(1) Vision: To develop technically competent Aeronautical Engineers of the highest academic standards, to meet the national and global requirements of industry and society.

(2) Mission:

To inculcate the students with well-designed teaching and learning process in all spheres of Aeronautical Engineering by nurturing them in to skillful and ethical professionals in their pursuit.

(3) Program Educational Preambles (PEO's):

PEO-1 Graduates of the programme will have successful professional careers in industry, government, academia, Space, and Defense with innovative ideas, sustained interest and potential to contribute for the development and current needs of the aeronautical industries in the country and the world.

PEO-2 To Prepare the exhibit skills to work individually and as part of the team with ethics as per needs of the aeronautical industries in the country and the world.

PEO-3 To develop the expertise in theoretical and experimental aspects of different domains of aeronautical engineering.

(4) Programme Outcomes (PO's):

PO-01: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of aircraft problems.

PO-02: Problem Analysis: To Identify the existing/future problem in aeronautical engineering and to formulate, review research literature, and analyze problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO-03: Design/development of solutions: Design solutions for aircraft and its components or processes that meet the needs with appropriate consideration for the public health and safety, and the cultural, Societal and environmental considerations.

PO-04: Investigation: To conduct investigation such as crashed aircraft and take the input as a research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO-05: Modern Tool Usage: Create, select, and apply appropriate techniques in aviation, resources and modern aeronautical engineering and IT tools including prediction and modeling to complex aeronautical engineering activities with an understanding of the limitations.

PO06: The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO-07: Environment and Sustainability: Understand the impact of the professional aeronautical engineering solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development in aviation.

PO-08: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the Aeronautical Engineering practice.

PO-09: Individual and Team Work: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings and environment of Aeronautical Engineering.

PO-10: Communication: Communicate effectively on aerospace engineering problem and activities with the engineering community and with society at large such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.

PO-11: Project Management: Demonstrate aircraft knowledge and understanding of the aviation and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO-12: Life-Long Learning: Recognize the need for aircraft, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change in aviation.

(5) <u>Program Specific Outcomes (PSOs)</u>

PSO-1 Design, analyze, interpret, formulate and to find the solution for Aerospace related problems.

PSO-2 Ability to excel in aero modeling, UAV design, Aircraft Structures, Computational Aerodynamics and Combustion related problems.

(06) Programme PO's and PSO's Mapping

			PO 1	PO 2	PO3	PO4	PO5	PO 6	PO7	PO 8	PO 9	PO10	PO11	PO 12		
S. No	**Program**	**Courses Category**	Engineering Knowledge	Problem Analysis	Design/ Development of Solution	Investigation	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Team Work	Communication	Project Management	Life-Long Learning	**PSO 1**	**PSO 2**
1	BE (AE)	Humanities and Social Sciences including Management Courses	*	*			*	*		*		*		*		
2		Basic Science Courses	*	*	*	*	*		*							
3		Engineering Science Courses Including Workshop, Drawing, Basics of Electrical/Mechanical/Computer etc.	*	*	*		*							*	*	*
4		Professional Core Courses	*	*	*	*		*		*	*		*		*	*
5		Professional Elective Courses relevant to chosen specialization/branch	*	*	*	*	*	*		*	*			*	*	*
6		Open subjects – Electives from other Technical and /or Emerging *Subjects	*	*	*	*	*	*	*	*	*			*	*	*
7		Project Work, Seminar and Internship in Industry or elsewhere	*	*	*	*	*	*	*	*	*	*	*	*		*
8		Specific Core Subject		*	*	*										

9		Mandatory Course (Non Credit)						*	*	*	*	*		*		

(07) Semester wise PO's and SPO's Mapping

Semester	Name of the Courses/POs(Basic, Core Electives, Projects, Internships etc.)	PO 1	PO2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO11	PO1 2	PSO 1	PS O2
		Engineering Knowledge	**Problem Analysis**	**Design/Development of Solution**	**Investigation**	**Modern Tool Usage**	**The Engineer and Society**	**Environment and Sustainability**	**Ethics**	**Individual and Team Work**	**Communication**	**Project Management**	**Life-Long Learning**		
Semester-Ist	Mathematics-I	*	*	*	*								*	*	*
	Engineering Physics	*	*		*								*	*	
	Basic Computer Engineering	*	*	*	*	*			*		*		*		
	Basic Mechanical Engineering	*	*	*	*	*									
	Basic Civil Engineering & Mechanics	*	*	*				*							
	Language Lab					*			*	*	*		*		
	Self-Study / GD Seminar		*	*	*	*			*	*		*	*		
Semester-IInd	Mathematics-II	*	*	*	*								*	*	*
	Engineering Chemistry	*	*	*	*									*	*
	English for Communication	*							*	*	*		*	*	
	Basic Electrical & Electronics Engineering	*	*	*	*										
	Engineering Graphics	*	*	*	*										*
	Manufacturing Practices	*				*			*	*	*	*	*		
	Industrial Training			*	*		*	*	*	*		*	*	*	
Semester-IIIrd	Mathematics - III	*	*	*	*									*	*
	Elements of Aeronautics		*	*			*							*	*
	Fluid	*	*	*			*							*	*

	Mechanics														
	Thermodynamics	*	*	*			*							*	*
	Strength of Materials	*	*	*	*		*							*	
	Computer Programming	*	*	*	*	*									
	Self-Study /GD Seminar		*	*		*	*	*	*		*	*	*		
Semester-IVth	Energy, Ecology, Environment & Society						*	*		*				*	
	Aircraft Systems and Instrumentation	*	*											*	
	Aerodynamics I	*	*	*			*							*	*
	Aircraft Propulsion I	*	*	*	*									*	*
	Aircraft Structure I	*	*	*										*	*
	Java Programming			*	*	*							*		
	Industrial Training-I		*	*		*	*	*	*	*		*	*		
Semester-Vth	Aircraft Structure -II		*	*	*	*									*
	Aerodynamics -II		*	*	*			*							*
	Aircraft Propulsion –II		*	*											*
	Basics Aircraft Maintenance & Repair					*									
	Theory of Vibration	*													
	Nano Science & Technology	*													
	Heat and Mass Transfer	*	*		*					*				*	
	Industrial Training-II		*	*	*	*	*	*	*	*		*	*		
Semester VIth	Aircraft Design	*	*	*	*										*
	Aircraft Stability & Control	*	*	*	*										*
	Aircraft Rules & Regulation	*	*	*	*	*				*		*	*		
	Wind Tunnel Techniques	*	*	*	*										
	Fuel & Combustion	*	*	*	*		*	*	*						
	Maintenance of Radio & Communication Systems	*	*	*	*										
	Product Design &	*				*	*	*	*				*		

	Development														
	Management and Entrepreneurship		*	*	*			*					*		
	Minor Project	*													
Semester VIIth	Computational Fluid Dynamics	*	*	*	*	*	*	*							*
	Rockets and Missiles	*	*	*	*										
	Air Traffic Control and Planning	*	*	*	*	*									
	Flight Instrumentation	*	*	*	*			*		*		*	*		
	UAV System	*	*	*	*										
	Fatigue and Fracture system	*	*	*	*			*							
	Project Stage-I			*	*										
	Self-Study/GD/Seminar		*	*	*	*	*	*	*	*		*	*		
Semester VIIIth	Finite Elements Methods	*	*	*	*									*	*
	Avionics	*	*	*	*									*	*
	Industrial Aerodynamics	*	*	*	*	*				*		*	*		
	Economic Policies in India		*			*									
	Internet of Things		*	*				*							
	Project Stage-II	*	*		*									*	
I/III/IV (preferred Semester)	Mandatory Courses							*	*	*	*	*	*		

(08) <u>Structure of Programme</u>: To fulfill the need of development of all the POs/ GAs, as per above mapping, the following semester wise programme structure are as under.

[L= Lecture, T = Tutorials, P = Practical's & C = Credits]

Total Credits*= 160

Structure of Undergraduate Engineering program:

S. No.	Course Category	Credits of the EE Curriculum
1.	Humanities and Social Sciences including Management	11
2.	Basic Sciences	24
3.	Engineering Sciences including workshop, drawing, basics of electrical/mechanical/computer etc.	19
4.	Professional Core Subjects	52
5.	Professional Subjects: Subjects relevant to chosen specialization/branch	18
6.	Open Subjects: Electives from other technical and/or emerging subjects	18
7.	Project work, seminar and internship in industry or elsewhere	18
8.	Mandatory Courses [Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Knowledge Tradition]	Non-credit
	Total	**160**

***Definition of Credit:**

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
1 Hr. Practical (P) per week	0.5 Credit
2 Hours Practical (Lab)/week	1 Credit

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09) Scheme of Exanimation (Aeronautical Engineering) Academic Year 2019-20

I Semester

S. No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ Hour/ Week			Credits
			End Sem. Exam.	Mid Tests	Assignments/Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	BEBSC-101	Mathematics-I	60	30	10	-	-	100	3		-	3
2	BEBSC- 202	Engineering Physics	60	30	10	30	20	150	2	1	2	4
3	BEESC-203	Basic Computer Engineering	60	30	10	30	20	150	3	-	2	4
4	BEESC-204	Basic Mechanical Engineering	60	30	10	30	20	150	2	-	2	3
5	BEESC-205	Basic Civil Engineering & Mechanics	60	30	10	30	20	150	3	-	2	4
6	BEHSMC-206	Language Lab	-	-	-	30	10	40	-	-	2	1
7	BELC-107	Self-Study / GD Seminar					10	10			2	1
		Total	**300**	**150**	**50**	**150**	**100**	**750**	**13**	**1**	**12**	**20**

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II Semester

S. No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ Hour/ Week			Credits
			End Sem. Exam.	Mid Tests	Assignments/Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	BEBSC-201	Mathematics-II	60	30	10	-	-	100	3		-	3
2	BEBSC-102	Engineering Chemistry	60	30	10	30	20	150	3		2	4
3	BEHSMC-103	English for Communication	60	30	10	30	20	150	3	-	2	4
4	BEESC-104	Basic Electrical Engineering	60	30	10	30	20	150	2	-	2	3
5	BEESC-105	Engineering Graphics	60	30	10	30	20	150	2	1	2	4
6	BEESC-106	Manufacturing Practices	-	-	-	30	10	40	-	-	2	1
7	BELC-207	Industrial Training					10	**10**	**-**	**-**	**2**	**1**
		Total	**300**	**150**	**50**	**130**	**100**	**750**	**13**	**1**	**12**	**20**

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III SEMESTER

S. No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/ Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	BEA-301	Mathematics -III	60	30	10	-	-	100	3		-	3
2	AEA-302	Elements of Aeronautics	60	30	10	-	-	100	3		-	3
3	AEA-303	Fluid Mechanics	60	30	10	30	20	150	2	1	2	4
4	AEA-304	Thermodynamics	60	30	10	30	20	150	3	-	2	4
5	AEA-305	Strength of Materials	60	30	10	30	20	150	2	1	2	4
6	AEA-306	Computer Programming	-	-	-	30	20	50	-	-	2	1
7	AEA-307	Self-Study /GD Seminar	-	-	-	-	50	50	-	-	2	1
TOTAL			**300**	**150**	**50**	**120**	**130**	**750**	**13**	**2**	**10**	**20**

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IV SEMESTER

S.No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	BEA-401	Energy, Ecology, Environment & Society	60	30	10	-	-	100	3	-	-	3
2	AEA-402	Aircraft Systems and Instrumentation	60	30	10	30	20	150	2	1	2	4
3	AEA-403	Aerodynamics I	60	30	10	30	20	150	3		2	4
4	AEA-404	Aircraft Propulsion I	60	30	10	30	20	150	3	-	2	4
5	AEA-405	Aircraft Structure I	60	30	10	30	20	150	2	1	2	4
6	AEA-406	Java Programming	-	-	-	30	20	50	-	-	2	1
7	AEA-407	Industrial Training-I	To be completed during fourth semester break. Its evaluation/credit to be added in fifth semester									
	TOTAL		**300**	**150**	**50**	**150**	**100**	**750**	**13**	**2**	**10**	**20**

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V SEMESTER

S.No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	AEA-501	Aircraft Structure -II	60	30	10	30	20	150	2	1	2	4
2	AEA-502	Aerodynamics -II	60	30	10	30	20	150	2	1	2	4
3	AEA-503	Aircraft Propulsion -II	60	30	10	30	20	150	2	1	2	4
4	AEA-504	Program Elective - I	60	30	10	-	-	100	3	1	0	4
5	AEA-505	Open Core Elective - I	60	30	10	-	-	100	3	1	0	4
6	AEA-506	Industrial Training-II				150	100	250			4	2
	TOTAL		**300**	**150**	**50**	**240**	**160**	**900**	**12**	**5**	**10**	**22**

Program Elective - I	
AEA-504	AEA-504 (A) Basics Aircraft Maintenance & Repair
	AEA-504 (B) Theory of Vibration
Open Core Elective-I	
AEA-505	AEA-505 (A) Nano Science & Technology
	AEA-505 (B) Heat and Mass Transfer

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VI SEMESTER

S.No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	AEA-601	Aircraft Design	60	30	10	30	20	150	2	1	2	4
2	AEA-602	Aircraft Stability & Control	60	30	10	30	20	150	2	1	2	4
3	AEA-603	Program Elective - II	60	30	10	-	-	100	3	1	0	4
4	AEA-604	Program Elective - III	60	30	10	-	-	100	3	0	0	3
5	AEA-605	Open Core Elective-II	60	30	10	-	-	100	3	0	0	3
6	AEA-606	Minor Project	-	-	-	180	120	300	-	-	4	2
	TOTAL		**300**	**150**	**50**	**240**	**160**	**900**	**13**	**3**	**8**	**20**

Program Elective - II	
AEA-603	AEA-603 (A) Aircraft Rules & Regulation
	AEA-603 (B)Wind Tunnel Techniques
Program Elective - III	
AEA-604	AEA-604 (A) Fuel & Combustion
	AEA-604 (B) Maintenance of Radio & Communication Systems
Open Core Elective-II	
AEA-605	AEA-605 (A) Product Design & Development
	AEA-605 (B) Management and Entrepreneurship

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VII SEMESTER

S.No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ Hour/ Week			Credits
			End Sem. Exam.	Mid Tests	Assignments/Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	AEA-701	Computational Fluid Dynamics	60	30	10	30	20	150	3	0	2	4
2	AEA-702	Rockets and Missiles	60	30	10	30	20	150	3	0	2	4
3	AEA-703	Program Elective-IV	60	30	10	-	-	100	3	0	0	3
4	AEA-704	Open Core Elective-III	60	30	10	-	-	100	3	0	0	3
6	AEA-705	Project Stage-I	-	-	-	120	80	200	-	-	10	5
7	AEA-706	Self-Study/GD/Seminar					200	200			2	1
	TOTAL		**240**	**120**	**40**	**180**	**320**	**900**	**12**	**0**	**16**	**20**

Program Elective - IV	
AEA-703	AEA-703 (A) Air Traffic Control and Planning
	AEA-703 (B) Flight Instrumentation
Open Core Elective-III	
AEA-704	AEA-704 (A) UAV System
	AEA-704 (B) Fatigue and Fracture system

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VIII SEMESTER

S.No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/Quiz	End Sem. Practical & Viva	Practical Record /Assignment / Quiz / Presentation		L	T	P	
1	AEA-801	Finite Elements Methods	60	30	10	30	20	150	3	0	2	4
3	AEA-802	Program Elective-V	60	30	10	-	-	100	3	0	0	3
4	AEA-803	Open Elective-IV	60	30	10	-	-	100	3	0	0	3
6	AEA-804	Project Stage-II	-	-	-	240	160	400	-	-	16	8
TOTAL			**180**	**90**	**30**	**270**	**180**	**750**	**9**	**0**	**18**	**18**

Program Elective - V	
AEA-802	AEA-802 (A) Avionics
	AEA-802 (B) Industrial Aerodynamics
Open Elective-IV	
AEA-803	AEA 803(A)Economic Policies in India
	AEA 803(B) Internet of Things

* Additional open electives can be provided as per the availability of faculty in the University and student should produce prior permission from Dean with a batch of at least 5 students.

(10) Course Content

Semester- I

BEBSC-101 Mathematics-I

BEBSC-101	Mathematics-I	3L:0T:0P	3 credits	3Hrs/Week

Course Preamble:
The Preamble of this foundational course is to review mathematical concepts already learnt in higher secondary. This course will also introduce fundamentals of mathematical functions, derivatives and aspects of calculus to students. This course deep understanding of matrix, differential equations, Sequences and series, Vector Space as well as a strong sense of how useful the subject can be in other disciplines of learning.

Course Outcome:
Course work is designed to provide students the opportunity to learn key concepts of mathematical functions, key concepts of matrix , Vector Spaces as well as fundamentals and applications of integral calculus.

Unit-1: Calculus (10Hrs):
Rolle's theorem, Mean Value theorems, Expansion of functions by Mc. Laurin's and Taylor's for one variable; Taylor's theorem for function of two variables, Partial Differentiation, Maxima & Minima (two variables), Method of Lagrange's Multipliers.

Unit-2: Integral (10 Hrs):
Definite Integral as a limit of a sum and Its application in summation of series; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas, Multiple Integral, Change the order of the integration, Applications of multiple integral for calculating area and volumes of the curves.

Unit-3: Sequences and series (10 Hrs):
Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

Unit-4: Vector Spaces (5 Hrs):
Vector Space, Vector Sub Space, Linear Combination of Vectors, Linearly Dependent, Linearly Independent, Basis of a Vector Space, Linear Transformations.

Unit-5: Matrices (10 Hrs):
Rank of a Matrix, Solution of Simultaneous Linear Equations by Elementary Transformation, Consistency of Equation, Eigen Values and Eigen Vectors, Diagonalization of Matrices, Cayley-Hamilton theorem and its applications to find inverse.

References:

- G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
- Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

- Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
- Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11thReprint, 2010.
- D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
- N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

BEBSC- 202 Engineering Physics

BEBSC- 202	Engineering Physics	2L:1T:0P	3 credits	3Hrs/Week

Course Preambles:

- A comprehensive, high-quality education in the physical sciences
- A flexible curriculum with multiple concentrations that allows students to tailor their education according to their specific interests
- The opportunity to experience the excitement of scientific discovery through direct participation in faculty research
- An increased awareness of the physical processes in the surrounding world

Course Outcomes:

- An ability to apply knowledge of mathematics, science, and engineering.
- An ability to design and conduct experiments, as well as to analyze and interpret data.
- An ability to design a system, component, or process to meet desired needs within realistic constraints.
- An ability to function on multidisciplinary teams.
- An ability to identify, formulates, and solves engineering problems.
- An understanding of professional and ethical responsibility.
- An ability to communicate effectively.

Unit 1: Relativistic Mechanics: (6 Hrs):
Frame of reference, Inertial & non-inertial frames, Galilean transformations, Michelson-Morley experiment, Postulates of special theory of relativity, Lorentz transformations, Length contraction, Time dilation, Velocity addition theorem, Variation of mass with velocity, Einstein's mass energy relation, Relativistic relation between energy and momentum, Massless particle.

Unit 2:Solid state & Nuclear physics (5 Hrs):
Free electron theory of metals, Qualitative discussion of Kronig-penny model and origin of energy bands. Intrinsic and Extrinsic Semiconductors. V-I Characteristics of PN junction diode, Zener diode, Hall-effect.
Introduction to Nuclear Physics, Static properties of Nucleus, Nuclear liquid drop model, Nuclear Shell Model, Linear particle accelerator, Cyclotron, Betatron, Bainbridge mass sprectrograph.

Unit 3: Quantum Mechanics: (6Hrs):
Introduction to Quantum mechanics, Wave particle duality, Matter waves, Particle velocity, Phase velocity, Group velocity and their relation. Heisenberg's Uncertainty Principle. Time-dependent and time-independent Schrodinger wave equation, Solution to stationary state Schrodinger wave equation for one-Dimensional particle in a box, Compton Effect.

