes of revolution, force, and work; fundamental formulas and various techniques of integration applied to both single variable and multi-variable functions; tracing of functions of two variables.
Number of Units for Lecture and Laboratory	4 units lecture
Number of Contact Hours per Week	4 hours lecture
Prerequisite	Differential Calculus
Course Objectives	After completing this course, the student must be able to: 1. Properly carry out integration through the use of the fundamental formulas and/or the various techniques of integration for both single and multiple integrals; 2. Correctly apply the concept of integration in solving problems involving evaluation of areas, volumes, work, and force; 3. Sketch 3-dimensional regions bounded by several surfaces; and 4. Evaluate volumes of 3-dimensional regions bounded by two or more surfaces through the use of the double or triple integral.
Course Outline	1. Integration Concept / Formulas 1.1. Anti-Differentiation 1.2. Simple Power Formula 1.3. Simple Trigonometric Functions 1.4. Logarithmic Function 1.5. Exponential Function 1.6. Inverse Trigonometric Functions 1.7. Hyperbolic Functions 1.8. General Power Formula 1.9. Constant of Integration 1.10. Definite Integral 2. Integration Techniques 2.1. Integration by Parts 2.2. Trigonometric Integrals 2.3. Trigonometric Substitution 2.4. Rational Functions 2.5. Rationalizing Substitution 3. Application 3.1. Improper Integrals 3.2. Plane Area 3.3. Areas Between Curves 4. Other Applications 4.1. Volumes 4.2. Work 4.3. Hydrostatics Pressure and Force 5. Surfaces Multiple Integral as Volume

	5.1. Surface Tracing: Planes 5.2. Spheres 5.3. Cylinders 5.4. Quadratic Surfaces 5.5. Double Integrals 5.6. Triple Integrals 6. Multiple Integral as Volume 6.1. Double Integrals 6.2. Triple Integrals
Laboratory Equipment	None
Suggested References	Anton, Howard. *Multivariable Calculus*, 4th ed. New York: John Wiley & Sons, Inc., 1992. Berkey, Dennis D. *Calculus for Management and Social Sciences*, 2nd ed. Saunders College Publishing, 1990. Cozzens, Margaret B. and Richard D. Porter. *Mathematics with Calculus*. D.C. Heath & Co., 1987. Ellis, Robert and Benny Gulick. *Calculus with Analytic Geometry*. Harcourt Brace Jovanovich, 1990. Farlow, Stanley J. *Calculus and Its Application*. McGraw-Hill Publishing, 1990. Goldstein, Larry J., David C. Lay and David I. Schneider. *Calculus and Its Application*, 6th ed. Prentice Hall, Inc., 1993. Harsbarger, Ronald J. and James J. Reynolds. *Calculus with Applications*. D.C. Heath & Co., 1990. Hoffman, Laurence D. *Calculus for Business, Economics and the Social and Life Sciences*, 3rd ed. McGraw-Hill Book Co., 1989. Leithold, Louis. *The Calculus*, 7th ed. Addison-Wesley, 2001.

Course Name	**DIFFERENTIAL EQUATIONS**
Course Description	Differentiation and integration in solving first order, first-degree differential equations, and linear differential equations of order *n*; Laplace transforms in solving differential equations.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	Integral Calculus
Course Objectives	After completing this course, the student must be able to: 1. Solve the different types of differential equations; and 2. Apply differential equations to selected engineering problems.
Course Outline	1. Definitions 1.1. Definition and Classifications of Differential Equations (D.E.) 1.2. Order Degree of a D.E. / Linearity 1.3. Solution of a D.E. (General and Particular) 2. Solution of Some 1st Order, 1st Degree D.E. 2.1. Variable Separable 2.2. Homogeneous 2.3. Exact 2.4. Linear 2.5. Equations Linear in a Function 2.6. Bernoulli's Equation 3. Applications of 1st Order D.E. 3.1. Decomposition / Growth 3.2. Newton's Law of Cooling

	3.3. Mixing (Non-Reacting Fluids) 3.4. Electric Circuits 4. Linear D.E. of Order *n* 4.1. Standard Form of a Linear D.E. 4.2. Linear Independence of a Set of Functions 4.3. Differential Operators 4.4. Differential Operator Form of a Linear D.E. 5. Homogeneous Linear D.E. with Constant Coefficients 5.1. General Solution 5.2. Auxiliary Equation 6. Non-Homogeneous D.E. with Constant-Coefficients 6.1. Form of the General Solution 6.2. Solution by Method of Undetermined Coefficients 6.3. Solution by Variation of Parameters
Laboratory Equipment	None
Suggested References	Asin, Ricardo C. *Elementary Differential Equations*. National Book Store, 1991. Dela Fuente, Feliciano and Uy. *Elementary Differential Equations*. National Book Store, 1999.

Course Name	**PROBABILITY AND STATISTICS**
Course Description	Basic principles of statistics; presentation and analysis of data; averages, median, mode; deviations; probability distributions; normal curves and applications; regression analysis and correlation; application to engineering problems.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	College Algebra
Course Objectives	After completing this course, the student must be able to: 1. Define relevant statistical terms; 2. Discuss competently the following concepts: 2.1. Frequency distribution 2.2. Measures of central tendency 2.3. Probability distribution 2.4. Normal distribution 2.5. Inferential statistics 3. Apply accurately statistical knowledge in solving specific engineering problem situations.
Course Outline	1. Basic Concepts 1.1. Definition of Statistical Terms 1.2. Importance of Statistics 2. Steps in Conducting a Statistical Inquiry 3. Presentation of Data 3.1. Textual 3.2. Tabular 3.3. Graphical 4. Sampling Techniques 5. Measures of Central Tendency 5.1. Mean 5.2. Median 5.3. Mode 5.4. Skewness and Kurtosis

	6. Measures of Variation 6.1. Range 6.2. Mean Absolute Deviation 6.3. Variance 6.4. Standard Deviation 6.5. Coefficient of Variation 7. Probability Distributions 7.1. Counting Techniques 7.2. Probability 7.3. Mathematical Expectations 7.4. Normal Distributions 8. Inferential Statistics 8.1. Test of Hypothesis 8.2. Test Concerning Means, Variation, and Proportion 8.3. Contingency Tables 8.4. Test of Independence 8.5. Goodness-of-Fit Test 9. Analysis of Variance 10. Regression and Correlation
Laboratory Equipment	None
Suggested References	Sellers, Gene R. and Stephen A. Vardeman. *Elementary Statistics*, 2nd ed. Saunders College Publishing, 1982. Walpole, Ronald E., et al. *Probability and Statistics for Engineers and Scientists*, 7th ed. Prentice Hall, Inc., 2002.

B. NATURAL/PHYSICAL SCIENCES

Course Name	**GENERAL CHEMISTRY**
Course Description	Basic concepts of matter and its classification; mass relationships in chemical reactions; properties of gases, liquids, and solids; concepts of thermochemistry; quantum theory and electronic behavior; periodic relationship of elements in the periodic table; intramolecular forces; and solutions.
Number of Units for Lecture and Laboratory	4 units: 3 units lecture, 1 unit laboratory
Number of Contact Hours per Week	6 hours: 3 hours lecture, 3 hours laboratory
Prerequisite	None
Course Objectives	After completing this course, the student must be able to: 1. Apply significant figures and appropriate units in all measurements and calculations; 2. Classify matter; distinguish between physical and chemical properties/changes; 3. Define and explain the concepts of atomic mass, average atomic mass, mole, molar mass and perform calculations involving these; 4. Balance and interpret chemical equations and perform stoichiometric calculations; 5. Write, explain and apply the gas laws; 6. Discuss the kinetic molecular theory (KMT) of gases and use the KMT to qualitatively explain the gas laws; argue the differences between ideal and non-ideal gas behavior; 7. Define enthalpy; classify common processes as exothermic or endothermic

	and know the sign conventions; 8. Trace the various atomic theories; discuss the Bohr model; and explain the line spectra of hydrogen; Discuss the concept of electron density; contrast the Bohr's orbits with orbitals in the quantum theory; 9. Write electron configurations and orbital diagrams for multi electron atoms; 10. Use the periodic table to classify elements and predict trends in properties; 11. Write Lewis dot symbols and Lewis structure; 12. Explain valence bond theory, hybrid orbitals, and hybridization in common compounds 13. Distinguish between inter- and intramolecular forces; give examples of intramolecular forces and how they relate to physical properties; 14. Distinguish between crystalline and amorphous solids 15. Discuss various physical changes and interpret phase diagrams; 16. Distinguish different types of solutions; work with different concentration units; Understand the effect of temperature and pressure on solubility; and 17. Explain and apply colligative properties to determine molar mass.
Course Outline	1. The Study of Change 1.1. Introduction to Chemistry 1.2. Matter: Classification, States, Physical, and Chemical Properties 1.3. Measurement and Handling of Numbers 2. Atoms, Molecules, and Ions 2.1. The Atomic Theory 2.2. The Structure of the Atom 2.3. Atomic Number, Mass Number, Isotopes 2.4. The Periodic Table 2.5. Molecules and Ions 2.6. Chemical Formulas 2.7. Naming Compounds 3. Mass Relationships in Chemical Reaction 3.1. Atomic Mass 3.2. Molar Mass of an Element and Avogadro's Number 3.3. Molecular Mass 3.4. Percent Composition of Compounds 3.5. Chemical Reactions and Chemical Equations 3.6. Amounts of Reactants and Products 3.7. Limiting Reagents 3.8. Reaction Yield 4. Gases 4.1. Substances That Exist as Gases 4.2. Pressure of a Gas 4.3. The Gas Laws 4.4. The Ideal Gas Equation 4.5. Gas Stoichiometry 4.6. Dalton's Law of Partial Pressure 4.7. The Kinetic Molecular Theory of Gases 4.8. Deviation from Ideal Behavior 5. Thermochemistry 5.1. Energy Changes in Chemical Reactions 5.2. Introduction to Thermodynamics 5.3. Enthalpy 6. Quantum Theory and the Electronic Structure of Atoms 6.1. From Classical Physics to Quantum Theory 6.2. Bohr's Theory of the Hydrogen Atom 6.3. The Dual Nature of the Electron 6.4. Quantum Mechanics 6.5. Quantum Numbers 6.6. Atomic Orbitals 6.7. Electron Configuration 6.8. The Building-Up Principle 7. Periodic Relationships Among the Elements 7.1. Periodic Classification of the Elements

	7.2. Periodic Variation in Physical Properties 7.3. Ionization Energy 7.4. Electron Affinity 8. Chemical Bonding: Basic Concepts 8.1. Lewis Dot Structure 8.2. The Ionic Bond 8.3. The Covalent Bond 8.4. Electronegativity 8.5. Writing Lewis Structure 8.6. The Concept of Resonance 8.7. Bond Energy 9. Chemical Bonding: Molecular Geometry and Hybridization 9.1. Molecular Geometry 9.2. Dipole Moments 9.3. The Valence Bond Theory 9.4. Hybridization of Atomic Orbitals 9.5. Hybridization in Molecules Containing Double and Triple Bonds 10. Intermolecular Forces in Liquids and Solids 10.1. The KMT of Liquids and Solids 10.2. Intermolecular Forces 10.3. Properties of Liquids 10.4. Crystalline vs. Amorphous Solids 10.5. Phase Changes 10.6. Phase Diagrams 11. Physical Properties of Solutions 11.1. Types of Solutions 11.2. A Molecular View of the Solution Process 11.3. Concentration Units 11.4. Effect of Temperature and Pressure on Solubility 11.5. Colligative Properties
Laboratory Equipment	Chemistry Laboratory (see attached)
Suggested References	Chang, Raymond. *Chemistry*, 8th ed. (International Ed.). New York: McGraw Hill, 2005. Eubanks, Lucy P., et al. *Chemistry in Context*, 5th ed. Boston: McGraw Hill, 2006. Masterton, William L. and Cecile N. Hurley. *Chemistry: Principles and Reactions*, 5th ed. Canada: Thomson Brooks/Cole, 2004. Brady, James E., and Fred Senese. *Chemistry: Matter and Its Changes*, 4th ed. New Jersey: John Wiley & Sons, Inc., 2004. Brown, Theodore L., et al. *Chemistry: The Central Science*, 9th ed. New Jersey: 2003. Silberberg, Martin S. *Chemistry: The Molecular Nature of Matter and Change*, 3rd ed. (International Ed.). New York: McGraw Hill, 2003.

Course Name	**PHYSICS 1**
Course Description	Vectors; kinematics; dynamics; work, energy, and power; impulse and momentum; rotation; dynamics of rotation; elasticity; and oscillation.
Number of Units for Lecture and Laboratory	4 units: 3 units lecture, 1 unit laboratory
Number of Contact Hours per Week	6 hours: 3 hours lecture, 3 hours laboratory
Prerequisites	College Algebra Plane and Spherical Trigonometry
Course Objectives	After completing this course, the student must be able to:

	1. Differentiate a vector from a scalar; 2. Determine the resultant of concurrent vectors; 3. Solve problems in kinematics; 4. Apply Newton's Laws of Motion; 5. Determine the gravitational force between different masses; 6. Solve problems involving centripetal force for horizontal and vertical curves; 7. Compute the work done on a given body; 8. Relate work and energy; 9. Solve problems by applying the law of conservation of energy; 10. Solve problems in impulse and momentum and collisions; 11. Determine the stress and strain on a body; and 12. Determine the period of a body in simple harmonic motion.
Course Outline	1. Work, Energy and Power 1.1. Definition of Work, Energy and Power 1.2. Conservation of Energy 2. Impulse and Momentum 2.1. Definition of Impulse and Momentum 2.2. Conservation of Momentum 3. Vector 3.1. Vectors and Scalars 3.2. Graphical Method 3.3. Analytical Method 4. Vector Subtraction 5. Kinematics 5.1. Equations of Kinematics 5.2. Freely Falling Bodies 5.3. Projectile Motion 6. Dynamics 6.1. Newton's Laws of Motion 6.2. Friction 6.3. First Condition of Equilibrium 7. Work, Energy and Power 7.1. Definition of Work, Energy and Power 7.2. Conservation of Energy 8. Impulse and Momentum 8.1. Definition of Impulse and Momentum 8.2. Conservation of Momentum 8.3. Collisions, Coefficient of Restitution 9. Rotation 9.1. Definition of torque 9.2. Second Condition of Equilibrium 9.3. Center of Gravity 10. Dynamics of Rotation 10.1. Kinematics of Rotation 10.2. Dynamics of Rotation 10.3. Center of Gravity 11. Elasticity 11.1. Hooke's Law 11.2. Stress and Strain 11.3. Modulus of Elasticity 12. Oscillations 12.1. Definition of Vibration Motion and Simple Harmonic Motion 12.2. Kinematics of Simple Harmonic Motion 12.3. Simple Pendulum
Laboratory Equipment	Physics Laboratory

Suggested References	Cutnell, J.D. and K.W. Johnsons. *Physics*, 4th ed. Halliday, David, Robert Resnick and Jearl Walker. *Fundamentals of Physics*, 5th ed. John Wiley & Sons, Inc., 1996. Serway, Raymond A. and John W. Jewett Jr. *Physics for Scientists and Engineers*, 6th ed. Brooks/Cole Publishing Co., 2003. Young, Hugh D. and Roger A. Freedman. *University Physics*, 10th ed. Addison Wesley.

