

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
B.E. in Aerospace Engineering
Scheme of Teaching and Examinations 2022
 Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
 (Effective from the academic year 2023-24)

III Semester

Sl. No	Course	Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PCC	BAS301	Aero Engineering Thermodynamics	TD: AS PSB: AS	3	0	0		03	50	50	100	3
2	IPCC	BAS302	Aerospace Materials and Processes	TD: AS PSB: AS	3	0	2		03	50	50	100	4
3	IPCC	BAS303/B AE303	Fluid Mechanics	TD: AS PSB: AS	3	0	2		03	50	50	100	4
4	PCC	BAS304	Introduction to Aerospace Engineering	TD: AS PSB: AS	3	0	0		03	50	50	100	3
5	PCCL	BASL305/B AEL305	Computer Aided Aircraft Drawing	TD: AS PSB: AS	0	0	2		03	50	50	100	1
6	ESC	BAS306x	ESC/ETC/PLC	TD: AS PSB: AS	3	0	0		03	50	50	100	3
7	UHV	BSCK307	Social Connect and Responsibility	Any Department	0	0	2		01	100	---	100	1
8	AEC/ SEC	BAS358x	Ability Enhancement Course/Skill Enhancement Course - III		If the course is a Theory				01	50	50	100	1
					1	0	0						
					If a course is a laboratory				02				
0	0	2											
9	MC	BNSK359	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	0
		BPEK359	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK359	Yoga	Yoga Teacher									
Total									550	350	900	20	

<p>PCC: Professional Core Course, PCCL: Professional Core Course laboratory, UHV: Universal Human Value Course, MC: Mandatory Course (Non-credit), AEC: Ability Enhancement Course, SEC: Skill Enhancement Course, L: Lecture, T: Tutorial, P: Practical S= SDA: Skill Development Activity, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation. K : This letter in the course code indicates common to all the stream of engineering. ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course</p>			
Engineering Science Course (ESC/ETC/PLC)			
BAS306A/ BAE306A	Introduction to Drone Technology	BAS306C	Introduction to Python
BAS306B/ BAE306B	Mechanism & Machine Theory	BAS306D/ BAE306D	IOT Concepts and Algorithms
Ability Enhancement Course – III			
BAS358A/ BAE358A	Development of Soft Skills for Engineers	BAS358C	Digitalization in Aerospace Engineering
BAS358B/ BAE358B	Ethics, Technology and Engineering	BAS358D/ BAE358D	Coding Literacy
<p>Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical's of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23 may please be referred.</p>			
<p>National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.</p>			

AERO ENGINEERING THERMODYNAMICS		Semester	III
Course Code	BAS301	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		
<p>Course objectives: This course will enable students to</p> <ul style="list-style-type: none"> • Understand various concepts and definitions of thermodynamics. • Comprehend the I-law and II-law of thermodynamics. • Acquire the knowledge of various types of gas cycles. 			
<p>Teaching-Learning Process (General Instructions) These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> 1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem 3. Adoption of Project-based/Activity Based learning 4. Practising the foundational knowledge 			
Module-1			
<p>Fundamental Concepts & Definitions: Thermodynamics definition and scope, Microscopic and Macroscopic approaches. Some practical applications of engineering thermodynamic Systems, Characteristics of system boundary and control surface, examples. Thermodynamic properties; definition and Modules, intensive and extensive properties. Thermodynamic state, state point, state diagram, path and process, quasi-static process, cyclic and non-cyclic processes; Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall, thermal equilibrium, chemical equilibrium. Zeroth law of thermodynamics, Temperature; concepts, scales, fixed points and measurements.</p> <p>Work and Heat: Mechanics-definition of work and its limitations. Thermodynamic definition of work; examples, sign convention. Displacement work; as a part of a system boundary, as a whole of a system boundary, expressions for displacement work in various processes through p-v diagrams. Shaft work; Electrical work. Other types of work. Heat</p>			
Module-2			
<p>First Law of Thermodynamics: Joules experiments, equivalence of heat and work. Statement of the First law of thermodynamics, extension of the First law to non - cyclic processes, energy, energy as a property, modes of energy, pure substance; definition, two-property rule, Specific heat at constant volume, enthalpy, specific heat at constant pressure. Extension of the First law to control volume; steady state-steady flow energy equation, important applications, analysis of unsteady processes such as film and evacuation of vessels with and without heat transfer.</p>			
Module-3			

Second Law of Thermodynamics:

Devices converting heat to work; (a) in a thermodynamic cycle, (b) in a mechanical cycle. Thermal reservoir. Direct heat engine; schematic representation and efficiency. Devices converting work to heat in a thermodynamic cycle; reversed heat engine, schematic representation, coefficients of performance. Kelvin - Planck statement of the Second law of Thermodynamics; PMM I and PMM II, Clausius statement of Second law of Thermodynamics, Equivalence of the two statements; Reversible and Irreversible processes; factors that make a process irreversible, reversible heat engine, Carnot cycle, Carnot principles.

Entropy: Clausius inequality; Statement, proof, application to a reversible cycle. Entropy; definition, a property, change of entropy, principle of increase in entropy, entropy as a quantitative test for irreversibility, calculation of entropy using Tds relations, entropy as a coordinate. Available and unavailable energy.

Module-4

Pure Substances & Ideal Gases: Mixture of ideal gases and real gases, ideal gas equation, compressibility factor use of charts. P-T and P-V diagrams, triple point and critical points. Sub-cooled liquid, Saturated liquid, mixture of saturated liquid and vapour, saturated vapour and superheated vapour states of pure substance with water as example. Enthalpy of change of phase (Latent heat). Dryness fraction (quality), T-S and H-S diagrams, representation of various processes on these diagrams.

Thermodynamic relations

Maxwell's equations, Tds relations, ratio of heat capacities, evaluation of thermodynamic properties from an equation of state.

Module-5

Gas Power Cycles: Efficiency of air standard cycles, Carnot, Otto, Diesel cycles, P-V & T-S diagram, calculation of efficiency.

Vapour power cycle: Simple Rankine cycle, Analysis and performance of Rankine Cycle, Ideal and practical regenerative Rankine cycles – Reheat and Regenerative Cycles, Binary vapour cycle.

Course outcome (Course Skill Set)

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

1. Apply the concepts and definitions of thermodynamics.
2. Differentiate thermodynamic work and heat and apply I law and II law of thermodynamics to different process.
3. Apply the principles of various gas cycles.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1. A Venkatesh, "Basic Engineering Thermodynamics", Universities Press, India, 2007, ISBN 13: 9788173715877
2. P K Nag, "Basic and Applied Thermodynamics", 2nd Ed., Tata McGraw Hill Pub. 2002, ISBN 13: 9780070151314

Reference Books

1. Yunus A. Cengel and Michael A. Boles, "Thermodynamics: An Engineering Approach", Tata McGraw Hill publications, 2002, ISBN 13: 9780071072540
2. J.B. Jones and G.A. Hawkins, John Wiley and Sons, "Engineering Thermodynamics", Wiley 1986, ISBN 13: 9780471812029
3. G.J. Van Wylen and R.E. Sonntag, "Fundamentals of Classical Thermodynamics", Wiley Eastern, Wiley, 1985, ISBN 13: 9780471800149
4. Y.V.C. Rao, "An Introduction to Thermodynamics", Wiley Eastern, 1993, ISBN 13: 9788173714610.

5. B.K Venkanna, Swati B. Wadavadagi “Basic Thermodynamics”, PHI, New Delhi, 2010, ISBN 13: 978-8120341128.

Web links and Video Lectures (e-Resources):

- <https://nptel.ac.in/courses/101104067>

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

AEROSPACE MATERIALS AND PROCESSES		Semester	3
Course Code	BAS302	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	03
Examination nature (SEE)	Theory/Practical		
<p>Course objectives: This course will enable students to</p> <ul style="list-style-type: none"> • Acquire knowledge of different aerospace materials & their properties. • Understand the Heat Treatment processes of aircraft metals and alloys • Characteristics and Applications of Aluminium alloys, Ceramics, Composites and High Temperature Materials. 			
<p>Teaching-Learning Process (General Instructions) These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> 1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem 3. Adoption of Project-based/Activity Based learning 4. Practising the foundational knowledge 			
MODULE-1			
<p>Mechanical Behavior of Engineering Materials: Introduction to aerospace materials and their classification, Linear and non-linear elastic properties - Stress and Strain Curves - Yielding and strain Hardening, Toughness - Modules of resilience -- Bauchinger's effect - Effect of notches - Testing and flaw detection of materials and components, knowledge of various material testing machines</p>			
MODULE-2			
<p>Non-ferrous materials in aircraft construction: Aluminum and its alloys: Types and identification. Properties - Castings - Heat treatment processes - Surface treatments.</p> <p>Magnesium and its alloys: Cast and Wrought alloys - Aircraft application, features specification, fabrication problems, Special treatments.</p> <p>Titanium and its alloys: Applications, machining, forming, welding and heat treatment, Copper Alloys.</p> <p>Wood and fabric in aircraft construction and specifications - Glues Use of glass, plastics & rubber in aircraft, Introduction to glass & carbon composite.</p>			
MODULE-3			
<p>Ferrous materials in aircraft construction: Steels: Plain and low carbon steels, various low alloy steels, aircraft steel specifications, corrosion and heat resistant steels, structural applications.</p> <p>Maraging Steels: Properties and Applications.</p> <p>Super Alloys: Use - Nickel base - Cobalt base - Iron base - Forging and Casting of Super alloys - Welding, Heat treatment.</p>			
MODULE-4			

Ceramics and Composites: Introduction, modern ceramic materials, cermets, glass ceramic, production of semi-fabricated forms, Carbon/Carbon composites, Fabrication processes and its aerospace applications involved in metal matrix composites, polymer composites.

MODULE-5

Temperature driven Materials Characterization: Classification, production and characteristics, Methods and testing, Determination of mechanical and thermal properties of materials at elevated temperatures, Application of these materials in Thermal protection systems of Aerospace vehicles, High temperature material characterization.

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments
1	Machining by plain turning, taper turning & step turning
2	Machining by knurling operation
3	Machining by drilling and boring operation
4	Machining by internal and external thread cutting
5	Machining by eccentric turning
6	Machining by square and hexagon in shaping machine
7	Cutting of gear teeth using milling machine
8	Grinding operations using grinding machine
9	CNC Machine tool operations and processes
10	Geometric dimensioning and Tolerancing
11	Operational introduction to industrial robotics.
12	Additive Manufacturing

Course outcome (Course Skill Set)

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

- Apply the knowledge about the mechanical behaviour of different aircraft & aerospace materials.
- Explain the applications of Aluminium alloys, Ceramics and Composites Materials.
- Evaluate the importance of high temperature materials and their characterization.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.

The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks**).
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test (**duration 02/03 hours**) after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks**.
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:**Text Books**

1. Titterton G F, Aircraft Material and Processes, English Book Store, New Delhi, 5th edition, 1998, ISBN-13: 978-8175980136
2. H Buhl, Advanced Aerospace Materials, Springer, Berlin 1992, ISBN-13: 978-3540558880.