Unit 4: Wave Optics: (10 Hrs):
Interference: Coherent sources, Interference in uniform and wedge shaped thin films, Newton's Rings and its applications. Fraunhoffer diffraction at single slit and at double slit, absent spectra, Diffraction grating, Spectra with grating, Dispersive power of grating, Rayleigh's criterion of resolution. Resolving power of grating and Prism.

Unit 5: Fibre Optics & Lasers: Fibre Optics (6 Hrs):

Introduction to fiber optics, Acceptance angle, Numerical aperture, Normalized frequency, Classification of fiber, Attenuation and Dispersion in optical fibers. Laser: Absorption of radiation, Spontaneous and stimulated emission of radiation, Einstein's coefficients, Population inversion, various levels of Laser, Ruby Laser, He-Ne Laser, Laser applications.

Reference:

- Concepts of Modern Physics - AurthurBeiser (Mc-Graw Hill)
- Introduction to Special Theory of Relativity- Robert Resnick (Wiley)
- Optics - Brijlal& Subramanian (S. Chand)
- Engineering Physics: Theory and Practical- Katiyar and Pandey (Wiley India)
- Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New)
- Engineering Physics-Malik HK and Singh AK (McGrawHill).

BEBSC- 202	**Engineering Physics**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiments:

- To determine the wavelength of sodium light by Newton's ring experiment.
- To determine the wavelength of different spectral lines of mercury light using plane transmission grating.
- To determine the energy band gap of a given semiconductor material.
- To determine the plank's constant with help of photocell.
- Resolving Power of Telescope.
- V-I Characteristics of P-N Junction diode.
- Zener diode characteristics.
- To determine the dispersive power of prism.

Lab Outcomes:

Student can perform and understand about dispersive power of prism, characteristics of diode, semiconductor material, and can measure the wavelength.

BEESC-203 Basic Computer Engineering

BEESC-203	**Basic Computer Engineering**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Course Preamble:

- Successfully practice computer engineering to serve state and regional industries, government agencies, or national and international industries.
- Work professionally in one or more of the following areas: computer hardware and software design, embedded systems, computer networks and security, system integration, and electronic design automation.
- Achieve personal and professional success with awareness and commitment to their ethical and social responsibilities, both as individuals and in team environments.

Course Outcome:

- An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

Unit –1: Computer: (10Hrs):

Definition, Classification, Organization i.e. CPU, register, Memory & Storage Systems, I/O Devices, and System & Application Software. Computer application E-Business, Bio-Informatics, health Care, Remote Sensing & GIS, Meteorology and, Computer Gaming, Multimedia and Animation etc.

Unit –2: Introduction to Algorithms (10 Hrs):

Complexities and Flowchart, Introduction to Programming, Categories of Programming Languages, Program Design, Programming Paradigms, Characteristics or Concepts of OOP, Procedure Oriented Programming VS object oriented Programming. Introduction to C, Character Set, Tokens, Precedence and Associativity, Program Structure, Data Types, Variables, Operators, Expressions, Statements and control structures, I/O operations, Array, Functions,

Unit – 3: Computer System Overview (10 Hrs):

Basic Elements, Instruction Execution, Interrupts, Memory Hierarchy, Cache Memory, Direct Memory Access, Multiprocessor and Multicore Organization. Operating system overview-Preambles and functions, Evolution of Operating System. - Computer System Organization- Operating System Structure and Operations- System Calls, System Programs, OS Generation and System Boot.

Unit 4: Computer Networking (8 Hrs):

Introduction, Goals, OSI Model, Functions of Different Layers. Internetworking Concepts, Devices, TCP/IP Model. Topology, Introduction to Internet, World Wide Web, E• commerce Computer Security Basics: Introduction to viruses, worms, malware, Trojans, Spyware and Anti-Spyware Software, Different types of attacks like Money Laundering, Information Theft, Cyber Pornography, Email spoofing,

Denial of Service (DoS), Cyber Stalking, ,Logic bombs, Hacking Spamming, Cyber Defamation, Security measures Firewall,

Unit 5: Data base Management System (10 Hrs):

Introduction, File oriented approach and Database approach, Data Models, Architecture of Database System, Data independence, Data dictionary, DBA, Primary Key, Data definition language and Manipulation Languages. Cloud computing: definition, cloud infrastructure, cloud segments or service delivery models (IaaS, PaaS and SaaS), cloud deployment models/ types of cloud (public' private, community and hybrid clouds), Pros and Cons of cloud computing

Reference:

- Introduction of computers: Peter Norton, TMH
- Object oriented programming with c++ :E.Balaguruswamy,TMH
- Object oriented programming in C++: Rajesh k.shukla ,Wiley India
- Computer network: Andrew Tananbaum,PHI
- Data base management system,Korth,TMH
- Operating system-silberschatz and Galvin-Wiley India

BEESC-203	**Basic Computer Engineering**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiment:

- Study of input and output devices of computer systems.
- Write a program of addition, subtract, multiplication and division by using C.
- Write a program to check weather a number is prime or not.
- Study of various types of Operating System.
- Study and practice of basic Linux commands-ls, cp, mv, rm, chmod kill, ps etc.
- Design color coding of straight & crossover cable.
- Installation of oracle 10g. Also create an employee table.

Lab Outcome:

- Student can interact properly with various input and output devices of computer systems.
- Student can perform the basic formulation and also check about the prime number, even number etc.
- Student learns to install software and operate various operating system.

BEESC-204 Basic Mechanical Engineering

BEESC-204	Basic Mechanical Engineering	2L:0T:0P	2 credits	2Hrs/Week

Course Preamble:

- To provide a comprehensive knowledge of basic mechanical systems.
- Basic concepts from mechanical engineering sciences,
- Basic concepts I.C Engine
- Modern engineering tools (machine-tools, laboratory instrumentation, Working principle of steam Engine), and related subjects to design mechanical engineering components

Course Outcome:

- After successful completion of this course students will able to
- To describe and use basic engineering concepts
- principles and components of mechanical equipment
- measuring & testing method of physical quantities
- Assessment of boiler component.

Unit 1: Materials (6 Hrs):

Classification of engineering material, Composition of Cast iron and Carbon steels, Iron Carbon diagram. Alloy steels their applications. Mechanical properties like strength, hardness, toughness ductility, brittleness , malleability etc. of materials , tensile test- Stress-strain diagram of ductile and brittle materials ,

Unit 2: Measurement (10 Hrs):

Concept of measurements, errors in measurement, Temperature, Pressure, Velocity, Flow strain, Force and torque measurement, Vernier caliper, Micrometer, Dial gauge, Slip gauge, Sine-bar and Combination set. Production Engineering: Elementary theoretical aspects of production processes like casting, carpentry, welding etc Introduction to Lathe and Drilling machines and their various operations.

Unit 3: Fluids (6Hrs):

Fluid properties pressure, density and viscosity etc. Types of fluids , Newton's law of viscosity , Pascal's law , Bernoulli's equation for incompressible fluids, only working principle of Hydraulic machines, pumps, turbines, Reciprocating pumps .

Unit 4: Thermodynamics (10Hrs):

Thermodynamic system, properties, state, process, Zeroth, First and second law of thermodynamics, thermodynamic processes at constant pressure, volume, enthalpy & entropy.

Steam Engineering: Classification and working of boilers, mountings and accessories of boilers, Efficiency and performance analysis, natural and artificial draught, steam properties, use of steam tables.

Unit 5: Reciprocating Machines (5 Hrs) :

Working principle of steam Engine, Carnot, Otto, Diesel and Dual cycles P-V & T-S diagrams and its efficiency, working of two stroke & four stroke Petrol & Diesel engines. Working principle of compressor.

References:

- Kothandaraman & Rudramoorthy, Fluid Mechanics & Machinery, New Age .

- Nakra & Chaudhary , Instrumentation and Measurements, TMH.
- Nag P.K, Engineering Thermodynamics , TMH .
- Ganesan , Internal Combustion Engines, TMH .

BEESC-204	**Basic Mechanical Engineering**	**0L:0T:1P**	**2 credits**	**2Hrs/Week**

List of Experiments:

- Study of Universal Testing machines.
- Linear and Angular measurement using, Micrometer, Slip Gauges, Dial Gauge.
- Study of Lathe Machine.
- Study of Drilling Machines.
- Verification of Bernoulli's Theorem.
- Study of various types of Boilers.
- Study of different IC Engines.
- Study of different types of Boilers Mountings and accessories.

Lab Outcome:

- Student gets familiar with Universal Testing machines, Lathe Machine, Drilling Machines.
- Student can know and identify about Boilers Mountings and accessories etc.

SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES

Outcome based Curriculum for

Undergraduate Degree Courses in Engineering & Technology

Department of Aeronautical Engineering

BEESC-205 Basic Civil Engineering & Mechanics

BEESC-205	Basic Civil Engineering & Mechanics	3L:0T:0P	3 credits	3Hrs/Week

Course Preamble:

The goal of this Engineering Mechanics course is to expose students to problems in mechanics as applied to plausibly real-world scenarios. Problems of particular types are explored in detail in the hopes that students will gain an inductive understanding of the underlying principles at work; students should then be able to recognize problems of this sort in real-world situations and respond accordingly.

Course Outcomes:

- Demonstrate knowledge of various surveying methods.
- Conduct a chain survey.
- Conduct a compass survey.
- Conduct leveling survey and be able to do RL calculations.
- Demonstrate knowledge of properties of various building materials.
- Draw free body diagrams and determine the resultant of forces and/or moments.
- Determine the centroid and second moment of area of sections.
- Apply laws of mechanics to determine efficiency of simple machines with consideration of friction.
- Analyse statically determinate planar frames.

Unit 1: Building Materials & Construction (10 Hrs)

Stones, bricks, cement, lime, timber-types, properties, test & uses, laboratory tests concrete and mortar Materials: Workability, Strength properties of Concrete, Nominal proportion of Concrete preparation of concrete, compaction, curing. Elements of Building Construction, Foundations conventional spread footings, RCC footings, brick masonry walls, plastering and pointing, floors, roofs, Doors, windows, lintels, staircases – types and their suitability

Unit 2: Surveying & Positioning (10 Hrs):

Introduction to surveying Instruments – levels, theodolites , plane tables and related devices. Electronic surveying instruments etc. Measurement of distances – conventional and EDM methods, measurement of directions by different methods, measurement of elevations by different methods. Reciprocal leveling.

Unit 3: Basics of Engineering Mechanics covering (10 Hrs):

Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces ,Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy

Unit 4: Centroid and Centre of Gravity covering (10 Hrs):

Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

Unit 5: Friction covering (8 Hrs):

Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, Basic Structural Analysis covering, Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames

Reference:

- S. Ramamrutam & R.Narayanan; Basic Civil Engineering, Dhanpat Rai Pub.
- Prasad I.B., Applied Mechanics, Khanna Publication.
- Punmia, B.C., Surveying, Standard book depot.
- Shesha Prakash and Mogaveer; Elements of Civil Engg & Engg. Mechanics; PHI.

BEESC-205	**Basic Civil Engineering & Mechanics**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiments:

- To perform traverse surveying with prismatic compass, check for local attraction and determine corrected bearings and to balance the traverse by Bowditch's rule.
- To perform leveling exercise by height of instrument of Rise and fall method.
- To measure horizontal and vertical angles in the field by using Theodolite.
- To determine (a) normal consistency (b) Initial and Final Setting time of a cement Sample.
- To determine the workability of fresh concrete of given proportions by slump test or compaction factor test.
- To determine the Compressive Strength of brick.
- To determine particle size distribution and fineness modulus of course and fine Aggregate.
- To verify the law of Triangle of forces and Lami's theorem.
- To verify the law of parallelogram of forces.
- To verify law of polygon of forces
- To find the support reactions of a given truss and verify analytically.
- To determine support reaction and shear force at a given section of a simply Supported beam and verify in analytically using parallel beam apparatus.
- To determine the moment of inertia of fly wheel by falling weight method.
- To verify bending moment at a given section of a simply supported beam.

Lab Outcome:

- Student can perform the surveying with prismatic compass, perform leveling exercise.
- Student learn well to determine the Compressive Strength of brick , parallelogram of forces, moment of inertia and bending moment.

BEHSMC-206 Language Lab

BEHSMC-206	**Language Lab and Seminar**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

Course Preamble:

- This course intends to impart practical training in the use of English Language for
- Communicative purposes and aims to develop students' personality through language Laboratory.
-

Course Outcome:

Student can learn Public Speaking and oral skills with the use of English Language.

Topics to be covered in the Language laboratory sessions:

- Introducing oneself, family, social roles.
- Public Speaking and oral skills with emphasis on conversational practice, extempore speech, JAM(Just a minute sessions), describing objects and situations, giving directions, debate, telephonic etiquette.
- Reading Comprehension: Intensive reading skills, rapid reading, and reading aloud (Reading material to be selected by the teacher).
- To write a book review. Standard text must be selected by the teacher.
- Role plays: preparation and delivery topic to be selected by teacher/faculty.

BELC–107 Self Study / GD Seminar

BELC–207	**Self-Study / GD Seminar**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

Course Preamble:
To improve the mass communication and convincing / understanding skills of students and it is to give student an opportunity to exercise their rights to express themselves. Evaluation will be done by assigned faculty based on group discussion and power point presentation.

Course Outcomes:

- Analytical thinking
- Lateral thinking
- constructive argument
- Communication skill
- Presentation of views

Students will discuss the course related and interdisciplinary topics for problem solving. They will improve the mass communication and convincing / understanding skills about subject and their related problem in a group of students.

BEBSC-201 Mathematics-II

BEBSC-201	Mathematics-II	3L:0T:0P	3 credits	3Hrs/Week

Course Preambles:

- To introduce the basic concepts required to understand, construct, solve and interpret differential equations.
- To teach methods to solve differential equations of various types.
- To give an ability to apply knowledge of mathematics on engineering problems

Course Outcomes:

The students will be able to:

- Classify differential equations according to certain features.
- Solve first order linear equations and nonlinear equations of certain types and interpret the solutions.
- Understand the conditions for the existence and uniqueness of solutions for linear differential equations
- Solve second and higher order linear differential equations with constant coefficients and construct all solutions from the linearly independent solutions
- Find series solutions about ordinary and regular singular points for second order linear differential equations.
- Solve initial value problems using the Laplace transform.
- Solve systems of linear differential equations with methods from linear algebra.

Unit -1: Ordinary Differential Equations I (10 Hrs):

Differential Equations of First Order and First Degree (Leibnitz linear, Bernoulli's, Exact), Differential Equations of First Order and Higher Degree, Higher order differential equations with constants coefficients, Homogeneous Linear Differential equations, Simultaneous Differential Equations.

Unit-2: Ordinary differential Equations II (10 Hrs):

Second order linear differential equations with variable coefficients, Method of variation of parameters, Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Unit 3: Partial Differential Equations (10 Hrs)

Formulation of Partial Differential equations, Linear and Non-Linear Partial Differential Equations, Homogeneous Linear Partial Differential Equations with Constants Coefficients.

Unit 4: Functions of Complex Variable (10 Hrs)

Functions of Complex Variables: Analytic Functions, Harmonic Conjugate, Cauchy-Riemann Equations (without proof), Line Integral, theorem ,Cauchy Integral formula (without proof), Singular Points, Poles & Residues, Residue Theorem, Application of Residues theorem for Evaluation of Real Integral

Unit 5: Vector Calculus (8 Hrs)

Differentiation of Vectors, Scalar and vector point function, Gradient, Geometrical meaning of gradient, Directional Derivative, Divergence and Curl, Line Integral, Surface Integral and Volume Integral, Gauss Divergence, Stokes and Green theorems.

References:

- G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint,
- Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
- W. E. Boyce and R. C. Dip Rima, Elementary Differential Equations and Boundary Value Problems, 9th, End. Wiley India, 2009.
- S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
- E. A. Codington, an Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
- E. L. Inca, Ordinary Differential Equations, DoverPublications, 1958.
- J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., McGraw Hill,
- N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

BEBSC-102 Engineering Chemistry

BEBSC-102	**Engineering Chemistry**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Course Preamble:

- To acquire knowledge about hardness of water and importance of water in industrial purpose.
- To understand the concept of molecular spectroscopy.
- To gain the knowledge of about polymeric material and biodegradable substances.
- To understand the mechanism of lubricant and properties of lubricant.

Course Outcomes:

- Develop innovative methods to produce soft water for industrial use.
- Identify the structure of unknown / new compounds with the help of spectroscopy.
- Substitute metal with conducting polymers and produce cheaper biodegradable polymers to reduce environmental pollution.
- Apply their knowledge for use and protect to industrial and domestic equipment.

Unit-1: Atomic and molecular structure (8Hrs)

Schrodinger equation. Particle in box solutions and their applications for conjugated molecules and nanoparticles. Molecular orbitals of diatomic molecules and plots of the multicenter orbitals. Equations for atomic and molecular orbitals. water treatment-Introduction, hardness of water, Units of hardness, disadvantage of hard water, scale and sludge formation in boilers, boilers troubles.

Unit-2: Spectroscopic techniques and applications (10Hrs)

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterization techniques. Diffraction and scattering.

Unit-3: Intermolecular forces and Potential Energy Surfaces (8Hrs)

Ionic, dipolar and van Der Waals interactions. Lubricant-Introduction, mechanism of lubricant, classification of lubricant, properties of lubricating oils.

Unit-4: Use of free energy in chemical Equilibrium (10Hrs)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. High Polymers-Introduction, nomenclature, types of polymerization, classification of polymers, plastics-important, thermo-plastic resins and thermo setting resin,

Unit-5: Periodic properties (10Hrs)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries

References:

- University chemistry, by B. H. Mahan
- Chemistry: Principles and Applications, by M. J. Sienko and R. A.
  Plane Fundamentals of Molecular Spectroscopy, by C. N. Banwell
- Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.
- Physical Chemistry, by P. W. Atkins

BEBSC-102	**Engineering Chemistry**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiments:

- Determination of surface tension and viscosity
- Determination of chloride content of water
- Determine the change of viscosity of given lubricating oil with change in temperature by Redwood Viscometer No. 1.
- Determine the change of viscosity of given lubricating oil with change in temperature by Redwood Viscometer No. 2.
- To determine the flash and fire point of given lubricating oil by Cleveland's open cup apparatus.
- To determine the flash and fire point of given lubricating oil by Abel's closed cup apparatus.
- To determine the flash and fire point of given lubricating oil by Pensky Marten's apparatus.
- To determine the total hardness of given water sample by titrating it against EDTA solution using EBT as an indicator.

Laboratory Outcomes:
The students will learn to:

- Estimate rate constants of reactions from concentration of reactants/products as a function of time
- Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc
- Synthesize a small drug molecule and analyse a salt sample

BEHSMC-103 English for Communication

BEHSMC-103	**English for Communication**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Course Preambles:

- To enhance Professional competence in reading, writing, listening and speaking.
- To modify the tactic of providing information about the language by using several techniques.
- To minimize the Grammar Translation Method of ELT by replacing it with Direct Learning Method.
- To Introduce Communicative Method of ELT and focusing the teaching pedagogy to the student-centered learning rather than the teacher-centered learning.
- To develop the skills to master three major forms of communications which are vital in academic and professional settings namely professional presentations, interviews and group communications respectively.
- To provide a deep insight of techniques for delivering effective presentations, appealing job interviews, and actively participating in various forms of group communication.

Course Outcomes:

At the end of this course students will have:

- Ability to design a language component or process to meet desired need within Realistic, Constraints such as economic, environmental, social, political, ethical Scenario.
- Ability to analyze the usage of English words in different contexts.
- An understanding of technical and academic articles' comprehension.
- The ability to present oneself at multinational levels knowing the type of different Standards of English.