Course Name	**PHYSICS 2**
Course Description	Fluids; thermal expansion, thermal stress; heat transfer; calorimetry; waves; electrostatics; electricity; magnetism; optics; image formation by plane and curved mirrors; and image formation by thin lenses.
Number of Units for Lecture and Laboratory	4 units: 3 units lecture, 1 unit laboratory
Number of Contact Hours per Week	6 hours: 3 hours lecture, 3 hours laboratory
Prerequisite	Physics 1
Course Objectives	After completing this course, the student must be able to: 1. Describe the characteristics of fluids at rest and in motion; 2. Compute the buoyant force on an object immersed in a fluid; 3. Compute the pressure and flow speed of a fluid at any point in a flow tube; 4. Determine the amount of expansion of a given material in relation to temperature change; 5. Determine the change in temperature of a given amount of material that loses or gains; 6. Solve problems about the law of heat transfer; 7. Describe the three methods of heat transfer; 8. Discuss the properties of waves; 9. Describe the modes of vibration of strings and air columns; 10. Solve problems on Doppler Effect; 11. Compute the electric force between electric charges; 12. Compute the electric field due to electric charges; 13. Compute the electric potential due to a charge and electric potential energy of charges; 14. Define electric current, electric resistance and voltage; 15. Solve problems on resistance and cells in series and parallel; 16. State Kirchhoff's rules and apply them in a given circuit; 17. Compute the magnetic field of a given current-carrying conductors; 18. Compute the magnetic torque on a current conductor in a magnetic field; and 19. Describe image formation by mirrors and lenses.
Course Outline	1. Fluids 1.1. Pressure, Specific Gravity, Density 1.2. Archimedes' Principle 1.3. Rate of Flow and Continuity Principle 1.4. Bernoulli's Principle 1.5. Torricelli's Theorem 2. Thermal Expansion, Thermal Stress 3. Heat Transfer 4. Calorimetry 4.1. Specific Heat 4.2. Law of Heat Exchange 4.3. Change of Phase 5. Waves

	5.1. Types of Waves and Their Properties 5.2. Sounds 6. Electrostatics 6.1. Charge 6.2. Coulomb's Law 6.3. Superposition Principle 6.4. Electric Field Intensity 6.5. Work and Potential 6.6. Capacitors, Dielectrics 7. Electricity 7.1. Current 7.2. Resistance 7.3. EMF 7.4. Ohm's Law 7.5. Energy and Power in Circuits 7.6. Series and Parallel Connections 7.7. Kirchhoff's Rules 8. Magnetism 8.1. Magnetic Field of Moving Changes 8.2. Magnetic Filed of Current Element 8.3. Motion of a Charge in a Magnetic Field 8.4. Biot-Savart Law 8.5. Force on a Moving Charge in a Magnetic Field 8.6. Torque on a Current-Carrying Loop 9. Optics 9.1. Light as Electromagnetic Waves 9.2. Properties of Reflection and Refraction 10. Image Formation by Plane and Curved Mirrors 10.1. Graphical Methods 10.2. Mirror Equation 11. Image Formation by Thin Lenses 11.1. Graphical Methods 11.2. Lens Equation
Laboratory Equipment	Physics Laboratory
Suggested References	Cutnell, J.D. and K.W. Johnsons. *Physics*, 4th ed. Halliday, David, Robert Resnick and Jearl Walker. *Fundamentals of Physics*, 5th ed. John Wiley & Sons, Inc., 1996. Serway, Raymond A. and John W. Jewett Jr. *Physics for Scientists and Engineers*, 6th ed. 2004. Young, Hugh D. and Roger A. Freedman. *University Physics*, 10th ed. Addison Wesley.

C. BASIC ENGINEERING SCIENCES

Course Name	ENGINEERING DRAWING
Course Description	Practices and techniques of graphical communication; application of drafting instruments, lettering scale, and units of measure; descriptive geometry; orthographic projections; auxiliary views; dimensioning; sectional views; pictorial drawings; requirements of engineering working drawings; and assembly and exploded detailed drawings.
Number of Units for Lecture and Laboratory	1 unit laboratory
Number of Contact Hours per Week	3 hours laboratory
Prerequisite	None
Course Objectives	After completing this course, the student must be able to: 1. Understand the importance of technical drawing knowledge and skills as applied to the various areas of engineering; 2. Apply the basic concepts of technical drawing and sketching; and 3. Prepare technical drawings.
Course Outline	1. Engineering Lettering 2. Instrumental Figures 3. Geometric Construction 4. Orthographic Projection 5. Dimensioning 6. Orthographic Views with Dimensions and Section View 7. Sectional View 8. Pictorial Drawing 9. Engineering Working Drawings 10. Assembly and Exploded Detailed Drawings
Laboratory Equipment	1. Drafting table 2. Drawing instruments 2.1. One 30-60 degree triangle 2.2. One 45 degree triangle 2.3. One technical compass 2.4. One protractor
Suggested References	French, Thomas E., Charles J. Vierck and Robert J. Foster. *Engineering Drawing and Graphic Technology*, 14th ed. McGraw-Hill, 1993. Giesecke, Frederick E. *Principles of Engineering Graphics*, 2nd ed. Prentice Hall, Inc., 1993. Giesecke, Frederick E., et al. *Technical Drawing*, 12th ed. 2002. Luzadder, Warren J. *Fundamentals of Engineering Drawing*, 11th ed. Prentice Hall, Inc., 1992. Luzadder, Warren J. and Jon M. Duff. *Introduction to Engineering Drawing*, 2nd ed. 1992.

Course Name	COMPUTER FUNDAMENTALS AND PROGRAMMING
Course Description	Basic information technology concepts; fundamentals of algorithm development; high-level language and programming applications; computer solutions of engineering problems.
Number of Units for Lecture and Laboratory	2 units laboratory

Number of Contact Hours per Week	6 hours laboratory
Prerequisite	Second Year Standing
Course Objectives	After completing this course, the student must be able to: 1. Understand basic information technology concepts; 2. Use application software and the Internet properly; 3. Acquire proficiency in algorithm development using a high-level programming language; 4. Use the computer as a tool in engineering practice.
Course Outline	1. Introduction to Computers 1.1. Computer Organization 1.2. Number Systems and Data Representation 1.3. Application Software: Word Processing and Spreadsheet 1.4. The Internet 2. Programming 2.1. Algorithm Development 2.2. Programming Fundamentals
Laboratory Equipment	1. Personal computer with: 1.1. Operating system 1.2. Word processing software 1.3. Spreadsheet software 1.4. High-level programming language 1.5. Internet browser and Internet connection
Suggested References	Caputo, Tony C., *Build Your Own Server*, McGraw-Hill, 2003. Kruse, Robert L., Bruce P. Leung and Clovis L. Tondo. *Data Structures and Program Design in C*, 2nd ed. Prentice Hall, Inc., 1996. Press, Barry and Marcia Press. *PC Upgrade and Repair Bible*, Desktop Edition. John Wiley & Sons, Inc., 2004. Sebesta, Robert W. *Concepts of Programming Languages*, 4th ed. Addison-Wesley Publishing Co., 1999.

Course Name	**COMPUTER-AIDED DRAFTING**
Course Description	Concepts of computer-aided drafting (CAD); introduction to the CAD environment; terminologies; and the general operating procedures and techniques in entering and executing basic CAD commands.
Number of Units for Lecture and Laboratory	1 unit laboratory
Number of Contact Hours per Week	3 hours laboratory
Prerequisite	Third Year Standing
Course Objectives	After completing this course, the student must be able to: 1. Define the terms related to computer-aided drafting systems; 2. Identify the important tools used to create technical drawings in CAD; 3. Create electronic drawings (e-drawing) using CAD; and 4. Appreciate the usefulness of the knowledge and skills in computer aided drafting as applied in his/her professional development.

Course Outline	1. Introduction to CAD Software 2. CAD Drawing 3. Snapping, Construction Elements 4. Dimensioning 5. Plotting, Inputting Images 6. 3D and Navigating in 3D 7. Rendering
Laboratory Equipment	1. Personal computer with: 1.1. Operating system 1.2. CAD software 2. Printer or plotter
Suggested References	*CAD Software User's Manual.*

Course Name	**STATICS OF RIGID BODIES**
Course Description	Force systems; structure analyses; friction; centroids and centers of gravity; and moments of inertia.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisites	Physics 1 Integral Calculus
Course Objectives	After completing this course, the student must be able to: 1. Understand the principles of equilibrium of particles; 2. Undertake vector operations such as vector cross and dot product; 3. Determine forces of 2D and 3D structures; 4. Understand the principles of static, wedge and belt friction; 5. Determine centroids, center of mass and center of gravity of objects; 6. Determine moment of inertia, mass moment of inertia; and 7. Analyze the stresses of trusses, beams and frames.
Course Outline	1. Introduction to Mechanics; Vector Operations 2. Force Vectors and Equilibrium of Particles 3. Vector Cross and Dot Product 4. Moment of a Force 5. Couples; Moment of a Couple 6. Equivalent Force Systems in 2D and 3D 7. Dry Static Friction, Wedge and Belt Friction 8. Centroid; Center of Mass; and Center of Gravity 9. Distributed Loads and Hydrostatic Forces; Cables 10. Moment of Inertia; Mass Moment of Inertia 11. Trusses; Frames and Machines; Internal Forces 12. Beams; Shear and Bending Moment Diagrams
Laboratory Equipment	None
Suggested References	Bedford, Anthony and Wallace Fowler. *Engineering Mechanics: Statics*, 3rd ed. New Jersey: Prentice Hall, Inc., 2002. Beer, Ferdinand P. and E. Russell Johnston Jr. *Vector Mechanics for Engineers: Statics*, 7th SI ed. Pacheco, Edgardo S. *Statics of Rigid Bodies*, SI ed.

Course Name	DYNAMICS OF RIGID BODIES
Course Description	Kinetics and kinematics of a particle; kinetics and kinematics of rigid bodies; work energy method; and impulse and momentum.
Number of Units for Lecture and Laboratory	2 units lecture
Number of Contact Hours per Week	2 hours lecture
Prerequisite	Statics of Rigid Bodies
Course Objectives	After completing this course, the student must be able to: 1. Understand the principles governing the motion of particles, velocity and acceleration; 2. Understand the principles of Newton's Second Law and its applications; 3. Understand kinetics of particles in particular energy and momentum methods; and 4. Understand kinematics of rigid bodies, its energy and momentum.
Course Outline	1. Introduction to Dynamics 2. Position, Velocity, and Acceleration 3. Determination of the Motion of the Particles 4. Uniform Rectilinear Motion 5. Uniformly Accelerated Rectilinear Motion 6. Position Vector, Velocity, and Acceleration 7. Derivatives of Vector Functions 8. Rectangular Components of Velocity and Acceleration 9. Motion Relative to a Frame in Translation 10. Tangential and Normal Components 11. Radial and Transverse Components 12. Motion of Several Particles (Dependent Motion) 13. Kinetics of Particles: Newton's Second Law 13.1. Newton's Second Law of Motion 13.2. Linear Momentum of the Particle, Rate of Change of Linear Momentum 13.3. System of Units 13.4. Equation of Motion 13.5. Dynamic Equilibrium 13.6. Angular Momentum of Particle, Rate of Change of Angular Momentum 13.7. Equations in Terms of Radial and Transverse Components 13.8. Motion Under a Central Force 14. Kinetics of Particles: Energy and Momentum Methods 14.1. Work of Force 14.2. Kinetic Energy of a Particle, Principle of Work and Energy 14.3. Applications of the Principle of Work and Energy 14.4. Potential Energy 14.5. Conservative Forces 14.6. Conservation of Energy 14.7. Principle of Impulse and Momentum 14.8. Impulsive Motion 14.9. Impact 14.10. Direct Central Impact 14.11. Oblique Central Impact 14.12. Problems Involving Energy and Momentum 15. Systems of Particles 15.1. Application of Newton's Second Laws to Motion of a System of Particles 15.2. Linear and Angular Momentum of a System of Particles 15.3. Motion of Mass Center of a System of Particles 15.4. Angular Momentum of a System of Particles About Its Mass Center 15.5. Conservation of Momentum for a System of Particles 15.6. Kinetic Energy of a System of Particles 15.7. Work-Energy Principle, Conservation of Energy for a System of

	Particles 15.8. Principle of Impulse and Momentum for a System of Particles 16. Kinematics of Rigid Bodies 16.1. Translation 16.2. Rotation About a Fixed Axis 16.3. Equations Defining the Rotation of a Rigid Body About a Fixed Axis 16.4. General Plane Motion 16.5. Absolute and Relative Velocity in Plane Motion 16.6. Instantaneous Center of Rotation in Plane Motion 16.7. Absolute and Relative Acceleration 16.8. Rate of Change of a Vector with Respect to a Rotating Frame 16.9. Plane Motion of a Particle Relative to a Rotating Frame; Coriolis Acceleration 16.10. Motion About a Fixed Point 16.11. General Motion 16.12. Three-Dimensional Motion of a Particle Relative to a Rotating Frame; Coriolis Acceleration 16.13. Frame of Reference in General Motion 17. Plane Motion of Rigid Bodies: Forces and Accelerations 17.1. Equation of Motions 17.2. Angular Momentum of a Rigid Body in Plane Motion 17.3. Plane Motion of a Rigid Body. D' Alembert's Principle 17.4. Solution of Problems involving the Motion of a Rigid Bodies 17.5. Systems of Rigid Bodies 17.6. Constrained Plane Motion 18. Plane Motion of Rigid Bodies: Energy and Momentum Methods 18.1. Principle of Work and Energy for a Rigid Body 18.2. Work of Forces Acting on a Rigid Body 18.3. Kinetic Energy of a Rigid Body in Plane Motion 18.4 Systems of Rigid Bodies 18.5 Conservation of Energy 18.6 Principle of Impulse and Momentum 18.7 Conservation of Angular Momentum 18.8 Impulsive Motion 18.9 Eccentric Impact
Laboratory Equipment	None
Suggested Reference	Beer and Johnston. *Vector Mechanics for Engineers: Dynamics*, 7th SI ed. McGraw-Hill, 2003.

Course Name	**MECHANICS OF DEFORMABLE BODIES**
Course Description	Axial stress and strain; stresses for torsion and bending; combined stresses; beam deflections; indeterminate beams; and elastic instability.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	Statics of Rigid Bodies
Course Objectives	After completing this course, the student must be able to: 1. Understand the concepts of stress and strain; 2. Calculate stresses due to bending, shears, and torsion under plain and combined loading; 3. Analyze statically determinate and indeterminate structures; and 4. Determine the elastic stability of columns.

Course Outline	1. Load Classification 2. Concept of Stress, Normal and Shear Stress 3. Stresses under Centric Loading 4. Stress Concentration 5. Plane Stress 6. Principal Stresses for Plane Stress 7. Mohr's Circle for Plane Stress 8. Deformations, Normal and Shear Strains 9. Material Properties 10. Working Stresses 11. Deformation in a System of Axially Loaded Members 12. Temperature Effects on Axially Loaded Members 13. Statically Indeterminate Members 14. Thin-Walled Pressure Vessel 15. Torsional Stresses; Elastic Torsion Formula 16. Torsional Deformation; Power Transmission 17. Flexural Stresses by the Elastic Curve 18. Moment Equation Using Singularity Function 19. Beam Deflection by the Double Integration Method 20. Area Moment Theorems 21. Moment Diagram by Parts 22. Beam Deflection by Area Moment Method 23. Statically Indeterminate Beams 24. Buckling of Long Straight Columns 25. Combined Loadings 26. Analysis of Riveted Connections by the Uniform Shear Method 27. Welded Connections
Laboratory Equipment	None
Suggested References	Hibbeler, Russell C. *Mechanics of Materials*, 5th ed. Prentice Hall, Inc., 2002. Higdon, Archie, et al. *Mechanics of Deformable Bodies*, 4th ed. John Wiley & Sons, 1989. McGill, David and Wilton M. King. *Engineering Mechanics, An Introduction to Dynamics*, 3rd ed. PWS Publishing Co., 1995.

Course Name	**ENGINEERING ECONOMY**
Course Description	Concepts of the time value of money and equivalence; basic economy study methods; decisions under certainty; decisions recognizing risk; and decisions admitting uncertainty.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	Third Year Standing
Course Objectives	After completing this course, the student must be able to: 1. Solve problems involving interest and the time value of money; 2. Evaluate project alternatives by applying engineering economic principles and methods and select the most economically efficient one; and 3. Deal with risk and uncertainty in project outcomes by applying the basic economic decision making concepts.