Reference Books

1. Balram Gupta, Aerospace material Vol. 1,2,3,4ARDB, S Chand & Co ,2009, ISBN-13: 978-8121922005.
2. Parker E R, Materials for Missiles and Space, McGraw-Hill Inc., US, 1963, ISBN-13: 978 0070485013
3. Hill E T, The Materials of Aircraft Construction, Pitman London.
4. C G Krishnadas Nair, Handbook of Aircraft materials, Interline publishers, Bangalore, 1993

Web links and Video Lectures (e-Resources):

- <https://nptel.ac.in/courses/112107086>.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

FLUID MECHANICS		Semester	3
Course Code	BAS303/BAE303	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	03
Examination nature (SEE)	Theory/Practical		
<p>Course objectives: This course will enable students to</p> <ul style="list-style-type: none"> • Understand the basic fluid properties. • Understand the governing laws of fluid flow. • Acquire the knowledge of types of fluid flows. 			
<p>Teaching-Learning Process (General Instructions) These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> 1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem 3. Adoption of Project-based/Activity Based learning 4. Practising the foundational knowledge 			
MODULE-1			
<p>Basic Considerations: Introduction, Dimensions- Modules and physical quantities, Continuum view of gases and liquids, Pressure and Temperature scales, Physical properties of fluids.</p> <p>Fluid Statics: Pressure distribution in a static fluid, Pressure and its measurement, hydrostatic forces on plane and curved surfaces, buoyancy, illustration by examples.</p>			
MODULE-2			
<p>Fluids in motion: Methods of describing fluid motion, types of fluid flow, continuity equation in 3 dimensions, velocity potential function and stream function. Types of motion, Source sink, doublet, plotting of stream lines and potential lines Numerical problems.</p> <p>Fluid Kinematics: Kinematics of fluid motion and the constitutive equations, Integral (global) form of conservation equations (mass, momentum, energy) and applications, Differential form of conservation equations (continuity, Navier-Stokes equations, energy equation).</p>			
MODULE-3			
<p>Fluid Dynamics: Equations of motion: Euler's and Bernoulli's equation of motion for ideal and real fluids. Momentum equation, Fluid flow measurements. Numerical problems.</p> <p>Dimensional analysis and similarity: Dimensional homogeneity, methods of dimensional analysis, model analysis, types of similarity and similitude. Dimensionless numbers. Model laws. Numerical problems.</p>			
MODULE-4			
<p>Flow past Immersed bodies: Introduction to boundary layer, boundary layer thickness, Karman's integral momentum theory, drag on a flat plate for laminar and turbulent flow, Drag on immersed bodies. Expression for drag and lift. Kutta -Joukowski theorem; Fundamentals of aerofoil theory, Numerical problems.</p>			
MODULE-5			

Compressible flow and Boundary Layers theory:

Steady, one-dimensional gas dynamics, Propagation of pressure waves in a compressible medium, velocity of sound, Mach number, Mach cone, Stagnation properties, Bernoulli's equation for isentropic flow, normal shock waves. Numerical Problem; Laminar and turbulent boundary layers.

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments
1	Calibration of Venturimeter.
2	Determination of discharge of a given Pipe Flow using Venturimeter/Orifice meter.
3	Determination of Coefficient of discharge for a small orifice by a constant head method.
4	Determination of Coefficient of discharge for a small orifice by a variable head method.
5	Determination of Viscosity of a Fluid.
6	Calibration of contracted Rectangular Notch.
7	Verification of Bernoulli's equation.
8	Pipe friction apparatus with loss of head on pipe fittings.
9	Determination of Coefficient of loss of head in a sudden contraction and friction factor.
10	Estimation of Major loss/Minor losses for a given flow system.
11	Determination of state of flow in a closed conduit using Reynolds Experiment.
12	Impact of Jet over a flat surface.

Course outcomes (Course Skill Set):

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

- Evaluate the effect of fluid properties.
- Apply the governing laws of fluid flow.
- Classify different types of fluid flows.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks**).
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test (**duration 02/03 hours**) after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks**.
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:**Books**

1. Bansal, R.K, "Fluid Mechanics and Hydraulics Machines", Laxmi Publications (P) Ltd., New Delhi 2015, ISBN-13: 978-8131808153.
2. Radhakrishnan. E, "Fluid Mechanics", Prentice-Hall of India Pvt. Ltd, 2010, ISBN 13: 9788120331839.

Reference Books

1. Yunus A. Cengel & John M Cimbala, Fluid Mechanics and Applications, McGraw Hill Education; 3rd edition, 2013, ISBN-13: 978-0073380322.
2. Ramamritham. S "Hydraulic Fluid Mechanics and Fluid Machines", Dhanpat Rai & Sons, Delhi, 1988, ISBN 13: 9788187433804.
3. Kumar. K.L., "Engineering Fluid Mechanics" (VII Ed.) Eurasia Publishing House (P) Ltd., New Delhi, 1995, ISBN 13: 9788121901000.
4. Streeter. V. L., and Wylie, E.B., "Fluid Mechanics", McGraw Hill, 1983, ISBN 13: 9780070665781

Web links and Video Lectures (e-Resources):

- <https://home.iitk.ac.in/~nikhilk/Book.pdf>
- <https://nptel.ac.in/courses/112104118>
- <https://nptel.ac.in/courses/105101082>

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

INTRODUCTION TO AEROSPACE ENGINEERING		Semester	III
Course Code	BAS304	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		
<p>Course objectives: This course will enable students to</p> <ul style="list-style-type: none"> • Understand basic principles of aviation and the history of space vehicles. • Acquire the basic knowledge of aircraft structures, aerodynamics, propulsion, materials and aircraft systems & instrumentation. • Understand the basics of space propulsion, spacecrafts and their orbits. 			
<p>Teaching-Learning Process (General Instructions) These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> 1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem 3. Adoption of Project-based/Activity Based learning 4. Practising the foundational knowledge 			
Module-1			
<p>Introduction to Aircrafts: History of aviation, International Standard atmosphere, Atmosphere and its properties, Temperature, pressure and altitude relationships, Classification of aircrafts, V/STOL machines, Modern developments in Aviation like UAV</p> <p>Introduction to Space Flight: History of Space Flight & spacecraft technologies Difference between space and atmosphere, upper atmosphere, Introduction to basic orbital mechanics, types of Orbits (LEO, MEO, Geosynchronous and Geostationary, Polar orbits), Kepler's Laws of planetary motion.</p>			
Module-2			
<p>Basic principles of flight: Significance of speed of sound, Propagation of sound, Mach number, subsonic, transonic, supersonic, hypersonic flows, Bernoulli's theorem, Aerodynamic forces and moments on an Airfoil, Lift and drag components, lift curve, drag curve, types of drag, factors affecting lift and drag; Centre of pressure and its significance, Aerodynamic centre, Aspect ratio, Airfoil nomenclature, Basic characteristics of airfoils, NACA nomenclature, Simple problems on lift and drag.</p>			
Module-3			
<p>Aircraft Propulsion: Introduction, Classification, Piston Engine & its application, Brayton cycle, Principle of operation of Turbo-prop, turbojet and turbofan engines, Introduction to ramjets and scramjets; performance characteristics.</p> <p>Rocket Propulsion: Principles of operation of rocket, Classification of Rockets, Types of rockets and typical applications, Introduction to Space Exploration.</p>			

Module-4
Aircraft Structures and Materials: Introduction, General types of construction, Monocoque, Semi-Monocoque and Geodesic structures, Typical wing and fuselage structure; Metallic and non-metallic materials for aircraft application. Aluminium alloy, titanium, stainless steel and composite materials for aerospace applications.
Module-5
Aircraft Instruments: Instrument Displays, Introduction to Navigation Instruments, Basic Air data systems & Probes, Mach meter, Air speed indicator, Vertical speed indicator, Altimeter, Gyro based instruments.
Aircraft Systems: Introduction to Hydraulic and pneumatic systems, Air Conditioning and Cockpit pressurization system, Generation and distribution of Electricity on board the airplane, Aircraft Fuel System, Fire Protection, Ice and Rain Protection System.
Course outcome (Course Skill Set)
At the end of the course the student will be able to: <ol style="list-style-type: none"> 1. Apply the basic knowledge & principles of aviation & spaceflight. 2. Apply the concepts of fundamentals of flight, basics of aircraft structures, aircraft & rocket propulsion and aircraft materials during the development of an aircraft 3. Appreciate the complexities involved during development of flight vehicles.
Assessment Details (both CIE and SEE)
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.
Continuous Internal Evaluation:
<ul style="list-style-type: none"> • For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks. • The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered • Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. • For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.
Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.
Semester-End Examination:
Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for

the course (**duration 03 hours**).

5. The question paper will have ten questions. Each question is set for 20 marks.
6. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
7. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1. John D. Anderson, "Introduction to Flight", McGraw-Hill Education, 8th edition, 2015, ISBN: 978-0078027673.
2. Lalit Gupta and O P Sharma, Fundamentals of Flight Vol-I to Vol-IV, Himalayan Books. 2006, ISBN: 9788170020752

Reference Books

1. Ian Moir, Allan Seabridge, "Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration", John Wiley & Sons, 3rd edition, 2011, ISBN: 9781119965206
2. Sutton G.P., "Rocket Propulsion Elements", John Wiley, New York, 9th edition, 2016, ISBN: 9781118753910
3. A.C. Kermode, "Flight without formulae", Pearson Education India, 5th edition, 1989, ISBN: 9788131713891
4. Nelson R.C., "Flight stability and automatic control", McGraw-Hill, 2nd edition, 1998, ISBN: 9780071158381

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc20_ae12/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

Computer Aided Aircraft Drawing		Semester	3
Course Code	BASL305/BAEL305	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2	SEE Marks	50
Credits	01	Exam Hours	100
Examination type (SEE)	Practical/Viva-Voce		
<p>Course objectives: This course will enable students to</p> <ul style="list-style-type: none"> • Understand and interpret drawings of machine and aircraft components • Prepare assembly drawings either manually or by using standard CAD packages. • Familiarize with standard components and their assembly of an aircraft. 			
Sl.NO	Experiments		
1	Sections of Solids: Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problems on axis inclinations, spheres and hollow solids). True shape of sections.		
2	Orthographic Views: Conversion of pictorial views into orthographic projections of simple machine parts with or without section. (Bureau of Indian Standards conventions are to be followed for the drawings) Hidden line conventions. Precedence of lines.		
3	Thread Forms: Thread terminology, sectional views of threads. ISO Metric (Internal & External) BSW (Internal & External) square and Acme. Sellers thread, American Standard thread.		
4	Fasteners: Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly) simple assembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, counter sunk head screw, grub screw, Allen screw.		
5	Keys & Joints: Parallel key, Taper key, Feather key, Gibhead key and Woodruff key.		
6	Riveted Joints: Single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag, using snap head rivets). Cotter joint (socket and spigot), knuckle joint (pin joint) for two rods.		
7	Couplings: Split Muff coupling, protected type flanged coupling, pin (bush) type flexible coupling, Oldham's coupling and universal coupling (Hooks' Joint)		
8	Design of propeller and hub assembly.		
9	Design of Landing Gear Assembly.		
Demonstration Experiments (For CIE)			
10	Design of UAV		
11	Design of fuselage.		
12	Design of wing.		
<p>Course outcomes (Course Skill Set): At the end of the course the student will be able to:</p> <ul style="list-style-type: none"> • Distinguish drawings of machine and aircraft components • Identify assembly drawings either manually or by using standard CAD packages. • Practise with standard components and their assembly of an aircraft. 			

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement

evaluation rubrics shall be decided jointly by examiners.

- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Suggested Learning Resources:

- <https://transport.itu.edu.tr/docs/librariesprovider99/dersnotlari/dersnotlarires112e/not/cadd-1.pdf?sfvrsn=4>

INTRODUCTION TO DRONE TECHNOLOGY		Semester	III
Course Code	BAS306A/ BAE306A	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		
<p>Course objectives: This course will enable students to</p> <ul style="list-style-type: none"> • Comprehend the basic evolution of Drones / UAV systems. • Acquire the knowledge of basic aerodynamics, performance, stability and control. • Understand the propulsion, loads and structures. • Understand Regulations and Certification aspects 			
<p>Teaching-Learning Process (General Instructions) These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> 1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem 3. Adoption of Project-based/Activity Based learning 4. Practising the foundational knowledge 			
Module-1			
<p>Basics: Introduction, History, UV types: UGV, UAV, USV, UUWV, Drones in India, Future scope. Introduction to nano drones and Swarm Drones Principles, Newton's Laws, Degrees of Freedom, Stick Movements, Flight Modes, Basic Manoeuvres, Takeoff, Pitch, Roll, Yaw, Landing.</p>			
Module-2			
<p>Components and Systems: Basic components, Micro controllers, microprocessors, Sensors, Pre-Flight Checks, Flight Planning, Transmitter, Receiver. Introduction to Arduino Sensors, Program Structures, Flight Controllers, Telemetry, Mission Planning, Camera, Binding, etc</p>			
Module-3			
<p>Air Worthiness: DGCA Rules and Regulations, Pilot Licensing requirements, NPNT Compliance. Certifications.</p>			
Module-4			
<p>Basics of Structures: Configurations, Payload Configurations, Design Considerations.</p> <p>Basics of Propulsion: Batteries, Hybrid Propulsions, IC Engines, Mini Turbines, Solar,</p>			
Module-5			
<p>Tuning, Testing, Manufacturing Constraints, Simulator Training, Applications CASE Studies: Construction and testing of a basic drone.</p>			
<p>Course outcome (Course Skill Set) At the end of the course, the student will be able to :</p> <ol style="list-style-type: none"> 1. Apply the basic concepts of UAV systems. 2. Explain the basic aerodynamics, performance, stability and control required for UAV. 3. Select the propulsion system and materials for structures. 4. Understand Regulatory and Certification aspects 5. Understand basic flight with experimentation 			

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Introduction to UAV Systems Paul Gerin, Fahlstrom, Thomas James Wiley Publication 4th Edition,2012
2. Unmanned Aerial Vehicles: DOD's Acquisition Efforts Alpha Editions.
3. Handbook of Unmanned Aerial Vehicles Valavanis, K., Vachtsevano S, George J Springer

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc22_ae15/preview
- https://onlinecourses.nptel.ac.in/noc22_ae16/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

MECHANISM & MACHINE THEORY		Semester	III
Course Code	BAS306B/ BAE306B	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		
<p>Course objectives: This course will enable students to</p> <ul style="list-style-type: none"> • Understand the theory of mechanisms including velocity, acceleration and static force analysis. • Acquire knowledge of spur gears, gear train, balancing of rotating and reciprocating masses. • Understand the concept of governors and gyroscope. 			
<p>Teaching-Learning Process (General Instructions) These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> 1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem 3. Adoption of Project-based/Activity Based learning 4. Practising the foundational knowledge 			
Module-1			
<p>Introduction to Mechanisms: Types of constrained motion, Link and its types, joints and its types, kinematic pair and its types, degrees of freedom, Grubler's criterion, Types of kinematic chains and inversions: Inversions of Four bar chain: Beam engine, coupling rod of a locomotive, Watt's indicator mechanism. Inversions of Single Slider Crank Chain: Pendulum pump or Bull engine, Oscillating cylinder engine, Rotary internal combustion engine, Crank and slotted lever quick return motion mechanism, Whitworth quick return motion mechanism. Inversions of Double Slider Crank Chain: Elliptical trammels, Scotch yoke mechanism, Oldham's coupling. Straight line motion mechanisms: Peaucellier's mechanism and Robert's mechanism. Intermittent Motion mechanisms: Geneva wheel mechanism and Ratchet and Pawl mechanism, Ackerman steering gear mechanism.</p>			
Module-2			
<p>Velocity, Acceleration and static force analysis of Mechanisms (Graphical Methods): Velocity and acceleration analysis of Four Bar mechanism, slider crank mechanism and Simple Mechanisms by vector polygons. Static force analysis: Introduction: Static equilibrium, Equilibrium of two and three force members. Members with two forces and torque. Free body diagrams, principle of virtual work. Static force analysis of four bar mechanism and slider-crank mechanism with and without friction.</p>			
Module-3			
<p>Spur Gears and Gear Trains Spur Gears: Gear terminology, law of gearing, Path of contact, Arc of contact, contact ratio of spur gear, Interference in involute gears, Methods of avoiding interference. Gear Trains: Simple gear trains, Compound gear trains, Reverted gear trains, Epicyclic gear trains, Analysis of epicyclic gear train (Algebraic and tabular methods), torques in epicyclic trains.</p>			
Module-4			

Balancing of Rotating and Reciprocating Masses

Balancing of Rotating Masses: Balancing of Several Masses Rotating in the Same Plane, Balancing of Several Masses Rotating in Different Planes (only Graphical Methods).

Balancing of Reciprocating Masses: Primary and Secondary Unbalanced Forces of Reciprocating Masses, Partial Balancing of Unbalanced Primary Force in a Reciprocating Engine, Balancing of Primary and secondary Forces of Multi-cylinder In-line Engines, Balancing of Radial Engines (only Graphical Methods)

Module-5**Governors and Gyroscope**

Governors: Types of governors; force analysis of Porter and Hartnell governors, Controlling force, stability, sensitiveness, isochronism, effort and power of Porter and Hartnell governors.

Gyroscopes: Vectorial representation of angular motion, gyroscopic couple, effect of gyroscopic couple on plane disc and aeroplane .

Course outcome (Course Skill Set)

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

1. Apply the theory of velocity, acceleration and static force analysis to design of mechanisms.
2. Design spur gears, gear train, balancing of rotating and reciprocating masses.
3. Apply governors and gyroscope.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 220B2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**).

The question paper will have ten questions. Each question is set for 20 marks.

1. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
2. The students have to answer 5 full questions, selecting one full question from each module.
3. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:**Books**

1. **Rattan S.S**, “Theory of Machines”, Tata McGraw-Hill Publishing Company Ltd., New Delhi, and 3rd edition -2009, ISBN: 007014477X, 9780070144774.
2. **J.J. Uicker, G.R. Pennock, J.E. Shigley**. “Theory of Machines & Mechanisms”, OXFORD 3rd Ed. 2009, ISBN-13: 978-0195371239

Reference Books

1. **R. S. Khurmi, J.K. Gupta**, “Theory of Machines”, Eurasia Publishing House, 2008, ISBN 13: 9788121925242.
2. **Robert L Norton**, “Design of Machinery” by McGraw Hill, 2001, ISBN-13: 978-0077421717.
3. **Ambekar**, “Mechanism and Machine theory”, PHI Learning Pvt. Ltd., 2007, ISBN 13: 9788120331341.

Web links and Video Lectures (e-Resources):

- <https://nptel.ac.in/courses/112105268>

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

INTRODUCTION TO PYTHON		Semester	III
Course Code	BAS306C	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		
<p>Course objectives: This course will enable students to</p> <ul style="list-style-type: none"> • Learn the syntax and semantics of the Python programming language. • Illustrate the process of structuring the data using lists, tuples • Appraise the need for working with various documents like Excel, PDF, Word and Others. • Demonstrate the use of built-in functions to navigate the file system. • Implement the Object Oriented Programming concepts in Python 			
<p>Teaching-Learning Process (General Instructions) These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> 1. Use https://pythontutor.com/visualize.html#mode=edit in order to visualize the python code 2. Demonstrate and visualize basic data types (list, tuple, dictionary). 3. Chalk and talk 4. Online and videos 			
Module-1			
<p>Python Basics: Entering Expressions into the Interactive Shell, The Integer, Floating-Point, and String Data Types, String Concatenation and Replication, Storing Values in Variables, Your First Program, Dissecting Your Program, Flow control: Boolean Values, Comparison Operators, Boolean Operators, Mixing Boolean and Comparison Operators, Elements of Flow Control, Program Execution, Flow Control Statements, Importing Modules, Ending a Program Early with sys. Exit (), Functions: def Statements with Parameters, Return Values and return Statements, The None Value, Keyword Arguments and print(), Local and Global Scope, The global Statement, Exception Handling, A Short Program: Guess the Number Textbook 1: Chapters 1 – 3</p>			
Module-2			
<p>Lists: The List Data Type, Working with Lists, Augmented Assignment Operators, Methods, Example Program: Magic 8 Ball with a List, List-like Types: Strings and Tuples, References, Dictionaries and Structuring Data: The Dictionary Data Type, Pretty Printing, Using Data Structures to Model Real-World Things, Textbook 1: Chapters 4 – 5</p>			
Module-3			
<p>Manipulating Strings: Working with Strings, Useful String Methods, Project: Password Locker, Project: Adding Bullets to Wiki Markup Reading and Writing Files: Files and File Paths, The os.path Module, The File Reading/Writing Process, Saving Variables with the shelve Module, Saving Variables with the print.format () Function, Project: Generating Random Quiz Files, Project: Multiclipboard, Textbook 1: Chapters 6 , 8</p>			

Module-4
<p>Organizing Files: The shutil Module, Walking a Directory Tree, Compressing Files with the zipfile Module, Project: Renaming Files with American-Style Dates to European-Style Dates, Project: Backing Up a Folder into a ZIP File,</p> <p>Debugging: Raising Exceptions, Getting the Traceback as a String, Assertions, Logging, IDLE's Debugger.</p> <p>Textbook 1: Chapters 9-10</p>
Module-5
<p>Classes and objects: Programmer-defined types, Attributes, Rectangles, Instances as return values, Objects are mutable, Copying,</p> <p>Classes and functions: Time, Pure functions, Modifiers, Prototyping versus planning,</p> <p>Classes and methods: Object-oriented features, Printing objects, Another example, A more complicated example, The init method, The __str__ method, Operator overloading, Type-based dispatch, Polymorphism, Interface and implementation,</p> <p>Textbook 2: Chapters 15 – 17</p>
<p>Course outcome (Course Skill Set)</p> <p>At the end of the course, the student will be able to :</p> <ol style="list-style-type: none"> 1. Demonstrate proficiency in handling loops and creation of functions. 2. Identify the methods to create and manipulate lists, tuples and dictionaries. 3. Develop programs for string processing and file organization 4. Interpret the concepts of Object-Oriented Programming as used in Python.
<p>Assessment Details (both CIE and SEE)</p> <p>The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.</p> <p>Continuous Internal Evaluation:</p> <ul style="list-style-type: none"> • For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks. • The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered • Any two assignment methods mentioned in the 220B2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. • For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment. <p>Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.</p> <p>Semester-End Examination:</p> <p>Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for</p>

the course (**duration 03 hours**).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Al Sweigart, “Automate the Boring Stuff with Python”, 1st Edition, No Starch Press, 2015. (Available under CC-BY-NC-SA license at <https://automatetheboringstuff.com/>) (Chapters 1 to 18, except 12) for lambda functions use this link: <https://www.learnbyexample.org/python-lambda-function/>
2. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist”, 2nd Edition, Green Tea Press, 2015. (Available under CC-BY-NC license at <http://greenteapress.com/thinkpython2/thinkpython2.pdf>) (Chapters 13, 15, 16, 17, 18) (Download pdf/html files from the above link)