Unit-1: Identifying Common errors in writing (8 Hrs):

Articles, Subject-Verb Agreement, Prepositions, Active and Passive Voice, Reported Speech: Direct and Indirect, Sentence Structure.

Unit-2: Vocabulary building and Comprehension (10Hrs)

Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, synonyms, antonyms, Reading comprehension.

Unit-3: Communication: (10 Hrs)

Introduction, Meaning and Significance, Process of Communication, Oral and Written Communication, 7 c's of Communication, Barriers to Communication and Ways to overcome them, Importance of Communication for Technical students, nonverbal communication.

Unit-4: Developing Writing Skills (10 Hrs)

Planning, Drafting and Editing, Precise Writing, Précis, Technical definition and Technical description. Report Writing: Features of writing a good Report, Structure of a Formal Report, Report of Trouble, Laboratory Report, Progress Report.

Unit-5: Business Correspondence (10 Hrs):

Importance of Business Letters, Parts and Layout; Application, Contents of good Resume, guidelines for writing Resume, Calling/ Sending Quotation, Order, Complaint, E-mail and Tender.

References:-

- Technical Communication : Principles and practice', Meenakshi Raman and Sangeeta Sharma (Oxford)
- 'Effective Business Communication', Krizan and merrier (Cengage learning)
- 'Communication Skill, Sanjay Kumar and pushlata, OUP2011
- "Practical English Usage Michael Swan OUP, 1995.
- "Exercises in spoken English Parts I-III CIEFL, Hyderabad, Oxford University Press
- On writing well, William Zinsser, Harper Resource Book 2001.
- Remedial English Grammar, F.T. Wood, Macmillan2007.

BEHSMC-103	**English for Communication**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

List of Experiments:

- Listening Comprehension.
- Pronunciation, Intonation, Rhythm
- Practicing everyday dialogues in English
- Interviews.
- Formal Presentation

Laboratory Outcomes:

The students will learn to:

- Proper skill of talking, listening and Pronunciation.
- Student will aware the terminology used during the interview and formal presentation

SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES

Outcome based Curriculum for

Undergraduate Degree Courses in Engineering & Technology

Department of Aeronautical Engineering

BEESC-104 Basic Electrical Engineering

BEESC-104	Basic Electrical Engineering	2L:0T:0P	2 credits	2Hrs/Week

Course Preambles:

Impart a basic knowledge of electrical quantities such as current, voltage, power, energy and frequency to understand the impact of technology in a global and societal context and to provide students the working knowledge for the analysis of basic DC and AC circuits used in electrical and electronic devices.

Course Outcomes:

- To understand and analyze basic electric and magnetic circuits.
- To study the working principles of electrical machines and power converters.
- To introduce the components of low voltage electrical installations.

Unit-1: Electrical circuit elements (8Hrs):

Electrical circuit elements (R, L and C), Concept of active and passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements, Kirchhoff's laws, Loop and-delta transformation, nodal methods, Superposition of a theorem, Thevenin theorem, Norton theorem.

Unit-2: AC Circuits (8 Hrs):

Representation of Sinusoidal waveforms –Average and effective values, Form and peak factors, Concept of phasor, phasor representation of sinusoidally varying voltage and current. Analysis of single phase AC Circuits consisting of R, L, C, RL, RC, RLC combinations (Series and Parallel), Apparent, active & reactive power, Power factor, power factor improvement. Concept of Resonance in series & parallel circuits, bandwidth and quality factor. Three phase balanced circuits, voltage and current relations in star and delta connections.

Unit-3: Magnetic circuit (6 Hrs)

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Unit-4: Machines (8 Hrs):

DC machines: Principle & Construction, Types, EMF equation of generator and torque equation of motor, applications of DC motors (simple numerical problems)

Three Phase Induction Motor: Principle & Construction, Types, Slip-torque characteristics, Applications (Numerical problems related to slip only)

Single Phase Induction motor: Principle of operation and introduction to methods of starting, applications.

Three Phase Synchronous Machines: Principle of operation of alternator and synchronous motor and their applications.

Unit-5: Components of LT Switchgear: (10 Hrs)

Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Importance of earthing. Types of Batteries, Important characteristics for Batteries. Elementary calculations for energy consumption and savings, battery backup.

References:

- Ritu Sahdev, "Basic Electrical Engineering",

- S. Singh, P.V. Prasad, "Electrical Engineeri
- D. P. Kothari and ElectricalI.J.Nagrath,Engineering","Basic Tat

BEESC-104	**Basic Electrical Engineering**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

List of Experiments:

- Verification of Kirchhoff"s laws
- Verification of Superposition and Thevenin Theorem.
- Measurement of power and power factor in a single phase ac series inductive circuit and study improvement of power factor using capacitor
- Study of phenomenon of resonance in RLC series circuit and obtain resonant frequency.
- Connection and measurement of power consumption of a fluorescent lamp (tube light).
- Measurement of power in 3- phase circuit by two wattmeter method and determination of its power factor for star as well as delta connected load.
- Determination of parameters of ac single phase series RLC circuit
- To observe the B-H loop of a ferromagnetic material in CRO.
- Determination of (i) Voltage ratio (ii) polarity and (iii) efficiency by load test of a single phase transformer
- Determination of efficiency of a dc shunt motor by load test
- To study running and speed reversal of a three phase induction motor and record speed in both directions.
- Demonstration of cut-out sections of machines: dc machine, three phase induction machine, single-phase induction machine and synchronous machine.

Laboratory Outcomes

- Get an exposure to common electrical components and their ratings.
- Make electrical connections by wires of appropriate ratings.
- Understand the usage of common electrical measuring instruments.
- Understand the basic characteristics of transformers and electrical machines.

BEESC-105 Engineering Graphics

BEESC-105	**Engineering Graphics**	**2L:1T:0P**	**3 credits**	**3Hrs/Week**

Course Preambles:

- Increase ability to communicate with people.
- Learn to sketch and take field dimensions.
- Learn to take data and transform it into graphic drawings.
- Learn basic Auto Cad skills.
- Learn basic engineering drawing formats.
- Prepare the student for future Engineering positions.

Course Outcomes:

Student's ability to hand letter will improve.

- Student's ability to perform basic sketching techniques will improve.
- Students will be able to draw orthographic projections and sections.
- Student's ability to use architectural and engineering scales will increase.
- Students ability to produce engineered drawings will improve
- Student's ability to convert sketches to engineered drawings will increase.
- Students will become familiar with office practice and standards.
- Students will become familiar with Auto Cad two dimensional drawings.
- Students will develop good communication skills and team work.

Unit-1: Introduction to Engineering Drawing (8 Hrs):

Principles of Engineering Graphics and their significance, usage of Drawing instruments, Lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales –Plain, Diagonal and Venire Scales;

Unit-2: Orthographic Projections **(8 Hrs):**

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes; Projections of Regular Solids those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale

Unit-3: Sections and Sectional Views of Right Angular Solids (6 Hrs):

Prism, Cylinder, Pyramid, Cone –Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only).

Unit-4: Isometric Projections (6 Hrs):

Principles of Isometric projection –Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

Unit-5: Overview of Computer Graphics (6 Hrs):

Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Objects, Isometric Views of lines, Planes, Simple and compound Solids; Customization & CAD Drawing consisting of set up of the drawing page and the printer, including scale settings, Setting up of Units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance.

References:

- Bhatt N.D., Paschal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
- Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
- Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
- Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
- CAD Software Theory and User Manuals.

BEESC-105	**Engineering Graphics**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiments:

- Sketching and drawing of geometries and projections based on above syllabus
- Term work: A min. of 30 hand drawn sketches (on size A4 graphic sketch Book) plus 5 CAD-printouts on size A4 sheets plus 10 sheets of size A2 or 6 sheets of size A1, (50% marks to be allotted for this record + 25% marks for attendance +25%marks for Teachers Assessment

Lab Outcome

Sketching and drawing of geometries and projections and able to make 2-D and 3-D design in CAD Software.

BEESC-106 Manufacturing Practices

BEESC-106	**Manufacturing Practices**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

Course Preambles:

- To understand process of cutting shaping.
- To understand working principles for various machining processes.
- To understand construction, working and applications of various machine tools.
- To learn basic set up, working and applications of a few important non-conventional machining processes to get hand on experience on various machine tools.

Course Outcomes:

- The students will be able to understand the details about machines used in production.
- The students will be able to understand the mechanics behind metal cutting.
- The students will be able to understand the finishing and super finishing processes.
- The students will be able to understand the Physics of material removal behind the various non-conventional machining processes.

Manufacturing is fundamental to the development of any engineering product. The course on Engineering Workshop Practice is intended to expose engineering students to different types of manufacturing / fabrication processes, dealing with different materials such as metals, ceramics, plastics, wood, glass etc. While the actual practice of fabrication techniques is given more weightage, some lectures and video clips available on different methods of manufacturing are also included.

- Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods
- CNC machining, Additive manufacturing
- Fitting operations & power tools
- Carpentry
- Plastic molding, glass cutting
- Metal casting
- Welding (arc welding & gas welding), brazing.

List of Experiments:

- Carpentry Shop Experiment To Make a T-LAP joint with wood Pieces
- Machine Shop Experiment To Perform Knurling on Iron Rod
- WELDING SHOP (LAP Joint) , Tools, Accessories, Diagram And Explanation
- SHEET METAL SHOP (Square Tray) , Parts, Accessories, Diagram And Explanation
- FITTING SHOP (Make a Joint) , Parts, Accessories, Diagram And Explanation
- CARPENTRY SHOP (T-Lap Joint) , Cutting Tools, Accessories, Diagram and Explanation
- MACHINE SHOP (the lathe machine) , Parts, Accessories, Diagram and Explanation

Lab Outcome:

Student able to learn Welding Shop, Sheet Metal Shop, Fitting Shop, Carpentry Shop and Machine Shop

BELC-207 Industrial Training

BELC-207	**Industrial Training**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

Lab Preamble:
Industrial Training is imparted with the following in mind:

- To provide comprehensive learning platform to students where they can enhance their employ ability skills and become job ready along with real corporate exposure.
- To Increase self-confidence of students and helps in finding their own proficiency.

Lab Outcomes:
At the end of the training, a student will be able to:

- Acquire and apply fundamental of engineering aspects learned during training.
- Become updated with all the latest changes in technological world.
- Ability to communicate efficiently.

SEMESTER -III

BEA-301 Mathematics-III

BEA-301	Mathematics-III	3L:0T:0P	3 credits	3Hrs/Week

Course Preambles:

To enable the students to apply the knowledge of Mathematics in various engineering fields by making them

- To understand the method of solving algebraic, transcendental equations and to determine the approximate value of the derivative & definite integral for a given data using numerical techniques.
- Able to expand the given periodic function defined in the given range in terms of sine and cosine multiple of terms as a Fourier series and to extremise the functional using integration technique and to solve the partial differential equation using different analytical techniques.

Course Outcomes:

On completion of this course, students will be able to

- Solve field problems in Engineering involving PDEs.
- Use the root finding techniques to solve practical engineering problems.
- To apply the concept of numerical analysis to find the relative strengths and weaknesses of each computation method and know which are most applicable for given problem.
- To apply the analytical technique to express periodic function as a Fourier sine and cosine series.
- Estimate Laplace and Fourier transform and z transform.

Unit 1: Numerical Methods: (10 hours)

Solution of polynomial and transcendental equations – Bisection method, Newton-Raphson method and Regula-Falsi method. Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae.

Unit 2: Numerical Methods: **(7 hours)**

Numerical Differentiation, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules. Solution of Simultaneous Linear Algebraic Equations by Gauss's Elimination, Gauss's Jordan, Crout's methods, Jacobi's, Gauss-Seidal, and Relaxation method.,

Unit 3: Numerical Methods: (10 hours)

Ordinary differential equations: Taylor's series, Euler and modified Euler's methods. RungeKutta method of fourth order for solving first and second orders equations, Milne's and Adam's predicator-corrector methods. Partial differential equations: Finite difference solution two dimensional Laplace equation and Poisson equation, Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for wave equation.

Unit 4: Transform Calculus: (10 hours)

Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem.

Evaluation of integrals by Laplace transform, solving ODEs by Laplace Transform method, Fourier transforms.

Unit 5: Concept of Probability: (10hours)
Probability Mass function, Probability Density Function, Discrete Distribution: Binomial, Poisson's, Continuous Distribution: Normal Distribution, Exponential Distribution.

References:

- P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2nd Edition, Reprint 2012.
- S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.
- Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2010.
- N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
- Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.
- P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book
- S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
- W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968. Statistics.

AEA-302 Elements of Aeronautics

AEA-302	Elements of Aeronautics	3L:0T:0P	3 credits	3Hrs/Week

Course Preamble:

- To introduce students with different types of aircraft.
- To familiarize the students with the different concept of flight.
- To expose the students to the ideas of Basic of Aeronautics.

Course Outcomes:

At the end of the course, a student will be able to:

- Recognize different Structural components.
- Understanding of Elements of Aircraft performance.
- Study of Basics of Rocket Technology

Unit 1: **Introduction to Flight (10 hours)**

Brief history of Aviation-Hot air balloon and heavier than air flying machines-early airplane configurations-Modern Airplanes-Components of airplane and their functions-Rotary wing aircrafts Space vehicles.

Unit 2: Fundamentals of Aeronautics (10 Hours)

International Standard Atmosphere-Pressure, Temperature and Density altitude, Basic Aerodynamics - Continuity, Momentum and Energy equations, Bernoulli's equation-Mach number subsonic, transonic, sonic and supersonic flow regimes, Measurement of pressure and airspeed IAS,EAS and TAS. Airfoil geometry and nomenclature-infinite and finite wing sections-lift, drag and moment coefficients-angle of attack aspect ratio-Reynolds number-induced drag and parasite drag airfoil characteristics, Elements of Aircraft performance, stability and control.

Unit 3: Aircraft Structure and Materials Fields (8 Hours)

Structural components of an airplane monocoque and semi-monocoque structure –materials for structural components – composite materials and their significance in Aviation Technology.

Unit 4: Aircraft Propulsion (10 Hours)

Propeller Engine – Gas Turbine Engine – Turbo prop, Turbo jet.Turbo fan Engines- specific fuel consumption-variation of thrust and power with speed and altitude – materials for engine components.

Unit 5: Space Vehicles & Astronautics (10 Hours)

Basics of Rocket Technology-escape velocity reentry vehicles-heat transfer problems of space vehicles-ablative cooling-Satellite technology–Hypersonic vehicles, Elements of Astronautics.

References:

- Kermode, A. C, Barnard, R. H and Philpott, D. R, Mechanics of Flight, Pearson education, 2012.
- Shevell, R. C., Fundamentals of Flight., Prentice hall (2nd edition), 1989.
- Steven, A. Brandt, Randall J. Stiles, John J. Bertin and Ray Whitford, Introduction to Aeronautics: A Design Perspective, AIAA Education series(2nd edition),2004.

AEA- 303 Fluid Mechanics

AEA-303	Fluid Mechanics	2L:1T:0P	3credits	3Hrs/Week

Course Preamble:
The course Preambles are:

- Identify importance of various fluid properties at rest and in transit
- Evaluate the performance characteristics of hydraulic turbines and pumps.

Course Outcome:
On completion of the course students will be able to

- Understand the concept of boundary layer theory and flow separation.
- Plot velocity and pressure profiles for any given fluid flow.

Unit 1: Introduction (10 Hours)
Fluid–definition-Fluid Properties-Newton law of viscosity-Classification of fluids-fluid statics Hydrostatic forces on submerged surfaces- Stability of floating bodies.

Unit 2: Fluid flow Analysis and Flow Measurement (10 Hours)
Ideal and real flow-Concept of continuum-Eulerian and Lagrangian approaches-Velocity field Path line, Streak line, Streamline Stream tube- Fluid acceleration-Continuity, momentum differential equations-Navier Stokes equation- Stream function – Vorticity – Irrotationality-Potential function Potential flow-Laplace equation-Bernoulli's equation and its applications-Venturimeter-Orifice meter, Flow Rate and Velocity Measurement.

Unit 3: Dimensional Analysis (8 Hours)
Buckingham Pi Theorem-Non dimensional numbers and their significance-Flow similarity and model studies.

Unit 4: Flow through Pipes (10 Hours)
Laminar and turbulent flow- Boundary layer flow – Boundary layer thickness - Reynolds number and its significance-Laminar fully developed pipe flow-HagenPoiseuille flow-Coefficient of friction Head loss – Darcy-Wiesbach equation-Hydraulic gradient Total energy lines-Moody's diagram Turbulent flow through pipes.

Unit 5: Fluid Machinery (7 Hours)
Classification of fluid machines-Reciprocating and centrifugal pumps impulse and reaction turbines, working principle of Pelton, Francis and Kaplan turbines-Velocity triangles-fans and blowers.

Reference:
1. Irving H Shames, Mechanics of Fluids, The McGraw Hill companies (4th edition), 2003.
2. Yuan, S.W, Foundations of Fluid Mechanics, Prentice-Hall, 1967.

AEA-303 Fluid Mechanics

AEA-303	**Fluid Mechanics**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

List of Experiments:

- To determine the local point pressure with the help of Pitot tube.
- To find out the terminal velocity of a spherical body in water.
- Calibration of Orifice meter and Venturi meter.
- Determination of Cc, Cv, Cd of Orifices.
- Calibration of Nozzle meter and Mouth Piece.

Lab Outcome:

Student can perform and understand the physical significance of Pitot tube, terminal velocity, Orifice meter and Venturi meter, Nozzle meter and Mouth Piece

AEA-304 Thermodynamics

AEA-304	**Thermodynamics**	**3L:0T:0P**	**3 credits**	**2Hrs/Week**

Course Preambles:

- The Preambles are to study
- To develop an understanding of thermodynamics,
- To compare the quality of energy in various forms and perform an exergy analysis on devices,
- To understand how thermodynamic systems are constructed and used in the world
- To perform a first law analysis (cycle analysis) on the systems producing power or heating/cooling effect

Course Outcomes: At the end of this course, Students will

- Calculate the exergy of a substance, the change in exergy for a substance undergoing a process.
- Calculate the irreversibility and second law efficiency of a process or device.
- Understand how thermal energy is converted into mechanical energy using a power cycle and why this process is important.

Unit 1: Basic Thermodynamics (10 Hours)

Systems, Zeroth law, First law - Steady flow energy equation - Heat and work transfer in flow and non-flow processes - Second law, Kelvin-Planck statement -Clausius statement – Reversibility and irreversibility - Concept of Entropy, Clausius inequality, Principle of increase of entropy – Absolute entropy – Availability - Entropy change in non-flow processes.

Unit 2: Air Power Cycles (8 Hours)

Carnot, Otto, Diesel, Dual, Sterling and Ericsson cycle - Air standard efficiency – Mean effective pressure – Actual and theoretical PV diagram of two stroke and four stroke IC engines.

Unit 3: Vapor Power Cycle (8 Hours)

Introduction – Rankine cycle – Means of increase of efficiency of the Rankin cycle – Ideal reheat and regenerative Rankine cycle – Second law analysis of vapor power cycles – Cogeneration.

Unit 4: Refrigeration and Air-Conditioning (8 Hours)

Principles of refrigeration and Psychometric - Vapor compression - Vapor absorption types - Co-efficient of performance, Properties of refrigerants – Basic Principle and types of Air conditioning.

Unit 5: Thermodynamics of Aircraft Propulsion Cycles (12 Hours)

Isentropic flow through passages – Brayton cycle – Brayton cycle with intercooling, reheat and regeneration – Ideal jet propulsion cycles. Basics of heat transfer.

