10.1Objectives

On successful completion of the programme, the graduate shall be able to
a) Design, manufacture and assemble spacecraft, mechanical components and systems,
b) Solve engineering problems by analysis and empirical methods, including application of the computer,
c) Install, commission, operate, maintain and service spacecraft, machinery, tools and equipment,
d) Prepare and read engineering drawings,
e) Prepare and present engineering reports, and
f) Apply relevant social science principles to manage engineering organisations and maintain cordial human relations.

11. Components of **each programme** of study (where applicable)

(a) Required (core) course (s)
(b) Elective course (s)
(c) Research component
(d) Practical training, industrial attachment, internship, clinical experience, etc.,
(e) Semester - by semester schedule of course, showing the credit value of each course.

11.1Year One, Semester One

SN	Course	Code	Title	T	P	C
1	MATH	151	Algebra	4	1	4
2	ENGL	157	Communication Skills I	2	0	2
3	EE	151	Applied Electricity	2	2	3
4	CE	155	Environmental Studies	2	0	2
5	ME	159	Technical Drawing	2	2	3
6	AERO	157	Introduction to Aviation Technology	1	2	2
7	ME	157	Introduction to Information Technology	1	2	2
8	ILS	151	Information in Literacy Skills I	2	0	2
9	**Total**		**Semester**	**16**	**9**	**20**
10			**Cumulative**	**16**	**9**	**20**

11.2 Year One, Semester Two

SN	Course	Code	Title	T	P	C
1	MATH	152	Calculus with Analysis	4	1	4
2	ENGL	158	Communication Skills II	2	0	2
3	EE	152	Basic Electronics	2	2	3

4	ME 158	Engineering Graphics	2	4	3
5	ME 164	Statics of Solid Mechanics	2	1	2
6	ME 158	Computer Programming for Engineers	1	3	2
7	AERO 174	Aerospace Design Project I	1	5	2
8	ILS 152	Information in Literacy Skills II	2	0	2
9	**Total**	**Semester**	**16**	**16**	**20**
10		**Cumulative**	**30**	**25**	**38**

11.3Year Two, Semester One

SN	Course Code	Title	T	P	C
1	MATH 251	Differential Equations	4	1	4
2	ENGL 263	Literature in English I	1	0	1
3	ME 261	Dynamics of Solid Mechanics	2	0	2
4	ME 251	Introduction to Fluid Mechanics	2	0	2
5	ME 281	Engineering Materials I	2	0	2
6	ME 255	Strength of Materials I	3	1	3
7	AERO 293	Aerospace Engineering Vacation Training I	0	5	2
8	ME 295	Mechanical Engineering Laboratory I	0	3	1
9	CENG 291	Engineering in Society	1	4	1
10	**Total**	**Semester**	**15**	**14**	**18**
11		**Cumulative**	**45**	**39**	**56**

11.4Year Two, Semester Two

SN	Course Code	Title	T	P	C
1	MATH 252	Calculus with Several Variables	4	1	4
2	ENGL 264	Literature in English II	1	0	1
3	ME 258	Computer-Aided Design and Modelling	2	3	3
4	ME 264	Mechanisms Synthesis and Analysis I	3	1	3
5	AERO 256	Aerospace Structures	3	0	3
6	ME 266	Thermodynamics I	2	0	2
7	AERO 274	Aerospace Design Project II	2	1	2
8	**Total**	**Semester**	**17**	**6**	**18**
9		**Cumulative**	**62**	**45**	**74**

11.5Year Three, Semester One

SN	Course	Code	Title	T	P	C
1	MATH	353	Probability and Statistics	2	1	2
2	MATH	351	Numerical Methods	2	1	2
3	ME	363	Automatic Control I	2	1	2
4	AERO	395	Aerospace Engineering Laboratory I	0	3	1
5	AERO	391	Aerospace Industry and Engineering	3	0	3
6	AERO	351	Aerodynamics I	3	0	3
7	AERO	393	Aerospace Engineering Vacation Training II	0	5	2
8	ECON	151	Introduction to Economics I	2	0	2
9	**Total**		**Semester**	**14**	**11**	**17**
10			**Cumulative**	**76**	**56**	**91**

11.6Year Three, Semester Two

SN	Course	Code	Title	T	P	C
1	AERO	362	Air Vehicle Stability and Control	3	1	3
2	ME	392	Industrial Engineering and Ergonomics	2	1	2
3	AERO	374	Aircraft Performance and Design	3	1	3
4	AERO	368	Propulsion	2	2	3
5	ME	366	Heat Transfer	3	0	3
6	ME	362	Vibrations I	3	0	3
7	AERO	396	Aerospace Engineering Laboratory II	0	3	1
8	**Total**		**Semester**	**16**	**8**	**18**
9			**Cumulative**	**92**	**64**	**109**

11.7Year Four, Semester One

11.7.A Core Courses

SN	Course Code	Title	T	P	C
1	AERO 483	Avionics	3	1	3
2	AERO 491	Aviation Business Management	2	1	2
3	AERO 497	Final Year Project I	0	6	3
4	AERO 495	Aircraft Maintenance Engineering	2	1	2
5	AERO 473	Aerospace Vehicle Design	3	2	4
6	AERO 493	Aerospace Engineering Vacation Training III	0	5	2
7	***	Technical Elective I *(Refer to Sections 11.7.2 and 11.7.3)*	*	*	3
8	**Total**	**Semester**	*****	*****	**19**
		Cumulative	*****	*****	**128**

11.7.B Year Four Semester One Technical Elective

Select at least one technical elective from the courses listed in ***Section 11.7.3*** to bring the minimum credits per semester to 18 and also ensure the minimum of 144 credit hours required to graduate. A student may consult his/her academic supervisor in the selection of the technical elective(s).