Web links and Video Lectures (e-Resources):

- <https://www.learnbyexample.org/python/>
- <https://www.learnpython.org/>
- <https://pythontutor.com/visualize.html#mode=edit>

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes for list, tuple, string dictionary slicing operations using below link https://github.com/sushantkhara/Data-Structures-And-Algorithms-with-Python/raw/main/Python%203%20_%20400%20exercises%20and%20solutions%20for%20beginners.pdf

IOT CONCEPTS AND ALGORITHMS		Semester	III
Course Code	BAS306D/ BAE306D	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		
<p>Course objectives:</p> <ul style="list-style-type: none"> To apprise students with basic knowledge of IoT that paves a platform to understand physical and logical design of IOT. To introduce the technologies behind Internet of Things (IoT). To explain the students how to code for an IoT application using Arduino/Raspberry Pi open platform. To understand and apply the algorithm analysis techniques on searching and sorting Algorithms To critically analyze the efficiency of graph algorithms 			
<p>Teaching-Learning Process (General Instructions) These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> Teaching in classroom through Chalk, Talk and ICT Assignment of Home/field work on real-life problem Adoption of Project-based/Activity Based learning Practising the foundational knowledge 			
Module-1			
<p>Introduction to Internet of Things: Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT. Components in Internet of Things: Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Control Units - Communication modules (Bluetooth, Zigbee, Wifi, GPS, GSM Modules)</p>			
Module-2			
<p>Protocols and Technologies Behind IoT: IOT Protocols - IPv6, 6LoWPAN, MQTT, CoAP - RFID, Wireless Sensor Networks, Big Data Analytics, Cloud Computing, Embedded Systems.</p>			
Module-3			
<p>Open Platforms and Programming: IOT deployment for Raspberry Pi /Arduino platform-Architecture – Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.</p>			
Module-4			
<p>Introduction to Algorithms: Algorithm analysis: Time and space complexity - Asymptotic Notations and its properties Best case, Worst case and average case analysis – Recurrence relation: substitution method - Lower bounds – searching: linear search, binary search and Interpolation Search, Pattern search: The naïve string- matching algorithm - Rabin-Karp algorithm - Knuth-Morris-Pratt algorithm. Sorting: Insertion sort – heap sort</p>			
Module-5			
<p>Graph Algorithms: Graph algorithms: Representations of graphs - Graph traversal: DFS – BFS - applications - Connectivity, strong connectivity, bi-connectivity - Minimum spanning tree: Kruskal’s and Prim’s algorithm- Shortest path: Bellman-Ford algorithm - Dijkstra’s algorithm - Floyd-Warshall algorithm Network flow: Flow networks - Ford-Fulkerson method – Matching: Maximum bipartite matching</p>			

Course outcome (Course Skill Set)

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

1. Explain the concept of IoT.
2. Design portable IoT using Arduino/Raspberry Pi /open platform.
3. Apply data analytics and use cloud offerings related to IoT.
4. Analyze the efficiency of algorithms using various frameworks.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:**Books**

1. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017
2. Samuel Greengard, The Internet of Things, The MIT Press, 2015
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3rd Edition, Prentice Hall of India, 2009.
4. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran "Computer Algorithms/C++" Orient Blackswan, 2nd Edition, 2019

REFERENCES:

1. Perry Lea, "Internet of things for architects", Packt, 2018
2. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things - Key applications and Protocols", Wiley, 2012.
3. IOT (Internet of Things) Programming: A Simple and Fast Way of Learning, IOT Kindle Edition.
4. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, Pearson Education, 2012.
5. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Reprint Edition, Pearson Education, 2006.

Web links and Video Lectures (e-Resources):

- https://www.arduino.cc/https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

DEVELOPMENT OF SOFT SKILLS FOR ENGINEERS		Semester	III
Course Code	BAS358A/ BAE358A	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	01	Exam Hours	
Examination type (SEE)	Theory		
<p>Course objectives: This course will enable students to</p> <ul style="list-style-type: none"> • Understand the significance of soft skills for engineers • Acquire verbal and non-verbal communication skills • Get the essence of personal and professional leadership skills 			
<p>Teaching-Learning Process (General Instructions) These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> 1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem 3. Adoption of Project-based/Activity Based learning 4. Practising the foundational knowledge 			
Module-1			
Foundations of everyday leadership, Emotional intelligence, Leadership and collaborative abilities, Listening skills, Research and analytical skills			
Module-2			
Verbal and non-verbal communication, Stress Management and Tolerance, Email Writing, Public speaking and presentation			
Module-3			
Negotiation skills, and diffusing project conflict, managing project risks and changes, scope , time and cost management, Strategic Planning			
Module-4			
Creativity and vision, Problem-solving, writing code and cross-functional skill, digital product management			
Module-5			
Adaptability and staying positive, Applications of everyday leadership, Teamwork and people skills			
<p>Course outcome (Course Skill Set)</p> <p>At the end of the course the student will be able to:</p> <ol style="list-style-type: none"> 1. Apply soft skills for engineering profession. 2. Practise both verbal and non-verbal communication skills effectively. 3. Use personal and professional leadership skills 			
<p>Assessment Details (both CIE and SEE)</p> <p>The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.</p>			

Continuous internal Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 220B2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour**. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

OR

MCQ (Multiple Choice Questions) are preferred for 01 credit courses, however, if course content demands the general question paper pattern that followed for 03 credit course, then

1. The question paper will have ten questions. Each question is set for 10 marks.
2. There will be 2 questions from each module. Each of the two questions under a module may or may not have the sub-questions (with maximum sub-questions of 02, with marks distributions 5+5, 4+6, 3+7).
3. The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:**Books**

1. Fast-Tracking Your Career: Soft Skills for Engineering and IT Professionals 1st Edition by Wushow Chou (Author)
2. Soft Skills 3rd Edition: Personality Development for Life Success Paperback – 30 October 2021 by Prashant Sharma (Author)

Web links and Video Lectures (e-Resources):

- <https://www.ktit.pf.ukf.sk/images/clanky/Dokumenty/Desire/Softskillsforengineers.pdf>.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

ETHICS, TECHNOLOGY AND ENGINEERING		Semester	III
Course Code	BAS358B/ BAE358B	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	01	Exam Hours	
Examination type (SEE)	Theory		
<p>Course objectives: This course will enable students to</p> <ul style="list-style-type: none"> • Learn ethical values in engineering • Understand how ethics are followed in technology and engineering. • Share the ethical practices 			
<p>Teaching-Learning Process (General Instructions) These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> 1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem 3. Adoption of Project-based/Activity Based learning 4. Practising the foundational knowledge 			
Module-1			
Moral sensibility: the ability to recognize social and ethical issues in engineering			
Module-2			
Moral analysis skills: the ability to analyse moral problems in terms of facts, values, stakeholders and their interests;			
Module-3			
Moral creativity: the ability to think out different options for action in the light of (conflicting) moral values and the relevant facts;			
Module-4			
Moral judgement skills: the ability to give a moral judgement on the basis of different ethical theories or frameworks including professional ethics and common sense morality;			
Module-5			
Moral decision-making skills: the ability to reflect on different ethical theories and frameworks and to make a decision based on that reflection.			
<p>Course outcome (Course Skill Set)</p> <p>At the end of the course the student will be able to:</p> <ol style="list-style-type: none"> 1. Develop Ethical values in engineering and Technology 2. Adopt ethical practices 3. Assimilate the ethics in Engineering and Technology 			
<p>Assessment Details (both CIE and SEE)</p> <p>The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.</p>			

Continuous internal Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour**. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

OR

MCQ (Multiple Choice Questions) are preferred for 01 credit courses, however, if course content demands the general question paper pattern that followed for 03 credit course, then

1. The question paper will have ten questions. Each question is set for 10 marks.
2. There will be 2 questions from each module. Each of the two questions under a module may or may not have the sub-questions (with maximum sub-questions of 02, with marks distributions 5+5, 4+6, 3+7).
3. The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:**Books**

1. Ethics, Technology and Engineering , An Introduction- Wiley-Blackwell (an imprint of John Wiley & Sons Ltd)
2. Ethics in Engineering | 4th Edition Paperback – 1 July 2017by Mike W. Martin (Author)

Web links and Video Lectures (e-Resources):

- <https://cdn.prexams.com/6229/BOOK.pdf>
- <https://www.coursera.org/learn/ethics-technology-engineering>

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

DIGITALIZATION IN AEROSPACE ENGINEERING		Semester	III
Course Code	BAS358C	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	01	Exam Hours	
Examination type (SEE)	Theory		
<p>Course objectives: The course will enable the students to</p> <ul style="list-style-type: none"> • To become familiar with digitalization in Aerospace • To understand the importance of digitalization • To accelerate the learning of digitalization in Aerospace 			
<p>Teaching-Learning Process (General Instructions) These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> 1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem 3. Adoption of Project-based/Activity Based learning 4. Practising the foundational knowledge 			
Module-1			
Digitalisation and the Future of the Aerospace Industry, Digitization in Production, Human Factors 4.0: Requirements and challenges for humans, teams and organizations			
Module-2			
Managing Maintenance, Repair and Overhaul for Civil Aircraft, The psycho-social implications of digitalization, Collaborative Aircraft Design.			
Module-3			
The Significance of Testing concerning Maintenance of Aircraft, Maintenance in the Age of Digitalization			
Module-4			
Digital Avionics Networks, Mil-STD, Modeling and Simulation of Aerospace Systems, Digital Models			
Module-5			
Efficient Order Reduction of Parametric Models, Parametric Model Order Reduction for Structural Analysis.			
<p>Course outcome (Course Skill Set) At the end of the course the student will be able to :</p> <ol style="list-style-type: none"> 1. Apply digitalization in Aerospace 2. Implement digitalization in collaborative design, maintenance, repair and overhaul 3. Enhance the productivity thru digitalization in Aerospace 			

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous internal Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 220B2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour**. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

OR

MCQ (Multiple Choice Questions) are preferred for 01 credit courses, however, if course content demands the general question paper pattern that followed for 03 credit course, then

1. The question paper will have ten questions. Each question is set for 10 marks.
2. There will be 2 questions from each module. Each of the two questions under a module may or may not have the sub-questions (with maximum sub-questions of 02, with marks distributions 5+5, 4+6, 3+7).
3. The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:**Books**

1. Aerospace and Digitalization: A Transformation Through Key Industry 4.0 Technologies (Springer Briefs in Applied Sciences and Technology) 1st ed. 2021 Edition by Diego Carou (Author)
2. Digitalisation in Aeronautics and Space by coursera
3. Mastering The Digital World: A Guide to Understanding, Using and Exploiting Digital Media by Peter Cope

Web links and Video Lectures (e-Resources):

- <https://www.lll.tum.de/certificate/digitalisation-in-aeronautics-and-space/>
- https://www.repository.cam.ac.uk/bitstream/handle/1810/278896/CDBB_REP_002_Lamb_Final.pdf