Course Outline	1. Introduction 1.1. Definitions 1.2. Principles of Engineering Economy 1.3. Engineering Economy and the Design Process 1.4. Cost Concepts for Decision Making 1.5. Present Economy Studies 2. Money-Time Relationships and Equivalence 2.1. Interest and the Time Value of Money 2.2. The Concept of Equivalence 2.3. Cash Flows 3. Basic Economy Study Methods 3.1. The Minimum Attractive Rate of Return 3.2. The Present Worth Method 3.3. The Future Worth Method 3.4. The Annual Worth Method 3.5. The Internal Rate of Return Method 3.6. The External Rate of Return Method 3.7. The Payback Period Method 3.8. The Benefit/Cost Ratio Method 4. Decisions Under Certainty 4.1. Evaluation of Mutually Exclusive Alternatives 4.2. Evaluation of Independent Projects 4.3. Depreciation and After-Tax Economic Analysis 4.4. Replacement Studies 5. Decisions Recognizing Risk 5.1. Expected Monetary Value of Alternatives 5.2. Discounted Decision Tree Analysis 6. Decisions Admitting Uncertainty 6.1. Sensitivity Analysis 6.2. Decision Analysis Models
Laboratory Equipment	None
Suggested References	Blank, Leland T. and Anthony J. Tarquin. *Engineering Economy*, 6th ed. McGraw-Hill, Inc., 2005. Grant, Eugene L., et al., *Principles of Engineering Economy*, 8th ed. John Wiley & Sons, Inc., 1990. Newman, Donald G., Jerome P Lavelle and Ted S. Eschenbach. *Essentials of Engineering Economic Analysis*, 2nd ed., Oxford University Press, 2002. Park, Chan S. *Contemporary Engineering Economics*, 3rd ed. Addison Wesley, 2001. Riggs, James L., et al. *Engineering Economics*, 4th ed., McGraw-Hill, 1996. Sullivan, William G., Elin M. Wicks and James T. Luxhoj. *Engineering Economy*, 12th ed. Prentice Hall, Inc., 2002. Thuesen, Gerald J. and W.J. Fabrycky. *Engineering Economy*, 9th ed. Prentice Hall, Inc., 2001.

Course Name	**ENGINEERING MANAGEMENT**
Course Description	Decision-making; the functions of management; managing production and service operations; managing the marketing function; and managing the finance function.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture

Prerequisite	Third Year Standing
Course Objectives	After completing this course, the student must be able to: 1. Understand the field of engineering management; 2. Know and apply the different functions of management.
Course Outline	1. Introduction to Engineering Management 2. Decision Making 3. Functions of Management 3.1. Planning / Coordinating 3.2. Organizing 3.3. Staffing 3.4. Communicating 3.5. Motivating 3.6. Leading 3.7. Controlling 4. Managing Product and Service Operations 5. Managing the Marketing Function 6. Managing the Finance Function
Laboratory Equipment	None
Suggested References	Eisner, Howard. *Essentials of Project and System Engineering Management*, 2nd ed. John Wiley & Sons, Inc., 2002. Gram, Harold A. *An Introduction to Management.* Holt, Rinehart and Winston of Canada, Limited, 1990. Oberlender, Gerold D. *Project Management for Engineering and Construction*, 2nd ed. McGraw-Hill, 2000. Robbins, Stephen P. and Mary Coulter. *Management*, 6th ed. Prentice Hall, Inc., 1999. Wheeler, Thomas F. *Computer and Engineering Management.* McGraw-Hill, 1990.

Course Name	**ENVIRONMENTAL ENGINEERING**
Course Description	Ecological framework of sustainable development; pollution environments: water, air, and solid; waste treatment processes, disposal, and management; government legislation, rules, and regulation related to the environment and waste management; and environmental management system.
Number of Units for Lecture and Laboratory	2 units lecture
Number of Contact Hours per Week	2 hours lecture
Prerequisites	General Chemistry
Course Objectives	After completing this course, the student must be able to: 1. Understand the various effects of environmental pollution; 2. Know the existing laws, rules, and regulations of the government on environmental issues; 3. Identify, plan, and select appropriate design treatment schemes for waste disposal; and 4. Understand the importance of waste management and its relevance to the engineering profession.

Course Outline	1. Ecological Concepts 1.1. Introduction to Environmental Engineering 1.2. Ecology of Life 1.3. Biogeochemical Cycles 1.4. Ecosystems 2. Pollution Environments 2.1. Water Environment 2.2. Air Environment 2.3. Solid Environmental 2.4. Toxic and Hazardous Waste Treatment 3. Environmental Management System 3.1. Environmental Impact Assessment 3.2. Environmental Clearance Certificate
Laboratory Equipment	None
Suggested References	Bellardi, O'Brien. *Hazardous Waste Site Remediation.* John Wiley & Sons, Inc., 1995. Crites, Ron and G. Tchobanoglous. *Small and Decentralized Wastewater Management Systems.* McGraw-Hill, 1998. Davis, Mackenzie L. and Susan J. Masten. *Principles of Environmental Engineering and Science.* McGraw-Hill, 2004. Guzmar, Ruth and Roger Guzmar. *Environmental Education for Sustainable Development.* Wisdom Advocate Publishing, 2000. Heisketh, Howard. *Air Pollution Control - Traditional and Hazardous Pollutants.* Technomic Publishing Co., Inc., 1996. Henze, M., et al. *Wastewater Treatment.* Berlin: Springer Verlag, 1997. Kay, J.G., G.E. Keller and J.F. Miller. *Indoor Air Pollution.* Chelsea, Michigan: Lewis Publishers, 1991. Kiely, Gerard. *Environmental Engineering.* McGraw-Hill, 1997. Metcalf and Eddy, Inc. *Wastewater Engineering - Collection, Treatment and Disposal.* McGraw-Hill, 1991. Mihekic, James. *Fundamentals of Environmental Engineering.* John Wiley & Sons, Inc., 1999. Nemerow, N.L. and F. Agardy. *Strategies of Industrial and Hazardous Waste Management.* International Thomson Publishing Company, 1998. Ortolano, Leonard. *Environmental Regulation and Impact Assessment.* John Wiley & Sons, Inc., 1997. Perry, S., D. Rower and G. Tchobanoglous. *Environmental Engineering.* McGraw-Hill, 1985. Wark, K., C. Warner and W. Davis. *Air Pollution - Its Origin and Control.* Addison-Wesley, 1998.

Course Name	**SAFETY MANAGEMENT**
Course Description	Evolution of safety management; safety terminology; safety programs adopted by high risk industries; hazards in the construction, manufacturing, gas and power plants, and other engineering industries and how to prevent or mitigate them; techniques in hazard identification and analysis in workplaces; off-the-job safety; disaster prevention and mitigation; and incident investigation.
Number of Units for Lecture and Laboratory	1 unit lecture
Number of Contact Hours per Week	1 hour lecture
Prerequisites	Third Year Standing

Course Objectives	After completing this course, the student must be able to: 1. Understand the importance and the value of safety; 2. Know the health hazards and their prevention; 3. Identify and mitigate or prevent hazards; and 4. Apply the concepts and principles of safety in engineering practice.
Course Outline	1. Overview of Safety 2. Basic Safety Procedures in High Risk Activities and Industries 2.1. Procedure in Hazards Analysis in the Workplace 2.2. Control of Hazardous Energies 2.3. Confined Space Entry 2.4. Basic Electrical Safety 2.5. Fall Protection 2.6. Barricades and Scaffolds 2.7. Fire Safety and the Fire Code 2.8. Industrial Hygiene 2.9. Hazard Communication and Chemical Safety 3. Value Based Safety and Off-the-Job Safety 3.1. Safety as a Value; Choice vs. Compliance 3.2. Off-the-Job Safety (Residences and Public Places) 3.3. Safety as Related to Health Practices 4. Disaster Prevention and Mitigation 4.1. Rationale for Disaster Prevention and Loss Control 4.2. Planning for Emergencies 4.3. Emergency Response Procedures 5. Incident Investigation and Reporting 5.1. Accident Escalation, Incident Investigation and Reporting 5.2. Causal Analysis; Recognition of Root Cause 5.3. Identification of Corrective or Preventive Actions
Laboratory Equipment	None
Suggested References	Asfahl, C. Ray. *Industrial Safety and Health Management*, 5th ed. Prentice Hall, Inc., 2003. Department of Labor and Employment. *Occupational Health and Safety Standards.* Hopf, Peter S. *Designer's Guide to OSHA*, 2nd ed. New York: McGraw-Hill, 1982.

D. ALLIED COURSES

Course Name:	**THERMODYNAMICS**
Course Description	A course dealing with the thermodynamic properties of pure substances, ideal and real gases and the study and application of the laws of thermodynamics in the analysis of processes and cycles. It includes introduction to vapor and gas cycles.
Number of Units for Lecture and Laboratory	Lecture - 3 units
Number of Contact Hours per week	Lecture - 3 hours/ week
Prerequisite	Integral Calculus, Physics 2

Course Objectives	After completing this course, the student must be able to: 1. Understand the principles underlying the utilization of energy in the thermal systems; open and closed systems; and introduction to gas and vapor cycles.
Course Outline	1. Introduction 2. Basic Principles, Concepts and definition 3. First Law of Thermodynamics 4. Ideal Gases/ Ideal Gas Laws 5. Processes of Ideal Gases 6. Properties of Pure Substance 7. Processes of Pure Substance 8. Introduction to cycle analysis: Second Law of Thermodynamics 9. Introduction to Gas and vapor cycles
Laboratory Equipment	None
Suggested References	Engineering Thermodynamics, 4th Edition *by: M. David Burghardt and J.A. Harback* Engineering Thermodynamics , 2nd Ed. *By Francis F. Huang* Thermal Fluid Sciences *by Cengel and Boles* Fundamentals of Thermodynamics *by : Sonntag and Van Wylen* Thermodynamics *by: Kenneth Wark* Thermodynamics by: Shapiro and Moran

Course Name:	**ELEMENTARY ELECTRICAL ENGINEERING**
Course Description	This course provides the students a sound background in the theory and concepts of the fundamental and basic laws of electricity and magnetism. Practical applications such as electrical equipment, electrical safety, blueprint reading, house wiring, and lighting are introduced
Number of Units for Lecture and Laboratory	Lecture – 3 units
Number of Contact Hours per week	Lecture – 3 hours
Prerequisite	Physics 2
Course Objectives	After completing this course, the student must be able to: 1. Have a deeper understanding and appreciation about electric circuits. 2. Know the operating principles of AC-DC equipment. 3. Know the basic electrical blueprint reading, house wiring and lighting and electrical safety. 4. Appreciate the importance of the course to the student's field of study.
Course Outline	1. **DIRECT CURRENT.** Ohm's Law, Series, Parallel Connections, Batteries and Power. 2. **ALTERNATING CURRENT.** Voltage, Current & Phase, Peak, rms, Average Values. 3. **MAGNETISM.** Fundamentals, Magnetic Circuits, Units of Magnetics. 4. **ELECTRICAL MATERIALS.** Conductors, Insulators, Semiconductors. 5. **DC MACHINES / EQUIPMENT.** Fundamental Concepts, Motors, Meters. 6. **AC MACHINES / EQUIPMENT.** Fundamental Concepts, Motors, Transformers.

	7. **ELECTRICAL SAFETY.** Equipment Protection, Personnel Protection. 8. **BLUEPRINT READING.** Electrical Symbols, Electrical Diagrams. 16 **HOUSE WIRING AND LIGHTING**
Laboratory Equipment	None
Suggested References	*National Electrical Code Handbook.* Gussow, Milton; *Schaum's Outline Series: Basic Electricity Theory & Problems.* 1983 Fowler, Richard; *Electriity Principles & Applications.* 1989. Mullin, Ray C. and Smith, Robert L.; *Electrical Wiring (Commercial).*

Course Name:	**BASIC ELECTRONICS**
Course Description	This Course discusses the construction, operation and characteristics of basic electronics devices such as PN junction diode, light emitting diode, Zener diode, Bipolar Junction Transistor and Field Effect Transistor. Diode circuit applications such as clipper, clamper and switching diode circuits will be a part of the lecture. Operation of a DC regulated power supply as well as analysis of BJT and FET amplifier circuit will be tackled. This course also discusses the operation and characteristics of operational amplifiers
Number of Units for Lecture and Laboratory	Lecture - 3 units Laboratory – 1 unit
Number of Contact Hours per week	Lecture - 3 hours/ week Laboratory – 3 hours
Prerequisite	Elementary Electrical Engineering
Course Objectives	After completing this course, the student must be able to: 1. learn and understand the basic operation, construction and characteristics of different electronic devices such as PN, junction diode, light emitting diode, Zener diode, Bipolar junction Transistor, Field Effect Transistor and Operational Amplifier as well as their application 2. learn and understand the operation and a DC regulated power supply. 3. analyze BJT and FET amplifier circuits. 4. analyze Operational amplifier circuits.
Course Outline	1. Introduction to Electronics Definition, History and application of Electronics Common Electronics Components 2. Solid State Fundamentals Conductor, Insulator, Semiconductor 3. Semiconductor PN Junction Diode 3.1 Construction and operation, characteristic curve 3.2 Diode Equivalent Model 3.3 Diode Circuit Analysis 3.4 Light Emitting Diode 4. DC Regulated Power Supply 4.1 Block Diagram, Transformer, Rectifier 4.2 Simple Capacitor Filter 4.3 Voltage Regulator

	5. Bipolar Junction Transistor 5.1 Construction and schematic symbol 5.2 Region of Operation and characteristic curve of BJT Eber's Moll Model 5.3 Amplification factors and basic BJT Formula Switching Transistor Circuit 5.4 BJT amplifier Configuration 5.5 BJT amplifier Circuit analysis 5.6 FET Amplifier Regulation 5.7 JFET and MOSFET DC Analysis 5.8 FET AC small signal analysis 6. Operational Amplifiers 6.1 Block Diagram 1.2 Characteristics and Equivalent Circuit 1.3 Op-amp close loop operation
Laboratory Equipment	None
Suggested References	1. Electronic Circuit Analysis and Design by Neamen D. 2. Electronic Devices by Thomas Floyd

E. PROFESSIONAL COURSES

Course Name	**ADVANCED ENGINEERING MATHEMATICS FOR AeroE**
Course Description	A study of selected topics in mathematics and their applications in advanced courses in engineering and other allied sciences. It covers the study of Complex Numbers, Laplace and Inverse Laplace Transforms, Power series, Fourier series, Matrices and Determinants, Vector Analysis and Numerical Methods.
Number of Units for Lecture and Laboratory	Lecture – 3 units
Number of Contact Hours per week	Lecture – 3 hours
Prerequisite	Differential Equations
Course Objectives	After completing this course, the student must be able to: 1. Familiarize themselves with the different parameters, laws, theorems and the different methods of solutions in advance mathematics, 2. Develop their abilities on how to apply the different laws, methods and theorems particularly in complex problems.
Course Outline	1. Complex Numbers 2. Laplace and Inverse Laplace Transforms 3. Power Series 4. Fourier Series 5. Vector Analysis 6. Numerical Methods
Laboratory Equipment	NONE
Suggested References	1. Dulay,Virgilio, *Advanced Engineering Mathematics,* 1996 2. Kreyszig, Erwin, *Advanced Engineering Mathematics,* John Wiley and Son Publishing 1972 3. Bromwell,Arthur, *Advanced Mathematics in Physics and Engineering,* Mc Graw Hill Publishing 1953 4. Kolman, Bernard *Linear Algebra,* Mc Millan Publishing Hous1991 5. Scheid, Francis, *Numerical Analysis, Mc Graw Hill Publishing* 1968 6. *MatLab Manuals Rel 12, MSOffice 2000*

Course Name:	**AERODROME ENGINEERING AND MANAGEMENT**
Course Description:	The course includes study on aerodrome planning, design, operation and management.
Number of Units for Lecture and Laboratory:	3 unit lecture, 0 unit laboratory = 3 Units
Number of Contact Hours per Week:	3 hours lecture, 0 hour laboratory = 3 Hours
Pre - requisite:	Engineering Management, Air Laws and Regulations
Course Objectives:	After completing this course, the student must be able to: 1. know the characteristics and basic design requirements of an aerodrome and to be familiar with its operation and management.
Course Outline:	1. Introduction to Aerodrome 1.1 Aerodrome 1.2 Maneuvering Area 1.3 Apron 2. Aerodrome Data and Physical Characteristics 3. Aerodrome Planning 4. Aerodrome Design 4.1 Structural Design of Airport Pavements 4.2 Aircraft characteristics related to airport design 5. Aerodrome Facilities 5.1 Air Traffic control 5.2 Airport lighting systems 5.3 Air Navigational Services 5.4 Search and Rescue, and Firefighting 5.5 Passenger and Cargo handling service 5.6 Aircraft handling services and equipments 5.7 Airport Safety Management System (SMS)
Laboratory/ Equipment:	1. Field Trip to aerodrome facilities 2. Audio visual equipment 3. Aerodrome Charts
Suggested References:	1. Textbook 1.1 Horonjeff, McKelvey. *Planning and Design of Airports*. McGraw Hill. 4th Edition 2. References: 2.1 ICAO Annex 14 Volume 1 2.2 ICAO Annex 17 – Airport Security, Safeguarding Int'l Civil Aviation Against Acts of Unlawful Interference 2.3 Administrative Order No. 5 series 1967 Construction, Classification and Rating of Aerodromes whether national, Provincial, Municipal or Private 2.4 Administrative Order No. AGA-14.02 series 1973 Aerodrome for Aircraft Operation under VFR only 2.5 ICAO Doc 9774 - Manual on Certification of Aerodromes 2.6 ICAO Aerodrome Planning Manual 2.7 A.O. No. ATS 12.01-2 s 1985 Search and Rescue Services 2.8 ICAO Annex 10 Aeronautical Telecommunication 2.9 ICAO Doc 9426 Air Traffic Services Planning Manual 2.10 ICAO Annex 15 Aeronautical Information Services 2.11 ICAO Annex 16 Environmental Protection 2.12 Philippine Aeronautical Information Publication (AIP) 2.13 ICAO Doc 9137 Airport Services Manual 2.14 A.O. No. AGA 14.13, s. 1973, CAR