11.7.C Year Four First Semester Technical Electives

SN	Course	Code	Title	T	P	C
1	ME	461	Vibrations II	2	2	3
2	ME	463	Automatic Control II	3	1	3
3	ME	483	Mechatronics	3	1	3
4	MSE	451	Composite Materials	3	0	3
5	ME	473	Computer Aided Design and Manufacturing	2	2	3
6	ME	469	Facilities Design	3	1	3
7	ME	499	Operations Research	2	2	3
8	ME	451	Behaviour of Real Fluids	3	1	3
9	ME	455	Strength of Materials III	2	2	3

11.8Year Four, Semester Two

11.8.A Core Courses

SN	Course	Code	Title	T	P	C
1	ME	492	Entrepreneurship Development and Management	2	1	2
2	AERO	452	Aerodynamics II	2	1	2
3	AERO	498	Final Year Project II	0	10	5
4	AERO	456	Applied Meteorology	2	1	2
5	AERO	492	Aerospace Safety and Air Security	2	1	2
6	****	***	Technical Elective II *(refer to Sections 11.8.2 and 11.8.3)*	*	*	3
7	**Total**		**Semester**	*****	*****	**16**
8			**Cumulative**	*****	*****	**144**

11.8.B Core Courses

Select at least one technical elective from Departments of Mechanical and Materials engineering courses listed in ***Section 11.8.3*** to bring the minimum credits for the semester to 16 and also ensure the minimum of 140 credit hours required to graduate. A student may consult his/her academic supervisor in the selection of the technical elective(s).

11.8.C Second Semester Technical Electives

SN	Course	Code	Title	T	P	C
1	ME	462	Mechanisms Synthesis and Analysis II	2	2	3
2	ME	456	Finite Element Methods	3	1	3

3	ME 468	Internal Combustion Engines	3	1	3
4	ME 474	Production Planning and Control	3	0	3
5	ME 472	Machine Shop and Factory Design	2	1	3
6	ME 494	Human Factors and Ergonomics	3	0	3

12. DESCRIPTION OF COURSE CONTENT

12.1Description of course content for Year One Semester One

12.1.1 MATH 151 Algebra

(4, 1, 4)

Introduction to Algebra: Brief history of numbers; Natural numbers and real numbers: Principle of mathematical induction.
Complex Numbers: Definitions; Addition, multiplication , division; plane geometry of complex numbers; polar forms; de Moivre's theorem extraction of roots; Elementary functions of complex variable; Application to trigonometry.
Vector Algebra and Application: Vector space; Linear independence; Basis and dimension. Geometrical vectors; Cartesian basis; Scalar product and its properties; vector triple product and its properties. Applications: Equation of a straight line in various forms; Equation of a plane in various forms; intersection of lines in space and related kinematic problems; skewed lines.
Matrix Algebra: Definition; Matrix operations and properties. Definition of determinant and properties; inverse and methods of computation; Application to the solution of system of linear equations. Gaussian elimination, consistency. Eigen value problem; Diagonilization of symmetric matrix.

12.1.2 ENGL 157 Communication Skills I

(2, 0, 2)

The study of parts of a speech – the noun, verb, pronoun, adjective, adverb, and so forth. The use of the articles, the study of sentence ultimately leading to paragraph writing.

12.1.3 EE 151 Applied Electricity

(2, 2, 3)

Network Theorems: Kirchoff's Laws, Superposition, Thevenin's, Norton's and Reciprocity theorems, Delta-star and star transformations. Alternating Voltage and Current: Average and r.m.s values, harmonics, phasor representation of sinusoidal quantities, addition and subtraction of sinusoidal quantities. A.C Circuits: Active, reactive and apparent power, power factor, reactive and active loads and sources, solving single phase circuits using j operator and the concept of apparent power, solving 3-phase balanced and unbalanced loads.
Magnetic Circuits: Magnetomotive force, magnetic fields strength, permeability of free space, relative permeability, B-H curves of materials, solving magnetic problems.

12.1.4 CE 155 Environmental Studies

(2, 0, 2)

Humans and Nature. Introductory ecology. Electromagnetic spectrum. Ozone and global warming. Natural resources. Population. Concepts of Environmental: Noise, air, land and water pollution. Impact of Engineering Projects on the environment, and control measures. Environmental Laws and Regulations in Ghana.

12.1.5 ME 159 Technical Drawing

(2, 2, 3)

Introduction to drawing instruments and materials. Free hand sketching and visualisation of objects. Geometric construction. Principles of tangency and its application. Loci of points and its application. Projections of objects: Isometric and Orthographic projection in first angle standard.

12.1.6 AERO 157 Introduction to Aviation Technology

(1, 2, 2)

Discussions on aerospace engineering and aviation in Ghana and Africa. Visits and demonstration of the aerospace engineering laboratory. Basic components of the Aircraft including the wings, fuselage, tail plane etc. Introduction to ICAO and International Standard Atmosphere. Effects of flight controls, Elevators, Ailerons, Rudder etc. Aviation Communications including Aviation terminologies.

12.1.7 ME 157 Introduction to Information Technology

(1, 2, 2)

Introduction to computers. Computer hardware and software. Windows and word processing, Spreadsheet and Graphic presentation. Internet facilities and electronic mail. Introduction to computers programming using FORTRAN, C++, or any available programming language.