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

CODING LITERACY		Semester	III
Course Code	BAS358D/BAE358D	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	01	Exam Hours	
Examination type (SEE)	Theory		
<p>Course objectives: The course will enable the students to</p> <ul style="list-style-type: none"> • Become literate on foundation of codes • Be familiar to the concepts of code development and operation • Understand any code's structural components 			
<p>Teaching-Learning Process (General Instructions) These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> 1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem 3. Adoption of Project-based/Activity Based learning 4. Practising the foundational knowledge 			
Module-1			
Introduction, How Computer Programming Is Changing Writing, Why is coding literacy important? devices and software, digital environments, rules of code.			
Module-2			
Core coding concepts including statement, variable, flow control, and functions through digital media, such as graphics, animation, and sound, and interaction.			
Module-3			
Coding versus programming, develop a code, read a code, run a code, find high-level logic, use/know tools, know the language/conventions, Read best practices/design patterns			
Module-4			
Code Review, Simple Codes using Java script, MATLAB, R and Python			
Module-5			
Critical thinking and evaluation, functional skills, Advanced communication, collaboration, cultural and social understanding, Capstone project using codes			
<p>Course outcome (Course Skill Set)</p> <p>At the end of the course the student will be able to:</p> <ol style="list-style-type: none"> 1. Develop literacy so as to understand any code 2. Start using the concepts of code and develop it 3. Share the literacy with others 			

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous internal Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 220B2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour**. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

OR

MCQ (Multiple Choice Questions) are preferred for 01 credit courses, however, if course content demands the general question paper pattern that followed for 03 credit course, then

1. The question paper will have ten questions. Each question is set for 10 marks.
2. There will be 2 questions from each module. Each of the two questions under a module may or may not have the sub-questions (with maximum sub-questions of 02, with marks distributions 5+5, 4+6, 3+7).
3. The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:**Books**

1. Coding Literacy: How Computer Programming Is Changing Writing (Software Studies) by Annette Vee (Author)
2. The Pragmatic Programmer: From Journeyman to Master (2nd Edition) by Andrew Hunt and David Thomas
3. Computer Programming JavaScript, Python, HTML, SQL, CSS: The step by step guide for beginners to intermediate by Willam Alvin Newton (Author), Steven Webber (Author)

Web links and Video Lectures (e-Resources):

- <https://static.realpython.com/python-basics-sample-chapters.pdf>
- <http://www.uop.edu.pk/ocontents/A%20Guide%20to%20MATLAB.pdf>
- <https://matfuvit.github.io/UVIT/predavanja/literatura/TutorialsPoint%20JavaScript.pdf>
- https://cran.r-project.org/doc/contrib/Paradis-rdebuts_en.pdf

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
B.E. in Aerospace Engineering
Scheme of Teaching and Examinations2022
 Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
 (Effective from the academic year 2023-24)

IV Semester

Sl. No	Course	Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination			Credits	
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks		Total Marks
					L	T	P	S					
1	PCC	BAS401	Mechanics of Materials	TD: AS PSB: AS	3	0	0		03	50	50	100	3
2	IPCC	BAS402/ BAE402	Aerodynamics	TD: AS PSB: AS	3	0	2		03	50	50	100	4
3	IPCC	BAS403	Aerospace Propulsion	TD: AS PSB: AS	4	0	0		03	50	50	100	4
4	PCCL	BASL404	Energy Conversion Lab	TD: AS PSB: AS	0	0	2		03	50	50	100	1
5	ESC	BAS405x	ESC/ETC/PLC	TD: AS PSB: AS	3	0	0		03	50	50	100	3
6	AEC/ SEC	BAS456x	Ability Enhancement Course/Skill Enhancement Course - IV	TD and PSB: Concerned department	If the course is a Theory				01	50	50	100	1
					1	0	0						
					If a course is a laboratory				02				
					0	0	2						
4	BSC	BBOK407	Biology For Engineers	TD/ PSB: BT, CHE,	3	0	0		03	50	50	100	3
7	UHV	BUHK408	Universal human values course	Any Department	1	0	0		01	50	50	100	1
9	MC	BNSK459	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	0
		BPEK459	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK459	Yoga	Yoga Teacher									
Total									550	350	900	20	

PCC: Professional Core Course, **PCCL:** Professional Core Course laboratory, **UHV:** Universal Human Value Course, **MC:** Mandatory Course (Non-credit), **AEC:** Ability Enhancement Course, **SEC:** Skill Enhancement Course, **L:** Lecture, **T:** Tutorial, **P:** Practical **S= SDA:** Skill Development Activity, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Evaluation. **K :** This letter in the course code indicates common to all the stream of engineering.

Ability Enhancement Course / Skill Enhancement Course - IV

BAS456A	Introduction to Programming in Matlab	BAS456C	High Temperature and Smart Materials
BAS456B/ BAE456B	DRONE Pilot Training	BAS456D	Engineering and Society

Engineering Science Course (ESC/ETC/PLC)

BAS405A	Introduction to Robotics	BAS405C/ BAE405C	Introduction to Space Technology
BAS405B	Composite Materials	BAS405D	Aircraft systems & Instrumentation

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses is mandatory for the award of degree.

MECHANICS OF MATERIALS		Semester	IV
Course Code	BAS401	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		
<p>Course objectives: This course will enable students to</p> <ul style="list-style-type: none"> • Comprehend the basic concepts of strength of materials. • Acquire the knowledge of stress, strain under different loadings. • Understand the different failure theory. 			
<p>Teaching-Learning Process (General Instructions) These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> 1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem 3. Adoption of Project-based/Activity Based learning 4. Practising the foundational knowledge 			
Module-1			
<p>Basics of linear elasticity: The concept of stress & strain, state of stress & Strain at a point, Equilibrium equations, The state of plane stress and plane strain. Compatibility equations, Constitutive Laws (Hooke's Law), Stress-strain curves for brittle and ductile materials, Allowable stress, Material selection for structural performance.</p> <p>Simple & Compound Stresses: Extension / Shortening of a bar, bars with cross sections varying in steps, bars with continuously varying cross sections. Elongation due to self-weight. Volumetric strain, expression for volumetric strain, elastic constants, simple shear stress, shear strain, temperature stresses, Introduction to Plane stress, stresses on inclined sections, principal stresses & strains, Analytical & graphical method (Mohr's Circle) to find principal stresses & strains.</p>			
Module-2			
<p>Bending Moment and Shear Force in Beams: Introduction, Types of beams, loads and reactions, shear forces and bending moments, rate of loading, sign conventions, relationship between shear force and bending moments. Shear force and bending moment diagrams for different beams subjected to concentrated loads, uniformly distributed load, (UDL) uniformly varying load (UVL) and couple for different types of beams.</p> <p>Euler-Bernoulli beam theory: The Euler-Bernoulli assumptions, Implications of the Euler-Bernoulli assumptions, the Euler-Bernoulli Beam theory derivation, Bending stress equation, Moment carrying capacity of a section. Shearing stresses in beams, shear stress across rectangular, circular, symmetrical I and T sections (Only Numerical).</p>			

Module-3
<p>Deflection of Beams: Introduction, Differential equation for deflection. Equations for deflection, slope and bending moment. Double integration method for cantilever and simply supported beams for point load, UDL, UVL and Couple. Macaulay's method.</p> <p>Torsion of Circular Shafts and Elastic Stability of Columns: Introduction. Pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts. Power transmitted by solid and hollow circular shafts.</p>
Module-4
<p>Virtual work principles: Introduction, Equilibrium and work fundamentals, Principle of virtual work, Principle of virtual work applied to mechanical systems, Principle of virtual work applied to truss structures, Principle of virtual work applied to beams. Principle of complementary virtual work, internal virtual work in beams and solids.</p> <p>Energy methods: Conservative forces, Principle of minimum total potential energy, Strain energy in springs, Strain energy in beams, Strain energy in solids, Applications to trusses, Development of a finite element formulation for trusses, Principle of minimum complementary, Energy theorems, Reciprocity theorems, Saint-Venant's principle.</p>
Module-5
<p>Mechanical Properties of materials:</p> <p>Fracture: Type I, Type II and Type III.</p> <p>Creep: Description of the phenomenon with examples. Three stages of creep, creep properties, stress relaxation.</p> <p>Fatigue: Types of fatigue loading with examples, Mechanism of fatigue, fatigue properties, fatigue testing and S-N diagram.</p>
<p>Course outcome (Course Skill Set)</p> <p>At the end of the course the student will be able to:</p> <ol style="list-style-type: none"> 1. Apply the basic concepts of strength of materials. 2. Compute stress, strain under different loadings. 3. Distinguish the different failure theories.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 220B2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:**Text Books**

1. S.S. Bhavaikatii, "*Strength of Materials*", Vikas Publications House, New Delhi, 2012, ISBN-13: 978-8125927914.
2. S. Ramamrutham, R Narayanan, "*Strength of Materials*", Dhanapath Rai Publishing Company, New Delhi, 2012, ISBN 13: 9789384378264

Reference Books

1. T.H.G Megson "*Introduction to Aircraft Structural Analysis*", Butterworth-Heinemann Publications, 2007, ISBN 13: 9781856179324
2. Beer.F.P. and Johnston.R, "*Mechanics of Materials*", McGraw Hill Publishers, 2006, ISBN-13: 978-0073380285.
3. Timoshenko and Young "*Elements of Strength of Materials*", East-West Press, 1976, ISBN 10: 8176710199.
4. O.A.Bauchau and J.I.Craig "*Structural Analysis*" Springer Dordrecht Heidelberg London New York, ISBN 978-90-481-2515-9, e-ISBN 978-90-481-2516-6

Web links and Video Lectures (e-Resources):

- <https://nptel.ac.in/courses/105106172>

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

AERODYNAMICS		Semester	4
Course Code	BAS402/ BAE402	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	03
Examination nature (SEE)	Theory/Practical		
Course objectives:			
<ul style="list-style-type: none"> • Understand the basics of fluid mechanics as a prerequisite to Aerodynamics • Acquire knowledge on typical airfoil characteristics and two-dimensional flows over airfoil and study the incompressible over finite wings • Understand the concept of compressible flow and acquire the knowledge of shocks & wave formation 			
Teaching-Learning Process (General Instructions)			
These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.			
<ol style="list-style-type: none"> 1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem 3. Adoption of Project-based/Activity Based learning 4. Practising the foundational knowledge 			
MODULE-1			
Two Dimensional Flows & Incompressible Flow Over Airfoil			
Uniform flow, Source flow, Sink flow, Combination of a uniform flow with source and sink. Doublet flow. Non-lifting flow over a circular cylinder. Vortex flow. Lifting flow over a circular cylinder. Kutta-Joukowski theorem and generation of Lift, D'Alembert's paradox, Numericals.			
Incompressible flow over airfoils: Kelvin's circulation theorem and the starting vortex, vortex sheet, Kutta condition, Classical thin airfoil theory for symmetric and cambered airfoils. Numericals.			
MODULE-2			
Incompressible Flow Over Finite Wings			
Biot-Savart law and Helmholtz's theorems, Vortex filament: Infinite and semi-infinite vortex filament, Induced velocity. Prandtl's classical lifting line theory: Downwash and induced drag. Elliptical and modified elliptical lift distribution. Lift distribution on wings. Limitations of Prandtl's lifting line theory. Extended lifting line theory-lifting surface theory, vortex lattice method for wings. Lift, drag and moment characteristics of complete airplane.			
MODULE-3			
Applications of Finite Wing Theory & High Lift Systems			
Simplified horse-shoe vortex model, formation flight, influence of downwash on tail plane, ground effects. Swept wings: Introduction to sweep effects, swept wings, pressure coefficient, typical aerodynamic characteristics, Subsonic and Supersonic leading edges. Introduction to high-lift systems, flaps, leading-edge slats and typical high - lift characteristics. Critical Mach numbers, Lift and drag divergence, shock induced separation, Effects of thickness, camber and aspect ratio of wings, Transonic area rule, Tip effects. Introduction to Source panel & vortex lattice method.			
MODULE-4			
Basics of Compressible Flow			
Basics of thermodynamics-definition and basic relation, Energy Equation- For flow and non-flow process, adiabatic energy equation, stagnation pressure, temperature, density, reference velocities, Bernoulli's equation, Effect of Mach number on Compressibility, Isentropic flow with variable area-Area ratio as a function of Mach number, Impulse function, Mass flow rate, Flow through nozzles and diffusers			
MODULE-5			

Normal, Oblique Shocks and Expansion Waves

Governing Equations of Normal Shock Wave. Prandtl relation and Rankine - Hugoniot equation. Oblique shocks and corresponding relations. Shock polar & Hodograph plane. Supersonic flow over a wedge. Supersonic compression and supersonic expansion. Detached shocks. Mach reflection. Intersection of waves of same and opposite families.