Reference:

1. Holman.J.P, Thermodynamics, McGraw-Hill (3rd edition), 2007.
2. Gordon J. Van Wylen and Richard E. Sonntag and Claus Borgnakke, Fundamentals of Classical Thermodynamics – Vol 1, Wiley Eastern, 1994.

3. Arora C.P., Thermodynamics, Tata McGraw-Hill, New Delhi, 2003.

AEA-304	Thermodynamics	0L:0T:1P	1 Credits	2Hrs/Week

List of Experiments:

- To find mechanical equivalent of heat using Joules apparatus.
- To study working of impulse and reaction steam turbine by models.
- To study working of Gas turbines by models and to identify various processes of Brayton Cycle.
- To calculate COP of vapor compression refrigeration system and to plot on T-S, P-Hdiagrams.
- To plot specific fuel consumption versus rpm diagrams for diesel and petrol engine.

Lab Outcome:

Student will get through knowledge about the energy and basic laws of thermodynamics in usual condition as well as mixed phase condition.

AEA-305 Strength of Materials

AEA-305	**Strength of Materials**	**2L:1T:0P**	**3 credits**	**2Hrs/Week**

Course Preambles:

- To covers the relationship between stress and strain on deformable solids. Applies analysis to members subjected to axial, bending, and torsional loads. Covers combined stresses and properties of structural materials

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Analyze and design structural members subjected to tension, compression, torsion, bending and combined stresses using the fundamental concepts of stress, strain and elastic behavior of materials.
- Utilize appropriate materials in design considering engineering properties, sustainability, cost and weight.
- Perform engineering work in accordance with ethical and economic constraints related to the design of structures and machine parts

Unit 1: Moment of Inertia (10 Hours)

Moment of Inertia ,Mass Moment of Inertia , Area Moment Of Inertia, Parallel Axis theorem, Polar Moment of Inertia, Principal axes, Principal moment of Inertia.

Unit 2: Stress and Strain (10 Hours)

Definition, Stress- strain, uni-axial, bi-axial and tri-axial stresses, tensile & compressive stresses, shear stress-Elastic limit, Hooke's Law. Elastic Constants: Poisson's Ratio, Modulus of elasticity, Modulus of rigidity, Bulk modulus, Yield stress, Ultimate stress. Factor of safety, state of simple shear, relation between elastic constants, Volumetric Strain, Volumetric strain for tri-axial loading, Deformation of Tapering members, Deformation due to self-weight, bars of varying sections, composite sections, Thermal Stress.

Unit 3: Beams (8 Hours)

Shear Force and Bending Moment in Beams: Axial force, shear force and bending moment diagrams for statically determinate beams including beams with internal hinges for different types of loading, relationship between rates of loading, shear force & bending moment. Deflection of Cantilever, simply supported and over hanging beams using. Double integration and Macaulay's Method for different type of loadings.

Unit4: Stresses in Beams (10 Hours)

Theory of pure Bending, Assumptions, Flexural formula for straight beams, moment of resistance, bending stress distribution, Section moduli for different sections, beams for uniform strength, Flitches beams. Direct & Bending Stresses: Core of Section, Chimneys subjected to wind pressure Shear Stress in Beams: Distribution of shear stress, across plane sections used commonly for structural purposes, shear connectors.

Unit 5: Column & Torsion (7 Hours)

Buckling load, Types of end conditions for column, Euler's column theory and its limitations, Rankine- Gordon Formula, Torsion of circular shafts-solid and hollow, stresses in shafts when Transmitting power, shafts in series and parallel. Strain Energy: Resilience, proof Resilience, strain energy stored in the member due to gradually applies load, suddenly applied load, impact load. Strain energy stored due to Shear, Bending and Torsion.

References:

- Elements of Strength of Materials, Timoshenko and Young Affiliated East-West Press.
- Mechanics of Materials, James M. Gere (5th Edition), Thomson Learning.
- Strength of Materials, Subramanian, Oxford University Press, Edition 2005
- Mechanics of Materials, B.C Punmia Ashok Jain, Arun Jain, Lakshmi Publications, New Delhi.

AEA-305	**Strength of Materials**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiments:

- Standard tensile test on MS and CI test specimen.
- Direct/ cross Shear test on MS and CI specimen.
- Transverse bending test on wooden beams to obtain modulus of rupture.
- Fatigue test.
- Brinell hardness tests.

Lab Outcome:
Student can learn to measure the load under various loading conditions in MS and CI test specimen and also can perform the fatigue test.

AEA-306 Computer Programming

AEA-306	**Computer Programming**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

Lab Preambles:

- To Covers software design, implementation, and testing using Java. Introduces object-oriented design techniques and problem solving. Emphasizes development of secure, well-designed software projects that solve practical real-world problems

Lab Outcomes:

On successful completion of this course, student should be able to:

- To do coding of Java programming language for various programming technologies knowledge of the structure and model of the Java programming language, use the Java programming language for various programming technologies.
- Develop software in the Java programming language.
- Evaluate user requirements for software functionality for analysis, synthesis and evaluation.

List of Experiments:

- Write a Program to show Inheritance and Polymorphism
- Write a program to show Interfacing between two classes
- Write a program to Add a Class to a Package
- Write a program to demonstrate AWT.
- Write a program to Hide a Class
- Write a Program to show Data Base Connectivity Using JAVA
- Write a Program to show “HELLO JAVA ” in Explorer using Applet
- Write a Program to show Connectivity using JDBC
- Write a program to demonstrate multithreading using Java.

AEA-307 Self-study /GD Seminar (Internal Assessment)

AEA-307	**Self-study /GD Seminar (Internal Assessment)**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

The main Preamble is to improve the mass communication and convincing/understanding skills of students' .And to give the students an opportunity to exercise their rights to express themselves. The evaluation will be done based on their presentation work and group discussion.

SEMESTER –IV

BEA-401 Energy, Ecology, Environment & Society

BEA-401	Energy, Ecology, Environment & Society	3L:0T:0P	3 credits	3Hrs/Week

Course Preamble:
This course introduces students to environment concerns. Students are expected to learn about environment, factors affecting it, environmental ethics and its protection through

Course Outcomes:
On completion of this course, students will be able to

- Describe a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- Critically analyze technical subject matter (written or oral) for scientific merit apply learned environmental knowledge and understanding to solve technical /research problems in new contexts.

Unit 1: Sources of Energy (10Hrs):
Renewable & Non Renewable, Fossil fuel, Biomass Geothermal, Hydrogen, Solar, Wind, hydro, nuclear sources.

Unit-2: Segments of Environment: (8 Hrs):
Atmosphere, hydrosphere, Lithosphere, biosphere. Cycles in Ecosystem – Water, Carbon, Nitrogen. Biodiversity: Threats and conservation

Unit-3: Air Pollution: (10 Hrs):
Air pollutants, classification, (Primary & secondary Pollutants) Adverse effects of pollutants. Causes of Air pollution chemical, photochemical, Greenhouse effect, ozone layer depletion, acid Rain. Sound Pollution: Causes, controlling measures, measurement of sound pollution (deciblage), Industrial and non – industrial.

Unit-4: Water Pollution– (10 Hrs):
Water Pollution: Pollutants in water, adverse effects. Treatment of Domestic & Industrial water effluent. Soil Pollution – Soil Profile, Pollutants in soil, their adverse effects, controlling measures.

Unit-5: Society, Ethics & Human values– (10 Hrs):
Impact of waste on society. Solid waste management Nuclear, Thermal, Plastic, medical, Agriculture, domestic and e-waste). Ethics and moral values, ethical situations, Preambles of ethics and its study . Preliminary studies regarding Environmental Protection Acts , introduction to value education, self-exploration, Sanlam & swasthya.

References:

- Harris, CE, Prichard MS, Rabin's MJ, "Engineering Ethics"; Cengage Pub.
- Rana SVS ; "Essentials of Ecology and Environment"; PHI Pub.
- Raynold, GW "Ethics in information Technology"; Cengage.
- Svakumar; Energy Environment & Ethics in society; TMH

AEA-402 Aircraft System & Instrumentation

AEA-402	Aircraft System & Instrumentation	2L:1T:0P	3 Credits	3Hrs/Week

Course Preamble:
To impart knowledge of the hydraulic and pneumatic systems components and types of instruments and its operation including navigational instruments to the students

Course Outcomes:
At the end of the course, a student will be able to:

- Know the operation of airplane control system, Engine system, Air conditioning and pressing system.
- Know the operation of air data Instruments system

Unit-1: Aircraft Systems (10Hours)
Hydraulic systems –Study of typical workable systems –components–Hydraulic systems controllers –Modes of operation –Pneumatic systems –Working principles–Typical Pneumatic Power system –Brake system –Components, Landing Gear Systems Classification –Shock absorbers –Retroactive mechanism

Unit-2: Airplane Control Systems (10Hours)
Conventional Systems –Power assisted and fully powered flight controls –Power actuated systems –Engine control systems –Push pull rod system– operating principles –Modern control systems –Digital fly by wire systems –Auto pilot system, Active Control Technology.

Unit-3: Engine Systems (5Hours)
Fuel systems –Piston and Jet Engines –Components -Multi-engine fuel systems, lubricating systems -Piston and jet engines –Starting and Ignition systems –Piston and Jet engines.

Unit-4: Air-conditioning & Pressurizing System (10Hours)
Basic Air Cycle systems –Vapor Cycle Systems, Boot-strap air cycle system –Evaporative vapor cycle systems –Evaporation air cycle systems –Oxygen systems –Fire protection systems, De-icing and anti-icing system.

Unit-5: Aircraft Instruments (10Hours)
Flight Instruments and Navigation Instruments –Accelerometers, Air speed Indicators – Mach Meters –Altimeters -Gyroscopic Instruments–Principles and operation –Study of various types of engine instruments –Tachometers Temperature gauges –Pressure gauge – Operation and principles.

References:
1. Teager, S. Gas Turbine technology, McGraw Hill 1997.
2. Mckinley, J.L. and Bent R.D. Aircraft Maintenance & Repair, McGraw Hill, 1993

AEA-402	Aircraft System & Instrumentation	0L:0T:1P	1 Credits	2Hrs/Week

List of Experiments:

- Study on Mock up system used for aircraft steering.
- Typical workable hydraulic system used in aircraft.
- Study of Push pulls rod system.
- Study of Flight Instruments and Navigation Instruments
- Study of Vapor Cycle cooling Systems.

Lab Outcome:

- Student can perform the steering and various workable hydraulic system used in aircraft.
- Students get complete understanding about the Instruments and Navigation Instruments and Vapor Cycle cooling Systems.

AEA-403 Aerodynamics-I

AEA-403	Aerodynamics-I	3L:0T:0P	3 Credits	3Hrs/Week

Course Preambles:
This course covers concepts of subsonic aerodynamics for students of aerospace engineering. Its objective is to present theoretical aerodynamics with basic numerical applications of potential flow over basic configurations: airfoil, swept lifting surface, fixed and rotating, and over body of revolution.

Course Outcomes:
At the end of the Course, the student will be able to:

- Determine aerodynamic forces and moments on airfoil, wing and body of revolution in subsonic flow, including compressibility effect.
- Analyse boundary layer: velocity profile, thickness and friction coefficient.
- Determine basic aerodynamic characteristics of propeller.
- Apply presented numerical implementations to basic elements of aircraft configurations.

Unit-1: Review of Basic Fluid Mechanics (8 Hours)
System and Control volume approach, substantial, local and convective derivative, Continuity, momentum and energy equations, in viscid flow, Euler equation, incompressible Bernoulli's Equation. Circulation and Vorticity, Green's Lemma and Stokes Theorem, Barotropic Flow, Kelvin's theorem, Streamline, Stream Function, Irrigational flow, Potential Function, Equipotential Lines, Elementary Flows and their combinations.

Unit-2: Two Dimensional in viscid in Compressible Flow (10 Hours)
Ideal Flow over a circular cylinder, D'Alembert"s Paradox, Magnus effect, Kutta Joukowski's Theorem, Starting Vortex, Kutta condition, Real flow over smooth and rough cylinder.

Unit-3: Airfoil Theory (10 Hours)
Cauchy- Riemann relations, Complex Potential, Methodology of Conformal Transformation, Kutta-Joukowski transformation and its applications, Karman Trefftz Profiles, Thin Airfoil theory and its applications.

Unit-4: Subsonic Wing Theory (10 Hours)
Vortex Filament, Biot and Savart Law, Bound Vortex and trailing Vortex, Horse Shoe Vortex, Lifting Line Theory and its limitations.

Unit-5: Introduction to Laminar & Turbulent Flow (8 Hours)
Boundary layer and boundary layer thickness, displacement thickness, momentum thickness, Energy thickness, Shape parameter, Boundary layer equations for a steady, two dimensional Incompressible flow, Boundary Layer growth over a Flat plate, Critical Reynolds Number, blasius solution, Basics of Turbulent flow, Prandtl's mixing length hypothesis, Free shear layers.

References:

- Milne Thomson, L.H., Theoretical Aerodynamics, Macmillan, 19852. John J Bertin., Aerodynamics for Engineers, Pearson Education Inc, 2002
- Clancey, L J., Aerodynamics, Pitman, 1986.

AEA-403	**Aerodynamics-I**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

List of Experiments:

1. Calibration of subsonic wind tunnel.
2. Pressure distribution over smooth and rough cylinder.
3. Pressure distribution over symmetric airfoil.
4. Pressure distribution over cambered airfoil& thin airfoils.
5. Force measurement using wind tunnel balance.

Lab Outcome:

- Student able to calibrate the subsonic wind tunnel.
- Student can measure of Pressure distribution over smooth and rough cylinder, symmetric airfoil, cambered airfoil& thin airfoils and force measurement of using wind tunnel balance.

AEA- 404 Aircraft Propulsion –I

AEA-404	Aircraft Propulsion –I	3L:0T:0P	3 Credits	3Hrs/Week

Course Preamble:

- To learn basic aspects of Propulsion system and design of an aircraft.
- Identify the types of jet engine and its components.

Course Outcomes:

At the end of the course, a student will be able to:

- To understand the working principle of jet engine & its governing thermodynamic cycle.
- Understand the concept of working of Helicopters and Safety regulations in Aircraft Industry.
- Decide the configuration of the aircraft for a given mission and design the aircraft at a conceptual level.

Unit 1: Fundamentals of Gas Turbine Engines (10 Hrs)

Illustration of working of gas turbine engine–The thrust equation–Factors affecting thrust–Effect of pressure, velocity and temperature changes of air entering compressor–Methods of thrust augmentation – Characteristics of turboprop, turbofan and turbojet–Performance characteristics.

Unit 2: Subsonic and Supersonic Inlets for Jet Engines (10 Hrs)

Classification of combustion chambers–Important factors affecting combustion chamber design –Combustion process–Combustion chamber performance– Effect of operating variables on performance–Flame tube cooling–Flame stabilization–Use of flame holders–Numerical problems.

Unit 3: Combustion Chambers (10 Hrs)

Classification of combustion chambers–Important factors affecting combustion chamber design –Combustion process–Combustion chamber performance– Effect of operating variables on performance–Flame tube cooling–Flame stabilization–Use of flame holders–Numerical problems.

Unit 4: Nozzles (8 Hrs)

Theory of flow in isentropic nozzles–Convergent nozzles and nozzle choking– Nozzle throat conditions–Nozzle efficiency–Losses in nozzles–Over expanded and under– expanded nozzles–Ejector and variable area nozzles–Interaction of nozzle flow with adjacent surfaces–Thrust reversal.

Unit 5 : Compressors (7 Hrs)

Principle of operation of centrifugal compressor–Work done &pressure rise– Velocity diagrams –Diffuser vane design considerations–Concept of pre whirl–Rotation stall–Elementary theory of axial flow compressor–Velocity triangles–Degree of reaction–Three dimensional–Air angle distributions for free vortex and constant reaction designs–Compressor blade design–Centrifugal and Axial compressor performance characteristics.

References:

- Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H. “Gas Turbine Theory”, Longman, 1989.

- Oates, G.C., "Aero thermodynamics of Aircraft Engine Components", AIAA Education Series, New York, 1985.
- "Rolls Royce Jet Engine" –Third Edition –1983.

AEA-404	Aircraft Propulsion –I	0L:0T:1P	1 Credits	2Hrs/Week

List of Experiment:

- Study of an aircraft piston engine - assembly of sub systems.
- Study of an aircraft piston engine - various components, their functions and operating principles.
- Study of an aircraft jet engine - assembly of sub systems.
- Study of an aircraft jet engine - various components, their functions and operating principles.
- Study of forced convective heat transfer.

Lab Outcome:

- Student able to understand aircraft piston engine, aircraft jet engine, convective heat transfer.

AEA-405 Aircraft Structure –I

AEA-405	Aircraft Structure –I	2L:1T:0P	3 Credits	3Hrs/Week

Course Preamble:

To introduce students about the aircraft structure analysis:

- Have some theoretical foundations and an exposure to variation approaches to solid mechanics.
- Be better prepared to understand current technical literature in advanced solid mechanics.
- Be able to analyse a class of structural mechanical problems commonly encountered in the aeronautical industry.

Course Outcomes:

At the end of the course, a student will be able to:

- The ability to perform analysis, and interpret the results.
- Real aeronautical structure in an analytically or a computationally suitable form can be solve.
- To understand the theoretical foundations, the wider issues, complexities, and limitations involved in the analysis and design of modern aircraft structures.

Unit 1: Statically Determinate Structures (10 Hours)

Statically determinate frames –plane truss analysis –method of joints –method of sections 3D trusses –the landing gear tripod –beams of two materials.

Unit 2: Statically Indeterminate Structures (10 Hours)

Propped cantilevers –fixed-fixed beams–Clapeyron's 3 moment equation moment Distribution method.

Unit 3: Energy Methods (10 Hours)

Strain energy evaluation in structural members –energy theorems – dummy load & unit load methods –Maxwell's reciprocal theorem –energy methods applied to statically determinate and indeterminate beams, frames, rings & trusses.

Unit 4: Columns (10Hours)

Euler's column curve –inelastic buckling –effect of initial curvature –the South well plot – columns with eccentricity –use of energy methods –theory of beam columns –beam columns different end conditions –stresses in beam columns.

Unit 5: Failure Theories (5Hours)

Ductile and brittle materials –maximum principal stress theory - maximum principal strain Theory -maximum shear stress theory -distortion energy theory –octa hedral shear stress theory.

References:

- Donaldson, B.K., „Analysis of Aircraft Structures -An Introduction", McGraw Hill, 1993.
- Megson T M G, `Aircraft Structures for engineering students" Edward Arnold Publishers.
- Peery, D.J., and Azar, J.J., Aircraft Structures, 2nd edition, McGraw –Hill,N.Y., 1999.

AEA-405	**Aircraft Structures-1**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

List of Experiments:

- Study the construction of fuselage and identify the primary load carrying members
- Study the construction of wings.
- Measurement of deflection of Truss members.
- Study of Composite structure.
- Study the construction of landing gears.

Lab Outcome:

- Student able to understand construction of fuselage, construction of wings, Composite structure, Construction of Landing Gears.
- Student can measure the Deflection of Truss members.

AEA- 406 Java Programming

AEA-406	**Java Programming**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

Lab Preamble:

- Basics of software used in Aircraft.
- Designing and Simulation of electrical and electronics circuits.

Lab Outcomes:

At the end of the lab the students will be able to

- Design and simulate different electrical and electronics circuits
- Fabrication of Avionics Devices.
- Familiarization with various Aviation software like Matlab etc.