12.1.8 ILS 151 Information Literacy Studies I

(2, 0, 2)

Concept of information- Definition of concept of information, challenges of information (information explosion, information age), Formats of information, Prints and Electronics; Introduction to Information Lieracy- definition, standards, global developments, Rationale for/benefits of IL, Relevance of IL skills to academic work; Information Retrieval- The Concept of Information Retrieval, Information Retrieval Systems- manual tools for access (Classification schemes, bibliographical records, subject vs., keyboard, periodicals, indexes, abstracting services),

Electronic (Computer catalogues, Standalone and OPAC (Online Public Access Catalogue), Advanced catalogues search using Boolean operators and truncated; Types of Libraries and their relationship to University Education-Public libraries, Schools libraries, Special libraries, University/academic libraries, National libraries; Reference Information Tools – Print (Encyclopaedia, Dictionaries, Bibliographies, Indexes, Abstracts, Almanacs, etc), ; Electron (CD-ROM; Database; Internet; Audiovisual); Introduction to Library Catalogue-Type of catalogues (Manual and Electronic and access points, Union Catalogue), Bibliographic description of a book, use of content page and index, Basic electronic-based catalogue search.

12.2 Description of course content for Year One, Semester Two

12.2.1 MATH 152 Calculus with Analysis

(4, 1, 4)

Introduction to real numbers and point set on R: Real number operations: Order for real numbers; Completeness of real numbers; Absolute value; Intervals: Open and closed sets; Neighbourhoods; Limit points; Bolzano-Weierstrass Theorem.
Sequences. Series and functions; Limits of sequences of real numbers. Theorems on limits; Bounded monotonic functions; Local maxima and minima; Types of functions; polynomial, transcendental, and hyperbolic functions and their graphs. Odd, even and periodic functions. Convergence of series of real numbers; Test of convergence, series of functions and power series. Coordinate Geometry: Conic section in rectangular coordinates; parabola, ellipse, and hyperbola; Parametric equations of conic sections; Plane polar coordinates. Polar Curves.
Integration: Definite integrals; Definition of Riemann sum; Techniques of integration including method of substitution, partial fractions, by parts and reduction formulae.

12.2.2 ENGL 158 Communication Skills II

(2, 0, 2)

Communication process, skills in communication, channels of communication in an organisation, preparation of official documents such as letters, memos, reports, minutes and proposals. Oral presentation skills. Formal speech making. Conducting interviews and meetings.

12.2.3 EE 152 Basic Electronics

(2, 1,2)

Nature of atom. The vacuum valves (diode, triode, tetrode, pentode). Basic concepts of semiconductor charge carriers. Effective mass, mobility, conductivity, life time and recombination. Continuity equations, flow-equations, Hall effects, PN junctions, Choke, Rectification and Filteration. Bipolar transistors, its characteristics. CB, CC, CE configurations. The transistor and switching devices (ac – dc load lines). Small signal amplifiers.

12.2.4 ME 158 Engineering Graphics (2, 4, 3)

Introduction to free-hand sketching. Engineering drafting with AutoCAD, or any suitable computer drawing software. Application to the following: Geometrical construction, principles of tangency, loci of points, projections- classification based on distance of the source and the number

of views. Methods of development. Intersection of surfaces. Sectioning. Dimensioning. Tolerances. Fits Detail and Assembly drawings.

12.2.5 ME 164 Statics of Solid Mechanics

(2, 1, 2)

Fundamental Concepts: Basic terminologies in mechanics, laws of mechanics, Units of measurement (SI) and dimensions, Newton's Laws of Motion. Characteristics of a force, System of Forces, Vector representation of planer (2D) and spatial (3D) forces. Resultant and Equilibrium of coplanar forces: Force Systems, Triangle law of forces, resolution and resultant of forces, moment of a force, Varignon's theorem, free-Body diagrams and Equilibrium Equations. Structural Analysis: Assumptions, Two-dimensional trusses using the methods of joints and sections, Frames and machines. Friction: Frictional force, laws of dry friction, angle of friction, Problems involving dry friction, rope friction, square-and v-threaded screws, rolling resistances. Simple Machines: Definitions, law of machine, mechanical advantage, velocity ratio, and efficiency, self-locking and overhauling in machines, types of simple machines. Method of Virtual Work: Work done by Forces and moments. Centre of gravity and area moment of inertia: centre of gravity and centroid of a body, determination of centroid from first principle, parallel and perpendicular axes theorems, centroid of composite sections, experimental determination of centre of gravity, Resultant of distributed line loads, liquid pressure and flexible cables.

12.2.6 ME 158 Engineering Graphics

(2, 4, 3)

Introduction to free-hand sketching. Engineering drafting with AutoCAD, or any suitable computer drawing software. Application to the following: Geometrical construction, principles of tangency, loci of points, projections- classification based on distance of the source and the number of views. Methods of development. Intersection of surfaces. Sectioning. Dimensioning. Tolerances. Fits Detail and Assembly drawings.

12.2.7 AERO 174 Aerospace Design Project I (1, 5, 2)

The development of ingenuity and resourcefulness in engineering designs. Conceptual designs or copy designs of existing or new engineering systems. Execution of the steps between the initial conception of a design and the completion of a product. Individual or small group projects and visits to industrial plants.

12.2.8 ILS 152 Information Literacy Studies II

(2, 0, 2)

Database – Definition, Types/Features/Charateristics/Quality/Strength and Weakness of Database, Manual (e.g. catalogue – card, book and sheaf) and Electronic-types (Offline, Online, Computer-

based, Standalone/OPAC, Electronic books, journals and other serials), Element of Databases – fields and records (Numerical/statistical databases, full text databases, images, audio-visual); Electronic Databases at KNUST Library – Offline (CD-ROM e.g. Medline, Cochrane Library, FAO, WHO, GAINS), Online – Journal database – e.g. EBSCO, EMERALD, JSTOR, AGORA, HINARI, ELDIS, DOAJ, etc.; Introduction to Searching for Information on Internet – Information available on the internet, Strategies for Searching the internet (URLS, domain codes, sample sites), Basic search for information using the Internet, Search engines (Meta search engines, Information gateways, Subject-based Directories, Web Directories, Scholarly databases); Evaluation of Sources –evaluation criteria (accuracy, authority, purpose currency, objectively, appropriateness) for reference material, book, periodicals, magazines, paper sources and Internet sources; Legal and Ethical Uses of Information – Legal issues: Definition of terms, Copyright, Plagiarism and Fair use and their effects on the use of information, Ethical issues – How to cite sources.