Course Name:	**AERONAUTICAL LABORATORY**
Course Description:	The course includes a series of experimental work on subsonic wind tunnel. It consists of wind tunnel familiarization, airflow visualization, wing aerodynamic characteristics, airfoil chordwise pressure distribution, drag of bluff bodies, high lift devices, end plates and winglets.
Number of Units for Lecture and Laboratory:	1 unit lecture, 2 units laboratory = 3 Units
Number of Contact Hours per Week:	1 hour lecture, 6 hours laboratory = 7 Hours
Pre - requisite:	Fundamentals of Aerodynamics
Course Objectives:	After completing this course, the student must be able to design and conduct experiments on airfoils and other aerodynamic bodies using a wind tunnel.
Course Outline:	1. Wind Tunnel Familiarization 2. Air flow Visualization 3. Calibration of the 3-D Balance 4. Test Section Calibration 5. Free Stream Turbulence 6. Drag Measurements 7. Wing and High Lift Devices Testing Lectures are conducted inside the Aeronautical Laboratory where experiments could immediately be conducted.
Laboratory/ Equipment:	1. Refer to Annex II – Aeronautical Laboratory equipment. 2. Film showing using multimedia projectors will assist in the instruction.
Suggested References:	1. Textbook 1.1 William H. Rae Jr. and Allan Pope. *Low-Speed Wind Tunnel Testing*. Second Edition. 1984 2. References 2.1 Pope, John Wiley & Sons. *Wind Tunnel Testing*. 2.2 Pankhurst and Holder. *Wind Tunnel Technique*. 2.3 Civil Aviation Manual (CAM)

Course Name:	**AIRCRAFT AVIONICS**
Course Description:	The course includes the discussions on the description and operation of the different aircraft electrical and electronics systems, and aircraft instruments.
Number of Units for Lecture and Laboratory:	4 units lecture, 0 unit laboratory = 4 Units

Number of Contact Hours per Week:	4 hours lecture, 0 hour laboratory = 4 Hours
Pre - requisite:	Aircraft Systems
Course Objectives:	After completing this course, the student must be able to: 1. know and understand the design and operation of the different aircraft instrument and avionics systems 2. apply such knowledge in aircraft maintenance, inspection and design.
Course Outline:	1. Aircraft Electrical System 1.1 Review of basic electricity 1.2 Aircraft electrical generating system 1.3 Aircraft emergency power generating system 1.4 Aircraft electrical distribution system 2. Aircraft Communications Systems 2.1 Review of Basic Electronics 2.2 Radio theory 2.2.1 Radio Waves and Propagation 2.2.2 Frequency Spectrum 2.3 Basic Communication System 2.3.1 HF/ VHF Communication 2.3.2 SELCAL 2.3.3 Interphones 3. Aircraft Navigation System 1.1 Basic Navigation system 1.1.1 Direction Finding 1.1.2 Non-directional beacon 1.1.3 Marker beacon 1.1.4 VHF Omni-directional Range 1.1.5 Distance Measuring Equipment 1.1.6 Tactical Air Navigation 1.2 Advance Navigation system 1.2.1 Satellite Navigation System 1.2.2 Inertial Navigation system 2. Aircraft Instruments 2.1 Principal Element of Instrument 2.1.1 Transmitting Mechanism 2.1.2 Displays/ Indication 2.1.3 Range and Markings 2.2 Pitot-Static Instrument and System 2.2.1 Altimeter 2.2.2 Airspeed Indicator 2.2.3 Air Temperature 2.2.4 Vertical Speed Indicator/ ROC 2.2.5 Gyro instruments
Laboratory/ Equipment:	An aircraft visit shall be required.
Suggested References:	1. Textbooks 1.1 MAX F. Henderson Jeffesen. *Aircraft Instruments and Avionics* 1.2 Thomas A. Eismin. *Aircraft Electricity and Electronics.* McGraw-Hill International Editions. 5th Edition. 1994 2. References: 2.1 Airplane Manufacturers Training Manuals 2.2 Pallette. Pitman. *Aircraft Instruments.* London 1981 2.3 Pellet, Longman. *Aircraft Electrical Systems.* Scientific and Technical, 3rd Edition 2.4 Kluver Academics, RPG Collinson. *Intro to Avionics Systems.* 2003

Course Name:	**AIRCRAFT MAINTENANCE AND INSPECTION**
Course Description:	The course includes discussions on the maintenance tasks performed on an aircraft, the documentations, tools, equipments and standard procedures used to accomplish such tasks.
Number of Units for Lecture and Laboratory:	3 Units Lecture, 1 Unit Laboratory = 4 Units
Number of Contact Hours per Week:	3 Hours Lecture, 3 Hours Laboratory = 6 Hours
Pre - requisite:	Aircraft materials and processes
Course Objectives:	After completing this course, the student must be able to: 1. Identify the basic maintenance tasks performed on an aircraft. 2. Know the basic tools and ground support equipments used for aircraft maintenance. 3. Understand standard practices observed in aircraft maintenance 4. Understand different documentations used in aircraft maintenance 5. Know the differentiate methods of destructive and non-destructive type of aircraft inspection
Course Outline Lecture:	1. Basic Maintenance Program 1.1 Aircraft Manufacturer Maintenance Planning Documents (MPD) 1.2 Other maintenance program to include the CPCP, SSID and the mandatory Mod Program 2. Airplane checks based on the Aircraft Operating Specifications (AOS) 3. Familiarization on Technical Publications 3.1 Standard aircraft manuals (AMM, SRM, WDM) 3.2 Service Bulletin (SB) 3.3 Airworthiness Directives (AD) 3.4 Alert Service Bulletin (ASB) 3.5 Mandatory Bulletin 4. Purpose and use of different aircraft tools and ground support equipments 5. Aircraft Maintenance Standard Practices 6. Different methods of inspection (Destructive and Non-destructive) 7. Airplane Corrosion and Control 7.1 Nature of Corrosion 7.2 Different types of Corrosion 7.3 Identifying corrosion in the different part of aircraft 7.4 Repair of corroded airplane 7.5 Prevention and Control of Corrosion. 8. Aging Aircraft program review of recommended modifications for compliance
Course Outline Laboratory:	1. Corrosion Control 1.1 Identification of corrosion 1.2 Cleaning of corroded parts 1.3 Application of corrosion preventive compound 2. Magnetic Particle and Penetrant Testing 2.1 Preparation of materials 2.2 Selection and set-up of equipments for testing 2.3 Actual testing of materials 2.4 Identification and evaluation of results 3. Radiographic Inspection

	3.1 Visit to a radiographic inspection facility to witness actual radiographic inspection of an aircraft part 4. Ultrasonic Inspection 4.1 Visit to an ultrasonic inspection facility to witness actual ultrasonic inspection of an aircraft part 5. Eddy Current Testing 5.1 Visit to an eddy current testing facility to witness actual inspection of an aircraft part
Laboratory/ Equipment:	1. Refer to Annex II –Aircraft Maintenance and Inspection Shop Equipment. 2. Multi-media presentation of different aircraft equipments could help in the instruction.
Suggested References:	1. Text book 1.1 Ralph Bent. *Maintenance & Repair of Aerospace Vehicles*. New York, McGraw Hill 1980 2. References 2.1 McKinley & Bent. *Basic Science for Aerospace Vehicles*. 2.2 Airline Maintenance Program Handbook 2.3 FAA Advisory Circular (FAA AC 43-3) Non-destructive Testing for Aircraft 2.4 *Aircraft Inspections repair and alterations* (Sept. 8, 1998 Edition)

Course Name:	**AIRCRAFT MATERIALS AND PROCESSES**
Course Description:	The course includes the studies of the physical & chemical properties of aircraft materials (ferrous and non-ferrous metals, and composite materials) and its application to aircraft. Also includes all the metallurgical and forming process, testing, inspection and corrosion control, and material failure analysis.
Number of Units for Lecture and Laboratory:	3 units lecture, 0 unit laboratory = 3 Units
Number of Contact Hours per Week:	3 hours lecture, 0 hour laboratory = 3 Hours
Pre - requisite:	Physics 2 and General Chemistry
Course Objectives:	After completing this course, the student must be able to: 1. know and identify metallic and non-metallic materials, its properties and its application to aircraft 2. know all the processes, testing and inspection of these materials. 3. Discussion on composite materials will also be included.
Course Outline:	1. Properties of Materials 1.1 Aircraft fabrics 1.2 Aircraft plastics 1.3 Aircraft metals 2. Material Processes 2.1 Cold working of aircraft metals 2.2 Heat treatment of aircraft metals

	2.3 Welding, Riveting and other processes 3. Aircraft Material Testing and Inspection 3.1 Destructive testing 3.2 Non-Destructive testing 3.3 Other tests 4. Composite Materials 4.1 Properties 4.2 Applications 5. Advance Aircraft Materials
Laboratory/ Equipment:	NONE
Suggested References:	1. Textbook 1.1 George Titterton. *Aircraft Materials and Processes.* Pitman publishing. 1956 2. References 2.1 Sodenberg, George A. *Finishing Materials & Methods.* McKnight & McKnight Publishing Company. 1998 2.2 Goetzel, Claus G. *Space Materials Handbook.* Addison-Wesley Publishing Company, Inc. 2.3 Brian Hoskin and Alan Baker. *Composite Materials for Aircraft Structures.* American Institute of Aeronautics, Inc. (AIAA). 2004

Course Name:	**AIRCRAFT STRUCTURE 1**
Course Description:	The course includes the general loads on aircraft; types of structures, load and stress analysis of statically determinate structures and statically indeterminate structures, trusses, beams, frames and rings, continuous structures; pressure vessels; columns and plates.
Number of Units for Lecture and Laboratory:	5 units lecture, 0 unit laboratory = 5 Units
Number of Contact Hours per Week:	5 hours lecture, 0 hour laboratory = 5 Hours
Pre - requisite:	Mechanics of Deformable Bodies, Airframe Construction and Repair, Advanced Engineering Mathematics
Course Objectives:	After completing this course, the student must be able to develop concepts needed to analyze the outside forces, reaction loads, bending moment, truss and frame analysis, stress analysis of simple structures, statically determinate and indeterminate structures on members of wing, fuselage, engine mount and landing gear structures.
Course Outline:	1. Introduction – Review of: 1.1 Structural designs/Systems 1.2 Loads and stresses in aircraft structures 1.3 Section properties 1.4 Allowable stress 1.5 Design of members 1.6 Statically determinate and indeterminate members

	1.7 Types of structures 1.8 Stress and strain 1.9 Forces and couples, laws of statics, reactions 2. Axially loaded members 2.1 Tension and compression on members 2.2 Truss analysis 2.3 Methods of joints 2.4 Methods of Moments 2.5 Methods of shears 3. Beams 3.1 Shear and bending moments 3.2 Relations between load, shear and moment 3.3 Theory of stress in bending 3.4 Deflection of beams 3.5 Continuous beams
Laboratory Equipment:	NONE
Suggested References:	1. Textbook 1.1 David Perry. *Aircraft Structures.* McGraw Hill Book Company, 1982. 2. References 2.1 John Wiley and Sons. *Mechanics of Aircraft Structures.* 1998 2.2 Williams, Edward Arnold. *The Theory of aircraft structures. An Introduction.* 2.3 Bruhn, EF. *Analysis and Design of Flight Vehicle Structures.* 1973 2.4 Niles & Newell. *Airplane Structures.* 2.5 Sechler. *Airplane structural Analysis and Design.*

Course Name:	**AIRCRAFT STRUCTURES 2**
Course Description:	The course includes studies on loads and stresses acting on, and the reactions of, beams, plates, thin-walled sections and other complex aircraft structures. It also introduces composite structures.
Number of Units for Lecture and Laboratory:	5 units lecture, 0 Unit laboratory = 5 Units
Number of Contact Hours per Week:	5 hours lecture, 0 hour laboratory = 5 Hours
Pre - requisite:	Aircraft Structures 1
Course Objectives:	After completing this course, the student must be able to: 1. Analyze loads and stresses acting on aircraft fittings, thin walled sections, rings and frames; 2. know the design concepts of structures required to resists such loads; 3. Understand the fundamental theory of elasticity, stress concentration on aircraft structures and composite structures.

Course Outline:	1. Design criteria and determination of loads (Fittings and Connections) 1.1 Economy in fitting design 1.2 Fitting design loads/Margin of safety 1.3 Factor of safety 1.4 Aircraft Bolts and bolt fitting 1.5 Bolt and lug strength analysis 1.6 Multiple riveted or bolted joints subjected to eccentric loads 2. Engineering Materials and Properties 3. Torsion-Stresses and Deflections 3.1 Torsion of members with circular cross sections, other symmetrical cross sections and thin open sections 3.2 Transmission of power by a cylindrical shaft 4. Buckling design of structural elements 5. Thin hollow sections 5.1 Shear distribution in a torque box 5.2 Single cell torque box 5.3 Two-spar wing with flanges 5.4 Two-cell torque box with one spar flanges 5.5 Two cell torque box with two spars flanges 5.6 Multiple cell torque box 6. Shear center 7. Deflection analysis of structures 8. Introduction to Wing and Fuselage Stress Analysis by Modified Beam Theory 9. Loads and Stresses on Ribs and Frames 10. Wing Problem Analysis: Cutouts, Shear Lag, Swept Wing 11. Connections and Designs Details 12. Welded Connections
Laboratory/ Equipment:	NONE
Text Books and References:	1. Textbook 1.1 Bruhn, EF. *Analysis and Design of Flight Vehicle Structures*. 1973 2. References 2.1 John Wiley and Sons. *Mechanics of Aircraft Structures*. 1998 2.2 Williams, Edward Arnold. *The Theory of aircraft structures. An Introduction*. 2.3 Perry. *Aircraft Structures*. McGraw-Hill Book Company, 1982. 2.4 Lloyd and Hackman. *Analysis and Design of Filamentary Composite Structures*. 2.5 Brian Hoskin and Alan Baler. *Composite Materials for Aircraft Structures*. American Institute of Aeronautics, Inc. (AIAA). 2.6 Michael CY NIU. *Airframe Structural Design*. 1999

Course Name:	**AIRCRAFT SYSTEMS**
Course Description:	The course includes lectures on the description and operation of the different airframe systems
Number of Units for Lecture and Laboratory:	4 units lecture, 0 unit laboratory = 4 Units
Number of Contact Hours per Week:	4 hours lecture, 0 hour laboratory = 4 Hours
Pre - requisite:	Basic electronics

Course Objectives:	After completing this course, the student must be able to know the design and operation of the different aircraft mechanical systems
Course Outline:	1. Pneumatics 1.1 Sources of Pneumatics 1.2 Operation and Description 1.3 Indications 2. Air conditioning and Pressurization 2.1 Operation and Description 2.2 Indications 3. Hydraulics 3.1 Operation and description 3.1.1 Hydraulic Power Generation 3.1.2 Distribution 3.2 Indication 4. Flight Controls 4.1 Operation and description 4.1.1 Primary vs. secondary flight controls 4.1.2 Mechanical vs. fly-by-wire 4.1.3 Trimming 4.2 Indication and control 5. Auto Pilot 5.1 Operation and Description 5.2 Indication and control 6. Landing Gear 6.1 Operation and description 6.1.1 Extension/ Retraction (Normal 6.1.2 Alternate extension 6.1.3 Steering 6.1.4 Wheels and Brakes 6.1.4.1 Auto Brakes 6.1.4.2 Normal and Alternate Brakes 6.1.5 Antiskid 7. Fuel System 7.1 Operations and Description 7.1.1 Storage 7.1.2 Venting 7.1.3 Fueling and defueling 7.1.4 Distribution 7.2 Indications 8. Fire Protection (APU, Powerplant and Cargo) 8.1 Operations and Description 8.1.1 Detection 8.1.2 Indication (aural & visual) 8.1.3 Extinguishing 9. Water and Waste 9.1 Operation and description 9.1.1 Potable water system 9.1.2 Gallery 9.1.3 Lavatories 10. Oxygen 10.1 Operation/ Description 10.1.1 Passenger 10.1.2 Crew 10.1.3 Portable Oxygen 11. Ice and Rain Protection System 11.1 Operation and description 11.1.1 Areas with anti-ice and de-ice 11.1.2 Rain repellant system 11.1.3 Windshield wiper