List of Experiments:

- Installation of J2SDK
- Write a program to show Scope of Variables
- Write a program to show Concept of CLASS in JAVA
- Write a program to show Type Casting in JAVA
- Write a program to show How Exception Handling is in JAVA
- Write a Program to show Inheritance
- Write a program to show Polymorphism
- Write a program to show Access Specifiers (Public, Private, Protected) in JAVA
- Write a program to show use and Advantages of CONTRUCTOR
- Write a program to show Interfacing between two classes
- Write a program to Add a Class to a Package
- Write a program to show Life Cycle of a Thread
- Write a program to demonstrate AWT.
- Write a program to Hide a Class
- Write a Program to show Data Base Connectivity Using JAVA
- Write a Program to show “HELLO JAVA ” in Explorer using Applet
- Write a Program to show Connectivity using JDBC
- Write a program to demonstrate multithreading using Java.
- Write a program to demonstrate applet life cycle.
- Write a program to demonstrate concept of servlet.

AEA- 407- Industrial Training – I

AEA- 407	**Industrial Training – I**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

Lab Preamble:

Industrial Training is imparted with the following in mind-

- To provide comprehensive learning platform to students where they can enhance their employ ability skills and become job ready along with real corporate exposure.
- To enhance students' knowledge in electrical technology.
- To Increase self-confidence of students and helps in finding their own proficiency
- To cultivate student's leadership ability and responsibility to perform or execute the given task.
- To provide learners hands on practice within a real job situation

Lab Outcomes:

At the end of the training, a student will be able to:

- acquire and apply fundamental of engineering aspects learned during training.
- Become updated with all the latest changes in technological world.
- Ability to communicate efficiently.
- Ability to identify, formulate and model problems in real practical field and find engineering solution based on a systems approach.
- Awareness of the social, cultural, global and environmental responsibility as an engineer.

The Industrial Training– I should be the outcome of the training done/performed during semester break of $4^{th\ sem}$ .It should be submitted in hardware form (proto type)or simulation form along with proper data and certificates issued during project training. It should cover the electrical engineering aspects learned during training. A Power point presentation should also be submitted at the time of submission.
To be completed during fourth semester break. Its evaluation/credit to be added in fifth semester

Semester -V

AEA-501 Aircraft Structure- II

AEA-501	**Aircraft Structure- II**	**2L:1T:0P**	**3 credits**	**2Hrs/Week**

Course Preambles:

To provide the behavior of loads experience of aircraft indigenous components.

- To provide the students adopt with various methods for analysis of aircraft wings and fuselage.
- To provide conception design of major aircraft structural components.
- To provide the better understate the low weight structures..

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Ability to understand loads acting an aircraft.
- Ability to identify& resolve the structural design& its limitations.
- Ability to improvise distribution their loads on aircraft member with safer limits.
- Ability to understand the design of low weight to high strength panel member.
- Ability to analyze the aircraft real structural components such as wings and fuselage.

Unit 1: Fundamentals of Structural Analysis (10 hours)

Basic Elasticity: stress, notation for forces and stresses , equation of equilibrium, plane stress, Boundary conditions, determination of stresses on inclined planes, principal stresses, strain, Compatibility equations, plane strain, determination of strains on inclined planes principal Strains, stress-strain relationship.

Unit 2: Bending of Thin Walled Beams (10 hours)

Bending of open and closed thin walled beams: Symmetrical bending, unsymmetrical bending, deflection due to bending, calculation of section properties, application of bending theory, temperature effects, and numerical problems.

Unit 3: Shear Flow (8 hours)

Torsion of beams: torsion of closed section beams, torsion of multi-cell section, shear center, properties of shear center, numerical problems.

Unit 4: Introduction to Controller Design (10 hours)

Bredt-Batho formula, Shear flow in open section, Shear flow in closed section, shear flow in boom section, combination of open and close section.

Unit 5: Airworthiness and Airframe Loads (10 hours)

Airworthiness, factor of safety-flight envelope, load factor determination, loads on an aircraft, safe life and fail safe structure, fatigue, creep and relaxation, materials used in an aircraft.

References:

- Megson T.H.G., Aircraft Structure for engineering students, Edward Arnold.
- Perry D.J. and Azar J.J., Aircraft Structures, McGraw hill.

AEA-501 Aircraft Structure- II

AEA-501	**Aircraft Structure- II**	**0L:0T:1P**	**1 Credits**	**2 Hrs/week**

List of Experiments:

- Verification of Maxwell's Reciprocal theorem & principle of superposition.
- Shear center location for open sections.
- Deflection of beams with various end conditions for different load.
- Shear center location for closed sections.

Lab Outcome:

- Student able to understand Shear center location for open sections, close sections.
- Student can measure the loading condition of beams with various end conditions for different load.

AEA-502 Aerodynamics-II

AEA-502	Aerodynamics-II	2L:1T:0P	3 Credits	3Hrs/Week

Course Preambles:

- To introduce the concepts of compressibility,
- To make the student understand the theory behind the formation of shocks and expansion fans in Supersonic flows.
- To introduce the methodology of measurements in Supersonic flows.

Course Outcomes:

- Calculate the compressible flow through a duct of varying cross section.
- Use quasi one-dimensional theory to analyze compressible flow problems.
- Estimate fluid properties in Rayleigh and Fanno type flows.
- Estimate the properties across normal and oblique shock waves.

Unit 1: Fundamental Aspects of Compressible Flow: (10 Hours)
Compressibility, Continuity, Momentum and energy equation, Calorically perfect gas, Mach number, speed of sound –Velocity relation, Mach cone, Mach angle, One dimensional Isentropic flow through variable area duct, Static and Stagnation properties, Critical conditions, Characteristic Mach number, Area-Mach number relation, Maximum discharge velocity.

Unit 2: Shock and Expansion Waves (10 Hours)
Normal shock relations, Prandtl's relation, Huguenot equation, Rayleigh Supersonic Pitot tube equation, Moving normal shock waves, Oblique shocks, Θ-β-M relation, Shock Polar, Reflection of oblique shocks, left running and right running waves, Interaction of oblique shock waves, slip line, Rayleigh flow, Fanno flow, Expansion waves, Prandtl-Meyer expansion, Maximum turning angle, Simple and nonsimple regions, operating characteristics of Nozzles.

Unit 3: Two Dimensional Compressible Flow (10 Hours)
Potential equation for 2-dimensional compressible flow, Linearization of potential equation, perturbation potential, Linearized Pressure Coefficient, Linearized subsonic flow, Prandtl-Glauert rule, Linearized supersonic flow, Method of characteristics.

Unit 4: High Speed Flow Over Airfoils, Wings and Airplane (40 Hours):
Supercritical Airfoil Sections, Transonic area rule, Swept wing, Airfoils for supersonic flows, Lift, drag, Pitching moment and Centre of pressure for supersonic profiles, Shock expansion theory, wave drag, supersonic wings, Design considerations for supersonic aircrafts.

Unit 5: Special Topics (6 Hours)
Shock-Boundary layer interaction, Wind tunnels for transonic, Supersonic and hypersonic flows, shock tube, Gun tunnels, Supersonic flow visualization, Introduction to Hypersonic Flows.

References:

1. Anderson, J. D, Modern Compressible Flow, McGraw-Hill & Co., 2002.
2. Rathakrishnan, E, Gas Dynamics, Prentice Hall of India, 2004.

AEA-502	**Aerodynamics-II**	**0L:0T:1P**	**1 Credits**	**2 Hrs/week**

List of Experiments:

- The lift and drag over an NACA-0012 Aerofoil
- Study of shock tube
- Study of supersonic aircraft vehicle.
- Shock wave generation over the spacecraft.
- Study of subsonic compressible flow.

Lab Outcome:

- Student able to understand subsonic compressible flow, supersonic aircraft vehicle, Shock wave generation, shock tube and can make test the drag over an NACA-0012 Airfoil.

AEA-503 Aircraft Propulsion –II

AEA-503	Aircraft Propulsion –II	2L:1T:0P	3 Credits	3Hrs/Week

Course Preambles:
To impart make students understand theory in non-air-breathing and hypersonic propulsion methods to students so that they are familiar with various propulsion technologies associated with space launch vehicles, missiles and space probes.

Course Outcomes:

- Understanding ramjet and hypersonic air breathing propulsion systems.
- To get familiarity in rocket propulsion systems.
- Knowing the applications and principles of liquid and solid-liquid propulsion systems.
- To gain knowledge about the advanced propulsion technique used for interplanetary mission.

Unit 1: Aircraft Gas Turbines: **(10 Hours)**
Impulse and Reaction Types of gas turbines – Velocity triangles and power output – Elementary theory Vortex theory – Choice of blade profile, pitch and chord – Estimation of stage performance– Limiting factors in gas turbine design- Overall turbine performance – Methods of blade cooling –Matching of turbine and compressor – Numerical problems.

Unit 2: Ramjet Propulsion: (10 Hours)
Operating principle – Sub critical, critical and supercritical operation – Combustion in ramjet Engine – Ramjet performance – Sample ramjet design calculations – Introduction to scramjet Preliminary concepts in supersonic combustion – Integral ram- rocket- Numerical problems.

Unit 3: Fundamentals of Rocket Propulsion: (10 Hours)
Operating principle – Specific impulse of rocket - Rocket nozzle classification – Rocket performance considerations – Numerical Problems.

Unit 4: Advanced Propulsion Techniques: (8Hours)
Solid propellant rockets – Selection criteria of solid propellants – Important hardware components of solid rockets – Propellant grain design considerations – Liquid propellant rockets– Selection of liquid propellants – Thrust control in liquid rockets – Cooling in liquid rockets –Limitations of hybrid rockets.

Unit 5: State Space Analysis: **(10 Hours)**
Electric rocket propulsion – Ion propulsion techniques – Nuclear rocket – Types – Solar sail- Preliminary Concepts in nozzle less propulsion.

References:

- Anderson J.D. Introduction to flight, McGraw Hill Education (India) Pvt. Ltd.
- Ganesan V. Gas Turbines, McGraw Hill Education (India) Pvt. Ltd.
- Sutton, G.P., ―Rocket Propulsion Elements‖, John Wiley & Sons Inc., New York, 5thEdn.

AEA-503	**Aircraft Propulsion –II**	**0L:0T:1P**	**1 Credits**	**2 Hrs/week**

List of Experiments:

- Water Rocket
- Water jet study
- Calorific value estimation
- Ignition Delay Measurement
- Identification of burning rate

Lab Outcome:

- Student able to understand can measure Ignition Delay, Burning rate, Calorific value, and can develop the Water Rocket, Water jet study.

Program Elective - I

AEA-504 (A) Basics Aircraft Maintenance & Repair

AEA-504 (A)	**Basics Aircraft Maintenance & Repair**	**3L:1T:0P**	**4 Credits**	**4Hrs/Week**

Course Preambles:

- To make the students to familiarize with the Aircraft maintenance procedure an practice.
- Must have knowledge of basics of Aeronautics and its components.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Apply maintenance procedure to Aircraft Structure
- Identify the Aircraft components and faults
- Apply nondestructive testing procedures to identify the defects
- Apply overhauling procedure to new aircraft.

Unit 1: Welding in Aircraft Structure (12 Hours)

Equipment used in welding shop and their maintenance – Ensuring quality welds –Welding jigs and fixtures – Soldering and brazing.

Sheet Metal Repair and Maintenance (12 Hours)

Inspection of damage – Classification – Repair or replacement – Sheet metal inspection – N.D.T. Testing – Riveted repair design, Damage investigation.

Unit 2: Plastics and Composites in Aircraft (12 Hours)

Review of types of plastics used in airplanes – Maintenance and repair of plastic components – Repair of cracks, holes etc., various repair schemes – Scopes. Inspection and Repair of composite components – Special precautions.

Unit 3: Aircraft Jacking and Rigging (12 Hours)

Airplane jacking and weighing and C.G. Location. Balancing of control surfaces –Inspection maintenance. Helicopter flight controls. Tracking and balancing of main rotor.

Unit 4: Synchronous Machines (12 Hours)

Trouble shooting and maintenance practices–Service and inspection–Inspection and maintenance of landing gear systems. – Inspection and maintenance of air-conditioning and pressurization system, water and waste system. Installation and maintenance of Instruments – handling– Testing– Inspection. Inspection and maintenance of auxiliary systems. Position and warning system.

Unit 5: Computer aided Design (CAD): (12 Hours)

Hazardous materials storage and handling, Aircraft furnishing practices – Equipment's. Trouble Shooting - Theory and practices.

References:

- Larry Reithmeir, ―Aircraft Repair Manual‖, Palamar Books, Marquette, 1992.
- BRIMM D.J. BOGGES H.E., ―Aircraft Maintenance‖, Pitman Publishing corp. New York. Electrical machines and equipment design exercise examples using Ansoft's Maxwell 2D machine design package.

AEA-504 (B) Theory of Vibration

AEA-504 (B)	**Theory of Vibration**	**3L:1T:0P**	**4 Credits**	**4Hrs/Week**

Course Preambles:

- To study the effect of time dependent forces on mechanical systems and to get the natural characteristics of system with more degree of freedom systems.
- To study the vibration and aero elastic effects of aircraft wing.

Course Outcomes

- Gaining understanding of single and multi-degree vibrating systems
- Ability to use numerical techniques for vibration problems
- Knowledge acquired in aero elasticity and fluttering.
- Differentiate types of vibrations according to dampness and particle motion.
- Solve Rayleigh and Holzer method to find natural frequency of an object

Unit 1: Introduction (12 hours)

Types of vibrations, S.H.M, principle of super position applied to Simple Harmonic Motions. Beats, Fourier theorem and simple problems.

Unit 2: Maxwell's Equations (12 hours)

Single degree of freedom systems. Undamped free vibration, natural frequency of free vibration, spring and Mass elements, effect of mass of spring, Compound Pendulum. Single degree of freedom systems, different types of damping, concept of critical damping and its importance, study of response of viscous damped systems for cases under damping, critical and over damping, Logarithmic decrement.

Unit 3: Forced Vibration & Vibration Measuring Instruments (12 hours)

Single degree of freedom systems, steady state solution with viscous damping due to harmonic force. Solution by Complex algebra, reciprocating and rotating unbalance, vibration isolation, transmissibility ratio. Due to harmonic excitation and support motion. Vibration of elastic bodies– Vibration of strings – Longitudinal, lateral and torsional Vibration.

Unit 4: Systems with two Degrees of Freedom (12 hours)

Introduction, principle modes and Normal modes of vibration, co-ordinate coupling, Generalized and principal co-ordinates, free vibration in terms of initial conditions. Geared systems. Forced Oscillations-Harmonic excitation. Applications: a) Vehicle suspension. b) Dynamic vibration absorber. c) Dynamics of reciprocating Engines. Continuous Systems: Introduction, vibration of string, longitudinal vibration of rods, Torsional vibration of rods, Euler's equation for beams.

Unit 5: Waveguides (12 hours)

Introduction, Influence coefficients, Maxwell reciprocal theorem, Dunkerley's equation. Orthogonally of principal modes, Method of matrix iteration-Method of determination of all the natural frequencies using sweeping matrix and Orthogonally principle. Holzer's method, Stodola method.

Reference:

1. Theory of Vibrations W.T.Thomson.
2. Theory of Vibrations Grover & Nigam

AEA-505 (A) Nano science & Technology

AEA-505 (A)	**Nano science & Technology**	**3L:1T:0P**	**4 Credits**	**4Hrs/Week**

Course Preambles

To foundational knowledge of the Nano science and related fields.2.To make the students acquire an understanding the Nano science and Applications 3. To help them understand in broad outline of Nano science and Nanotechnology.

Course Outcomes

After completing this course students will be able to:

- Learn about the background on Nano science
- Understand the synthesis of nanomaterial's and their application and the impact of nanomaterial's on environment
- Apply their learned knowledge to develop Nanomaterial's.

Unit 1: Bonding in Atoms (12 hours)

Giant molecular solids. Electronic conduction, system classification confined to one, two or three dimension and their effect on properties, top-down and bottom-up processes.

Unit II: Characterization (12 hours)

Characterization using scanning electron microscopy (SEM), electro probe microanalysis (EPMA), transmission electron microscopy (TEM) including energy dispersive X-ray (EDX) analysis, electron energy loss spectroscopy (EELS), Auger electron spectroscopy (AES), low energy electron diffraction (LEED), reflection high energy electron diffraction (RHEED).

Unit 3: Technique-1 (12 hours)

When photons are used as probes, generally electrons/photons are emitted and are analyzed as light microscopy including confocal and two photon microscopy, X-ray diffraction (XRD), X-ray fluorescence (XRF), X-ray absorption spectroscopy (XAS), infrared spectroscopy (IR), Raman spectroscopy (Raman), Luminescence, and X-ray photo electron spectroscopy (XPS). Proximal probe technique to monitor the interaction between a localized probe and a sample surface.

Unit 4: Technique-2 (12 hours)

Atomic force microscopy (AFM), scanning tunneling microscopy (STM) and scanning tunneling spectroscopy (STS). There is also position-sensitive atom probe (POSAP) spectroscopy. Inorganic nanostructures, optical properties, exactions, pn junctions, phonons, quantum confinement, quantum dots, colloidal quantum dots, characterization and application like biopolymer tagging and light emitting semiconductor quantum dots, Nano magnetism in technology and the challenges.

Unit 5: Chemistry (12 hours)

Chemistry of carbon, light emission from organic molecules, fluorescence and electroluminescence, synthetic metals, carbon nanotubes, Nano cuboids, grapheme, carbon quantum dots. Carbon Nano tube as Nano test tube for quantum dot synthesis, functionalized Nano particles for biological applications, bio mineralization. DNA as a nanotechnology building block, directed assembly using biomolecules., molecular motors, biological motors, artificial photosynthesis, solar energy transduction.

Reference:

AEA-505(B) Heat and Mass Transfer

AEA-505 (B)	**Heat and Mass Transfer**	**3L:1T:0P**	**4 Credits**	**4Hrs/Week**

Course Preambles:

- To study the effect of time dependent forces on mechanical systems and to get the natural characteristics of system with more degree of freedom systems.
- To study the vibration and aero elastic effects of aircraft wing.

Course Outcomes:

- Gaining understanding of single and multi-degree vibrating systems
- Ability to use numerical techniques for vibration problems
- Knowledge acquired in aero elasticity and fluttering.
- Differentiate types of vibrations according to dampness and particle motion.
- Solve Rayleigh and Holzer method to find natural frequency of an object.

Unit 1: Fundamentals (12 Hours)

Modes of heat transfer: Conduction –Convection – Radiation

Unit 2: Heat Conduction (12 Hours)

Steady and unsteady state heat conduction in solids - Effect of variation of thermal conductivity on heat transfer in solids –conduction with heat generation –Heat transfer problems in infinite and semi-infinite solids–Critical radius of insulation-Extended surfaces-Application of numerical techniques.

Unit 3: Free and Forced Convection (12 Hours)

Convection fundamentals: Basic equations, Boundary layer concept, Dimensional analysis Free Convention: Laminar boundary layer equation- Free convection in atmosphere free Convection on a vertical flat plate –Integral method - Empirical relation in free convection – External flow. Forced convection: Forced convection - Laminar and turbulent convective heat transfer analysis in flows between parallel plates, over a flat plate and in a circular pipe. Empirical relations - numerical techniques in problem solving.

.**Unit 4: Radiative Heat Transfer and Heat Exchangers (12 Hours)**

Concept of black body-Intensity of radiation-Laws of Black body Radiation-Radiation from non-black surfaces- real surfaces –Radiation between surfaces-Radiation shape factors-Radiation shields. HEAT EXCHANGERS: Types-overall heat transfer coefficient- LMTD-NTU method of heat exchanger Analysis.

Unit 5: Ac-dc bidirectional boost converter (6 Hours)

Heat transfer problems in gas turbine combustion chambers - Rocket thrust chambers Aerodynamic heating - Ablative heat transfer.

References:

- Sachdeva, S.C. Fundamentals of Engineering, Heat and Mass Transfer, Wiley Eastern Ltd., New Delhi, 1981.
- 2.Lienhard, J.H., ―A Heat Transfer Text Book‖, Prentice Hall Inc., 1981.
- 3.Holman, J.P., ―Heat Transfer‖, McGraw-Hill Book Co., Inc., New York, 6th Edn, 1991.