12.3 Description of course content for Year Two, Semester One

12.3.1 MATH 251 Differential Equations

(4, 1, 4)

Ordinary differential equations; First and second order linear differential equations; System of differential linear equations with constant coefficients; Laplace transforms; Using MATLAB to solve ordinary differential equations Solution in series; Classifications of second order partial differential equations and reduction to canonical forms; Solution of simple boundary and initial value problems by separation of variables.

12.3.2 ENGL 263 Literature in English I

(1, 0, 1)

Literature as Poetry: What is a poem, and its characteristics? Difference between a poem and a song. The figure of speech and the literary device. Practical Appreciation. Literature as Drama: What is a play, and its characteristics? Drama as Theatre. Shakespeare. The Modern Play.
Texts to be studied: Selected African and English poems. One Shakespeare play and one Modern African play.

12.3.3 ME 261 Dynamics of Solid Mechanics

(2, 1, 2)

Kinematics of a Particle: Continuous and Erratic Rectilinear Motions, Rotational Motions, Curvilinear Motions including Projectiles, Dependent and Relative Motion Analysis of Two Particles. Kinetics of a Particle: Equation of Motion for a System of Particles. Work and Energy: Work, Energy, Power, Efficiency, principle of Conservation of Energy. Impulse and Momentum: Principle of Linear impulse and momentum, Conservation of linear momentum for system of particles, Impact, Angular momentum, moment of a force and angular moment momentum, principle of angular impulse and momentum. Centre of Gravity and mass moment of inertia: centre of gravity from first principle and composite bodies, mass moment of inertia, radius of gyration, parallel axis theorem, and moment of inertia of composite bodies. Kinetics of a Rigid Body: Planar Kinetic Equations of Motion including Translation, rotation about a fixed axis and general planar motion. Work and Energy for a rigid body:

Kinetic energy, work a force and a couple, principle of conservation of energy for rigid bodies. Impulse and Momentum for a rigid body: Linear and angular momentum, principle of impulse and momentum, conservation of momentum, eccentric impact. Rotary balancing: single and multi-planes using graphical and analytical methods.

12.3.4 ME 251 Introduction to Fluid Mechanics

(2, 0, 2)

Characteristics of fluids: Properties of fluids; Density or mass density, Viscosity; Types of fluids; Thermodynamic properties; Compressibility; Surface tension and capillarity.
Fluid Statics: Pressure variation in a fluid at rest; Absolute, gauge, atmospheric and vacuum pressures; Measurement of pressure: manometers, mechanical gauges; Thermodynamics properties; Hydrostatic forces on submerged Surfaces; Buoyancy and floatation. Kinematics of Fluid Flow: Methods of describing fluid Motion; Types of fluid flow; Rate of flow or discharge; Continuity equation; Velocity and acceleration. Ideal fluid flow: Velocity potential function and stream function.
Introduction to dimensional analysis: Secondary or derived quantities, dimensional homogeneity, methods of dimensional analysis: Reyleigh's method, Buckingham's pie theorem, method of selecting repeating variables, procedure for solving problems by Buckingham's pie theorem.

12.3.5 ME 281 Engineering Materials I

(2, 0, 2)

Materials Science: Imperfections and diffusion in solids. Phase diagrams and transformations. The structure of metals and other materials: Properties and processing of engineering materials: Mechanical properties – hardness, ductility, brittleness, toughness, strength etc. Elastic and plastic behaviours. Dislocations and strengthening mechanisms. Thermal properties – Heat capacity, thermal conductivity, expansion and stresses. Mechanical engineering materials. Introduction to ferrous and non-ferrous metals. Introduction to polymers. Introduction to engineering ceramics. Materials selection.

12.3.6 ME 255 Strength of Materials I (3, 1, 3)

Simple stress and strain within the elastic limit. Stress-Strain Curve. Stress on an Oblique Plane Under Axial Loading. Stress, strain and deformation under axial loading (determinate and indeterminate). Thermal stress. Multi-axial loading (or Generalised Hooke's Law). Stress concentration under axial loading. A brief review of area moment of inertia. Torsional stress, strain and deformation of circular solid and hollow shafts. Stress concentration in circular Shafts. Tensile bending and shear bending of symmetric beams. Bending of symmetric composite beams. Stress concentration under pure bending. Shear force and Bending-moment diagrams of uniform cross-sectioned beams using the sectional method. Compound Loading and stress-strain system (or Mohr's stress and strain circles). Thin-Walled Pressure Vessels. Theories of Static failure.

12.3.7 AERO 293 Aerospace Engineering Vacation Training I

(0, 5, 2)

Three weeks attachment each year to the Air Force School of Trade Training, Burma Camp for first had training on the operations and maintenance of aircraft including systems such as hydraulics pneumatics, avionics. Hands-on mechanical and electrical workshop practice; aircraft

safety, etc. Training may include "air experience" and simulator flying experience. Certificates are awarded to students after Aero 493 by the Air Force.

12.3.8 ME 295 Mechanical Engineering Laboratory I

(0, 3, 1)

Practical sessions in ME 255 Strength of Materials I, ME 281 Mechanical Engineering Materials I, ME 251 Introduction to Fluid Mechanics, ME 261 Dynamics of Solid Mechanics. Technical reports and Power point presentations.