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments
1	Calibration of a subsonic wind tunnel: test section static pressure and total head distributions.
2	Smoke flow visualization studies on a two-dimensional circular cylinder at low speeds.
3	Smoke flow visualization studies on a two dimensional airfoil at different angles of incidence at low speeds.
4	Smoke flow visualization studies on a two dimensional multi element airfoil with flaps and slats at different angles of incidence at low speeds.
5	Tuft flow visualization on a wing model at different angles of incidence at low speeds: identify zones of attached and separated flows.
6	Surface pressure distributions on a two-dimensional smooth and rough circular cylinder at low speeds and calculation of pressure drag.
7	Surface pressure distributions on a two-dimensional symmetric airfoil.
8	Surface pressure distributions on a two-dimensional cambered airfoil at different angles of incidence and calculation of lift and pressure drag.
9	Calculation of total drag of a two-dimensional circular cylinder and cambered airfoil at low speeds using pitot-static probe wake survey.
10	Measurement of a typical boundary layer velocity profile on the tunnel wall (at low speeds) using a pitot probe and calculation of boundary layer displacement and momentum thickness.
11	Calculation of aerodynamic coefficients and forces acting on a model aircraft at various AOA and speeds using wind tunnel balance (With and Without Yaw).
12	Pressure measurements on airfoil for a case of reverse flow.
<p>Course outcomes (Course Skill Set): At the end of the course, the student will be able to:</p> <ul style="list-style-type: none"> • Evaluate typical airfoil characteristics and two-dimensional flows over airfoil • Compute and analyse the incompressible flow over finite wings 	

- Apply finite wing theory and design high lift systems from the aerodynamics view point
- Calculate the lift and drag & apply the flow visualization techniques.
- Estimate the pressure distribution over the bodies.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks**).
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test (**duration 02/03 hours**) after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks**.
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Books

1. **Anderson J.D**, "Fundamental of Aerodynamics", 5th edition, McGraw-Hill International Edition, New York (2011), ISBN-13: 978-0073398105.
2. **Yahya, S.M.**, "Fundamentals of Compressible flow", Wiley Eastern, 2003

Reference Books

1. **Clancy L. J.** "Aerodynamics", Sterling book house, New Delhi. (2006), ISBN 13: 9780582988804
2. **Louis M. Milne-Thomson**, "Theoretical Aerodynamics", Imported Edition, Dover Publications, USA (2011), ISBN 9780486619804.
3. **Radhakrishnan, E.**, "Gas Dynamics", Prentice Hall of India.1995 edition.
4. **E. L. Houghton, P.W. Carpenter**, "Aerodynamics for Engineering Students", 5th edition, Elsevier, New York. (2010), ISBN-13: 978-0080966328

Web links and Video Lectures (e-Resources):

- <https://www.mooc-list.com/course/16101x-introduction-aerodynamics-edx>
- <http://nptel.ac.in/syllabus/101105059/>
- <http://nptel.ac.in/courses/112105171/1>
- <http://nptel.ac.in/courses/112104118/>

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

AEROSPACE PROPULSION		Semester	4
Course Code	BAS403	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	4:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	03
Examination nature (SEE)	Theory/Practical		
<p>Course objectives: This course will enable students to</p> <ul style="list-style-type: none"> • Understand the working principles of gas turbine and ramjet propulsion systems, the design principles of inlets, combustion chambers, nozzles used in them. • Learn the operation of compressors and turbines in gas turbine propulsion systems. • Understand the operation of rocket propulsion 			
<p>Teaching-Learning Process (General Instructions) These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> 1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem. 3. Adoption of Project-based/Activity Based learning. 4. Practising the foundational knowledge. 			
MODULE-1			
<p>Introduction: Classification of power plants - Methods of aircraft propulsion – Propulsive efficiency – Specific fuel consumption - Thrust and power- Factors affecting thrust and power- Illustration of working of Gas turbine engine - Characteristics of turboprop, turbofan and turbojet , Ram jet, Scram jet – Methods of Thrust augmentation.</p>			
MODULE-2			
<p>Propeller Blade Theory: Momentum theory, Blade element theory, combined blade element and momentum theory, propeller power losses, propeller performance parameters, prediction of static thrust- and in flight, negative thrust, prop fans, ducted propellers, propeller noise, propeller selection, propeller charts</p>			
MODULE-3			
<p>Nozzles and Combustion Chamber: Subsonic and supersonic inlets – Relation between minimum area ratio and external deceleration ratio – Starting problem in supersonic inlets –Modes of inlet operation, jet nozzle – Efficiencies – Over expanded, under and optimum expansion in nozzles – Thrust reversal. Classification of Combustion chambers - Combustion chamber performance – Flame tube cooling – Flame stabilization.</p>			
MODULE-4			
<p>Compressor and Turbine: Introduction to centrifugal compressors- Axial flow compressor- geometry- twin spools- three spools- stage analysis- velocity polygons- degree of reaction – radial equilibrium theory- performance maps- axial flow turbines- geometry- velocity polygons- stage analysis- performance maps- thermal limit of blades and vanes.</p>			
MODULE-5			

Introduction to rocket propulsion: Introduction to rocket propulsion – Reaction principle – Thrust equation – Classification of rockets based on propellants used – solid, liquid and hybrid – Comparison of these engines with special reference to rocket performance – electric propulsion – classification- electro thermal – electro static – electromagnetic thrusters- geometries of Ion thrusters- beam/plume characteristics – hall thrusters.

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments
1	Study of forced convective heat transfer over a flat plate.
2	Determination of heat of combustion of aviation fuel.
3	Measurement of burning velocity of a premixed flame.
4	Combustion performance studies in a jet engine combustion chamber.
5	Study of Free Jet
6	Study of Wall jet
7	Preparation of Propellant
8	Computation of burning rate of the propellant.
9	Estimate the Calorific value of propellant
10	Measurement of Ignition delay of a single propellant with different shapes.
11	Establishing flame stability of pre-mixed flame through flame stability setup.
12	Performance study of Hybrid Motor using a thrust stand and Analysis of grain stress and strain of a solid propellant.

Course outcome:

After studying this course, students will be able to:

- Analyze the engineering concepts of air breathing propulsion systems.
- Distinguish the different types of compressors.
- Choose the propellant based on the application

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks**).
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test (**duration 02/03 hours**) after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks**.
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Text Books

1. Hill P.G. and Peterson, C.R. Mechanics and Thermodynamics of Propulsion, Pearson India, 2nd edition, 2009, ISBN-13: 978-8131729519.
2. Cohen, H. Rogers, G.F.C. and Saravanamuttoo H.I.H, Gas Turbine Theory, DORLING KINDERSLEY, 5th edition, 2002, ISBN-13: 978-8177589023.

Reference Books

1. G.C. Oates, "Aerothermodynamics of Aircraft Engine Components", AIAA Education Series, 1985, ISBN-13: 978-0915928972.
2. G.P. Sutton, "Rocket Propulsion Elements", Wiley India Pvt Ltd, 7th Edition, 2010, ISBN-13: 978-8126525775.
3. W.P. Gill, H.J. Smith & J.E. Ziurys, "Fundamentals of Internal Combustion Engines as applied to Reciprocating, Gas turbine & Jet Propulsion Power Plants", Oxford & IBH Publishing Co., 4th revised edition, 2007, ISBN-13: 978-8120417106.

Web links and Video Lectures (e-Resources):

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

ENERGY CONVERSION AND HEAT & MASS TRANSFER LAB		Semester	4
Course Code	BASL404	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2	SEE Marks	50
Credits	01	Exam Hours	100
Examination type (SEE)	Practical/Viva-Voce		
<p>Course objectives: This course will enable students to</p> <ol style="list-style-type: none"> 1. Familiarize with the flash point, fire point and viscosity of lubricating oils. 2. Study IC engine parts, opening and closing of valves to draw the valve-timing diagram. 			
Sl.NO	Experiments		
1	Determination of Flash point and Fire point of lubricating oil using Abel Pensky and Pensky Martins Apparatus.		
2	Determination of Calorific value of solid, liquid and gaseous fuels.		
3	Determination of Viscosity of lubricating oil using Torsion viscometers.		
4	Valve Timing diagram of 4-stroke IC Engine.		
5	Calculation of work done and heat transfer from PV and TS diagram using Planimeter.		
6	Performance Test on Four stroke Petrol Engine/Multi Cylinder and calculations of IP, BP, Thermal efficiencies, SFC, FP and to draw heat balance sheet.		
7	Heat transfer through natural and forced convection.		
8	Heat transfer from PIN-FIN apparatus.		
9	Determination of thermal conductivity of insulating material.		
10	Determination of overall heat transfer coefficient of a composite wall.		
11	Determination of Stefan Boltzmann constant.		
12	Determination of Critical heat flux and emissivity of a surface.		
<p>Course outcomes:</p> <p>At the end of the course the student will be able to:</p> <ul style="list-style-type: none"> • Calculate the flashpoint, calorific and viscosity values. • Analyse the performance of Four stroke and Multi cylinder engines 			

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

- The minimum duration of SEE is 02 hours

Suggested Learning Resources:

- <https://digitalcommons.calpoly.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1208&context=mesp>

Introduction to Robotics		Semester	4
Course Code	BAS405A	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	
Examination type (SEE)	Theory		
<p>Course objectives: The course will enable the students to</p> <ol style="list-style-type: none"> 1. Comprehend the mathematical representation of robots. 2. Understand the manipulators. 3. Acquire the knowledge of control, actuators and sensors. 			
<p>Teaching-Learning Process (General Instructions)</p> <p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> 1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem 3. Adoption of Project-based/Activity Based learning 4. Practising the foundational knowledge 			
Module-1			
<p>Introduction and Mathematical Representation of Robots: History of Robots, Types of Robots, Notation, Position and Orientation of a Rigid Body, Some Properties of Rotation Matrices, Successive Rotations, Euler Angles for fixed frames X- Y -Z and moving frame ZYZ. Transformation between coordinate system, Homogeneous coordinates, Properties of A/BT, Types of Joints: Rotary, Prismatic joint, Cylindrical joint, Spherical joint, Representation of Links using Denvit - Hartenberg Parameters: Link parameters for intermediate, first and last links, Link transformation matrices, Transformation matrices of 3R manipulator, PUMA560 manipulator, SCARA manipulator.</p>			
Module-2			
<p>Kinematics of Serial Manipulators: Direct kinematics of 2R, 3R, RRP, RPR manipulator, puma560 manipulator, SCARA manipulator, Stanford arm, Inverse kinematics of 2R, 3R manipulator, puma560 manipulator.</p> <p>Velocity and Static's of Manipulators: Differential relationships, Jacobian, Differential motions of a frame (translation and rotation), Linear and angular velocity of a rigid body, Linear and angular velocities of links in serial manipulators, 2R, 3R manipulators, Jacobian of serial manipulator, Velocity ellipse of 2R manipulator, Singularities of 2R manipulators, Statics of serial manipulators, Static force and torque analysis of 3R manipulator, Singularity in force domain.</p>			
Module-3			
<p>Dynamics of Manipulators: Kinetic energy, Potential energy, Equation of motion using Lagrangian, Equation of motions of one and two degree freedom spring mass damper systems using Lagrangian formulation, Inertia of a link, Recursive formulation of Dynamics using Newton Euler equation, Equation</p>			

of motion of 2R manipulator using Lagrangian Newton-Euler formulation

Trajectory Planning: Joint space schemes, cubic trajectory, Joint space schemes with via points, Cubic trajectory with a via point, Third order polynomial trajectory planning, Linear segments with parabolic blends, Cartesian space schemes, Cartesian straight line and circular motion planning

Module-4

Control: Feedback control of a single link manipulator- first order, second order system, PID control, PID control of multi link manipulator, Force control of manipulator, force control of single mass, Partitioning a task for force and position control- lever, peg in hole Hybrid force and position controller.