AEA 506 Industrial Training-II

AEA 506	**Industrial Training-II**	**0L:0T:4P**	**2 Credits**	**4Hrs/Week**

Course Outcomes:

At the end of this course students will demonstrate the ability to

- Analyze the dynamic response and the calibration of few instruments
- Learn about various measurement devices, their characteristics, their operation and their limitations.
- Understand statistical data analysis
- Understand computerized data acquisition.
- Conceive a problem statement either from rigorous literature survey or from the requirements raised from need analysis.
- Design, implement and test the prototype/algorithm in order to solve the conceived problem.
- Write comprehensive report on Minor project work.

Guidelines:

- The Minor-project is a team activity having 3-4 students in a team. This is electronic product design work with a focus on electronic circuit design.
- The Minor project may be a complete hardware or a combination of hardware and software.
- The software part in Minor project should be less than 50% of the total work.
- Minor Project should cater to a small system required in laboratory or real life.
- It should encompass components, devices, analog or digital ICs, micro controller with which functional familiarity is introduced.
- After interactions with course coordinator and based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and Preambles of Minor project.
- Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
- The student is expected to exert on design, development and testing of the proposed work as per the schedule.
- Art work and Layout should be made using CAD based PCB simulation software. Due considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design.

AEA-601 Aircraft Design

AEA-601	Aircraft Design	2L:1T:0P	4 Credits	3Hrs/Week

Course Preambles:

- Familiarize students with the important issues and methodologies of aircraft design.
- Illustrate the process of aircraft synthesis as an outcome of the integration of the disciplines of aerodynamics, performance, stability and control, propulsion, structures and aero elasticity.
- Develop the ability to function as a member of a team in a design setting; including the ability to conduct a peer review of the other team members.

Course Outcomes:

- After completing this course students will be able to:
- Perform preliminary design of a complete aircraft based on the specifications provided.
- Performing a detailed preliminary design of a complete aircraft.

Unit-1: Preliminaries (10 Hours)

Aircraft Design Requirements, specifications, role of users. Aerodynamic and Structural Consideration, Importance of weight. Airworthiness requirements and standards. Classifications of airplanes. Special features of modern airplane. Air Loads in Flight: Symmetrical measuring loads in flight, Basic flight loading conditions, Load factor, Velocity - Load factor diagram, gust load and its estimation, Structural limits.

Unit-2: Airplane Weight Estimation (10 Hours)

Weight estimation based on type of airplane, trends in wing loading, weight-estimation based on mission requirements, iterative approach. Basic Wing Design: Selection of airfoil selection, influencing factors. Span wise load Distribution and plan form shapes of airplane wing. Stalling take-off and landing Considerations. Wing drags estimation. High lift devices. Structural Design: Cockpit and aircraft passenger cabin layout for different categories, types of associated structure, features of light airplanes using advanced composite materials. Structural aspects of design of airplane, Bending moment and shear force diagram. Design principles of all metal stressed skin wing for civil and military applications.

Unit-3: Landing Gears (10 Hours)

Different kinds of landing gears, and associated arrangement for civil and military airplanes. Preliminary calculations for locating main and nose landing gears.

Unit-4: Integration of Structure and Power Plant (10 Hours)

Estimation of Horizontal and Vertical tail volume ratios. Choice of power plant and various options of locations, considerations of appropriate air-intakes. Integration of wing, fuselage, empennage and power plant. Estimation of center of gravity.

Unit-5 Introduction of advanced concepts: (5 Hours)

Supercritical Wings, relaxed static Stability, controlled configured vehicles, V/STOL aircraft and rotary wing vehicles. Design and layout of flying controls and engine controls.

References:

- Daniel P Raymer, Aircraft Design: A conceptual approach, AIAA Series, 1992.
- John D Anderson (Jr.), Airplane Performance and Design, mcgraw Hill.

AEA-601	**Aircraft Design**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

List of Experiment:

- Comparative configuration study of different types of airplanes.
- Comparative study on specification and performance details of aircraft.
- Preparation of comparative data sheets.
- Work sheet layout procedures.
- Comparative graphs preparation and selection of main parameters for the design.
- Preliminary weight estimations, selection of main parameters.
- Power plant selection, Airfoil selection, Wing tail and control surfaces.
- Preparation of layouts of balance diagram and three view drawings.
- Estimation of various Drags.
- Detailed performance calculations and stability estimates.

Lab Outcome:

- Student able to understand can develop the basic concept of any aircraft design.
- All students will learn the design of an Airplane for given preliminary specifications.

AEA-602 Aircraft Stability & Control

AEA-602	**Aircraft Stability & Control**	**2L:1T:0P**	**3 Credits**	**3Hrs/Week**

Course Preambles:

- To introduce the concept of Stability and control of Aircraft.
- To impart knowledge about various Aircraft motions and related stability.
- To introduce the concept of dynamic stability of Aircraft.

Course Outcomes:

After completing the course the student will be able to

- Understand the degree of freedom of aircraft system.
- Analyse the static stability Behaviour of the aircraft.
- Understand the dynamic longitudinal stability of aircraft.
- Perform the dynamic analysis to determine stability of aircraft.
- Estimate the requirement of control force and power plant.
- Assess the motion of unstable aircraft and related modes of instability.

Unit 1: Historical perspective (10 Hours)

Aerodynamic Nomenclature, Equilibrium conditions, Definition of static stability, Definition of longitudinal static stability, stability criteria, Contribution of airframe components: Wing contribution, Tail contribution, Fuselage contribution, Power effects Propeller airplane and Jet airplane Introduction, Trim condition. Static margin. Stick fixed neutral points. Longitudinal control, Elevator power, Elevator angle versus equilibrium lift coefficient, Elevator required for landing, Restriction on forward C.G. range.

Unit 2: Static Longitudinal Stability& Static Directional Stability (10 Hours)

Control-Stick free Introduction, Hinge moment parameters, Control surface floating characteristics and aerodynamic balance, Estimation of hinge moment parameters, The trim tabs, Stick-free Neutral point, Stick force gradient in unaccelerated flight, Restriction on aft C.G. Introduction, Definition of directional stability, Static directional stability rudder fixed, Contribution of airframe components, Directional control. Rudder power, Stick-free directional stability, Requirements for directional control, Rudder lock, Dorsal fin. One engine inoperative condition. Weather cocking effect.

Unit 3: Lateral Stability (10 Hours)

Introduction, definition of Roll stability. Estimation of dihedral effect, Effect of wing sweep, flaps, and power, Lateral control, Estimation of lateral control power, Aileron control forces, balancing the aileron. Coupling between rolling and yawing moments. Adverse yaw effects. Aileron reversal. Definition of Dynamic longitudinal stability. Types of modes of motion: long or phugoid motion, short period motion. Airplane Equations of longitudinal motion.

Unit 4: Yawning and Rolling Stability (10 Hours)

Derivation of rigid body equations of motion, Orientation and position of the airplane, gravitational and thrust forces, Small disturbance theory. Aerodynamic force and moment representation, Derivatives due to change in forward speed, Derivatives due to the pitching

velocity, Derivatives due to the time rate of change of angle of attack, Derivatives due to rolling rate, Derivatives due to yawing rate.

Unit 5: Control (5 Hours)

Routh‟s criteria. Factors affecting period and damping of oscillations. Effect of wind shear. Flying qualities in pitch. Cooper-Harper Scale. Response to aileron step-function, side-slip excursion. Dutch roll and Spiral instability. Auto- rotation and spin. Stability derivatives for lateral and directional dynamics.

Reference:

- Perkins, C.D., and Hage, R.E., “Airplane Performance stability and Control”, John Wiley Son Inc, New York, 1988.
- Nelson, R.C. “Flight Stability and Automatic Control”, McGraw-Hill Book Co., 2007.

AEA-602	**Aircraft Stability & Control**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

List of Experiment:

- Introduction to flight testing (V-n diagram).
- Evaluation of glider drag polar.
- Evaluation of cruise and climb performance of a small airplane.
- Observations of airplane dynamic modes and stall characteristics.
- Introduction to GPS based navigation.
- Introduction to auto-pilot.

Lab Outcome:

- Student can able to use the V-n diagram, drag polar chart.
- Student can able to understand the functioning of autopilot, GPS based navigation and able to evaluate the cruise and climb performance of a small airplane.

Program Elective - II

AEA-603(A) Aircraft Rules and Regulation

AEA-603(A)	**Aircraft Rules and Regulation**	**3L:1T:0P**	**4 Credits**	**4Hrs/Week**

Course Preambles:

- Familiarize students with the important terms and rules related with DGCA, ICAO.
- To impart the knowledge on the scope and purpose of Air rules and regulation

Course Outcomes:

- After completing this course students will be able to:
- Identify the flight operations between different altitudes
- Differentiate the runway restrictions and limitations.

Unit-1: C.A.R. Series 'A and B' C.A.R. Series A (12Hours)

Procedure for Civil Air Worthiness Requirements and Responsibility Operators Vis- À-Vis Air Worthiness Directorate Responsibilities of operators / owners-Procedure of CAR issue, amendments etc., Objectives and targets of airworthiness directorate; Airworthiness regulations & safety oversight of engineering activities of operators.

Unit-2: C.A.R. Series 'C' and 'D' C.A.R. Series 'C' (12Hours)

Defect Recording, Monitoring, Investigation and Reporting Defect recording, reporting, investigation, rectification and analysis; Flight report; Reporting and rectification of defects observed on aircraft; Analytical study of in-flight readings & recordings; Maintenance control by reliability Method.

C.A.R.SERIES_D' – and Aircraft Maintenance Programmes

Reliability Programmes (Engines); Aircraft maintenance programme & their approval; on condition maintenance of reciprocating engines; TBO–Revision programme; Maintenance of fuel and oil uplift and consumption records –Light aircraft engines.

Unit-3: C.A.R. SERIES E AND'F' (12Hours)

C.A.R. SERIES E–Approval of Organization

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

C.A.R.SERIES_F'–Airworthiness and Continued Air Worthiness

Procedure relating to registration of aircraft; Procedure for issue/revalidation of Type Certificate of aircraft & its engines/propeller; Issue/revalidation of Certificate of Airworthiness.

Unit-4: C.A.R. SERIES 'L'&'M" (12Hours)

Issue of AME License, its classification and experience requirements, Mandatory Modifications/Inspections.

Unit-5: C.A.R. SERIES 'T'&'X' (12Hours)

Flight testing of (Series) aircraft for issue of C of A; Flight testing of aircraft for which C of A had been previously issued. Registration Markings of aircraft; Weight and balance control of an aircraft; Provision of first aid kits & Physician"s kit in an aircraft; Concessions; Aircraft

log books; Document to be carried on board on Indian registered aircraft; Procedure for issue of tax permit.

Reference:

- Aeronautical Information Circulars (relating to Airworthiness) from DGCA 2000.
- Aircraft Manual (India) Volume‖–Latest Edition, the English Book Store, 17-1, Connaught Circus, New Delhi

AEA-603(B) Wind Tunnel Techniques

AEA-603(B)	**Wind Tunnel Techniques**	**3L:1T:0P**	**4 Credits**	**4Hrs/Week**

Course Preambles:

- To provide knowledge of various types of wind tunnels and test techniques.
- To introduce the basic concepts of measurement of pressure, velocity, forces and moments on models.
- To provide knowledge of various flow visualization techniques

Course Outcomes:

After completing this course students will be able to:

- Choose proper high speed wind tunnel for required test.
- Choose correct model for wind tunnel testing
- Estimate the forces and moments for given model
- Arrive the pressure, velocity and temperature using measurement techniques
- Choose the proper flow visualization techniques

Unit 1: Principles of Model Testing (12Hours)

Buckingham Theorem – Non-Dimensional Numbers – Scale Effect Types of Similarity.

Unit 2: Wind Tunnels (12Hours)

Classification – Special problems of Testing in Subsonic, Transonic, supersonic and hypersonic speed regions – Layouts – sizing and design parameters.

Unit 3: Calibration of Wind Tunnels (12Hours)

Test section speed – Horizontal buoyancy – Flow angularities – Turbulence measurements – Associated instrumentation – Calibration of supersonic tunnels.

Unit 4:Wind Tunnel Measurements (12Hours)

Pressure and velocity measurements – Force measurements – Three component and six component balances – Internal balances.

Unit 5: Flow Visualization Techniques (12Hours)

Smoke and Tuft grid techniques – Dye injection special techniques – Optical methods of flow visualization.

References:

- Rae, W.H. and Pope, A. “Low Speed Wind Tunnel Testing”, John Wile Publication, 1914.
- Pope, A., and Goin, L., “High Speed wind Tunnel Testing”, John Wiley, 1915.

Program Elective - III

AEA-604 (A) Fuel & Combustion

AEA-604 (A)	Fuel & Combustion	3L:0T:0P	3 Credits	3Hrs/Week

Course Preambles:

- To build up knowledge of the concepts and theories of a of classical fuel combustion.
- To develop understanding of the basic principles and concepts of advanced fuel combustion and control process.

Course Outcomes:

- After completing this course students will be able to:
- Students with the required skills for analyzing thermal cycles.
- Students will get understand fundamental physical and chemical principles regarding formation and control of air pollutants in industrial and technological processes.

Unit 1: Characterization (12Hours)

Fuels –Types and Characteristics of Fuels –Determination of Properties of Fuels –Fuels Analysis –Proximate and Ultimate Analysis –Moisture Determination –Calorific Value –Gross& Net Calorific Values –Calorimetry-DuLong‟s Formula for CV Estimation –Flue gas Analysis –Orsat Apparatus –Fuel, Ash Storage & Handling -Spontaneous Ignition Temperatures.

Unit 2: Solid Fuels & Liquid Fuels (12Hours)

(a) Solid Fuels Types –Coal Family –Properties –Calorific Value –ROM, DMMF, DAF and Bone Dry Basis–Ranking –Bulk & Apparent Density –Storage –Washability –Coking & Caking Coals –Renewable Solid Fuels –Biomass –Wood Waste –Agro Fuels –Manufactured Solid Fuels.

(b) Liquid Fuels Types –Sources –Petroleum Fractions –Classification –Refining –Properties of Liquid Fuels: Calorific Value, Specific Gravity, Flash & Fire Point, Octane Number, Cetane Number -Alcohols –Tar Sand Oil –Liquefaction of Solid Fuels.

Unit 3: Gaseous Fuels (12Hours)

Classification –Composition & Properties –Estimation of Calorific Value –Gas Calorimeter –Rich & Lean Gas –Wobbe Index –Natural Gas –Dry & Wet Natural Gas –Stripped NG –FoulandSweet NG –LPG –LNG –CNG –Methane –Producer Gas –Gasifiers –Water Gas –TownGas –Coal Gasification –Gasification Efficiency –Non-Thermal Route –Biogas –Digesters –Reactions –Viability –Economics.

Unit 4: Combustion: Stoichiometry & Kinetics (12Hours)

Stoichiometry –Mass Basis and Volume Basis –Excess Air Calculation –Fuel & Flue Gas Compositions –Calculations –Rapid Methods –Combustion Processes –Stationary Flame –Surface or Flameless Combustion –Submerged Combustion –Pulsating & Slow Combustion Explosive Combustion-Mechanism of Combustion –Ignition & Ignition Energy –Spontaneous Combustion –Flame Propagation –Solid, Liquid and Gaseous Fuels Combustion –Flame Temperature –Theoretical, Adiabatic & Actual –Ignition Limits –Limits of Inflammability.

Unit 5: Combustion Equipment's (12Hours)

Coal Burning Equipment's –Types –Pulverized Coal Firing –Fluidized Bed Firing –Fixed Bed and Recycled Bed –Cyclone Firing –Spreader Stokers –Vibrating Grate Stokers –Sprinkler Stokers –Traveling Grate Stokers –Oil Burners –Vaporizing Burners –Atomizing Burners –Design o burners –Gas Burners –Atmospheric Gas Burners –Air Aspiration Gas Burners –Burners. Classification according to Flame Structures –Factors Affecting Burners & Combustion.

References:

- Samir Sarkar, "Fuels & Combustion", Second Edition, Orient Longman, 1990.
- Bhatt, "Vora Stoichiometry‟, Second Edition, Tata Mcgraw Hill, 1984.
- Blokh AG, "Heat Transfer in Steam Boiler Furnace", Hemisphere Publishing Corp., 1988.
- Civil Davies, "Calculations in Furnace Technology", Pergamon Press, Oxford, 1966.

- Sharma SP, Mohan Chander, "Fuels & Combustion", Tata Mcgraw Hill, 1989.

AEA-604(B) Maintenance of Radio & Communication Systems

AEA-604(B)	Maintenance of Radio & Communication Systems	3L:0T:0P	3 Credits	3Hrs/Week

Course Preambles:

- To study the electrical cable and resistors.
- To know the various types of antennas and battery
- To understand the basic radio systems.

Course Outcomes:

- This course provides the students deep knowledge Satellite Communications and its application to aircraft.
- At the end of course, students will should able to work on ac and dc measuring instruments.
- The course will focus on various types of antennas.

Unit 1: Electrical Cable and Resistors (12Hours)

Basics of the application and identification of electrical cables used in Aircraft radio installation, crimping and soldering techniques, bonding continuity and insulation tests. Composition, performance (stability and tolerance) and limitations of the fixed resistors and varistors (carbon composition, carbon film, wire wound and metallic film).

Unit 2: AC and DC Measuring Instruments (12Hours)

Electrical power distribution systems, the operation and construction of static inverters, rotary inverters and transformer rectifier units. Basics of interference caused by electrical and ignition system to radio apparatus, methods of minimizing or suppressing such interference, bonding and screening.

Unit 3: Construction and Identification of Various Types of Antennas (12Hours)

The voltage and current distribution along antenna of various length; characteristics of ground planes. Very high frequency (VHF) and high frequency (HF) airborne communications; frequency bands allocation; the methods of propagation and the ranges expected, both day and night; calculation of approximate range of communication (line of sight) with given data. The performance levels expected and specifications of typical airborne HF and VHF communication systems; the principle of operation, installation practices and procedures, functioning of the operating controls and indications and maintenance of typical HF and VHF communication transceivers. Theory of operation, performance level and specifications of an Audio Integration System.

Unit 4: Battery (12Hours)

Working principles and testing of Lead Acid and Nickel Cadmium and Silver Zinc batteries Principles, Characteristics and operation of the under mentioned systems: Automatic Direction Finder (ADF) Systems, Very High Frequency (VHF) Omni, Directional Range System.

Unit 5: Basic Radio Systems (12Hours)

Instrument Landing Systems, Weather Radar Systems, Microwave Devices, Air Traffic Control (ATC) Transponder System, Omega Navigation System, Radio Altimeter Systems, Cockpit Voice Recorder. Distance Measuring Equipment, Doppler Navigation System, Microwave Landing System, GPWS, And Emergency Locator Transmitters. Computers, Simulators. Flight Control Systems. Basics of state-of-the-art communication and navigation systems. Principles of Satellite Communications and its application to aircraft.

Reference:

1. RF Hansforde, Heywood and Company London: Radio Aids to Civil Aviation.
2. George Kannedy: Electronic Communication System, McGraw Hill
3. Brian Kendal: Manual of Avionics, Blackwell.

Open Core Elective-II

AEA-605 (A) Product Design & Development

AEA-605 (A)	Product Design & Development	3L:0T:0P	3 Credits	3Hrs/Week

Course Preambles:

- Familiarize students with the Product design, development and management process over whole product life cycle.
- To understand Methodology for product design, development and management
- To know Lean new product introduction
- To build the relationship of tangible product and brand
- To know the Marketing and product specification.