12.4 Description of course content for Year Two, Semester Two

12.4.1 MATH 252 Calculus of Several Variables

(4, 1, 4)

Differentiation: Partial differentiation; Total derivatives and their applications.
Differentiation under the integral sign;; Multiple integrals; Double integrals- Cartesian and Polar coordinates; Triple integrals – Cartesian, Cylindrical, and Spherical coordinates; Applications. Line, surface, and volume integrals; Triple scalar and vector products; Differentiation of vectors and vector fields. Differentiation of implicit functions; Functions of several variable –Limits. Continuity. Differentiability and Extreme; Gamma and Beta functions; Functions of complex variables; Conformal mapping; Contour integrations.

12.4.2 ENGL 264 Literature in English II

(1, 0, 1)

Continuation of ENGL 263. Literature as Narrative. Traditional (19th Century) Narrative. Contemporary narrative. The African Novel.
Text to be studied: One African Novel and one English Novel.

12.4.3 ME 258 Computer-Aided Design and Modelling

(2, 3, 3)

Introduction to 3-D computer graphics software: Solid Edge, etc. Application to the following: Technical Surface finish, measurement, methods of examination and specification, hardening, joints and weld forms, specification of weld. The design process and the role of CAD; Techniques for geometric modelling; Principles of computer graphics; Finite element modelling: Design databases: Standards for computer-aided design: Artificial intelligence and Expert systems.

.

12.4.4 ME 264 Mechanism Synthesis and Analysis I

(3, 1, 3)

This course is an introductory course in dynamics of machinery. It covers underlying theories and techniques for analysis and synthesis of mechanical systems which consist of planar linkages, mechanical drives and cams. It places emphasis on the use of graphical techniques and computer simulation tools. The topics covered include

Fundamentals: Definitions and terminology, degrees of freedom, types of motion, mechanisms and structures, motors and drives. Dynamics of Linkages: Analysis of position, velocity, acceleration and dynamic forces in linkages using both graphical and analytical methods.

Graphical Linkage Synthesis: Introduction to type synthesis, function, path and motion generations, Dimensional synthesis up to three positions including quick-return mechanisms Grashof Condition for four-bar linkage, Inversion, introduction to Coupler and Cognates.

Cam Design and Dynamic Analysis: Cam terminology, single and double dwell cam design, displacement diagrams and polynomial functions, pressure angle and radius of curvature, Practical Design and Manufacturing considerations. Transmission of rotational motion: Gears and gear trains including Epicyclic/Planetary Trains, roller drives, belt drives and Chain drives.

12.4.5 AERO 256 Aerospace Structures (3, 0, 3)

Deflection of beams: Singularity/Marcolay's method, strain energy method, moment-area method, strain-energy method. Shear and torsion on stable cross sections. Compression and shear buckling using both Analytical and empirical methods. Fatigue, creep and fracture mechanics concepts. Efficient distribution of material to meet requirements of stiffness, Strength and stability, Elastic and limit design of efficient structures. Bending and Torsion under plastic conditions.

12.4.6 ME 266 Thermodynamics I

(2, 0, 2)

This course is delivered to other departments with the course code as ME 265 or ME 166 as applicable.

Energy, heat and work. First and second law of thermodynamics and corollaries. Application to liquids, vapours and gases. Perfect gases. Property tables. Flow and non-flow processes. Analysis of ideal vapour and gas power cycles.

12.4.7 AERO 274 Aerospace Design Project II

(2, 1, 2)

Principles of mechanical engineering design. Design of machine members under static and fatigue loads. Application to individual and group projects.

12.5 Description of course content for Year Three, Semester One

12.5.1 MATH 353 Probability and Statistics

(2, 1, 2)

(Pre-requisites Analysis II). Introduction to probability. Random variables and functions of random variables. Mathematical expectations and moments. Special discrete and continuous distribution: Binomial, exponential, gamma, chi-square, t – and F – sums of random variables. Laws of large numbers. Central limit theorem.

12.5.2 MATH 351 Numerical Methods

(2, 1, 2)

Finite differences: Difference tables, forward, backward and central differences. Linear systems: Matrix methods, Gaussian elimination, Gauss–Siedel, ill–conditioning. Errors: Sources, estimates, propagation. Floating point arithmetic. Operators. Curve fitting. Interpolation. Langrage, Newton's forward and backward. Euler and Runge-Kutta methods. Collation polynomials. Newton – Raphson's method.

12.5.3 ME 363 Automatic Control I

(2, 1, 2)

This is an introductory course in control of systems composing of mechanical, electrical, thermal and fluid elements. General analytical and design tools for physical systems are developed. Topics include basic terminologies in control, types of control systems, system representation and analysis, and computer simulation. Topics explored include:
Fundamentals: Basic terminologies in Automatic Control, Open and Closed Loop Control Systems, Feedback System, History of Control System Development, Application of Automatic Control, Feedback and Feedfoward Control. System Representation: Signal Flow Graph, Block Diagrams. System Analysis: Laplace Transformation, Inverse Laplace Transformation, Transient response, Performance Indices, Stability Criterion (Routh Criterion). Components of Control Systems: Electrical, Hydraulic and Pneumatic, Mechanical and Thermal Components. System Simulation: electromechanical analogies and analogue computers

12.5.4 AERO 395 Aerospace Engineering Laboratory I

(0, 3, 1)

Practical sessions in ME 262 Mechanisms Synthesis and Analysis I, ME 266 Thermodynamics I,

ME 363 Automatic Control I, AERO 351 Aerodynamics I, and AERO 256 Aerospace Structures and Materials. Technical reports and Power point presentations.