Laboratory/ Equipment:	1. An aircraft visit shall be required. 2. Systematic diagrams of typical aircraft system
Suggested References:	1. Textbook 1.1 Casper, W Y. *Transport Category Aircraft Systems*. IAP Inc. 1990 2. References 2.1 Airplane Manufacturers Training Manuals 2.2 William A. Nesse. *Aircraft Hydraulic Systems*. 3rd Edition, 1991

Course Name:	**AIRFRAME CONSTRUCTION AND REPAIR**
Course Description:	The course includes lectures on aircraft structures, aircraft hardware, working tools, machines and other related equipments used in aircraft repair. It also includes discussions on typical airframe modification and repair practices for metal and non-metal structures and use of applicable finishes and aircraft paints.
Number of Units for Lecture and Laboratory:	2 units lecture, 2 units laboratory = 4 Units
Number of Contact Hours per Week:	2 hours lecture, 6 hours laboratory = 8 Hours
Pre - requisite:	Aircraft Materials and Processes
Course Objectives:	After completing this course, the student must be able to: 1. Know and make applicable repair methods for different types of aircraft structural damages, 2. Identify standard aircraft hardware and materials, know its characteristics and identify possible substitutes, 3. Interpret structural drawings and identify other requirements.
Course Outline Lecture:	1. Aircraft structural components: primary & secondary parts 2. Review of physical, mechanical and chemical properties of materials and its required finishes 3. Physical and mechanical properties of aircraft hardware 4. Structural Modification and repair procedures 4.1 Damage tolerance/limits 4.2 Repair techniques 5. Adhesives, sealant, finishes and other chemicals used in aircraft construction and repair 6. Interpretation of structural drawings including finishes and processes
Course Outline Laboratory:	1. Familiarization with sheet metal tools and equipment 2. Familiarization of structural hardware 3. Actual identification of aircraft structural materials. 4. Have hands-on experience on the use of working tools and equipments for the structural repairs. 5. Actual joining of steel parts using both electric and gas welding equipments.
Laboratory/ Equipment:	Refer to Annex II – Airframe Shop equipment

Suggested References:	1. Textbook 1.1 AC 43-13 Methods, Techniques, Inspection & Repair (New Issue) 2. References 2.1 US Mil handbook # 5 2.2 OEM Structural Repair Manuals 2.3 Bent. *Maintenance and Repair of Aerospace Vehicle*. FAA AC 43.13v FAA Repair Method and Techniques (Chapter 12). 2.4 Dace Crant. *Aircraft Sheet Metal*. Wyoming Aviation Maintenance Publishing Inc. 2.5 Bent, Ralph D. *Aircraft Maintenance & Repair*. McGraw Hill Book Co. Inc.

Course Name:	**AIR LAWS AND REGULATIONS**
Course Description:	The course includes the study of the Aeronautical Engineering Law and other local and foreign Air Laws and Regulations relevant to Aeronautical Engineering.
Number of Units for Lecture and Laboratory:	3 Units Lecture, 0 Unit Laboratory = 3 Units
Number of Contact Hours per Week:	3 Hours Lecture, 0 Hour Laboratory = 3 Hours
Pre - requisite:	None
Course Objectives:	After completing this course, the student must be able to understand Philippine Air Laws and other international regulations pertaining to the design, maintenance, repair, alteration and operation of aircraft.
Course Outline:	1. Introduction 1.1 Familiarization on: 1.1.1 National organizations (ATO, CAB, SAEP, etc.) 1.1.2 International Organizations (ICAO, FAA, IATA, etc.) 2. Aeronautical Engineering Law 2.1 Basic Law 2.2 Implementing Rules and Regulations of P.D. 1570 2.3 Code of Ethics 3. Philippine Civil Air Regulations 3.1 Philippines R.A. 776 s1952 Civil Aeronautics Act of the Philippines 3.2 Administrative Orders: 3.2.1 A.O. No. 4-A s1970 Maintenance, Repair, and Alteration of Airframes, Power plants, Propellers and Appliances 3.2.2 A.O. No. 1 s1979 Aircraft Noise 3.2.3 A.O. No. FSS 8.01 s1987 Standard of the Airworthiness of Aircraft 3.2.4 A.O. No. 121 s2001 Certification and Operation of Scheduled and Non-Scheduled International/Domestic Air Carrier 3.2.5 A.O. No. 135 certification and operation of Air taxi operation 3.2.6 A.O. No. 60, s. 2001, Airframe and Plant Mechanic License 3.2.7 A.O. No. 91, s. 2001 General Operating Rules. 4. Foreign Air Laws and Regulations 4.1 Federal Air Regulations No. 21/ 23/ 25/ 27/ 29/ 31/ 33/ 35/ 36 4.2 ICAO Annexes 4.3

Laboratory/ Equipment:	NONE
Suggested Text Books and References:	1. Textbooks: 1.1 Aeronautical Engineering Law 1.2 U.S. Federal Aviation Regulations 1.3 ATO Administrative Orders 1.4 ICAO Annexes and Documents 1.5 IATA Technical Publications

Course Name:	**AIRCRAFT DESIGN 1**
Course Description:	The course includes lectures on the procedures of aircraft design, general design requirements, aircraft specifications, selection of propulsion system, weight estimate and center of gravity determination, and preliminary performance calculations including flight envelopes. The actual drawing of the airplane to be designed and other calculations are done during laboratory time.
Number of Units for Lecture and Laboratory:	3 units lecture, 2 units laboratory = 5 Units
Number of Contact Hours per Week:	3 hours lecture, 6 hours laboratory = 9 Hours Note: Laboratory hours are for design and computational exercises performed in either the Aeronautical Laboratory or in Computer (CADD) Laboratory.
Pre - requisite:	Applied Supersonic Aerodynamics, Aircraft Systems, Reciprocating Engines, Gas Turbine Engines
Course Objectives:	After completing this course, the student must be able to: 1. Define a complete specification of an aircraft he/she plans to design, estimate its weight and center of gravity location, and 2. Conduct a preliminary performance calculation using the knowledge he/she acquired in aerodynamics, aircraft systems, propulsion and aircraft structures.
Course Outline:	1. Design Concept 1.1 Airplane Type Selection 1.2 Design Procedure 2. Preliminary aircraft specifications 3. Preliminary Three View drawing 4. Integration of Propulsion System 5. Airfoil Selection 6. External loads determination 7. Preliminary Weight Estimate 8. Centroid Computation 9. Center of Gravity Envelope 10. Preliminary Performance Calculations
Laboratory/ Equipment:	Computers

Suggested Text Books and References:	1. Textbooks 1.1 Daniel Raymer. *Aircraft design: A Conceptual Approach*. American Institute of Aeronautics, Inc. (AIAA). 1.2 Jenkinson and Marchman. *Aircraft Design Project for Engineering Students*. 2003 2. References 2.1 Stinton. Danrol. *Design of Aeroplane*. 1983 2.2 Torrenseck, Egbery. *Synthesis of Subsonic Airplane Design*. 1982 2.3 Anderson. *Aircraft Layout & Detail Design*. McGraw hill Fundamentals of aircraft design-school of engineering, University of Daytona, Ohio 2.4 Wood. *Aerospace Vehicle Design*. Volume 1, Johnson publishing company. 2.5 Roskam, Jan. *Airplane Design I-VIII*. DAR Corporation, 2000 2.6 Teichmann. *Airplane Design Manual*. Pitman Publishing, 1958 2.7 Code of Federal Regulations-US –FAA

Course Name:	**AIRCRAFT DESIGN 2**
Course Description:	This is a continuation of Airplane Design 1. It includes lectures on the detail design requirements and concepts of major aircraft parts and aircraft systems, aircraft stability and control. Laboratory work includes actual drawing of the aircraft and its parts and wind tunnel test of a scaled model.
Number of Units for Lecture and Laboratory:	3 units lecture, 2 units laboratory = 5 Units
Number of Contact Hours per Week:	3 hours lecture, 6 hours laboratory = 9 Hours Note: Laboratory hours are for design and computational exercises performed in either the Aeronautical Laboratory or in Computer (CADD) Laboratory.
Pre - requisite:	Aircraft Design 1, Aircraft Structure 2
Course Objectives:	After completing this course, the student must be able to: 1. Adapt international standards to the design of an airplane 2. Define the systems and interior configuration of the airplane 3. Determine its final performance characteristics.
Course Outline:	1. Layout Design 1.1 Cockpit design 1.2 Fuselage Layout Design 1.3 Wing layout design 1.3.1 Aerodynamic and operational design consideration 1.3.2 Corrected Airfoil Characteristics 1.4 Empennage layout design 1.5 Landing Gear layout design 1.5.1 Brake system 1.5.2 Steering system 1.6 Flight control system Layout Design 1.7 Fuel system Layout Design 2. Controllability, maneuverability and trim 3. Static and dynamic stability 4. Final performance calculations 5. Final Three Views

Laboratory/ Equipment:	1. Reports from Airplane Design I 2. Refer to Annex II –Aeronautical and Computer Laboratory Equipment. 3. Scaled model
Suggested Text Books and References:	1. Textbooks 1.1 Daniel Raymer. *Aircraft design: A Conceptual Approach*. American Institute of Aeronautics, Inc. (AIAA). 1.2 Jenkinson and Marchman. *Aircraft Design Project for Engineering Students*. 2003 2. References 2.1 Stinton. Danrol. *Design of Aeroplane*. 1983 2.2 Torrenseck, Egbery. *Synthesis of Subsonic Airplane Design*. 1982 2.3 Anderson. *Aircraft Layout & Detail Design*. McGraw hill Fundamentals of aircraft design-school of engineering, University of Daytona, Ohio 2.4 Wood. *Aerospace Vehicle Design*. Volume 1, Johnson publishing company. 2.5 Roskam, Jan. *Airplane Design I-VIII*. DAR Corporation, 2000 2.6 Teichmann. *"Airplane Design Manual*. Pitman Publishing. 1958 2.7 Code of Federal Regulations-US –FAA

Course Name:	**AIR TRANSPORT ECONOMICS AND MANAGEMENT**
Course Description:	The course includes discussions on air transport organization: organizational structure, departmental functions, accountabilities, interdepartmental relationships and standard practices on personnel. It also includes market analyses and techniques and economic studies and introduction to decision-making tool through case studies.
Number of Units for Lecture and Laboratory:	3 units lecture, 0 unit laboratory = 2 Units
Number of Contact Hours per Week:	2 hours lecture, 0 hour laboratory = 2 Hours
Pre - requisite:	Engineering Economy, Engineering Management, Air Laws and Regulation
Course Objectives:	After completing this course, the student must be able to: 1. Know the historical development of air transportation and understand an ideal organizational structure and its function. 2. Understand approaches to economic studies mostly used in an air transport industry and some application of computer systems technology in such studies.
Course Outline:	1. Air Transportation Overview of historical development 2. Air Transport Industry 3. Economic Characteristics of Air Transportation including organization 4. Principles of Airline & Fleet Planning 5. Air Transport Marketing 6. Computer Systems Technology in Air Transportation 7. Air Transportation Maintenance, Production and Management 8. Air agreements and the International Civil Aviation Organization 9. Case study

Laboratory/ Equipment:	NONE
Suggested Text Books and References:	1. Textbook: 1.1 Alexander T. Wells. *Air transportation- A management Perspective* 2. References: 2.1 Air transport – A Marketing Perspective by Stephen Shaw Magtibay "Economics of Air Transportation, Compilation"

Course Name:	**APPLIED SUBSONIC AERODYNAMICS**
Course Description:	The course includes the study of airplane performance, maneuvering and gust loads, flight envelope, stability and control, and vibration and flutter.
Number of Units for Lecture and Laboratory:	5 units lecture, 0 unit laboratory = 5 Units
Number of Contact Hours per Week:	5 hours lecture, 0 hour laboratory = 5 Hours
Pre - requisite:	Fundamentals of Aerodynamics, Aircraft Propulsion system
Course Objectives:	After completing this course, the student must be able to have adequate knowledge on Airplane Performance, Airplane Flight Loads and Stability and Control.
Course Outline:	1. Review of Aircraft Propulsion System 1.1 Piston Engines 1.1.1 Power output and fuel efficiency 1.1.2 Factors affecting power output 1.1.3 Performance charts for piston engines 1.2 Jet engines 1.2.1. Operational Characteristics of turbo-props 1.2.2. Thrust, power and fuel consumption of gas turbine engines 1.3 Propeller Performance 1.3.1 Static thrust 1.3.2 In-flight thrust and power 1.3.3 Negative thrust 2 Fundamentals of flight Performance 2.1 Steady un-powered flight 2.2 Steady powered flight 2.3 Steady, level, powered flight 2.4 Climb and Drift-down Performance 2.5 Take-Off and Landing 2.6 Endurance and Range 2.7 Maneuvering and flight envelope 3 Stability and control 3.1 Stability and control during steady flight 3.2 Stability and control during perturbed flight
Laboratory/ Equipment:	NONE
Suggested Text Books and References:	1. Textbook 1.1 Anderson, John D, Jr. *Introduction to Flight.* 3rd Edition. 2. References 2.1 Jones, Bradley. *Elements of Practical Aerodynamics.* 2.2 Ashley and Landah. *Aerodynamics of Wings and Bodies.* 2.3 E. Arthur Bornes. *Engineering Supersonic Aerodynamics.* 1st Edition

Course Name:	**APPLIED SUPERSONIC AERODYNAMICS**
Course Description:	This is the third course in aerodynamics which includes discussions on isentropic flow, shock wave formation, friction and heat transfer and concepts of supersonic airfoil/wing design.
Number of Units for Lecture and Laboratory:	5 units lecture, 0 unit laboratory = 5 Units
Number of Contact Hours per Week:	5 hours lecture, 0 hour Laboratory = 5 Hours
Pre - requisite:	Applied Subsonic Aerodynamics
Course Objectives:	After completing this course, the student must be able to: The student shall be able to on the following: 1. Have adequate knowledge on Compressible Flows 2. Have adequate knowledge on Shock wave formation and effects 3. Have adequate knowledge on Aerodynamics Characteristics of High-Speed Airfoils and Plan forms Configurations 4. Have adequate knowledge on Composite Design and Performance of Supersonic Aircrafts and Missiles
Course Outline:	1. Brief Review of Thermodynamics Aerodynamics 1.1 Perfect Gas 1.2 Equation of State 1.3 Speed of Sound 1.4 Bernoulli's Equation for Compressible Fluid 1.5 Mach Number 1.6 Reynolds Number 2. Effects of Compressibility 2.1 Law of Continuity 2.2 Effect of Mach Number on Continuity 2.3 Property Relationships 2.4 Critical Velocity, Critical Mach Number, Critical Pressure Coefficient 2.5 Dynamic Similarity (Wind Tunnel) 2.6 Reservoir 3. Mach Number and Shock Waves 3.1 Mach Number and Classification 3.2 Mach Lines and Wave Fronts 4. Normal Shock Waves 4.1 Mach Number Across a Normal Space Waves 4.2 Pressure-density, Velocity and Temperature Across Normal Shock Waves 5. Two-dimensional Characteristics 5.1 The Appropriate Theory 5.2 Exact Theory 6. Airfoil Characteristics 6.1 Two-dimensional Characteristics 6.1.1 Use of the 2nd Order Approximation 6.1.2 Aerodynamics Characteristics of a Two-dimensional Symmetrical Double-Wedge Airfoil 6.1.3 Optimum Group-Sectional Shapes 6.1.4 Moment and Center of Pressure

	6.1.5 Sweep Back 7. Bodies of Revolution 7.1 Aerodynamics Characteristics 7.1.1 Conical Nose 7.1.2 Ogival Nose 7.1.3 Ducted Nose and Ogives 7.1.4 Internal Lift of Ducted Noses 7.1.5 Above Noses Mounted Ahead of Cylinder Shapes 7.1.6 Base Bag
Laboratory/ Equipment:	NONE
Suggested Text Books and References:	1. Textbook 1.1 E. Arthur Bornes. *Engineering Supersonic Aerodynamics*. 1st Edition. 2. References 2.1 Clancy, L.S. *Aerodynamics*. 2.2 Anderson, John D, Jr. *Introduction to Flight*. 3rd Edition. 2.3 James EA John, Allyn and Bacon, Boston. *Gas Dynamics*. 1972