Course Outcomes:

- After completing this course students will be able to:
- Identify and analyse the product design and development processes in manufacturing industry.
- Define the components and their functions of product design and development processes and their relationships from concept to customer over whole product lifecycle.
- Analyse, evaluate and apply the methodologies for product design, development and management.

Unit 1: Introduction to Product Design (12Hours)

Applications, Relevance, Product Definition, Scope, Design definitions, the role and nature of design, Old and new design methods, Design by evolution vs design by innovation. Examples such evolution of bicycle, safety razor etc. Need based development, Technology based developments. Physical reliability& Economic feasibility of design concepts

Unit 2: Morphology of Design (12Hours)

Divergent, Transformation and Convergent phases of product design, Identification of need, Analysis of need, Design criteria, Functional aspects, Aesthetics, ergonomics, form (structure). Shape, size, color, Creativity, Mental blocks in creativity, Removal of blocks, Ideation Techniques.

Unit 3: Transformations stage of design (12Hours)

Brainstorming &Synaptic, Morphological techniques, Utility concept, Utility value, Utility index, Economic aspects of design, Fixed and variable costs, Break-even analysis, Product Appraisal Information and literature search, patents, standards and codes, Environment and other safety considerations in product design.

Unit4: Reliability (12Hours)

Reliability considerations in product design, Bath tub curve, Reliability of systems in series and parallel. Failure rates, MTTF and MTBF, Optimum spares from reliability consideration.

Unit5: Design of displays and controls (12Hours)

Man-Machine interface, Compatibility of displays and controls, Ergonomic aspects of design, Anthropometric data and its importance in design.

References:

- Product Design & Manufacturing - A.K.Chitale & R.C.Gupta, Prentice Hall. Engg .
  Product Design -C .D. Cain, Bussiness Books.

AEA-605 (B) Management and Entrepreneurship

AEA-605 (B)	**Management and Entrepreneurship**	**3L:T:0P**	**3 Credits**	**3Hrs/Week**

Course Preambles:

- Understanding basic concepts in the area of entrepreneurship,
- Understanding the role and importance of entrepreneurship for economic development,
- Developing personal creativity and entrepreneurial initiative,
- Adopting of the key steps in the elaboration of business idea,
- Understanding the stages of the entrepreneurial process and the resources needed for the successful development of entrepreneurial ventures.

Course Outcomes:

- Identify the elements of success of entrepreneurial ventures,
- Consider the legal and financial conditions for starting a business venture,
- Evaluate the effectiveness of different entrepreneurial strategies, specify the basic performance indicators of entrepreneurial activity,

Unit 1: Management & Planning (12Hours)
Definition, Importance – Nature and Characteristics of Management, Management Functions, Roles of Manager, Levels of Management, Managerial Skills, Management &Administration, Management as a Science, Art & Profession Nature, Importance and Purpose Of Planning, Types of Plans, Steps in Planning, Limitations of Planning, Decision Making – Meaning, Types of Decisions- Steps in Decision Making.

Unit 2: Organizing and Staffing (12Hours)
Meaning, Nature and Characteristics of Organization – Process of Organization, Principles of Organization, Departmentalization, Committees –meaning, Types of Committees, Centralization Vs Decentralization of Authority and Responsibility, Span of Control (Definition only), Nature and Importance of Staffing, Process of Selection and Recruitment.

Unit 3: Entrepreneurship (12Hours)
Definition of Entrepreneur, Importance of Entrepreneurship, concepts of Entrepreneurship, Characteristics of successful Entrepreneur, Classification of Entrepreneurs, Entrepreneur – An Emerging Class, Comparison between Entrepreneur and Entrepreneur, Myths of Entrepreneurship, Entrepreneurial Development models, Entrepreneurial development cycle, Problems faced by Entrepreneurs and capacity building for Entrepreneurship**.**

Unit4: Modern Small Business Enterprises (12Hours)
Role of Small Scale Industries, Concepts and definitions of SSI Enterprises, Government policy and development of the Small Scale sector in India, Growth and Performance of Small Scale Industries in India, Sickness in SSI sector, Problems for Small Scale Industries, Impact of Globalization on SSI, Impact of WTO/GATT on SSIs, Ancillary Industry and Tiny Industry.

Unit 5: Project Management (12Hours)
Meaning of Project, Project Objectives & Characteristics, Project Identification- Meaning & Importance; Project Life Cycle, Project Scheduling, Capital Budgeting, Generating an Investment Project Proposal, Project Report-Need and Significance of Report, Contents, Formulation, Project Analysis-Market, Technical, Financial, Economic, Ecological, Project

Evaluation and Selection, Project Financing, Project Implementation Phase, Human & Administrative aspects of Project Management, Prerequisites for Successful Project Implementation.

References:

- Principles of Management–P. C. Tripathi, P. N. Reddy–Tata McGraw Hill,
- Dynamics of Entrepreneurial Development & Management Vasant Desai Himalaya Publishing House.
- Management Fundamentals- Concepts, Application, Skill Development-Robers Lusier Thomson.

AEA-606 Minor Project

AEA-606	**Minor Project**	**0L:0T:4P**	**2 Credits**	**4Hrs/Week**

Course Outcomes:

At the end of this course students will demonstrate the ability to

- Analyze the dynamic response and the calibration of few instruments
- Learn about various measurement devices, their characteristics, their operation and their limitations
- understand statistical data analysis
- Understand computerized data acquisition.
- Conceive a problem statement either from rigorous literature survey or from the requirements raised from need analysis.
- Design, implement and test the prototype/algorithm in order to solve the conceived problem.
- Write comprehensive report on Minor project work.

Guidelines:

- Minor Project should cater to a small system required in laboratory or real life.
- After interactions with course coordinator and based on comprehensive literature survey/need analysis, the student shall identify the title and define the aim and Preambles of Minor project.
- Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
- The student is expected to exert on design, development and testing of the proposed work as per the schedule.
- Art work and Layout should be made using CAD based PCB simulation software. Due considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design.

AEA-701 Computational Fluid Dynamics

AEA-701	Computational Fluid Dynamics	3L:0T:0P	3 Credits	3Hrs/Week

Course Preamble:

- To introduce Governing Equations of viscous fluid flows
- To introduce numerical modeling and its role in the field of fluid flow and heat transfer
- To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.
- To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.

Couse Outcomes:

- Upon completion of this course, the students can able
- To create numerical modeling and its role in the field of fluid flow and heat transfer
- To use the various discretization methods, solution procedures and turbulence modeling to solve flow and heat transfer problems.

Unit1: Governing Equations and Boundary Conditions (10 Hours)
Basics of computational fluid dynamics–Governing equations of fluid dynamics–Continuity, Momentum and Energy equations–Chemical species transport–Physical boundary conditions–Time-averaged equations for Turbulent Flow–Turbulent–Kinetic Energy Equations–Mathematical behaviour of PDEs on CFD-Elliptic, Parabolic and Hyperbolic equations.

Unit 2: Finite Difference and Finite Volume Methods for Diffusion (10 Hours)
Derivation of finite difference equations–Simple Methods–General Methods for first and second order accuracy–Finite volume formulation for steady state One, Two and Three-dimensional diffusion problems–Parabolic equations–Explicit and Implicit schemes–Example problems on elliptic and parabolic equations–Use of Finite Difference and Finite Volume methods.

Unit 3: Finite Volume Method for Convection Diffusion (10 Hours)
Steady one-dimensional convection and diffusion–Central, upwind differencing schemes properties of discretization schemes–Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law,QUICK Schemes.

Unit4: Flow Field Analysis (10 Hours)
Finite volume methods-Representation of the pressure gradient term and continuity equation–Staggered grid–Momentum equations–Pressure and Velocity corrections–Pressure Correctionequation, SIMPLE algorithm and its variants–PISO Algorithms.

Unit 5: Turbulence Models and Mesh Generation (10 Hours)
Turbulence models, mixing length model, Two equation (k-Є) models–High and low Reynolds number models–Structured Grid generation–Unstructured Grid generation–Mesh refinement– Adaptive mesh–Software tools.

References:

- Versteeg, H.K., and Malalasekera, W.,"An Introduction to Computational Fluid Dynamics: The finite volume Method", Pearson Education Ltd. Second Edition–2007.

AEA-701	**Computational Fluid Dynamics**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

List of Experiment:

- Introduction to Modeling and Simulation Software to Aerodynamic problems.
- Solution for the one dimensional wave equations using explicit method of Lax Using Finite Difference Method (code development)
- Solution for the one dimensional Heat Conduction Equation using Explicit Method using Finite Difference Method (Code Development)
- Generation of the Algebraic Grid (Code Development)
- Generation of the Elliptic Grids (Code Development)
- Numerical Simulation of flow over an airfoil using commercial software Packages.
- Numerical Simulation of supersonic flow over a Wedge using commercial Software packages.
- Numerical Simulation of flat Plate Boundary Layer using commercial Software packages.
- Numerical Simulation of laminar flow through pipe using commercial Software packages.
- Numerical Simulation of flow past cylinder using Commercial Software packages.

Lab Outcome:
Student can able to do the coding for Boundary Layer, laminar flow through pipe, Heat Conduction, supersonic flow over a Wedge, flow over an airfoil and make simulation for various structures.

AEA-702 Rockets and Missile

AEA-702	**Rockets and Missile**	**3L:0T:0P**	**3 Credits**	**3Hrs/Week**

Course Preamble:
To give exposure on important topics like rocket motion, rocket aerodynamics and staging & control of rockets to students to enrich their knowledge in the area of missile flight

Couse Outcomes:

- Knowledge in types of rockets and missiles with respect to Indian & international scenario
- Gaining information's on aerodynamics of rocket and missiles
- Knowledge on stages and remote control of rockets missiles.

Unit 1: Classification of Rockets and Missiles (10 Hours)
Various methods of classification of missiles and rockets–Basic aerodynamic characteristics of surface to surface, surface to air, air to surface and air to air missiles–Examples of various Indian space launch vehicles and missiles–Current status of Indian rocket programme with respect to international scenario.

Unit 2: Aerodynamics of Rockets and Missile (10 Hours)
Airframe components of rockets and missiles–forces acting on a missile while passing through atmosphere–classification of missiles–slender body aerodynamics–method of describing forces and moments–lift force and lateral moment–lateral aerodynamic damping moment–longitudinal moment–drag estimation–up wash and downwash in missile bodies–rocket dispersion.

Unit 3: Rocket Motion in Free Space and Gravitational Field (10 Hours)
One dimensional and two-dimensional rocket motions in free space and homogeneous gravitational fields–description of vertical, inclined and gravity turn trajectories–determination of range and altitude–simple approximations to determine burn out velocity and altitude–estimation of culmination time and altitude.

Unit 4: Staging of Rockets and Missiles (10 Hours)
Design philosophy behind multi staging of launch vehicles and ballistic missiles–optimization of multistage vehicles–stage separation techniques in atmosphere and in space–stage separation dynamics and lateral separation characteristics.

Unit 5: Control of Rockets and Missiles (10 Hours)
Introduction to aerodynamic and jet control methods–various types of aerodynamic control methods for tactical and short range missiles-aerodynamic characteristics-various types of thrust vector control methods including secondary injection thrust vector control for launch vehicles and ballistic missiles.

References:

- Cornelisse, J.W., "Rocket Propulsion and Space Dynamics", J.W. Freeman & Co.Ltd, London,1982
- Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 5thEdition, 1993.

AEA-702	**Rockets and Missile**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

List of Experiment:

- Determination of heat of combustion of Liquid fuels
- To determine flash point and fire point of diesel, Pensky-Martins Apparatus.
- To determine the effect of temperature on Kinematic Viscosity of glycerin by Redwood Viscometer.
- Proximate Analysis of wax and coke.
- To determine the calorific value of solid fuel using Bomb Calorimeter.

Lab Outcome:
Student can able to identify heat of combustion of Liquid fuels, Proximate Analysis of wax and coke, and able to calculate the value of flash point, calorific value and viscosity of fuel.

Program Elective-IV

AEA-703 (A) Air Traffic Control and Planning

AEA-703 (A)	**Air Traffic Control and Planning**	**3L:0T:1P**	**3 credits**	**3Hrs/Week**

Course Preamble:
To study the procedure of the formation of aerodrome and its design and air traffic control.
Couse Outcomes:

- Understanding the requirement of air traffic control systems and types of air traffic control system.
- Knowledge in flight information systems and rules of air traffic systems.
- Knowledge indirection indicator systems for air navigation.

Unit 1: Basic Concepts (10 Hours)
Objectives of air traffic control systems - Parts of ATC services – Scope and Provision of ATCs – VFR & IFR operations – Classification of ATS air spaces – Various kinds of separation – Altimeter setting procedures – Establishment, designation and identification of units providing ATS – Division of responsibility of control.
Unit 2: Air Traffic Systems (10 Hours)
Area control service, assignment of cruising levels - minimum flight altitude - ATS routes and significant points – RNAV and RNP – Vertical, lateral and longitudinal separations based on time distance –ATC clearances – Flight plans – position report
Unit3: Flight Information Systems (10 Hours)
Radar service, Basic radar terminology – Identification procedures using primary / secondary radar – performance checks – use of radar in area and approach control services – assurance control and co-ordination between radar / non radar control – emergencies – Flight information and advisory service – Alerting service – Co-ordination and emergency procedures – Rules of the air.
Unit 4: Aerodrome Data (10 Hours)
Aerodrome data - Basic terminology – Aerodrome reference code – Aerodrome reference point –Aerodrome elevation – Aerodrome reference temperature – Instrument runway, physical Characteristics; length of primary / secondary runway – Width of runways – Minimum distance between parallel runways etc. – obstacles restriction.
Unit 5: Navigation and Other Services (10 Hours)
Visual aids for navigation Wind direction indicator – Landing direction indicator – Location and characteristics of signal area – Markings, general requirements – Various markings – Lights, general requirements – Aerodrome beacon, identification beacon – Simple approach lighting system and various lighting systems – VASI & PAPI - Visual aids for denoting obstacles; object to be marked and lighter – Emergency and other services.
References:

- Aircraft Manual (India) Volume I", latest Edition – The English Book Store, 17-1, Connaught Place, New Delhi.
- PANS – RAC – ICAO DOC 4444", Latest Edition, The English Book Store, 17-1, Connaught Place, New Delhi.

AEA-703 (B) Flight Instrumentation

AEA-703 (B)	**Flight Instrumentation**	**3L:0T:1P**	**3 credits**	**3Hrs/Week**

Course Preamble:

- To familiarize the available basic concepts of Flight instruments to the engineers.
- To Understand the necessary knowledge that are needed in significance and operations of Flight instruments

Couse Outcomes:

- The students will also have an exposure to various topics such as measurement concepts, air data sensors and measurements, Flight Management Systems, and other instruments pertaining to gyroscopic measurements and Engine data measurements.
- Student will be able to deploy these skills effectively in understanding and analyzing the instrumentation methods in avionics engineering.

Unit 1: Measurement Science and Displays (10 Hours)
Instrumentation brief review-Concept of measurement-Errors and error estimation-Functional elements of an instrument system –Transducers - classification - Static and dynamic characteristics- calibration - classification of aircraft instruments - Instrument displays panels and cockpit layout.

Unit 2: Air Data Instruments and Synchro Transmission Systems (10 Hours)
Air data instruments-airspeed, altitude, Vertical speed indicators. Static Air temperature, Angle of attack measurement, Synchronous data transmission system

Unit3: Gyroscopic Instruments (10 Hours)
Gyroscope and its properties, gyro system, Gyro horizon, Direction gyro-direction indicator, Rate gyro-rate of turn and slip indicator, Turn coordinator, acceleration and turning errors.

Unit4: Aircraft Compass Systems &Flight Management System (10 Hours)
Direct reading compass, magnetic heading reference system-detector element, monitored gyroscope system, DGU, RMI, deviation compensator. FMS- Flight planning-flight path optimization-operational modes-4D flight management

Unit5: Power Plant Instruments (10 Hours)
Pressure measurement, temperature measurement, fuel quantity measurement, engine power and control instruments-measurement of RPM, manifold pressure, torque, exhaust gas temperature, EPR, fuel flow, engine vibration, monitoring.

References:

- Doeblin.E.O, “Measurement Systems Application and Design”, McGraw-Hill, New York, 1999.
- HarryL.Stilz, “Aerospace Telemetry”, Vol I to IV, Prentice-Hall Space Technology Series.
- Murthy, D.V.S., “Transducers and Measurements”, McGraw-Hill, 1995
- Pallet, E.H.J. “Aircraft Instruments & Integrated systems”, Longman Scientific and Technical, McGraw-Hill, 1992.

Open Core Elective-III

AEA-704 (A) UAV System

AEA-704 (A)	**UAV System**	**3L:0T:0P**	**3 Credits**	**3Hrs/Week**

Course Preamble:

- To make the students to understand the basic concepts of UAV systems design.

Couse Outcomes:

- Ability to design UAV system
- Ability to identify different hardware for UAV.

Unit 1: Introduction to UAV (10 Hours)

History of UAV–classification–Introduction to Unmanned Aircraft Systems--models and prototypes–System Composition-applications

Unit 2: The Design of UAV Systems (10 Hours)

Introduction to Design and Selection of the System-Aerodynamics and Airframe Configurations Characteristics of Aircraft Types Design Standards and Regulatory Aspects UK,USA and Europe-Design for Stealth--control surfaces-specifications.

Unit 3: Avionics Hardware (10 Hours)

Autopilot–AGL-pressure sensors-servos-accelerometer–gyros-actuators-power supply processor, integration, installation, configuration, and testing

Unit 4: Communication Payloads and Controls (10 Hours)

Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range –modems-memory system-simulation-ground test-analysis-trouble shooting

Unit 5: The Development of UAV Systems (10 Hours)

Waypoints navigation-ground control software-System Ground Testing System In-flight Testing Future Prospects and Challenges-Case Studies–Mini and Micro UAVs.

References:

- Reg Austin "Unmanned Aircraft Systems UAV design, development and deployment", Wiley,2010.
- Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.

AEA-704 (B) Fatigue and Fracture

AEA-704 (B)	Fatigue and Fracture	3L:0T:0P	3 credits	3Hrs/Week

Course Preamble:

- To understand the basic concepts involved in fatigue analysis and to study the importance of fracture mechanics in aerospace applications.

Couse Outcomes:

- Ability to apply mathematical knowledge to define fatigue behaviors
- Ability to perform fatigue design
- Ability to analyses the fracture due to fatigue

Unit 1: Fatigue of Structures (10 Hours)
S.N. curves-Endurance limits-Effect of mean stress, Goodman, Gerber and Soderberg relations and diagrams-Notches and stress concentrations- Neubers stress concentration factors-Plastic stress concentration factors-Notched S.N. curves–Fatigue of composite materials.

Unit 2: Statistical Aspects of Fatigue Behaviour (10 Hours)
Low cycle and high cycle fatigue-Coffin-Mansons relation-Transition life-cyclic strain hardening and softening-Analysis of load histories-Cycle counting techniques-Cumulative damage-Miners theory-Other theories.

Unit 3: Physical Aspects of Fatigue (10 Hours)
Phase in fatigue life-Crack initiation-Crack growth-Final Fracture-Dislocations-fatigue fracture surfaces.

Unit 4: Fracture Mechanics (10 Hours)
Strength of cracked bodies-Potential energy and surface energy-Griffith□s theory-Irwin-Orwinextension of Griffith□s theory to ductile materials-stress analysis of "cracked bodies-Effect of thickness on fracture toughness"-stress intensity factors for typical 'geometries.

Unit 5: Fatigue Design and Testing (10 Hours)
Safe life and Fail-safe design philosophies-Importance of Fracture Mechanics in aerospace structures-Application to composite materials and structures.