12.5.5 AERO 391 Aerospace Industry and Engineering

(3, 0, 3)

The philosophy of airplane and spacecraft design. Satellites. Physics of flight. Basic helicopter and aerospace vehicle aerodynamics. Types of aerospace power systems and their construction. Aerospace engine installation requirements. Rockets. Solar power applications in aerospace systems. Aerospace craft construction. Aerospace craft instruments.

12.5.6 AERO 351 Aerodynamics I

(3, 0, 3)

Application of theoretical fluid mechanics to aerodynamics. Theory of lift: Joukowski airfoil and extensions, thin airfoil theory, lifting line and surface theory.

12.5.7 AERO 393 Aerospace Engineering Vacation Training II

(0, 5, 2)

Three weeks attachment each year to the Air Force School of Trade Training, Burma Camp for first had training on the operations and maintenance of aircraft including systems such as hydraulics pneumatics, avionics. Hands-on mechanical and electrical workshop practice; aircraft safety, etc. Training may include "air experience" and simulator flying experience. Certificates are awarded to students after Aero 493 by the Air Force.

12.5.8 ECON 151 Introduction to Economics I (2, 0, 2)

The nature and scope of economics. Consumer choice. Determination of prices in different market conditions, production theory, and theory of distribution.

12.6 Description of course content for Year Three, Semester Two

12.6.1 AERO 362 Air Vehicle Stability and Control (3, 1, 3)

Study of motion of aircraft, equations of motion, aerodynamic force representation, longitudinal and lateral motions, response to controls and to atmospheric disturbances, handling and flying qualities criteria and other figures of merit.

12.6.2 ME 392 Industrial Engineering and Ergonomics (2, 1, 2)

The same course is offered for different groups of students in the first semester and second semesters as ME 391 and ME 392, respectively.

Historical perspective; Methods Engineering, Methods and Work study etc. Productivity improvement techniques. Demand forecasting. Inventory management. Facility layout. Materials handling, Maintenance management. Total Quality Management. Human factors in engineering: A series of topics including machine systems, work conditions and ergonomics. Industrial Psychology: Motivation, performance analysis and measurement.

12.6.3 AERO 374 Air Vehicle Performance and Design (3, 1, 3)

Introduction to flight dynamics and environment, general equations of motion in three dimensions, aircraft weight and balance fundamentals: influence of weight and balance on airplane performance, flight environment: the importance of atmospheric factors and the influence of density, temperature, humidity, pressure altitude, density altitude and other environmental conditions on performance of the air vehicle, basic concept and understanding of flight instruments, airplane performance: including takeoff, rate of climb, ceilings, power required, range, maximum endurance, descent, landing, operating limitations, stability and control, introduction to aviation regulations

12.6.4 AERO 368 Propulsion (2, 2, 3)

Introduction to propulsive systems. Gas dynamics of ducted flows. Dynamic flow mechanisms, Gas generators, propulsive systems. Analysis of thrust generation. Air breathing thrust generators. Rockets.

12.6.5 ME 366 Heat Transfer

(3, 0, 3)

Fundamentals of conduction, convection and radiation heat transfer. Applications to design of heat exchangers including solar collectors.

12.6.6 ME 362 Vibrations I

(3, 1, 3)

This course covers vibrations of single to multiple degrees of freedom systems with and without damping. In addition, it includes design for vibration isolation and suppression, practical considerations in vibration and human tolerance for vibration. The course explores the following topics:

Free Vibration of single degree of freedom linear systems: Harmonic motion, Vibration System Modelling, Energy methods and Stiffness. Response to Harmonic Excitation: Forced and Base Excitation of Undamped and Damped One-degree-of-freedom Systems, Rotating Unbalance, Coulomb and other forms of damping. General Forced Response: Impulse response functions, response to arbitrary and periodic inputs, transform methods, shock spectrum, Computer simulation of Time response of single degree of freedoms systems using Euler Method. Multiple-Degree-of-Freedom Systems: Two-Degree-of-Freedom Undamped Models, Eigenvalues and Natural Frequencies, Systems with More than Two Degrees of Freedom, Systems Viscous Damping, Forced Systems, Lagrange's Equations. Torsional vibration systems including geared systems. Design for Vibration: Acceptable Levels of Vibration, Vibration Isolation and Suppression, Practical Speeds of Rotating Disc, Optimization. Vibration Testing and Measuring: Measuring instruments and testing.

12.6.7 AERO 396 Aerospace Engineering Laboratory II (0, 3, 1)

Practical sessions in ME 362 Vibrations I , ME 392 Industrial Engineering and Ergonomics, AERO 356 Aircraft Stability and Control, ME 366 Heat Transfer, AERO 374 Aircraft Performance and Design, and AERO 368 Propulsion. Visits to local manufacturing industries. Mini-projects. Technical reports and power point presentations

12.7 Description of course content for Year Four, Semester One

12.7.1 AERO 483 Avionics

(3, 1, 3)

Introduction to pitot-static systems, aerospace electric circuits, analogue and digital electronics, electromechanical devices, electrical and electronic systems, aircraft instrumentation and data acquisition systems, aircraft navigation and communication systems. Discussion on reliability and causes of failure of aerospace electronic systems.

12.7.2 AERO 491 Aviation Business Management (2, 0, 2)

Introduction to management (definition and introduction to the main functions of management). Performance-related emoluments and other incentive systems. Inventory management, maintenance management, demand forecasting, aircraft and service concepts. Engineering economy. Accounting and cost accounting. Project Management.

12.7.3 AERO 497 Final Year Project I

(0, 6, 3)

Project work on an approved topic carried out under the supervision of a lecturer in the department. Project topics cover a broad range of areas including experimental work, design and manufacture of machines, writing of software, computer simulation, conduct of feasibility studies and survey research. Students either work individually or in groups depending on the nature of the project. The entire project work is to be completed in two semesters. AERO 497 Project I covers work in the first semester and is assessed by a written progress report and a seminar presentation by the student(s).