Course Name:	**AVIATION SAFETY**
Course Description:	The course includes familiarization with emergency system and procedures including occupational safety accessories; introduction to aircraft accident prevention through pre-accident analysis; study of available collected records and pertinent data dealing with all phases of aircraft accidents and incidents; ICAO safety standards and practices in the operations of different types of aircraft including crew resource management.
Number of Units for Lecture and Laboratory:	2 units lecture, 0 unit laboratory = 2 Units
Number of Contact Hours per Week:	2 hours lecture, 0 hour laboratory = 2 Hours
Pre - requisite:	Environmental Engineering, Safety Management
Course Objectives:	After completing this course, the student must be able to: 1. Familiarize with the emergency systems and procedures including occupational safety accessories 2. Analyze the pre-accident and study the data of all phases of aircraft accident and investigations. 3. Familiarize with the ICAO safety standards and practices in the operations of different types of aircraft as well as the understanding of human errors and its types, causes and consequences.
Course Outline:	1. Aircraft Emergency Systems 1.1 Description and operation 2. Emergency Procedures 3. Human Performance and Limitations 3.1 Psychological Factors 3.2 Medical and Physiological Factors

	3.3 Social and Organizational Factors 4. Stress and Human Errors 4.1 Stress 4.2 Stress Management 5. Occupational Safety Policies 5.1 Accident Prevention 5.2 Safety Rules 6. Aircraft Accident Investigation Procedures
Laboratory/ Equipment:	Audio-visual Equipment
Suggested Text Books and References:	1. Textbooks: 1.1 ICAO Aircraft Accident Investigation Manual 1.2 Alexander Wells. *Commercial Aviation Safety*. McGrawhill 2001 2. References: 2.1 ICAO Handbook for Aircraft Accident Investigation 2.2 A.O. No. FSS 13.01 s1973 Accident Investigation involving Civil Aircraft 2.3 Employees Basic Safety Handbook (PAL) 2.4 Jeppessen. *Aviation Safety*

Course Name:	**BASIC HELICOPTER AND PROPELLER DESIGN**
Course Description:	The course includes the principles, design and construction of aircraft propellers and helicopters
Number of Units for Lecture and Laboratory:	3 units lecture, 0 unit laboratory = 3 Units
Number of Contact Hours per Week:	3 hours lecture, 0 hour laboratory = 3 Hours
Pre - requisite:	Applied Supersonic Aerodynamics, Aircraft Systems, Reciprocating Engines, Gas Turbine
Course Objectives:	After completing this course, the student must be able to: 1. know the different types of propellers and its construction. 2. understand the principles of operation of the propeller. From the middle of the term, the discussion will be focused on helicopters: the different configurations of helicopter, the helicopter aerodynamics and principles of helicopter design.
Course Outline:	1. Introduction 1.1 Nomenclature of Aircraft Propeller 1.2 Fundamentals of Aircraft Propeller Construction 1.3 Materials used in Different Types of Propellers 1.4 Propeller Accessories 2. Classification of Aircraft Propellers and Operation 2.1 Fixed Pitch Propeller

	2.2 Adjustable Pitch Propeller 2.3 Controllable Pitch Propeller 2.4 Constant Speed Propeller 3. Forces Acting on Problems and Strength of Propeller 3.1 Thrust and Torque Forces 3.2 Lift and Drag 3.3 Centrifugal Force and Bending Stress 3.4 Propeller Center of Gravity 4. General Design Requirements. (Reporting and Research) 5. History of helicopters and its development 6. Helicopter configuration 7. Basic helicopter aerodynamics 7.1 Momentum theory and wake analysis 7.2 Blade element theory 7.3 Aerodynamics in forward flight 7.4 Performance 8. Basic helicopter design 8.1 Design concepts and requirements 8.2 Preliminary specifications (comparative analysis) 8.3 Design of the main rotor 8.4 Design of the fuselage and interiors 8.5 Design of the empennage 8.6 Design of the tail rotors 9. Preliminary weight estimates 10. Centroid computation 11. Center of Gravity Determination 12. Corrected Three-view drawing
Laboratory/ Equipment:	An aircraft visit shall be required.
Suggested Text Books and References:	1. Textbook 1.1 J. Gordon Leishman. *Principles of Helicopter Aerodynamics.* Cambridge University, 2000 2. References: 2.1 L.R. Jenkinson & J.F. Marchman III. *Aircraft Design Project for engineering Students.* 2003 2.2 Propeller Handbook – FAA 2.3 *Helicopter Design and Construction.* Matrix Publishers. 1984 2.4 Wayne Johnson. *Basic Helicopter Aerodynamic.* AIAA Education. 1990 2.5 Anderson. *Aircraft Layout & Detail Design.* McGraw hill Fundamentals of aircraft design-School of engineering, University of Daytona, Ohio 2.6 G.D. Padfield. *Helicopter Flight Dynamics.* 1996 2.7 Code of Federal Regulations-US –FAA

Course Name:	**COMPUTER AIDED DRAFTING AND DESIGN (CADD) 1**
Course Description:	The course introduces the CADD program, its interface, commands, concepts and special features. At the end of the course, the student shall also be able to know the intermediate topics on CADD which includes dimensioning, plotting and printing.

Number of Units for Lecture and Laboratory:	2 units lecture, 1 unit laboratory = 3 Units
Number of Contact Hours per Week:	2 hours lecture, 3 hours laboratory = 5 Hours Note: Lectures are conducted inside the Computer Laboratory for hands-on exercises in the computers.
Pre - requisite:	Computer Aided Drafting, Computer Fundamentals and Programming
Course Objectives:	After completing this course, the student must be able to: 1. Utilize computer aided design and drafting as basic tools in aircraft design 2. Build logically on the foundation until the student has a reasonable competency in most of the functions of the CADD
Course Outline:	1. CADD Familiarization 1.1 Commands 1.2 Starting 1.3 Screen 1.4 Input Methods 1.5 Beginning a New Drawing with the New Command 1.6 Opening an existing drawing with the Open Command 1.7 Working with Multiple Drawing 1.8 Changing the Units 1.9 Changing the Limits 1.10 Saving a Drawing 1.11 Exiting 2. Fundamentals I 2.1 Constructing Geometric Figures 2.2 Coordinate Systems 2.3 Object Selection 2.4 Modify objects 3. Fundamentals II 3.1 Drafting Setting
	3.2 Display Control 3.3 Setting Multiple Viewports 3.4 Creating and Modifying Layer System 3.5 Setting the Linetype Scale Factor 3.6 Undo and Redo Commands 4. Fundamental III 4.1 Drawing Construction Lines 4.2 Editing Text 4.3 Creating and Modifying Text Styles 4.4 Creating Objects from Existing Objects 4.5 Modifying Objects 5. Fundamentals IV 5.1 Splice Curves 5.2 Editing with Grips 5.3 Information about objects 6. Dimensioning 6.1 Dimension Terminology 6.2 Dimensioning Commands 6.3 Editing Dimension Text 6.4 Dimension Styles 6.5 Updating Dimensions

	6.6 Plotting/Printing 6.7 Planning the Plotted Sheet 6.8 Plotting from Model Space 6.9 Plotting from Lay-out 6.10 Criteria and Modifying Plot Style Tables 6.11 Configuring Plotters
Laboratory/ Equipment:	Refer to Annex II – Computer Laboratory Equipment
Suggested Text Books and References:	1.Textbook *1.1* Alan J. Kalameja, Aurodesk Press by Autodesk Press, .*The AUTOCAD 2002, Tutor fo Engineering Graphics (Vol 1 and 2)* 2. Reference 2.1 Thomas Steelman and G.V. Krishnan. *Harnessing AUTOCAD 2002*

Course Name:	**COMPUTER AIDED DRAFTING AND DESIGN (CADD) 2**
Course Description:	This course covers intermediate topics which includes hatching and boundaries, block and attributes, external references and drawing environments. Advance topics include utility commands, scripts and slides, 3D commands and autolisp.
Number of Units for Lecture and Laboratory:	2 units lecture, 1 unit laboratory = 3 Units
Number of Contact Hours per Week:	2 hours Lecture, 3 hours laboratory = 5 Hours Note: Lectures are conducted inside the Computer Laboratory for hands-on exercises in the computers.
Pre - requisite:	CADD 1
Course Objectives:	After completing this course, the student must be able to perform 3D drawing and rendering as applied to aircraft design.
Course Outline:	1. Hatching and Boundaries 2. Block References and Attributes 2.1 Creating Blocks 2.2 Explode Command 2.3 Base Command 2.4 Attributes 2.5 Dividing and Measuring Objects 3. External References 3.1 Attaching and Manipulating with the external reference command 3.2 Controlling the Display of External References 3.3 Managing External References Images 4. Design Center 5. Utility Command 6. Internet Utilities 7. 3D 7.1 Coordinate Systems 7.2 Viewing in 3D 7.3 Creating 3D Objects 7.4 Creating Meshes 7.5 Editing in 3D 7.6 Creating Solid Shapes 7.7 Creating Composite Solids 7.8 Editing 3D Solids 7.9 Mass Properties of a Solid

	7.10 Generating Views 7.11 Generating Profiles 8. Rendering 8.1 Setting up a Model 8.2 Rendering a Model 8.3 Setting up Lights 8.4 Setting up a Scene 8.5 Materials 8.6 Setting Preferences for Rendering 8.7 Saving an Image 8.8 Viewing an Image 9. Introduction to Visual Lisp 10. Practice Drawing as Applied to Aeronautical Engineering
Laboratory/ Equipment:	Refer to Annex II – Computer Laboratory Equipment
Suggested Text Books and References:	1. Textbook *1.2* Alan J. Kalameja, Aurodesk Press by Autodesk Press, .*The AUTOCAD 2002, Tutor fo Engineering Graphics (Vol 1 and 2)* 3. Reference *2.2* Thomas Steelman and G.V. Krishnan. *Harnessing AUTOCAD 2002*

Course Name:	**FUNDAMENTALS OF AERODYNAMICS**
Course Description:	The course includes the lectures on fundamental principles of flight; earths standards atmosphere and properties; aerodynamics and aerostatics; forces and moments acting on aircraft; properties of fluids and fluids laws; airfoil theories, finite wing theory and ground effect on aircrafts; wind tunnels and its applications.
Number of Units for Lecture and Laboratory:	5 units lecture, 0 unit laboratory = 5 Units
Number of Contact Hours per Week:	5 hours lecture, 0 hour laboratory = 5 Hours
Pre - requisite:	Physics 2, Integral Calculus
Course Objectives:	After completing this course, the student must be able to have knowledge on principles of flight, atmospheric properties, aerodynamics and aerostatics, forces and moments acting on aircraft, subsonic and supersonic wind tunnels, properties of fluids, airfoil theories, finite wing theory and ground effect.
Course Outline:	1. The atmosphere 1.1 Equation of State for a Perfect Gas 1.2 Standard atmosphere 1.2.1 Hydrostatic Equation 1.2.2 Troposphere and Stratosphere 2. Basic Aerodynamic Principles 2.1 Momentum Equation 2.2 Isentropic Flow 2.3 Speed of sound

	2.4 Low Speed Subsonic Wind Tunnels 2.5 Supersonic Wind Tunnels 2.6 Measurement of Airspeed 2.6.1 Incompressible Flow 2.6.2 Subsonic Compressible Flow 2.7 Introduction to Viscous Flow 2.7.1 Boundary Layers 3. Airfoil Theory 3.1 Aerodynamics of Cylinders and Speed 3.2 Airfoils 3.2.1 Lift, Drag and Moment Coefficient 3.2.2 Airfoil data 3.2.3 Compressibility Correction for Lift Coefficient 3.2.4 Critical Mach Number and Critical Pressure Coefficient 3.2.5 Divergence Mach Number 4. Wing Theory 4.1 Finite Wings 4.2 Aspect ratio correction 4.3 Drag 4.4 Effect of Wing profiles 4.5 Flaps and Other High Lift Devices 4.6 Ground effect
Laboratory/ Equipment:	NONE
Suggested Text Books and References:	1. Textbook 1.1 Anderson, John D, Jr. *Introduction to Flight.* 3rd Edition. 2. References *2.1* Jones, Bradley. *Elements of Practical Aerodynamics.* *2.2* Clancy, L.S. *Aerodynamics* 2.3 Shevell, Richard S. *Fundamentals of Flight.* 2.4 Abbott and Doenhoff. *Theory of Wing Sections.* 2.5 Pope, John Wiley & Sons. *Wind Tunnel Testing.*

Course Name:	**GAS TURBINE ENGINE**
Course Description:	The course includes discussions on the types, construction, development and the design principles of gas turbine engines.
Number of Units for Lecture and Laboratory:	4 units lecture, 1 unit laboratory = 5 Units
Number of Contact Hours per Week:	4 hours lecture. 3 hours laboratory = 7 hours
Pre - requisite:	Thermodynamics
Course Objectives:	After completing this course, the student must be able to: 1. Understand the construction of a gas turbine 2. Understand the description and operation of the different gas turbine engines

	3. Understand the design principles of a gas turbine engine for commercial or military aircraft using the knowledge in aerodynamics and thermodynamics
Course Outline Lecture:	1. History of Gas Turbine Engines 1.1 Origin and Development 2. Types of Gas Turbine Engines 2.1 Turbojets 2.2 Turbofan 2.3 Turboprop 2.4 Turbo shaft 2.5 Unducted/ Ducted Fan 3. Sections of a Gas Turbine Engine 3.1 Compressor Section 3.2 Diffuser 3.3 Combustor/ Combustion Chamber 3.4 Turbine Section 3.5 Exhaust 4. Powerplant Systems 4.1 Fuel Systems and Control 4.2 Engine Controls 4.3 Air System 4.4 Starting and Ignition 4.5 Engine indication 4.6 Lubrication system 4.7 Thrust reverse or Exhaust 5. After Burner 6. Engine Stations 7. Design of Engines for a new large aircraft 7.1 Creation of thrust in a jet engine 7.2 Gas turbine cycle 7.3 Principle and layout of jet engine 7.4 Elementary Fluid Mechanics of Compression Gases 7.5 Selection of Bypass ration 7.6 Dynamic Sealing and Dimensional Analysis 7.7 Turbomachinery Compressors and Turbines 8. Engine Component Characteristics and Engine Matching 8.1 Component Characteristics 8.2 Engine Matching Off-Design 9. Design of Engines for a New Fighter Aircraft 9.1 A new Fighter Aircraft 9.2 Lift, drag and effects of maneuvering 9.3 Engines for combat aircraft 9.4 Design point for a combat engine 9.5 Combat Engines Off-design 9.6 Turbomachinery for Combat Engine 10. Noise and Its regulation
Course Outline Laboratory:	1. Disassembly of a gas turbine engine 2. Parts identification 3. Parts inspection 4. Repair techniques 5. Assembly
Laboratory/ Equipment:	Gas Turbine Engine, Static or Cut-away
Suggested Text Books and References:	1. Michael Kroes and Thomas Wild. *Aircraft Powerplant.* Glencoe Aviation Technology. 7th Edition 2. Nicholas Cumptsy. *Jet Propulsion.* 2nd Edition

Course Name:	**OPERATIONS ENGINEERING**
Course Description:	The course includes air navigation, meteorology and route analysis. It also includes familiarization on weight and balance loading and trim charts and aircraft performance charts.
Number of Units for Lecture and Laboratory:	4 units lecture, 0 unit laboratory = 4 Units
Number of Contact Hours per Week:	4 hours lecture, 0 hour laboratory = 4 Hours
Pre - requisite:	Applied Subsonic Aerodynamics, Aerodrome Engineering and Management
Course Objectives:	After completing this course, the student must be able to: 1. Understand the basic principles of air navigation, including route analysis. 2. Know the different meteorological in aircraft operation; its cause and effect to aircraft operation. 3. Understand the development, presentation and use of weight and balance loading and plotting of trim charts and aircraft performance charts.
Course Outline:	1. Meteorology 1.1 The atmosphere 1.2 Pressure 1.3 Temperature 1.4 Density 1.5 Motion of the atmosphere 1.6 Formation of cloud and precipitation 1.7 Thunderstorms 1.8 Icing 1.9 Visibility 2. Air navigation 2.1 Earth and the system of coordinates, directions and distances 2.2 Maps and Aeronautical Charts 2.3 Applied Navigations 2.3.1 Measurement 2.3.2 Influence of wind 2.3.3 Speed 3. Weight and balance loading and trim charts 3.1 Center of gravity envelope 3.2 Loading limitations 3.3 Development, presentation and use of load and trim charts 4. Aircraft Performance Charts 4.1 Development and presentation of Performance charts 4.2 Takeoff and landing speeds 4.3 Take-off and lading weight determinations 4.4 Engine-out performance 5. Route analysis 5.1 Climb, cruise, descent and holding charts 5.2 Route data determination 5.3 Wind factor
Laboratory/ Equipment:	1. Aeronautical Maps and Charts 2. Audio-visual Presentation 3. Field Trip to ATO 4. Field trip to PAGASA

