RV Educational Institutions ®
RV College of Engineering ®

Autonomous Institution Affiliated to Visvesvaraya Technological University, Belagavi

Approved by AICTE, New Delhi

Go, change the world

Bachelor of Engineering (B.E)

Scheme and Syllabus of VII & VIII Semesters

2018 SCHEME

AEROSPACE ENGINEERING

2021-2022

VISION

Leadership in Quality Technical Education, Interdisciplinary Research & Innovation, with a Focus on Sustainable and Inclusive Technology

MISSION

1. To deliver outcome based Quality education, emphasizing on experiential learning with the state of the art infrastructure.
2. To create a conducive environment for interdisciplinary research and innovation.
3. To develop professionals through holistic education focusing on individual growth, discipline, integrity, ethics and social sensitivity.
4. To nurture industry-institution collaboration leading to competency enhancement and entrepreneurship.
5. To focus on technologies that are sustainable and inclusive, benefiting all sections of the society.

QUALITY POLICY

Achieving Excellence in Technical Education, Research and Consulting through an Outcome Based Curriculum focusing on Continuous Improvement and Innovation by Benchmarking against the global Best Practices.

CORE VALUES

Professionalism, Commitment, Integrity, Team Work, Innovation

RV COLLEGE OF ENGINEERING®

(Autonomous Institution Affiliated to VTU, Belagavi)
R.V. Vidyaniketan Post, Mysore Road
Bengaluru – 560 059

Bachelor of Engineering (B.E.)
Scheme and Syllabus of VII & VIII Semesters

2018 SCHEME

DEPARTMENT OF
AEROSPACE ENGINEERING

DEPARTMENT VISION

Emerge as a centre of excellence in Aerospace Engineering, Imparting Quality Technical Education, Interdisciplinary Research & Innovation with a focus on Societal empowerment through Sustainable & Inclusive Technologies.

DEPARTMENT MISSION

- Imparting Quality Technical Knowledge in Basic & Applied areas of Aerospace Engineering incorporating the principles of Outcome Based Education.
- Provide state-of-the art laboratories and infrastructure facilities, conducive to motivate Interdisciplinary Research and Innovation in Aerospace Engineering.
- Develop self-motivated engineers with a blend of Discipline, Integrity, Engineering Ethics and Social Responsibility.
- Strengthening collaboration with industries, research organizations and institutes for Internships, Joint Research and Consultancy.
- Focus towards Integrating Sustainable and Inclusive Technologies for Societal Symbiosis.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: To provide opportunities for successful professional career with a sound fundamental knowledge in Mathematics, Physical Science & Aerospace Engineering.

PEO2: Motivate innovative research in specialized areas of Aerospace Engineering viz Aerospace structural design, Aerodynamics, Aerospace Propulsion and Guidance & Control systems.

PEO3: Promoting development of problem solving abilities by adopting analytical, numerical and experimental skills with awareness on societal impact.

PEO4: Imbibing sound communication skills, team working ability, professional ethics and zeal for lifelong learning.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO	Description
PSO1	Utilization of the fundamental knowledge and skills of Aerospace Engineering to develop pragmatic solutions for complex Aerospace Engineering problems.
PSO2	Apply Professional Engineering practices and strategies in the development of systems and subsystems for Aerospace Applications.
PSO3	Exhibit Effective Communication skills and a Zeal to function with multi-disciplinary teams
PSO4	Demonstrate Professional Ethics and Responsibilities in Engineering practices towards the achievement of societal symbiosis.

ABBREVIATIONS

Sl. No.	Abbreviation	Meaning
1.	VTU	Visvesvaraya Technological University
2.	BS	Basic Sciences
3.	CIE	Continuous Internal Evaluation
4.	SEE	Semester End Examination
5.	PE	Professional Core Elective
6.	GE	Global Elective
7.	HSS	Humanities and Social Sciences
8.	CV	Civil Engineering
9.	ME	Mechanical Engineering
10.	EE	Electrical & Electronics Engineering
11.	EC	Electronics & Communication Engineering
12.	IM	Industrial Engineering & Management
13.	EI	Electronics & Instrumentation Engineering
14.	CH	Chemical Engineering
15.	CS	Computer Science & Engineering
16.	TE	Telecommunication Engineering
17.	IS	Information Science & Engineering
18.	BT	Biotechnology
19.	AS	Aerospace Engineering
20.	PY	Physics
21.	CY	Chemistry
22.	MA	Mathematics