12.7.4 AERO 495 Aircraft Maintenance Engineering (2, 1, 2)

Fundamental concepts. Types of maintenance programmes. Facilities and supporting services. Trouble-shooting and problem solving techniques: Why-why, because logic analysis (WWBLA), etc. Failure mode analysis, costs of options, replacement guide lines and trade-ins. aircraft maintenance practices. Regulations and Acts on Aircraft maintenance. Basic Principles of supervising. Organization, Time and People Management. Scheduled and Unscheduled maintenance planning and scope. Practical sessions on: fuselage, landing gear, engine, electrical and electronic systems, hydraulic and pneumatic systems, fuel pumps, instruments and control panels, etc.

12.7.5 AERO 473 Aerospace Vehicle Design (3, 2, 4)

Aircraft structures and materials. The classical laminate theory. Stress Concentrations in plates. Applications to aerospace craft. Thin wall pressure vessel. Some structural design aspects. The winding of pressure vessels. Fabrication processes. Departure from elementary stresses distribution: Cut outs, concentrated loads, diffusion. Theoretical optimum structures. Preliminary estimate of take-off weight, wing loading selection, main wing design fuselage design, horizontal and vertical tail design, engine selection, take-off and landing and structure design.

12.7.6 AERO 493 Aerospace Engineering Vacation Training III

(0, 5, 2)

Three weeks attachment each year to the Air Force School of Trade Training, Burma Camp for first had training on the operations and maintenance of aircraft including systems such as

hydraulics pneumatics, avionics. Hands-on mechanical and electrical workshop practice; aircraft safety, etc. Training may include "air experience" and simulator flying experience. Certificates are awarded to students after Aero 493 by the Air Force.

12.7.7 ME 461 Vibrations II

(3, 1, 3)

Vibrations II is designed to reflect on recent advances in vibration Technology and many Accreditation Board for Engineering and Technology, criteria and increased importance of engineering design, modal analysis and measurement. Topics covered include:
Distributed-Parameter Systems: Vibration of Strings and Cables, Modes and Natural frequencies, Vibration of Rods and Bars, Bending Vibration of beams. Vibration Testing and Experimental Modal Analysis: Measurement Hardware, Digital Signal Processing, Random Signal Analysis in Testing, Vibration Testing for Endurance and Diagnostics. Introduction to Finite Element Method: Bar, Three-Element bar, Lumped Mass Matrices. Computational Consideration: Influence of Coefficients and Dunkerley's Formula, Rayleigh's Method, Matrix Iteration, Computer simulation of Time response of Multi- degree of freedoms systems using Euler Method. Nonlinear Vibration: Single-degree-of-freedom Phase Plots, Equation Linearization, Pendulum, Nonlinear damping and Averaging. Vibration of machine foundations.

12.7.8 ME 463 Automatic Control II

(3, 1, 3)

This course gives a practical treatment of control of engineering systems composed of mechanical, electrical, thermal and fluid elements. General analytical and design tools for physical systems are developed.
Review of basic concepts and mathematical techniques used in Control Engineering. State-space representation of control systems. Frequency response methods. Stability analysis: Nyquist criterion. Controllability for a system of multiple inputs ,Root-locus System design. Nyquist, Bode and other plots. Gain and Phase margins, proportional control, compensator design Control system design and design specifications. Performance improvement and compensation.

12.7.9 ME 483 Mechatronics

(2, 2, 3) *This is an interdisciplinary course which involves mechanical, thermal, electrical and electronics engineering, programming and controls*. Topics explored include 19echatronics systems control, sensors and actuators, analog and digital control, integration of sensors, actuators and microcomputers including programmable logic controllers, design and programming of microcontroller.

12.7.10 MSE 451 Composite Materials (3, 0, 3)

Classification of composite materials; Polymer Matrix composites (PMCs), Metal Matrix Composites (MMCs), Ceramics Matrix Composites (CMCs). Ceramic reinforcements; Particle Reinforcements, Continuous and discontinuous fibres, Whiskers, Fabrication, Structure, Morphology and properties. Processing techniques,: Cold press and sintering, Hot pressing, Reaction bonding process, Combined hot pressing and reaction bonding, Whisker reinforced composites by hot pressing, etc. Interfacial area in composites, Crystallographic nature of the interface, Interfacial wetability, Types of bonding at the interface. Interface engineering for enhanced toughness and other properties of composites.

12.7.11 ME 473 Computer Aided Design and Manufacturing

(2, 2, 3)

The design process and the role of CAD. Defining the model. Techniques for geometrics modelling. Elements of interactive computer graphics. Techniques for geometric modelling. Principles of computer graphics. Finite element modelling. Design databases. Standards for computer-aided design. Expanding the capability of CAD- Artificial intelligence and Expert systems. The design/manufacture interface. The link to machine control – computer numerical control; machining centres; manual and computer-assisted part programming; the CAD/CAM approach to part programming; machining from 3D models. Rapid prototyping. Robotics technology – Robot types and motions; accuracy and repeatability; robot programming; robot applications; robot application to assembly. Cellular manufacturing

12.7.12 ME 469 Facilities Design

(3, 1, 3)

The course presents a study of the theory and practice of facilities design: activity and flow analysis, space requirements, layout techniques, material handling, warehousing, location selection, and problem-solving with computer-aided layout techniques. Design projects in plant layout required.

12.7.13 ME 499 Operations Research I

(3, 0, 3)

Deterministic models of operations research are discussed with special emphasis on linear programming. Topics covered include simplex algorithm, transportation problem. Network flow, dynamic programming, integer programming, multiple criteria and nonlinear programming models. Introduction to the concepts of probabilistic operations research models and solution techniques. Poisson process, Markov chains, queuing models and their applications, decision analysis, inventory models, risk analysis, and project networks.