	5. Aeronautical Weather Reports 6. W & B Trim sheets 7. Aircraft Performance Charts
Suggested Text Books and References:	1. Textbooks 1.1 Aviation Weather US DOT AC 00-6A 1.2 Air Navigation, U.S. Navy Hydrographic Office, H.O. Pub. No. 216, 1967 1.3 Boeing Aircraft Performance Handbook 2. References: 2.3 Aircraft Flight Manual 2.4 Weight and balance manual 2.5 Aircraft Operations manual 2.6 Philippine Aeronautical Information Publication (AIP) 2.7 National Geospatial-Intelligence Agency Aeronautical Charts 2.8 ICAO Annex 4 2.9 ICAO World Geodetic System, 1984 (WGS-84) Manual 2.10 Jeppesen Manuals 2.11 ICAO Annex 3 2.12 ICAO Doc. 8896 Manual of Aeronautical Meteorological Practice 2.13 Aviation Meteorology by HMSO

Course Name:	**RECIPROCATING ENGINES**
Course Description:	The course includes discussions on the history, development, construction, design and operation of reciprocating engines.
Number of Units for Lecture and Laboratory:	4 units lecture, 1 unit laboratory = 5 Units
Number of Contact Hours per Week:	4 hours lecture, 3 hours laboratory = 7 hours
Pre - requisite:	Thermodynamics, Aircraft Materials and Processes
Course Objectives:	After completing this course, the student must be able to: 1. Understand the development of the reciprocating engine. 2. Understand the construction of a reciprocating engine. 3. Learn the design principles and operation of reciprocating engines. 4. Understand the purpose and operation of the different systems in a reciprocating engine.
Course Outline Lecture:	1. History and Development of Reciprocating Engine 1.1 Engine Design and Classification 1.1.1 By Cylinder arrangement 1.1.2 By cylinder arrangement and displacement 1.1.3 By cooling method 1.2 Standard Designation for a reciprocating Engine 1.3 Reciprocating Engine Construction 1.3.1 Crankcase 1.3.2 Bearings 1.3.3 Crankshaft 1.3.4 Connecting rods and assemblies 1.3.5 Pistons 1.3.6 Piston rings 1.3.7 Piston pin and retainers

	1.3.8 Cylinders 1.3.9 Valves 1.3.10 Accessory section 1.3.11 Propeller reduction gears 2. Engine Operating Fundamentals 2.1 Otto cycle 2.2 Carnot cycle 2.3 Diesel cycle 2.4 Brayton cycle 2.5 Four stroke, five-event cycle 2.6 Two stroke cycle 2.7 Wankel cycle 2.8 Valve timing 2.9 Power Calculation 2.10 Engine Efficiency 3. Induction System and Supercharging 3.1 General Description 3.2 Principles of supercharging 3.3 Internal Single speed supercharger 3.4 Two-speed supercharger 3.5 Turbo-supercharge for light to large aircraft 3.6 Electronic turbo control system
Course Outline laboratory:	1. Disassembly of a reciprocating engine 2. Parts identification 3. Parts inspection 4. Repair techniques 5. Assembly 6. Engine Run-up 7.
Laboratory/ Equipment:	1. Reciprocating Engine – Static Model or cut-away model Refer to Annex II – Aircraft Maintenance and Inspection Shop for other required equipment
Suggested Text Books and References:	Michael Kroes and Thomas Wild. *Aircraft Powerplant*. Glencoe Aviation Technology. 7th Edition

Course Name:	**RELIABILITY ENGINEERING**
Course Description:	The course includes the studies on determining the inherent reliability of a product or process and the potential areas for improvement.
Number of Units for Lecture and Laboratory:	3 units lecture, 0 unit Laboratory = 3 Units
Number of Contact Hours per Week:	3 hours Lecture, 0 hour laboratory = 3 Hours
Pre - requisite:	Advance Engineering Mathematics, Probability and Statistics, Research Methods & Application
Course Objectives:	After completing this course, the student must be able to: 1. Evaluate the reliability potential of alternative designs 2. Prepare and investigate a reliability program plan.

Course Outline:	1. Maintenance and Reliability Introduction 1.1 Defining the Role of Engineer and Mechanic 1.2 Definition of Maintenance 1.3 Types of Maintenance 1.4 Definition of Reliability 1.5 Types of Reliability 2. Introduction to Reliability Centered Maintenance (RCM) Fundamentals 2.1 Origin of RCM, Maintenance Steering Group 2.2 Process Oriented Maintenance Programs 2.3 Task Oriented Programs 2.4 Maintenance Intervals 3. Failure Models and Measurement of Reliability 3.1 Failure Mode and Effect Analysis (FMEA) 3.2 Failure Mode Effect and Criticality Analysis (FMECA) 3.3 Fault Tree Analysis 3.4 Mean Time to Failure (MTTF) 3.5 Mean Time Between Failures (MTBF) 3.6 Failure Rate Patterns 4. Probability Distribution Function and their Application in Reliability Evaluation 4.1 Weibull Distribution 4.2 Gamma Distribution 4.3 Log Normal 5. Analytical System Reliability 5.1 Component Configurations 6. Reliability Programs and Implementation 6.1 Need of Reliability Program 6.2 Regulatory Authority 6.3 Reliability Control System 7. Investigation of Reliability Alerts
Laboratory/ Equipment:	Multi-media presentation
Suggested Text Books and References:	1. Textbooks: 1.1 Harry A. Kinnison. *Aviation Maintenance Management.* 2004, McGraw Hill, ISBn 0-07-142251-X 1.2 Patrick D.T.O' Connor. *Practical Reliability Engineering.* 4th Edition, ISBN 0470844639; 2. References: 2.1 *Reliability engineering.* Kluver Academics Publishers, 1993, Aggarwal 2.2 John Moubray. *Reliability Centered Maintenance.* Industrial Press, ISBN 0831131462; 2.3 R.Ramakumar. *Reliability Engineering: Fundamentals and Applications.* 1993, Prentice Hall, ISBN 0-13-276759-7; 2.4 Anthony Smith. *Reliability Centered Maintenance: Gateway to Class Maintenance.* 1993,New York, McGraw-Hill, Inc., ISBN 0-07-059046-X; 2.5 Joel Levitt. *Complete Guide to Preventive and Predictive Maintenance.* 2002, Industrial Press; 1st Edition, ISBN 0831131543; 2.6 John M. Gross. *Fundamentals of Preventive Maintenance.* American Management Association; 1st edition. 2002,ISBN 0814407366 ; 2.7 Mohammad Modarres. *Reliability and Risk Analysis.* 1993. Marcel Dekker Inc, ISBN 0824720008 3. Online references: 3.1 **www.weibull.com**: On-line Resources for Reliability Professionals; 3.2 www.resnapshot.com: Illustrated Case Studies in the Industrial

	World of Failure Analysis, Predictive Maintenance, and Non-Destructive Evaluation; 3.3 **www.maintenanceresources.com**: Reliability Centered Maintenance (RCM) Reference Articles; 3.4 **www.hq.nasa.gov/office/codej/codejx/rcm-iig.pdf**; RCM Guide for Facilities and Collateral Equipment; 3.5 **http://www.usace.army.mil/inet/usace-docs/armytm/tm5-698-2/c-1.pdf**: Introduction to Reliability Centered Maintenance (RCM); 3.6 **http://www.maint2k.com/what-is-rcm.html**: What is Reliability

Course Name:	**RESEARCH METHODS AND APPLICATION**
Course Description:	The course includes lectures on research technique; problem solving; survey of related literature; methods of data gathering, data interpretation and reporting; and implementation of findings.
Number of Units for Lecture and Laboratory:	2 units lecture, 0 unit laboratory = 2 Units
Number of Contact Hours per Week:	2 hours lecture, 0 hour laboratory = 2 Hours
Pre - requisite:	Technical Communications, Probability and Statistics
Course Objectives:	After completing this course, the student must be able to: 1. understand the problem and objectives of the research 2. know how to collect, evaluate and transform the data into meaningful information 3. present the information into a proper report form.
Course Outline:	1. Nature and Characteristics of Research 2. Research Problem and Objectives 3. Review of related Literature 4. Research Design 5. Selection and Finalization of Research Topic Applicable to Aviation Industry. 6. Presentation of Research Output
Laboratory/ Equipment:	NONE
Suggested Text Books and References:	1. Textbook: 1.1 Laurentina Paler- Calmorin. *Methods of Research and Thesis Writing.* 1995 2. References: 2.1 Estela G. Adanza. *Research Methods Principles and applications.* 1995 2.2 C.G. Sevilla. *Research Methods.* Revised ed., 1992

F. ELECTIVES

Course Name:	**ROCKET ENGINES**
Course Description:	This course includes discussions on the history, development, fundamentals, operating principles and construction of rocket propulsion system.
Number of Units for Lecture and Laboratory:	1 unit lecture, 1 unit laboratory = 2 Units
Number of Contact Hours per Week:	1 hour lecture, 3 hours laboratory = 4 hours
Pre - requisite:	Chemistry, Thermodynamics, Advanced Engineering Mathematics, Materials and Processes, Supersonic Aerodynamics
Course Objectives:	After completing this course, the student must be able to: 1. Understand the history and development of rocket propulsion. 2. Learn the fundamental and operating principles in rocket propulsion. 3. Understand the construction of a rocket system 4. Determine the performance a solid, liquid and hybrid rockets 5. Develop an application of the rocket propulsion 6. Perform rocket testing
Course Outline:	1. Classification of Rocket Propulsion 2. Fundamental Principles 3. Nozzle Theory and Thermodynamic Relations 4. Heat Transfer 5. Chemical Rocket Propellant Performance Analysis 6. Solid Propellants 7. Solid Propellant Rocket Fundamentals 8. Combustion of Solid Propellants 9. Liquid Propellants 10. Liquid Propellant Rocket Engine Fundamentals 11. Combustion of Liquid Propellants 12. Hybrid Propellant Rockets 13. Flight Performance
Laboratory/ Equipment:	1. Wind tunnel 2. Chemical Laboratory tools and equipment. 3. Static test stand
Suggested Text Books and References:	George Sutton. Rocket Propulsion Elements - An Introduction to the Engineering of Rockets. 6th Edition. John Wiley and Sons Inc.

Course Name:	**HOME-BUILT AIRCRAFT**
Course Description:	The course includes lecture on the shipment and packaging as well as receiving, handling and inventory of a kit plane aircraft. The course will also discuss the construction of composite and metal parts in compliance with manufacturer and or designer standard. Lecture will from time to time discusses the limitation and regulations as required by the Air Transportation Office and the U.S. FAA on aircraft construction and assembly.

Number of Units for Lecture and Laboratory:	2 units Lecture, 0 unit Laboratory = 2 Units
Number of Contact Hours per Week:	2 hours Lecture, 0 hour Laboratory = 2 hours
Pre - requisite:	Graduating Students only
Course Objectives:	After completing this course, the student must be able to: 1. Understand and learn how home-built airplane is shipped and the procedure in accepting and handling a cargo. 2. Identify aircraft tools and parts using aircraft part number, will learn the basic construction and assembly of kit plane aircraft, its testing and proper documentation.
Course Outline:	1. Preparation for kits plane construction 2. Basic kit plane construction 3. Composite construction 4. Metal monocoque construction 5. Steel-tube and aluminum tube construction 6. Wood and fabric construction 7. Completion 8. Procedure in test-flight testing 9. Documentation
Laboratory/ Equipment:	None
Suggested Text Books and References:	1. Ronald J. Wantajja. *Kitplane Construction*. 2nd ed., 2. Egbert Torrenbeck . *Synthesis of Subsonic Airplane Design*. 1982. 3. Code of Federal Regulations, U.S. FAA

Course Name:	**PROJECT FEASIBILITY STUDY**
Course Description:	This course includes lectures on contents, methods and techniques on the preparation of feasibility study including data gathering and analysis, presentation and reporting.
Number of Units for Lecture and Laboratory:	2 units Lecture, 0 unit Laboratory = 2 Units
Number of Contact Hours per Week:	2 hours Lecture, 0 hours in Laboratory = 2 hours
Pre - requisite:	Engineering Economics and Management, Research Methods and Applications, Probability and Statistics
Course Objectives:	After completing this course, the student must be able to prepare and present a complete feasibility study.

Course Outline:	1. Name of Enterprise 1.1 Definition Of The Project 1.2 Project Objectives 1.3 Economic Feasibility 2. Location 2.1 Location of the head office & plant site 2.2 Choice of location 3. Project's Objectives 3.1 Short range 3.2 Long range 4. Descriptive definition of the project 4.1 Related national program 4.2 Affinity to regional/scriptural studies 4.3 Project potential & proponent 5. Feasibility Criteria 5.1 Profitability 5.2 Impact on socio-economic environment 6. Highlights of the project 6.1 History 6.2 Time table and status 6.3 Nature of industry 6.4 Mode of financing 6.5 Investment cost 7. Major Assumption/Summary of the project 7.1 Market feasibility 7.2 Technical feasibility 7.3 Financial feasibility 7.4 Socio-economic feasibility 7.5 Management feasibility
Laboratory/ Equipment:	NONE
Suggested Text Books and References:	1. Textbook 1.1 Vicente Muro. *Preparing Project Feasibility Study.* volume 1 &2 2. References: 2.1 *How to Develop Project Feasibility Studies.* DAP development Academy of the Phil. 2.2 Forge H. Cuyugan. *A Business Planning* 2.3 Karl M. Ruppenthal. *Case Problem in Air Transportation* 2.4 Bill Gunston. *Transportation Problems in Prospect.* E.P. Dutton and Co., Inc.

II. NON-TECHNICAL COURSES

A. SOCIAL SCIENCES (Please refer to CMO 59., s. 1996)
B. HUMANITIES (Please refer to CMO 59., s. 1996)

C. LANGUAGES (Please refer to CMO 59., s. 1996 for English 1 and 2)

Course Name	ENGLISH 3 (TECHNICAL COMMUNICATION)
Course Description	The nature of technical communication; skills and strategies for reading and writing literature reviews, journal articles, and technical reports; making oral presentations.
Number of Units for Lecture and Laboratory	3 units lecture

Number of Contact Hours per Week	3 hours lecture
Prerequisites	English 1 English 2
Course Objectives	After completing this course, the student must be able to: 1. Differentiate technical writing from other types of writing; 2. Engage him/herself critically in the reading of a specialized text; 3. Write a summary and review of a journal article; 4. Write a research paper on a technical topic; and 5. Properly acknowledge sources by using a prescribed citation format; 6. Prepare an oral presentation on a technical topic; and 7. Deliver properly an oral technical presentation.
Course Outline	1. The Nature of Technical Communication 2. Technical Writing 2.1. Introduction to Technical Writing 2.2. Library Orientation 2.3. Technical Writing: Formal Schema/Style; Word Choice 2.4. Types of Text Structure in Technical Writing 2.5. Introduction to Research: Choosing a Topic, Outlining 2.6. Skills and Strategies for Reading and Writing Journal Articles, Literature Reviews, and Technical Reports 2.7. Evaluating Sources and Preparing a Preliminary Bibliography 2.8. Preparing and Interpreting Non-Prose Forms 2.9. Summarizing and Analyzing a Journal Article 2.10. Preparing the Different Parts of the Research Paper or Technical Report 2.11. Writing Bibliographies Using a Prescribed Format 2.12. Independent Study 3. Oral Technical Presentations 3.1. Preparing the Presentation Materials 3.2. Delivering the Technical Presentation
Laboratory Equipment	None
Suggested References	American Psychological Association. *Publication Manual of the American Psychological Association*, 4th ed. Washington, DC: American Psychological Association, 1994. Carreon, E. and C. Balarbar. *Series in English for Specific Purposes: Engineering*. Manila: DLSU Press, 1995. McWhorter, K. *Guide to College Reading*. New York: Longman, 2003. Penrose, J.M., R.W. Rasberry and R.J. Myers. *Advanced Business Communication*. Cincinnati: South-Western College Publishing, 1997. Weissberg, R. and S. Buker. *Writing Up Research: Experimental Research Report Writing for Students of English*. New Jersey: Prentice Hall, Inc., 1990.