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RV COLLEGE OF ENGINEERING®

(Autonomous Institution Affiliated to VTU, Belagavi)

AEROSPACE ENGINEERING

SEVENTH SEMESTER CREDIT SCHEME							
Sl. No	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			**Total Credits**
				L	**T**	**P**	
1.	18HS71	Constitution of India & Professional Ethics	HSS	3	0	0	**3**
2.	18AS72	Aircraft Performance and Stability	AS	3	0	0	**3**
3.	18AS73	Vibration Engineering (Theory & Practice)	AS	3	0	1	**4**
4.	18AS74	Internship*	AS	0	0	2	**2**
5.	18AS75	Aircraft Systems and Instrumentation (Theory & Practice)	AS	3	0	1	**4**
6.	18AS7FX	Elective F (PE)	AS	3	0	0	**3**
7.	18AS7GX	Elective G (PE)	AS	3	0	0	**3**
8.	18G7HXX	Elective H (GE)**	Res. BoS	3	0	0	**3**
Total Number of Credits				**21**	**0**	**4**	**25**
Total number of Hours/Week				**21**	**0**	**5+5**	

Note:

- * Internship (6 weeks) is to be carried during the vacation after 6th semester and evaluation shall be conducted during 7th semester for 2 credits.
- ** Students should take other department Global Elective courses.

EIGHTH SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			**Total Credits**
				L	**T**	**P**	
1	18ASP81	Major Project	AS	0	0	16	16
Total Number of Credits							**16**
Total number of Hours/Week				**0**	**0**	**32**	

VII Semester			
PROFESSIONAL ELECTIVES (GROUP F)			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1.	18AS7F1	Fatigue & Fracture Mechanics	03
2.	18AS7F2	Systems Engineering	03
3.	18AS7F3	Space Dynamics	03
4.	18AS7F4	Optical Fibre Communication	03

VII Semester			
PROFESSIONAL ELECTIVES (GROUP G)			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1.	18AS7G1	Hypersonic Aerodynamics	03
2.	18AS7G2	Theory of Aeroelasticity	03
3.	18AS7G3	Rotorcraft Dynamics	03
4.	18AS7G4	Aircraft Maintenance, Repair & Overhaul	03
5.	18AS7G5	Advanced Avionics	03

VII Semester				
GLOBAL ELECTIVES (GROUP H)				
Sl. No.	**Course Code**	**Host**	**Course Title**	**Page No.**
1.	18G7H01	AS	Unmanned Aerial Vehicles	31
2.	18G7H02	BT	Bioinformatics	33
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15.	18G7H15	HSS	Applied Psychology for Engineers	60
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Semester: VII						
CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS (Common to All Programs)						
Course Code	**:**	**18HS71**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Apply the knowledge of constitutional literacy to become aware of the fundamental rights and duties in their role as Engineers.
2	Understanding of ethical and legal aspects of advertising, consumer problems and their redressal mechanism related to product and service standards.
3	Discuss the knowledge of substantive Labor law and to develop skills for legal reasoning and statutory interpretations.
4	Evaluate individual role, responsibilities and emphasize on professional/ engineering ethics in shaping professions.