12.7.14 ME 451 Behaviour of Real Fluids

(3, 1, 3)

Flow around Submerged Bodies: Forces on submerged bodies; Force exerted by a flowing fluid on a stationary body; Drag; Lift; Expression for drag and lift; Dimensional analysis of drag and lift; Pressure drag and friction drag; Streamlined body; Bluff body; Drag on a sphere; Drag on a cylinder; Magnus effect; Development of lift on an airfoil; Steady-state of a flying object

One Dimensional Compressible Flow in a Duct: Thermodynamic relations; Equation of state; Expansion and compression of perfect gas; basic equations of compressible flow; Continuity equation; Bernoulli's equation; Momentum equations; Velocity of sound or pressure wave in a fluid; Mach number; Propagation of pressure waves (or disturbances) in a compressible fluid; Stagnation properties; Area-velocity relationship for compressible flow; Flow of compressible fluid through orifices and nozzles fitted to a large tank; Mass rate of flow of compressible fluid through venturimeter; Pitot-static tube in a compressible flow.

12.7.15 ME 455 Strength of Materials III

(2, 2, 3)

Elementary theory of elasticity. Sign notation of stresses (normal and shear) in three-dimensional system. Equilibrium of forces and moments in three-dimensional system using Cartesian and polar (cylindrical) coordinates. Complimentary shear stress. Plane stress and strain considerations. Compatibility equation. Airy stress function for stress prediction. Photoelastic theory for stress prediction.

12.8 Description of course content for Year Four, Semester Two

12.8.1 ME 492 Entrepreneurship Development and Management

(2, 1, 2)

Entrepreneurship and free enterprise. Business planning. Product and service concepts for new ventures. Marketing and new venture development. Organising and financing new ventures. Current trends in commerce (Internet commerce, e-commerce, etc.). Business Law/Law of Contract.

12.8.2 AERO 452 Aerodynamics II (2, 1, 2)

Compressible flow: Oblique shocks and waves. Supersonic airfoils and wings. Similarity laws. Slender body theory. Viscous flow: Navier Stokes equations, boundary layer theory.

12.8.3 AERO 498 Final Year Project II

(0, 10, 5)

This is a continuation of work started by the student on AERO 497 Project I. This course is assessed by a final report and a seminar presentation by the student(s).

12.8.4 AERO 456 Applied Meteorology

(2, 1, 2)

Introduction to the atmosphere. Introductory meteorology laboratory. Introduction to synoptic meteorology. Weather discussions and forecasting. Aviation meteorology. Atmosphere dynamics, Mesoscale meteorology.

12.8.5 AERO 492 Aerospace Safety and Air Security (2, 1, 2)

Air safety engineering, fire management, air traffic control and management, aviation weather information and communications.

12.8.6 ME 462 Mechanism Synthesis and Analysis II

(2, 2, 3)

Logical synthesis of mechanisms. Freudenstein's equation. Coordination of Crank velocities. Design of up to six-bar mechanism using algebraic method for a given output function with 4^{th} order approximation. Coupler Curves and Cognates. Motion and Path generation for common link mechanisms. Robert's theorem. Error estimation in a given synthesis. Optimisation using Chebyscher's theorem. High speed cam dynamics. Analytical derivation of cam profiles. Introduction to spatial mechanisms.

12.8.7 ME 456 Finite Element Methods

(2, 2, 3)

This course is an introductory course in finite element methods for thermal, stress and deformation analysis of mechanical elements. It covers finite element theories, problem formulation and use of all-purpose finite element programmes. The course seeks to introduce students to: Analysis of trusses, beam, frame, plane stress, plane strain, axisymmetric isoparametric, solid, thermal, and fluids using finite element methods. Students are introduced to commercial Finite Element software to solve engineering problems

12.8.8 ME 468 Internal Combustion Engines

(3, 1, 3)

Fuels and combustion. Air standard cycles. Engines types and their working principles. SI and CI engine characteristics. Criteria of performance for SI and CI engines. Engine emissions and air pollution. Gas turbines and their applications. Introduction to the design of reciprocating internal combustion engines.

.

12.8.9 ME 474 Production Planning and Control

(3, 0, 3)

This course introduces the concepts of demand forecasting, aggregate production planning, inventory control, project planning, line balancing and job scheduling. Students will be expected to work on projects involving enterprise resource planning and supply chain management

12.8.10 ME 472 Machine Shop & Factory Design

(2, 1, 2)

Introduction to machine shop and factory design. Choosing location for industrial plants. Planning the layout of the shop or factory to avoid unnecessary handling. Batch production, line-flow production. Handling work at machine; moving work about the shop: transport conveyors and work handling appliances – gravity, chain, and belt conveyors, hoists, cranes, trucks. Work flow; plant capacity. Storing materials and finished products. Tool rooms; accessibility of tool rooms. Tool room layouts, Industrial ventilation, lamination, quality and quantity, lighting design and economics. Sound, noise and ultrasonic noise control and applications. Accidents prevention, mechanical guarding of machines. Electrical equipment; occupational hazard and fire protection.

12.8.11 ME 496 Human Factors and Ergonomics

(3, 0, 3)

This course introduces ergonomics and biomechanics concepts. Topics include psychomotor work capabilities, anthropometry, environmental stressors, physical workload, safety, hazard and risk factor identification, work station design, and material handling. Introduction to the elements of cognitive human factors. Human sensation and perception, cognition, information processing, attention, signal detection theory, mental workload, and decision-making. Data collection methods and report writing are emphasized. Lab projects are required.