References:

- Prasanth Kumar, "Elements of fracture mechanics",Wheeter publication, 1999.
- Barrois W, Ripely, E.L., "Fatigue of aircraft structure,"Pergamon press. Oxford, 1983.

AEA 705 Projects Stage-I

AEA 705	**Project Stage-I**	**0L:0T:10P**	**5 credits**	**10Hrs/Week**

Course Outcomes:

At the end of this course students will demonstrate the ability to

- Design and validate electrical algorithms for optimum solution
- Analyze the dynamic response and the calibration of few instruments
- Build projects as per industry and society demands.

Guidelines:

- Minor Project should cater to a small system required in laboratory or real life.
- After interactions with course coordinator and based on comprehensive literature survey/need analysis, the student shall identify the title and define the aim and Preambles of Minor project.
- Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
- The student is expected to exert on design, development and testing of the proposed work as per the schedule.
- Art work and Layout should be made using CAD based PCB simulation software. Due considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design.

AEA-706 Self Study/GD/Seminar

AEA-706	**Self-Study/GD/Seminar**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

Course Preamble:

The main Preamble is to improve the mass communication and convincing/understanding skills of students and to give the students an opportunity to exercise their rights to express themselves. The evaluation will be done based on their presentation work and group discussion.

Couse Outcomes:

In terms of **content**, students will be able to

Presentation Skills

They will be able to make use of visual, audio and audio-visual material to support their presentation, and will be able to speak cogently with or without notes. Students will present either in groups or as individuals.

Discussion Skills

Students will be able to judge when to speak and how much to say, speak clearly and audibly in a manner appropriate to the subject, ask appropriate questions, use evidence to support claims, respond to a range of questions, take part in meaningful discussion

Listening Skills

Students will demonstrate that they have paid close attention to what others say and can respond constructively. Through listening attentively, they will be able to build on discussion fruitfully, supporting and connecting with other discussants. They will be able to follow academic discussions, infer meanings that are not overt, and take notes from a discussion or presentation.

Argumentative Skills and Critical Thinking

Students will develop persuasive speech, present information in a compelling, well-structured, and logical sequence, respond respectfully to opposing ideas, show depth of knowledge of complex subjects, and develop their ability to synthesize, evaluate and reflect on information.

Questioning

Through asking appropriate questions, students will demonstrate their understanding of discussions and spark further discussion.

Interdisciplinary Inquiry

Students will be able to reach across diverse disciplines to apply theories, methods and knowledge bases from multiple fields to a single question or problem.

Engaging with Big Questions

Students will engage with important questions that stimulate discussion and debate.

Studying Major Works

Students will engage with works that are widely held to be significant in the field of study, while recognizing cultural diversity and the ever-changing nature of what is regarded as important.

AEA-801 Finite Element Methods

AEA-801	Finite Element Methods	3L:0T:0P	3 Credits	3Hrs/Week

Course Preamble:

- To give exposure various methods of solution and in particular the finite element method.
- Gives exposure to the formulation and the procedure of the finite element method and its application to varieties of problems.

Couse Outcomes:

- Write flow chart of finite element steps and understand the convergence of the problem
- Solve stiffness matrix for bar, beam and frame problems using suitable boundary condition.
- Plane stress and plane strain condition are used to understand 2d structures.
- Modeling of 2d and 3d structures using isoperimetric elements
- Apply the concepts of finite element methods to solve fluid flow and heat transfer problems.

Unit 1: Introduction (10 Hours)

Review of various approximate methods – variational approach and weighted residual approach application to structural mechanics problems. finite difference methods- governing equation and convergence criteria of finite element method.

Unit 2: Discrete Elements (10 Hours)

Bar elements, uniform section, mechanical and thermal loading, varying section, 2D and 3D truss element. Beam element - problems for various loadings and boundary conditions – 2D and 3D Frame elements - longitudinal and lateral vibration. Use of local and natural coordinates.

Unit 3: Continuum Elements (10 Hours)

Plane stress, plane strain and axisymmetric problems. Derivation of element matrices for constant and linear strain triangular elements and axisymmetric element.

Unit 4: Isoperimetric Elements (10 Hours)

Definitions, Shape function for 4, 8 and 9 nodal quadrilateral elements, stiffness matrix and consistent load vector, evaluation of element matrices using numerical integration.

Unit 5 : Field Problem and Methods of Solutions (10 Hours)

Heat transfer problems, steady state fin problems, derivation of element matrices for two dimensional problems, torsion problems. bandwidth- elimination method and method of factorization for solving simultaneous algebraic equations – Features of software packages, sources of error.

Reference:

- An Introduction to the Finite Element Method, Reddy J.N., Tata McGraw-Hill, New Delhi.
- Concepts & Applications of Finite Element Analysis, Cook, Malkus, Plesha and Witt, Willey India, New Delhi.

AEA-801	**Finite Element Methods**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

List of Experiments:

- Write flow chart of finite element steps.
- Study and understand the convergence of the problem.
- Solve stiffness matrix for bar, beam and frame problems using suitable boundary condition.
- Plane stress and plane strain condition are used to understand 2d structures.
- Analysis of beams and frames (bending problems)
- Analysis of beams and frames (torsion problems)
- Nodal analysis problem.
- Heat transfer problems.
- Problems leading to analysis of three dimensional solids.
- Problems leading to analysis of axisymmetric solids.

Lab Outcome:
Student can able to do the coding for heat transfer analysis, structural analysis and make simulation for various structures.

Program Elective-V

AEA-802 (A) Avionics

AEA-802 (A)	Avionics	3L:0T:1P	3 credits	3Hrs/Week

Course Preamble:

- To introduce the basic of avionics and its need for civil and military aircrafts
- To impart knowledge about the avionic architecture and various avionics data buses
- To gain more knowledge on various avionics subsystems

Couse Outcomes:

- Ability to build Digital avionics architecture
- Ability to Design Navigation system
- Ability to design and perform analysis on air system.
- Integrate avionics systems using data buses.
- Analyze the performance of various cockpit display technologies.
- Design autopilot for small aircrafts using MATLAB

Unit1: Introduction to Avionics (10 Hours)

Need for avionics in civil and military aircraft and space systems – integrated avionics and weapon systems – typical avionics subsystems, design, technologies – Introduction to digital computer and memories.

Unit 2: Digital Avionics Architecture (10 Hours)

Avionics system architecture – data buses – MIL-STD-1553B – ARINC – 420 – ARINC – 629.

Unit 3: Flight Decks and Cockpits (10 Hours)

Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS.

Unit 4: Introduction to Navigation Systems (10 Hours)

Radio navigation – ADF, DME, VOR, LORAN, DECCA, OMEGA, ILS, MLS – Inertial Navigation Systems (INS) – Inertial sensors, INS block diagram – Satellite navigation systems – GPS.

Unit 5: Air Data Systems and Auto Pilot (10 Hours)

Air data quantities – Altitude, Air speed, Vertical speed, Mach Number, Total air temperature, Mach warning, Altitude warning – Auto pilot – Basic principles, Longitudinal and lateral auto pilot.

References:

- Middleton, D.H., Ed., "Avionics systems, Longman Scientific and Technical", Longman Group UK Ltd., England, 1989.
- Pallet.E.H.J., "Aircraft Instruments and Integrated Systems", Pearsons, Indian edition 2011.
- Spitzer, C.R. "Digital Avionics Systems", Prentice-Hall, Englewood Cliffs, N.J.,U.S.A. 1993. Spitzer. C.R. "The Avionics Hand Book", CRC Press, 2000

AEA-802 (B) Industrial Aerodynamics

AEA-802 (B)	**Industrial Aerodynamics**	**3L:0T:1P**	**3 credits**	**3Hrs/Week**

Course Preamble:

- To familiarize the learner with non-aeronautical uses of aerodynamics such as road vehicle, building aerodynamics and problems of flow induced vibrations

Couse Outcomes:

- Use of aerodynamics for non- aerodynamics such as vehicle, building.
- Solve the problems and able to analyses vibrations during flow
- Identify the Atmospheric boundary layer and applications of wind energy collectors.
- Analyze the aerodynamics of road vehicles, buildings and problems of flow induced vibrations.

Unit 1: Atmosphere (10 Hours)

Types of winds, Causes of variation of winds, Atmospheric boundary layer, Effect of terrain on gradient height, Structure of turbulent flows.

Unit 2 :Wind Energy Collectors (10 Hours)

Horizontal axis and vertical axis machines, Power coefficient, Betz coefficient by momentum theory.

Unit 3: Vehicle Aerodynamics (10 Hours)

Power requirements and drag coefficients of automobiles, Effects of cut back angle, Aerodynamics of trains and Hovercraft.

Unit 4: Building Aerodynamics (10 Hours)

Pressure distribution on low rise buildings, wind forces on buildings. Environmental winds in city blocks, Special problems of tall buildings, Building codes, Building ventilation and architectural aerodynamics.

Unit 5: Flow Induced Vibrations (10 Hours)

Effects of Reynolds number on wake formation of bluff shapes, Vortex induced vibrations, Galloping and stall flutter.

References:

- M.Sovran (Ed), "Aerodynamics and drag mechanisms of bluff bodies and Road vehicles", Plenum press, New York, 1978.
- Sachs. P., "Winds forces in Engineering", Pergamon Press, 1978.

Open Core Elective-IV

AEA 803(A) Economic Policies in India

AEA 803(A)	Economic Policies in India	3L:0T:0P	3 credits	3Hrs/Week

Course Preambles:

- The students get clear perspectives about social sciences and the subject matter of Economics.
- The students gather fundamental knowledge and information about theoretical foundations social sciences especially Economics.

Course Outcomes

On successful completion of the course, the student will:

- To enable the students to understand the theories and strategies of growth and development.
- The student becomes able to analyze individual rationality in situations of scarcity and choice

Unit –I Basic features and problems of Indian Economy: - (10 Hrs)

Nature of Indian Economy, demographic features and Human Resource Development (HDI), Problems of Poverty, Unemployment, Inflation, income inequality, Black money in India.

Unit-II Sectorial composition of Indian Economy (10 Hrs)

- Issues in Agriculture sector in India ,land reforms Green Revolution and agriculture policies of India , Industrial development , small scale and cottage industries, industrial Policy, Public sector in India, service sector in India.

Unit-III Economic Policies :- (10 Hrs)

Economic Planning in India , Planning commission v/s NITI Aayog, monetary policy in India, Fiscal Policy in India,

Unit IV Centre state Finance Relations, **(10Hrs)**

Finance commission in India. LPG policy in India.

Unit-V External sector in India: -(10Hrs)

India's foreign trade value composition and direction, India Balance of payment since 1991, FDI in India, Impact of Globalization on Indian Economy, WTO and India.

References:

- Dutt Rudder and K.P.M Sunderam (2001): Indian Economy, S Chand & Co. Ltd. New Delhi.
- Mishra S.K & V.K Puri (2001) "Indian Economy and –Its development experience", Himalaya Publishing House.
- KapilaUma: Indian Economy: Policies and Performances, Academic Foundation

AEA 803(B) Internet of Things

AEA 803(B)	Internet of Things	3L:0T:0P	3 Credits	3Hrs/Week

Course Preambles:

- To assess the vision and introduction of IoT.
- To Understand IoT Market perspective.
- To Implement Data and Knowledge Management and use of Devices in IoT Technology.
- To Understand State of the Art - IoT Architecture.
- To classify Real World IoT Design Constraints, Industrial Automation in IoT.

Course Outcomes:

On successful completion of the course, the student will:

- Understand the concepts of Internet of Things
- Analyze basic protocols in wireless sensor network
- Design IoT applications in different domain and be able to analyze their performance
- Implement basic IoT applications on embedded platform

Unit 1: Introduction to IoT - (10 Hrs)

Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs

Unit 2: IoT & M2M - (10 Hrs)

Machine to Machine, Difference between IoT and M2M, Software define Network

Unit 3 :Network & Communication (10 Hrs)

Network & Communication aspects Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination Challenges in IoT Design challenges, Development challenges, Security challenges, Other challenges

Unit 4 :Domain specific applications (6 Hrs)

Domain specific applications of IoT Home automation, Industry applications, Surveillance applications,

Unit 5: Other IoT applications (6 Hrs)

Developing IoTs Introduction to Python, Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python.

Reference:

- Vijay Madisetti, Arshdeep Bahga, “Internet of Things: A Hands-On Approach”
- Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

AEA 804 Projects Stage –II

AEA 804	**Projects Stage –II**	**0L:0T:16P**	**8 credits**	**16Hrs/Week**

Preambles:
The object of Project Work II & Dissertation is to enable the student to extend further the investigative study taken up under project stage-I, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department. The assignment to normally include:

- In depth study of the topic assigned in the light of the Report prepared;
- Review and finalization of the Approach to the Problem relating to the assigned topic;
- Preparing an Action Plan for conducting the investigation, including team work;
- Detailed Analysis/Modeling/Simulation/Design/Problem Solving/Experiment as needed;
- Final development of product/process, testing, results, conclusions and future directions;
- Preparing a paper for Conference presentation/Publication in Journals, if possible;
- Preparing a Dissertation in the standard format for being evaluated by the Department.
- Final Seminar Presentation before a Departmental Committee.

SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES

Outcome based Curriculum for

Undergraduate Degree Courses in Engineering & Technology

Department of Aeronautical Engineering

MANDATORY COURSES

Sr. No.	Course Code	Course Title	Credits	Preferred Semesters
1	MC	[Environmental Sciences, Induction Program, NSS/NCC] Constitution of India	Nil	I, III, IV,
		Total		0

Induction Program

MC	**Induction Program**	**0L:0T:0P**	**Nil**	**2Hrs/Week**

Induction program (mandatory)	**3 weeks duration** (Please refer Appendix-A for guidelines & also details available in the curriculum of Mandatory courses)
Induction program for students to be offered right at the start of the first year.	• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent People • Visits to local Areas • Familiarization to Dept./Branch & Innovations

A student has to undergo this induction program after joining the institute and before the commencement of classes. Normal classes of the engineering program shall begin after the students have undergone a three-week induction program. The Induction program for students comprises of Physical activities; Learning an art form; Literature & Cinema; Social Awareness; Lectures &Visits; Universal Human Values; Familiarization to Department/ Branch, College& Innovations.

AEA-308-NSS/NCC

AEA-308	**NSS/NCC**	**0L:0T:0P**	**Nil**	**2Hrs/Week**

Course Preamble

- To develop qualities of Character, Courage, Comradeship, Discipline, Leadership, Secular Outlook, Spirit of Adventure and the ideals of Selfless Service amongst the Youth of the Country.
- To Create a Human Resource of Organized, Trained and Motivated Youth, to Provide Leadership in all Walks of life and be always available for the Service of the Nation
- To Provide a Suitable Environment to Motivate the Youth to Take Up a Career in the Armed Forces.

Course Outcomes:

- To develop student's personality through community services
- Instilling discipline in the souls of the cadets,
- Imparting leadership, discipline, integration, adventure, military, physical and community development training

Course Content :

The National Cadet Corps (India)) was formed under NCC Act of 1948 and is open to school and college students on voluntary basis. The Cadets are given basic military training in small arms and parades. The motto of NCC is "Unity and Discipline". One week long NSS camp is organized every year where students undertake various social welfare activities like Blood Donation Camp, Tree Plantation and awareness programs on drug de-addiction, AIDS, Swine-flu and campaign for saving water and cleanliness.

Constitution of India

MC	**Constitution of India**	**0L:0T:0P**	**Nil**	**2Hrs/Week**

Unit 1: Introduction
Concept of liberty; Concept of positive and negative obligations
Unit 2: The Premises of Social Revolution
Intellectual and historical origins of the concept of Social Economic Justice in India.
Unit 3: Sixty years of civil rights movement in India:
Moderate nationalism and the emergence of the politics of socio-economic justice; Annie Besant, the Theosophical Society and the Home Rule League Movement,
Unit 4: Impact of Socialism on the Writing of the Indian Constitution [I], [1914-31]:
From the First World War to the Karachi Resolution: [a] Jawaharlal Nehru's arrival in national politics and his initiation in municipal politics; [b] The Bolshevik Revolution [1917] and its impact on growth of Indian socialism; [c] Growth and influence of Fabian socialists on Indian nationalism; [d] Commonwealth of India Bill [1925]; [e] National Demand or the Motilal Nehru Report [1927-8] and the Calcutta Congress [1928]; [f] Karachi Resolution of the Indian National Congress [1931]
Unit 5: Impact of Socialism on the Writing of the Indian Constitution [II], [1932-52]:
From the Demand for Adult Suffrage to Passing of the Constitution of India: [a] Growth of the Congress Socialist Party and the demand for the adoption of adult suffrage; [b] Panchayati Raj and empowerment in the Indian Constitution; [c] The National Plan [1938], the Bombay Plan [1944] and proposals for large-scale industrialization in India; [d] The August Offer [1940], Cripps Mission [1942] and the Cabinet Mission proposals [1946]; [e] The establishment of Indian Constituent Assembly [1946], the Indian Independence Act [1947], the working of the Constituent Assembly and the Assembly debates and the role of the Oligarchy comprising of Jawaharlal Nehru, Vallabhbhai Patel, Maulana Abul Kalam Azad and Rajendra Prasad in it; [f] Social reforms and State Security v. 'Due Process of Law'; [g] The introduction, passage and development of the Hindu Code Bill, 1956

References:

- Bagehot, Walter, An Introduction to English Legal History, [London, 1990]
- Berlin, Isaiah, Henry Hardy and Ian Harris, Liberty: Incorporating Four Essays on Liberty, [Oxford, 2002]
- Austin, Granville, The Indian Constitution: Cornerstone of a Nation, [Oxford, 1966] –, Working of a Democratic Constitution: A History of the Indian Experience, [New Delhi, 2003]
- Bagchi, Amiya Kumar, Private Investment in India, 1900-1939, [London, 1972]
- Bakshi, P.M., The Constitution of India: With Comments and Subject Index, [Delhi, 1991]
- Basu, Durgadas, Introduction to the Constitution of India, [New Delhi, 1995] –, Shorter Constitution of India, [Calcutta, 1959]
- Chandra, Bipan, [et al.], India's Struggle for Independence, [New Delhi, 1991]
- Coupland, Reginald, The Indian Problem, Three Volumes, [London, 1944]
- Dutta, Nilanjan, 'From Subject to Citizen: Towards a History of Indian Civil Rights Movement', in Michael Anderson and Sumit Guha, Changing Concepts of Rights and

Justice in South Asia, [New Delhi, 2000]

- Dhavan, Rajeev and Thomas Paul, Nehru and the Constitution, [Bombay, 1992]
- Forbes, Geraldine, Women in India, [Cambridge, 1996] Gauba, O.P., Constitutionalism in a Changing Perspective, [New Delhi, 1996]
- Mohanty, Manoranjan, 'Does India Need a New Constitution? [A Democratic Right Perspective on Constitutional Discourse]', in Surya Narayan Misra, Subhas Chandra Hazary and Amareshwar Misra, [ed.], Constitution and Constitutionalism in India, [New Delhi, 1999]

(09) Assessment

PO/Course Assesment Tools Types	PO/Course Assesment Tools	PO 1	PO 2	PO3	PO4	PO 5	PO 6	PO7	PO 8	PO9	PO10	PO11	PO 12
		Engineering Knowledge	Problem Analysis	Design/Development of Solution	Investigation	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Team Work	Communication	Project Management	Life-Long Learning
Direct Tools	Test	*	*	*	*				*		*	*	
	Assignments	*	*			*				*			
	lab /seminar/industrial training/projects(Rubrics)	*	*	*		*		*	*	*	*	*	*
Indirect Tools	Course end survey	*				*		*					
	Exit survey	*	*										*
	Faculty Survey		*	*	*			*					
	Alumni Survey	*			*		*		*	*	*		*
	Program Statistics	*			*				*			*	