Actuators: Types, Characteristics of actuating system: weight, power-to-weight ratio, operating pressure, stiffness vs. compliance, Use of reduction gears, comparison of hydraulic, electric, pneumatic actuators, Hydraulic actuators, proportional feedback control, Electric motors: DC motors, Reversible AC motors, Brushless DC motors, Stepper motors- structure and principle of operation, stepper motor speed-torque characteristics

Module-5

Sensors: Sensor characteristics, Position sensors- potentiometers, Encoders, LVDT, Resolvers, Displacement sensor, Velocity sensor-encoders, tachometers, Acceleration sensors, Force and Pressure sensors piezoelectric, force sensing resistor, Torque sensors, Touch and tactile sensor, Proximity sensors-magnetic, optical, ultrasonic, inductive, capacitive, eddy-current proximity sensors.

Course outcome (Course Skill Set)

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

1. Identify the mathematical representation of robots.
2. Classify the manipulators.
3. Classify the sensors and actuators.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 220B2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:**Books**

1. Ghosal A ,Fundamental Concepts and Analysis of Robotics,Oxford,2006,ISBN-13: 978-0195673913
2. Niku, S. B ,Introduction to Robotics Analysis, Systems, Applications,.., Pearso Education, 2008
3. Craig, J. J, Introduction to Robotics: Mechanics and Control, Addison-Welsey, 2nd edition, 1989.
4. Schilling R. J ,Fundamentals of Robotics, Analysis and Control,.., PHI,1st edition, 2011,ISBN-13: 978-8120310476

Web links and Video Lectures (e-Resources):

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
 - Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

COMPOSITE MATERIALS		Semester	4
Course Code	BAS405B	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	
Examination type (SEE)	Theory		
<p>Course objectives: The course will enable the students to</p> <ol style="list-style-type: none"> 1. Understand the advantages of composite materials compared to conventional materials 2. Evaluate the properties of polymer matrix composites with fiber reinforcements 3. Explain the manufacturing process and applications of composite materials 			
<p>Teaching-Learning Process (General Instructions) These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> 1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem 3. Adoption of Project-based/Activity Based learning 4. Practising the foundational knowledge 			
Module-1			
<p>Introduction to Composite Materials: Definition, classification of composite materials, classification of reinforcement - particulate, short fiber, whiskers, long fibers composites. matrix materials – metals, ceramics, polymers (including thermoplastics and thermosets), Carbon-Carbon Composites</p> <p>Metal Matrix Composites: MMC with particulate and short fiber reinforcement, liquid and solid-state processing of MMC – stir casting, squeeze casting. Properties of MMCs, Applications of Al, Mg, Ti based MMC</p>			
Module-2			
<p>Processing of Polymer Matrix Composites: Thermoset Polymers, Hand layup Process, Vacuum Bagging Process, Post Curing Process, Filament winding, Pultrusion, Pulforming, Autoclave Process.</p> <p>Processing of Polymer Matrix Composites: Thermoplastic Polymers, Extrusion process, Injection Moulding Process, Thermo-forming process. Post Processing of Composites – Adhesive bonding, drilling, cutting processes</p>			
Module-3			
<p>Micro-Mechanical Behavior of a Lamina: Determination of elastic constants-Rule of mixtures, transformation of coordinates, micro-mechanics-based analysis and experimental determination of material constants.</p> <p>Macro-Mechanical Behavior of a Lamina: Global and local axis for angle lamina, determination of global and local stresses and moduli, for 2D-UD lamina with different fiber orientation and different fiber materials glass, carbon and aramid fiber reinforcement.</p>			
Module-4			
<p>Failure Analysis: Failure Theory – Tsai-Hill, Tsai-Wu, Max Stress and Max Strain Classical plate theory- Stress and strain variation in a laminate- Resultant forces and moments- A B & D matrices- Strength analysis of a laminate.</p>			
Module-5			

Inspection & Quality Control: Destructive & Non-Destructive Testing, Tensile, Compression, Flexural, Shear, Hardness; ultrasonic testing – A-B-C scan

Applications of Composites Materials: Automobile, Aircrafts, missiles, Space hardware, Electrical and electronics, marine, recreational and Sports equipment, future potential of composites.

Course outcome (Course Skill Set)

After studying this course, students will be able to:

1. Explain the advantages of using composite materials as an alternative to conventional materials for specific applications
2. Describe the advanced fabrication and processing for producing composite parts.
3. Evaluate the micro- and macro-mechanical behavior of composite laminates

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 220B2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:**Text Books**

1. K.K Chawla, Composite Materials- Science and Engineering, Springer Verlag, 2nd edition, 1998, ISBN: 0-387-98409-7
2. Autar Kaw, Mechanics of Composites, CRC Press, 2nd edition, 2006, ISBN: 978-0-8493-1343-1

Reference Books:

1. Mein Schwartz, Composite Materials Handbook, Vol.3, Department of Defense, USA, 2002.
2. Ajay Kapadia, Non-Destructive Testing of Composite Materials, National Composites Network, Best Practices Guide, TWI Publications, 2006.
3. R M Jones, "Mechanics of Composite Materials", 2nd Edn, Taylor & Francis, 2015; ISBN: 978-1560327127

Web links and Video Lectures (e-Resources):

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Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

INTRODUCTION TO SPACE TECHNOLOGY		Semester	4
Course Code	BAS405C/BAE405C	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	Theory		
<p>Course objectives: This course will enable students to</p> <ul style="list-style-type: none"> • Understand the fundamentals of aerospace propulsion. • Understand the orbit mechanics and orbit maneuvers. • Acquire the knowledge of satellite attitude dynamics and space mission operations. 			
<p>Teaching-Learning Process (General Instructions) These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> 1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem 3. Adoption of Project-based/Activity Based learning 4. Practising the foundational knowledge 			
Module-1			
Fundamentals of Aerospace Propulsion, Space Environment, fundamentals of solid propellant rockets, Fundamentals of liquid propellant rockets, Rocket equation, Tsiolkovsky rocket equation, Concepts of Specific Impulse.			
Module-2			
Atmospheric Re-entry: Introduction-Steep Ballistic Re-entry, Ballistic Orbital Re-entry, Skip Re-entry, "Double-Dip" Re-entry, Skip reentry, glide reentry			
Module-3			
Fundamentals of Orbit Mechanics, Orbit Manoeuvre,: Two-body motion, Basic Orbital Elements, Hohmann Transfer, Bielliptical Transfer			
Module-4			
Satellite Attitude Dynamics: Attitude Control for Spinning Spacecraft, Attitude Control for Non-spinning Spacecraft, The Yo-Yo Mechanism, Gravity – Gradient Satellite,			
Module-5			
Space Mission Operations: Supporting Ground Systems Architecture and Team interfaces, Mission phases and Core operations, Command, Planning, Tracking, Telemetry.			
<p>Course outcome (Course Skill Set)</p> <p>At the end of the course, the student will be able to :</p> <ol style="list-style-type: none"> 1. Distinguish the types of aerospace propulsion. 2. Determine the attitude of the satellites. 3. Support the space mission operations. 			

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:**Books**

1. W.E. Wiesel, "Spaceflight Dynamics", McGraw Hill, 2nd edition, 2014, ISBN-13: 978-9332901650
2. J.W. Cornelisse, "Rocket Propulsion and Space Dynamics", J.W. Freeman & Co., Ltd., London, 1982.

Reference Books

1. Vincet L. Pisacane, "Fundamentals of Space Systems", Oxford University Press, 2005.
2. J. Sellers, "Understanding Space: An Introduction to Astronautics", McGraw Hill, 2nd edition, 2000, ISBN-13: 978-0072424683
3. Francis J Hale, "Introduction to Space Flight", Pearson, 1993, ISBN-13: 978-0134819129.
4. Charies D. Brown, "Spacecraft Mission Design", AIAA education Series, 1998.
5. Meyer Rudolph X, "Elements of Space Technology for aerospace Engineers", Meyer Rudolph X, Academic Press, 1999.

Web links and Video Lectures (e-Resources):

- <https://nptel.ac.in/courses/101101079>

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

AIRCRAFT SYSTEMS & INSTRUMENTATION		Semester	4
Course Code	BAS405D	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		
<p>Course objectives: This course will enable students to</p> <ol style="list-style-type: none"> 1. Understand the aircraft control systems. 2. Understand the aircraft systems. 3. Acquire the knowledge of aircraft instruments 			
<p>Teaching-Learning Process (General Instructions) These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> 1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem 3. Adoption of Project-based/Activity Based learning 4. Practising the foundational knowledge 			
Module-1			
<p>Airplane Control Systems: Conventional Systems, fully powered flight controls, Power actuated systems, Modern control systems, Digital fly by wire systems, Auto pilot system active control Technology</p>			
Module-2			
<p>Aircraft Systems: Hydraulic systems, Study of typical workable system, components, Pneumatic systems, Advantages, Working principles, Typical Air pressure system, Brake system, Typical Pneumatic power system, Components, Landing Gear systems, Classification.</p>			
Module-3			
<p>Engine Systems: Fuel systems for Piston and jet engines, Components of multi engines. lubricating systems for piston and jet engines - Starting and Ignition systems - Typical examples for piston and jet engines.</p>			
Module-4			
<p>Auxiliary System: Basic Air cycle systems, Vapour Cycle systems, Evaporative air cycle systems, Fire protection systems, Deicing and anti-icing systems.</p>			

Module-5

Aircraft Instruments: Flight Instruments and Navigation Instruments, Gyroscope, Accelerometers, Air speed Indicators, TAS, EAS, Mach Meters, Altimeters, Principles and operation, Study of various types of engine instruments, Tachometers, Temperature gauges, Pressure gauges, Operation and Principles.

Course outcome:

After studying this course, students will be able to:

1. Distinguish the conventional and modern control systems.
2. Classify the aircraft systems.
3. Categorize different types of aircraft instruments.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 220B2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:**Text Books**

1. Ian Moir and Allan Seabridge, 'Aircraft Systems: Mechanical, Electrical and Avionics-Subsystem Integration', Wiley India Pvt Ltd, 3rd edition, 2012, ISBN-13: 978-8126535217.
2. Pallet, E.H.J., "Aircraft Instruments and Integrated Systems", Longman Scientific and Technical, 1996.
3. R.P.G. Collinson., "Introduction to Avionics Systems", Springer, 3rd edition, 2011, ISBN-13: 978-9400707078.