ANNEX IV

LABORATORY REQUIREMENTS

A. CHEMISTRY & PHYSICS LABORATORY

B. AERONAUTICAL ENGINEERING LABORATORY

A. Chemistry & Physics Laboratory

GENERAL CHEMISTRY LABORATORY

Exercise	Required Equipment	Required Quantity*
1. Basic Laboratory Techniques a. Use of burner b. Preparation of solutions • Determination of mass • Measurements of volume • Calculation of density	 Burner Beaker Graduated cylinder Triple beam balance NaCl solution $Pb(NO_3)_2$ solution	 5 pcs. 5 pcs. 5 pcs. 5 pcs. 25 mL 25 mL
2. Separation techniques a. Filtration/decantation b. Sublimation c. Adsorption d. Distillation	Glass funnel Beaker Evaporating dish Filter stand Distillation apparatus Activated charcoal Staple wire Food color $KMnO_4$ solution	5 pcs. 5 pcs. 5 pcs. 5 pcs. 1 set-up 5 g 25 pcs. 5 g 25 mL
3. Classification of matter a. Differentiation of elements, compounds mixtures, colloids b. Differentiation of electrolyte from non-electrolyte c. Differentiation of acid, bases, salts.	Test tube pH paper Conductivity apparatus I_2 crystals $KClO_3$ solid NaOH solution HCl solution NaCl solution Sugar solution	50 pcs. 20 pcs. 1 set-up 3 g 3 g 25 mL 25 mL 25 mL 25 mL
4. Changes of matter and energy transformation a. Differentiation of physical from chemical change b. Law of conservation of mass c. Types of chemical reactions	Test tube Burner Evaporating dish Beaker Alcohol I_2 crystals Zn strips HCl solution Staple wire $CuSO_4$ solution	50 pcs. 5 pcs. 5 pcs. 5 pcs. 5 mL 5 g 5 pcs. 25 mL 25 pcs. 25 mL
5. Gas Laws a. Boyle's Law b. Charles's Law c. Graham's Law	Beaker Thermometer Syringe Glass tubing Sand bag NH_4OH solution HCl solution	5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 mL 5 mL
6. Solutions a. Factors affecting solubility b. Colligative properties	Test tube Beaker Alcohol	50 pcs. 5 pcs. 25 mL

	Hexane Sugar NaCl Urea Oil	25 mL 5 g 5 g 5 g 5 mL
7. Rates of chemical reactions, chemical equilibrium	Test tube Beaker Mg ribbon HCl solution $FeCl_3$ solution KSCN solution KCl solution Fe $(NO_3)_3$ solution	50 pcs. 5 pcs. 5 pcs. 25 mL 25 mL 25 mL 25 mL 25 mL
8. Redox reaction and electrochemistry	Battery Test tube Zn strips Cu strips Pb strips Pb $(NO_3)_2$ solution Zn $(NO_3)_2$ solution Alligator clip	5 pcs. 50 pcs. 5 pcs. 5 pcs. 5 pcs. 25 mL 25 mL 10 pcs.
9. Corrosion	Petri dish Battery Alligator clip Cu strips Zn strips Al strips Mg strips Electrolyte solution	5 pcs. 5 pcs. 10 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 25 mL

* Required Quantity is based on a class size of 25 students

PHYSICS 1 LABORATORY

Exercise	Required Equipment	Required Quantity*
1. An exercise to illustrate the principles, use, and precision of the vernier caliper and micrometer caliper	Ruler Vernier caliper Micrometer caliper Objects for measuring	5 pcs. 5 pcs. 5 pcs. 5 sets
2. An exercise to verify the graphical and analytical methods of determining resultant forces.	Force table Weight holder Masses Meter stick Protractor	5 pcs. 20 pcs. 5 sets 5 pcs. 5 pcs.

	Alternate apparatus: Force frame Spring balance Weight holder Masses Ruler	 5 pcs. 15 pcs. 15 pcs. 5 sets 5 pcs.
3. An exercise to observe and verify the elements of motion along the straight line	Linear air track with blower and trolley Timer/stopwatch Meter stick Free fall apparatus Metal balls of different sizes Clamp Support rod *Alternate apparatus:* Spark timer/ticker timer Paper tape Stopwatch Plane board with stand Clamp Wooden cart Scissors Carbon paper Masking tape Meter stick	5 pcs. 5 pcs. 5 pcs. 5 pcs. 12 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 1 set 5 pcs.
4. An exercise to observe and verify the elements of motion in two dimensions	Blackwood ballistic pendulum Metal ball Meter stick Carbon paper Inclined plane Protractor *Alternate apparatus:* Projectile apparatus Metal ball/plastic solid ball Photogate Timer/stopwatch Time of flight receptor pad Carbon paper White paper Meter-stick	5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.
5. An exercise to verify the laws of motion	Atwood's machine Masses Stopwatch String *Alternate apparatus:* Frictionless dynamic track Smart pulley Stopwatch Weight holder	5 pcs. 5 sets 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.

	String Clamp	5 pcs. 5 pcs.
6. An exercise to determine the coefficients of static and kinetic friction of various surfaces	Friction board with pulley Friction block with different surfaces Glass plate of size similar to friction board Platform/triple beam balance Weight holder Meter stick Slotted masses, 5-500g	5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 sets
7. An exercise to verify the work-energy theorem	Dynamic cart Frictionless dynamic track Masses Weight holder Clamp String Timer/stopwatch Platform/triple beam balance Support rod	5 pcs. 5 pcs. 5 sets 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.
8. An exercise to verify the principles of conservation of mechanical energy	Metal stand Clamp Metal ball String Meter stick Cutter blade Hanging mass Carbon paper White paper Masking tape	5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 10 pcs. 10 pcs. 1 set
9. An exercise to verify the principles of conservation of momentum	Ramp/launcher Metal stand Clamp Metal balls of different sizes Meter stick Carbon paper White paper Masking tape	5 pcs. 5 pcs. 5 pcs. 10 pcs. 5 pcs. 10 pcs. 10 pcs. 1 set
10. An exercise to verify the condition of the body in rotational equilibrium	Demonstration balance Vernier caliper Platform/triple beam balance Masses Meter stick	5 pcs. 5 pcs. 5 pcs. 5 sets 5 pcs.
11. An exercise to verify the forces involved in uniform circular motion	Centripetal force apparatus Meter stick Mass with hook Platform/triple beam balance Stopwatch	5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.

12. An exercise to verify the principle of simple harmonic motion	Clamp Masses Weight holder Meter stick Support rod Spring *Alternate apparatus:* Hooke's Law apparatus	5 pcs. 5 sets 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.
13. An exercise to measure specific gravity	*Liquids:* Hydrometer jar U-tube Inverted U-tube Beaker Masses Meter stick Vernier caliper Specimen of liquids *Solids*: Beam balance Hydrometer jar Beaker Thread Thermometer Specimen of solids *Alternate apparatus:* Mohr-Westpal Balance	 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 sets 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 sets 5 pcs.
14. An exercise to observe and verify the elements of transverse wave motion	Sonometer Weight holder Set of masses Tuning forks of three different frequencies Rubber hammer Meter stick	5 pcs. 5 pcs. 5 pcs. 5 sets 5 pcs. 5 pcs.

* Required Quantity is based on a class size of 25 students

PHYSICS 2 LABORATORY

Exercise	Required Equipment	Required Quantity*
1. An exercise to determine the specific heats of solids by the methods of mixture	Calorimeter Stirrer for shot Specimen for shot Thermometer Platform/triple beam balance Beaker	5 pcs. 5 pcs. 5 sets 5 pcs. 5 pcs. 5 pcs.

	Ice Water	5 sets
2. An exercise to measure the coefficient of linear expansion	Thermal expansion apparatus Steam generator Ohmmeter/VOM Connectors Basin/container Hot and cold water	5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.
3. An exercise to measure the mechanical equivalent of heat	Mechanical equivalent of heat apparatus Ohmmeter/VOM Mass (10 kg) Thermometer Vernier caliper Platform/triple beam balance	5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.
4. An exercise to observe and verify the elements of electric charge	Van de Graff generator Tissue paper Aluminum foil Metal conductor with insulated handle Fluorescent lamp Masking Tape Power Source Galvanometer Conducting paper Field mapper kit/mapping Apparatus Connectors	2 sets 2 sets 2 sets 2 sets 2 sets 1 set 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 sets
5. An exercise to illustrate Ohm's Law	Panel board/circuit board VOM or multitester DC power supply Bridging plugs/connecting wires Fixed resistor SPST switch SPDT switch *Alternate apparatus:* Bread board Jumper	5 pcs. 5 pcs. 5 pcs. 5 sets 15 pcs. 5 pcs. 5 pcs. 5 pcs. 5 sets
6. An exercise to determine and compare the resistance of different conductors	1-m slide wire/ wheatstone bridge Power supply VOM or multitester Galvanometer Potentiometer Fixed resistor Unknown resistor SPST switch Connecting wires	5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 sets

7. An exercise to verify the principles of series and parallel connections	Panel board/circuit board VOM or multitester DC power supply Bridging plugs/connecting wires Fixed resistors *Alternate apparatus:* Bread board Jumper	5 pcs. 5 pcs. 5 pcs. 5 sets 15 pcs. 5 pcs. 5 sets
8. An exercise to verify the relationship among the electromotive force, current, and resistance of cells in series and parallel	Dry cells Switch VOM or multitester Resistors Panel board/circuit board Bridging plugs/connecting wires *Alternate apparatus:* Bread board Jumper	10 pcs. 5 pcs. 5 pcs. 10 pcs. 5 pcs. 5 sets 5 pcs. 5 sets
9. An exercise to observe the applications of Kirchhoff's Law	Power supply Fixed resistors VOM or multitester Bridging plugs/connecting wires Panel board/circuit board *Alternate apparatus:* Bread board Jumper	10 pcs. 25 pcs. 10 pcs. 5 sets 5 pcs. 5 pcs. 5 sets
10. An exercise to determine the electrical equivalent of heat	Electric calorimeter Thermometer Beam balance Masses Stop watch VOM or multitester Rheostat DC power source Connecting wires Switch	5 pcs. 5 pcs. 5 pcs. 5 sets 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 sets 5 pcs.
11. An exercise to observe the relationships between resistance and capacitance in the circuit	Power source Fixed capacitor (330 microfarad) Fixed Resistor (100 ohms) Connecting wires VOM or multitester Stopwatch	5 pcs. 5 pcs. 5 pcs. 5 sets 5 pcs. 5 pcs.
12. An exercise to observe the principle of magnetic field	Natural magnets Horseshoe magnets Bar magnets	5 pcs. 5 pcs. 10 pcs.

	Ring Glass plate Iron fillings Frame for bar magnets Compass Mounted straight wire Coil Solenoid Battery Reversing switch *Alternate apparatus:* Tesla meter / tangent galvanometer	5 pcs. 5 pcs. 5 sets 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 2 sets
13. An exercise to demonstrate the Faraday's law of electromagnetic induction	Coils Galvanometer VOM or multitester AC power supply Bar magnets Connecting wires	5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.
14. An exercise to verify the law of reflection and refraction	Optics bench Light source, sodium/mercury lamps Ray table and base Component holder Slit plate Slit mask Ray optics mirror Cylindrical lens	5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.
15. An exercise to investigate and study the image formation in mirror and lenses	Optic bench Light source Ray table and base Component holder Parallel ray lens Slit plate Ray optics mirror 5 cm focal length spherical mirror -15cm focal length concave lens 10cm/7.5 cm focal length convex lens 15 cm focal length convex lens Viewing screen Crossed arrow target	5 pcs. 5 pcs. 5 pcs. 15 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.

* Required Quantity is based on a class size of 25 students

B. Aeronautical Engineering Laboratory

MINIMUM EQUIPMENT REQUIREMENTS
BACHELOR OF SCIENCE IN AERONAUTICAL ENGINEERING

A. Aeronautical Laboratory

Item Nbr.	Specifications	Minimum Required Quantity
1	Wind tunnel and associated equipments	1
2	Multi-manometer	1
3	Wing model with pressure ports	1
4	Scaled models of sphere, hemispherical cup and flat plate	1
5	Scaled models of wing with flap, wing with slot, wing with slat	1
6	Scaled models of wing, end plates and winglets	1
7	Smoke Flow tunnel	1
8	Scaled models of different shapes: airfoil, sphere, hemispherical cup and flat plate	5
9	Writing table with stools	10

B. Airframe Shop

Item Nbr.	Specifications	Minimum Required Quantity
1	Air Compressor with air lines (2hp, 60psi)	1
2	Air drill, 3/8"	10
3	Aprons	10
4	Beehive and quick change retainer springs	10
5	Bucking bars, assorted	10
6	Cherry power riveter	5
7	Cleco fasteners, mixed sizes (3/32, 1/8,5/32,3/16	500
8	Cleco pliers	10
9	Common hand tools, set	10
10	Counter-sink tool 100° C	10
11	Deburring tool	10
12	Diagonal cutler	10
13	Dimple and die set	10
14	Drill bit set	10
15	Drill stop kit	10
16	Electric welding equipment	2
17	Face shield	10
18	Files, set, numerous sizes	10
19	Furnace-electric or gas with temperature control	1
20	Gloves, pairs	10
21	Goggles	10
22	Grinder, electric	1
23	Grinder, Pneumatic	2

24	GRP chemicals	10
25	Hacksaw	10
26	Hammer	10
27	Hand rivet squeezer	10
28	Hand seamer	10
29	Hand snips	5
30	Hardness tester	1
31	Lathe machine	1
32	Mallets	10
33	Mask with dust filter/painter's mask	10
34	Metal shears	1
35	Milling machine	1
36	Oxyacetylene welding equipment	2
37	Paint brush, kit, numerous sizes	10
38	Panel beaters	5
39	Pop rivet gun	5
40	Portable hand punch kit	5
41	Quenching bath	1
42	Rivet cutter	10
43	Rivet gun, offset handle	10
44	Rivet set, 10° offset	10
45	Rivet set, flush	10
46	Rivetset, Straight	10
47	Rivets, blind, Numerous sizes	500
48	Rivets, solid, Numerous sizes	500
49	Safety wire twister	5
50	Scriber	10
51	Sheet metal clamps, assorted	10
52	Sheet metal hand brake	1
53	Soldering set	5
54	Squeezer set mix	10
55	Steel brush	10
56	Steel divider/compass	10
57	Steel rule	10
58	Steel square	5
59	Table vise	10
60	Vise grip	10
61	Welder's hammer	10
62	Working table with stools	10

C. Aircraft Maintenance and Inspection Shop

Item Nbr.	Specifications	Minimum Required Quantity
1	Corrosion Inhibiting compound	1
2	Cleaning solvents	1
3	Inspection light	10
4	Inspection mirror	10
5	Magnetic Particle and Penetrant Testing	1
6	Magnifying glass-l0x to 20x magnification	10
7	Scouring brush	10
8	Specimens of corroded materials	5 per type
9	Aircraft with Operational Engine (reciprocating)	1
10	Dye Penetrant Test kit	1

D. Aircraft Engine Shop

Item Nbr.	Specifications	Minimum Required Quantity
1	Appropriate special tools for engines, set	1
2	Compression tester	1
3	Dial indicator	3
4	Feeler gauge	5
5	Go-no-go gauge	5
6	Magnifying glass-6X magnification	5
7	Mechanics hand tools, set	2
8	Micrometer	5
9	Piston ring compressor	1
10	Spring depressor and compressor	1
11	Timing light	3
12	Torque wrench, various sizes	3
13	Typical aircraft gas turbine engine	1
14	Typical aircraft reciprocating engine	1
15	Venier caliper	5

E. Computer Laboratory (CADD)

Item Nbr.	Specifications	Minimum Required Quantity
1	Multimedia Projector	1
2	Computer set meeting system requirements with CDRW drive and USB port	20
3	Deskjet Printer (colored)	2
4	Plotter	1
5	CADD Software	10