Reference Books

4. Lalit Gupta and OP. Sharma, 'Aircraft Systems (Fundamentals of Flight Vol. IV)', HimalayanBooks;2006.
5. Treager. S, "Gas Turbine Technology", McGraw-Hill, 3rd edition, 2013, ISBN-13: 978-1259064876.
6. R.W. Sloley and W.H. Coulthard, 'The aircraft Engineers Handbook, No 4, Instruments', 6th Edition, 2005, ISBN-13: 978-8175980518.
7. SR. Majumdar, 'Pneumatic Systems', Tata McGraw Hill Publishing Co, 1st Edition, 2001, ISBN-13: 978-0074602317.
8. William A Neese, 'Aircraft Hydraulic Systems', Himalayan Books, 2007.
9. Middleton, D.H., Ed., "Avionics Systems, Longman Scientific and Technical", Longman Group UK Ltd., England, 1989, ISBN-13: 978-0582018815.

Web links and Video Lectures (e-Resources):

- <https://nptel.ac.in/courses/101104071>

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

INTRODUCTION TO PROGRAMMING IN MATLAB		Semester	4
Course Code	BAS456A	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	01	Exam Hours	03
Examination type (SEE)	Theory		
<p>Course objectives: This course will enable students to</p> <ol style="list-style-type: none"> 1. To learn how to programme with MATLAB 2. To be familiar with programming environments of MATLAB 3. To carry lab sessions using MATLAB 			
<p>Teaching-Learning Process (General Instructions) These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> 1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem 3. Adoption of Project-based/Activity Based learning 4. Practising the foundational knowledge 			
Module-1			
Basics: Introduction, writing simple expression, Data types, MATLAB Array, Creating vectors and matrices, Operators, Properties of matrix, Replicating data to form a matrix			
Module-2			
MATLAB Graphics and Plotting: 2-Dimensional Plots, Plot Aesthetics, Multiple Plots, Subplotting.			
Module-3			
Scripts And Functions: Making simple scripts and function Files, Input and Output Arguments, Types of functions, Global and Persistent variables, Polynomial functions, Recursive Functions Common errors in Using Functions.			
Module-4			
Control Structures loops and File Handling: Conditional statements, Loops, Nested Loops, Break and Continue, File types, Handling External Files			
Module-5			
Modeling and Simulink: Creating a Simulink Model, Dealing with the Complex System Equation, Creating Sub System, Masking Subsystem, Using the Blocksets and toolbox, Development of Graphical user interface			
<p>Course outcome (Course Skill Set)</p> <ol style="list-style-type: none"> 1. Program with MATLAB 2. Develop basic to complex code in the programming environments of MATLAB 3. Modify and Maintain codes written using MATLAB 			

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

1. Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
2. Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
3. Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
4. Weightage to be given for neatness and submission of record/write-up on time.
5. Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
6. In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
7. The suitable rubrics can be designed to evaluate each student's performance and learning ability.
8. The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).
9. The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.

- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Suggested Learning Resources:

Books

1. Programming in MATLAB ®: A problem-solving approach, 1e Paperback by Patel / Mittal (Author)

Web links and Video Lectures (e-Resources):

- <https://www.mccormick.northwestern.edu/documents/students/undergraduate/introduction-to-matlab.pdf>

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

DRONE PILOT TRAINING		Semester	4
Course Code	BAS456B/ BAE456B	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	03
Examination type (SEE)	Theory		
<p>Course objectives: The course will enable the students to</p> <ul style="list-style-type: none"> Remember the basics principles and rules of flying a drone Understand the functioning of all components of drone Make and Fly the drone 			
<p>Teaching-Learning Process (General Instructions) These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> Teaching in classroom through Chalk, Talk and ICT Assignment of Home/field work on real-life problem Adoption of Project-based/Activity Based learning Practising the foundational knowledge 			
Module-1			
Regulations of DGCA , Basic Principles of Flight, ATC Procedures & Radio Telephony			
Module-2			
Fixed wing Operations/Aerodynamics, Multi rotor Operations/Aerodynamics.			
Module-3			
Weather & Meteorology , Drone equipment and maintenance , Emergency Identification & handling			
Module-4			
Payload installation & utilization, Image/video interpretation, Final Test Theory			
Module-5			
Flight Simulator training, Practical lessons in Lab, Practical flying lessons			
<p>Course outcome (Course Skill Set)</p> <p>At the end of the course the student will be able to:</p> <ol style="list-style-type: none"> Apply the principles of Drone flying Repair and Install the components of drone Judge flying conditions for Drone 			
<p>Assessment Details (both CIE and SEE)</p> <p>The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.</p> <p>Continuous internal Examination (CIE)</p> <ul style="list-style-type: none"> For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks. 			

- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 220B2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour**. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

OR

MCQ (Multiple Choice Questions) are preferred for 01 credit courses, however, if course content demands the general question paper pattern that followed for 03 credit course, then

1. The question paper will have ten questions. Each question is set for 10 marks.
2. There will be 2 questions from each module. Each of the two questions under a module may or may not have the sub-questions (with maximum sub-questions of 02, with marks distributions 5+5, 4+6, 3+7).
3. The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

Books

1. https://dgt.gov.in/sites/default/files/CTSRPA-DronePilot_CTS_NSQF-4.pdf
2. https://www.faa.gov/training_testing/testing/acs/media/uas_acs.pdf
3. <https://irp.fas.org/doddir/army/34-212.pdf>.

Web links and Video Lectures (e-Resources):

- [https://www.udemy.com/course/uasuv-drone-remote-pilot-certification-test-part-107/?utm_source=adwords&utm_medium=udemyads&utm_campaign=LongTail la.EN cc.INDIA&utm_content=deal4584&utm_term=. ag 118445032537 . ad 533094112755 . kw . de c . dm . pl . ti dsa-1212271230479 . li 9061992 . pd . &matchtype=&gclid=Cj0KCQjwvpv2TBhDoARIsALBnVnlSE-vcBq9eqdjjxQwqhUpnkk5V3mLMhYOcjdEsfCc1Kd-VtLdpUaAjFTEALw_wcB](https://www.udemy.com/course/uasuv-drone-remote-pilot-certification-test-part-107/?utm_source=adwords&utm_medium=udemyads&utm_campaign=LongTail%20la.EN%20cc.INDIA&utm_content=deal4584&utm_term=.ag%20118445032537.ad%20533094112755.kw.de%20c.dm.pl.ti.dsa-1212271230479.li%209061992.pd.&matchtype=&gclid=Cj0KCQjwvpv2TBhDoARIsALBnVnlSE-vcBq9eqdjjxQwqhUpnkk5V3mLMhYOcjdEsfCc1Kd-VtLdpUaAjFTEALw_wcB)
- <https://www.youtube.com/watch?v=ixYnzcZZu9g>

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

HIGH TEMPERATURE AND SMART MATERIALS		Semester	4
Course Code	BAS456C	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:1	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	01	Exam Hours	01
Examination type (SEE)	Theory		
Course objectives:			
<ol style="list-style-type: none"> 1. Understand the different types of high temperature materials 2. Select the materials for suitable applications. 3. Get basic knowledge about the smart materials. 			
Teaching-Learning Process (General Instructions)			
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.			
<ol style="list-style-type: none"> 1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem 3. Adoption of Project-based/Activity Based learning 4. Practising the foundational knowledge 			
Module-1			
Introduction to composite materials, Polymer matrix composites, Specialty composites, Carbon-Carbon composites, Nanocomposites			
Module-2			
Carbon based materials, Ceramic materials, Metallic materials, High temperature polymers			
Module-3			
Materials for space environment: Radiation shielding materials, Atomic oxygen resistant materials, Space suit materials and materials for life support systems			
Module-4			
Smart materials and structures: System intelligence- components and classification of smart structures, common smart materials and associated stimulus-response, Application areas of smart systems			
Module-5			
Smart systems for space applications: Elastic memory composites, Smart corrosion protection coatings, Self-healing materials, Sensors, Actuators, Transducers, MEMS, Deployment devices, Molecular machines			
Course outcome (Course Skill Set)			
At the end of the course the student will be able to:			
<ol style="list-style-type: none"> 1. Identify the different types of high temperature materials 2. Apply the materials for suitable applications 3. Appreciate the use of smart materials. 			

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous internal Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 220B2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour**. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

OR

MCQ (Multiple Choice Questions) are preferred for 01 credit courses, however, if course content demands the general question paper pattern that followed for 03 credit course, then

1. The question paper will have ten questions. Each question is set for 10 marks.
2. There will be 2 questions from each module. Each of the two questions under a module may or may not have the sub-questions (with maximum sub-questions of 02, with marks distributions 5+5, 4+6, 3+7).
3. The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:**Books**

1. R.M. Jones, Mechanics of Composites, 2nd ed., Taylor & Francis, 1999.
 2. T. G. Gutowski, (Ed.) Advanced Composites Manufacturing, John Wiley & Sons, New York 1997
 3. G. Savage, Carbon-Carbon Composites, 1st ed., Chapman and Hall, 1993.
 4. M. Scheffler, P. Colombo, Cellular Ceramics, Structure, Manufacturing, properties and Applications, 1st ed., Wiley-VCH, 2006.
 5. D.J. Leo, Engineering Analysis of Smart Material Systems, Wiley 2007.
 6. M. Addington, D.L. Schodek, Smart Materials and New Technologies in Architecture, Elsevier 2005
- Brian Culshaw, Smart Structures and Materials, Artech House, 2000

Web links and Video Lectures (e-Resources):

- <https://nptel.ac.in/courses/113105081>

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

ENGINEERING AND SOCIETY		Semester	III
Course Code	BAS456D	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	01	Exam Hours	03
Examination type (SEE)	Theory		
<p>Course objectives: By exploring links between the engineering profession and society, students will develop a clearer understanding of what it means to be a responsible and ethical professional in a technical field. Students will also further develop their communication skills, learning to present technical material and document their sources for multiple audiences.</p>			
<p>Teaching-Learning Process (General Instructions) These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> 1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem 3. Adoption of Project-based/Activity Based learning Practising the foundational knowledge 			
Module-1			
Course Introduction and Definitions, Descriptions, Mechanism and Process			
Module-2			
Instructions and Visuals, Engineering as Social Experimentation			
Module-3			
Presentations and Summaries, Commitment to Safety			
Module-4			
Proposals and Documentation, Global Issues			
Module-5			
Ethics Presentations, Workplace Rights and Responsibilities			
<p>Course outcome (Course Skill Set) At the end of the course the student will be able to:</p> <ol style="list-style-type: none"> 1. Identify the responsibilities. 2. Apply the ethics in the professional field. 			

3. Enhance their skills.

Assessment Details (both CIE and SEE)

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Continuous internal Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
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- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
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Semester End Examinations (SEE)

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OR

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3. The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:**Books****REFERENCES:**

1. Schinzinger and Martin, Introduction to Engineering Ethics, McGraw Hill, 2000
2. Finkelstein, Pocket Book of Technical Writing for Engineers and Scientists, 2 nd Ed., McGraw Hill, 2005

Web links and Video Lectures (e-Resources):

<http://onlineethics.org/>
<http://www.nspe.org/Ethics/CodeofEthics/index.html>
<http://www.writing.engr.psu.edu/>

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

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