Unit - I	**10 Hrs**
Indian Constitution- Salient features of Indian Constitution ,Preamble to the Constitution of India; Provisions Relating to Citizenship in India- at the Commencement of the Constitution and Later with latest amendments, Modes of Acquisition and Termination of Citizenship of India. Scope & Extent of Fundamental Rights-Articles 14-32 with case studies; Right to Information Act, 2005 with Case studies.	
Unit – II	**10 Hrs**
Directive Principles of State Policy- Significance of Directive Principles of State Policy, Fundamental Duties in the Constitution of India; Union Executive- President and State Executive-Governor; Parliament & State Legislature; Council of Ministers; Anti-defection law; Union and State Judiciary; Emergency provisions; Elections, Administrative tribunals. Human Rights & Human Rights Commission.	
Unit –III	**06 Hrs**
Consumer Protection Law - Definition and Need of Consumer Protection; Consumer Rights under the Consumer Protection Act, 2019; Unfair Trade Practice, Defect in goods, Deficiency in services; Product liability and Penal Consequences, False and Misleading Advertisement, E-Commerce**,** Alternate dispute Redressal mechanism**;** Redresses Mechanisms under the Consumer Protection Act, 2019. **An overview of Indian Penal Code 1860 (Law Of Crimes)**	
Unit – IV	**06 Hrs**
Introduction to Labour Legislations - Industrial Relation, Labour Problem and Labour Policy in India; Labour Welfare and Social Security- Factories Act, 1948, Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013; the Child Labour (Prohibition and Regulation) Act, 1986, Maternity Benefit (Amendment) Act, 2017; Industrial Dispute Act, 1947, Reference of Disputes to Boards, Courts or Tribunals.	
Unit –V	**07 Hrs**
Scope and aims of engineering ethics (NSPE Code of Ethics), Responsibility of Engineers, Impediments to responsibility. Honesty, Integrity and reliability, Risks, Safety and Liability in Engineering. Corporate Social Responsibility. Statutory Provision regarding prohibition and prevention of Ragging.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Demonstrate the citizen's fundamental Rights, duties & consumer responsibility capability and to take affirmative action as a responsible citizen.
CO2	Identify the conflict management in legal perspective and judicial systems pertaining to

	professional environment, strengthen the ability to contribute to the resolve of human rights & Ragging issues and problems through investigative and analytical skills.
CO3	Understanding process of ethical and moral analysis in decision making scenarios and inculcate ethical behavior as a trait for professional development.
CO4:	Apply the knowledge to solve practical problems with regard to personal issues & business Enterprises.

Reference Books	
1	Dr. J. N Pandey, Constitutional Law of India, Central Law Agency, 2020 edition
2	Avtar Singh: Law of Consumer Protection: Principles and Practice, Eastern Book Company, 5th Edition, 2015, ISBN -13:978-9351452461
3	S.C. Srivastava: Industrial Relation and Labour Laws, Vikas Publishing House, 6th Edition, 2012, ISBN: 9789325955400
4	Jr. Charles E Harris, Michael. S. Pritchard and Michael J Rabins, Engineering Ethics, Wadsworth Cengage Learning, 5th Edition, 2009, ISBN-978-0495502791

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20. **Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.**

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	-	-	-	-	-	-	-	1	-	1
CO2	3	2	2	1	-	-	-	-	-	1	-	1
CO3	3	3	2	2	-	-	-	-	-	1	-	1
CO4	3	3	3	3	-	-	-	-	-	1	-	1

High-3: Medium-2 : Low-1

Semester: VII						
AIRCRAFT PERFORMANCE AND STABILITY (Theory)						
Course Code	**:**	**18AS72**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**3:0:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: To enable the students to:	
1	State different parameters associated with airplane and their performance
2	Understand and Explain the terminologies related to steady performance of airplanes
3	Describe the effect of static longitudinal stability on the performance of propeller and jet planes
4	Derive conclusions on performance of airplanes subjected to dynamic longitudinal instability
5	Understand and explain the concept of Dynamic Lateral and Directional Stability

Unit-I	**08 Hrs**
Elements of Aircraft Performance-I: Equation of motion, Thrust required for level un accelerated flight, Thrust available and maximum velocity, Power required for level un accelerated flight and power available and maximum velocity-piston prop and Jet engine, Altitude effects, Rate of Climb, Gliding flight, Absolute and service ceilings, Time to climb.	
Unit -II	**08 Hrs**
Elements of Aircraft Performance-II: Range and Endurance-Propeller and Jet driven airplane, Take-off and landing Performance, Turning Flight and V-n Diagram, Accelerated Rate of climb. **Static Longitudinal Stability:** Equilibrium conditions, Definition of static stability, Definition of longitudinal static stability, stability criteria, Contribution of airframe components: Wing contribution, Tail contribution, Fuselage contribution, Power effects- Propeller airplane and Jet airplane.	
Unit -III	**08 Hrs**
Static Longitudinal Stability and control Stick-Fixed: Trim Condition, Static Margin, Stick Fixed Neutral Point, Longitudinal control, Elevator Power, Elevated Angle vs. Equilibrium Lift Coefficient, Elevator required for Landing and Restrictions on Forward CG range. **Static Longitudinal Stability and control Stick-Free:** Hinge Moment Parameters, Control Surface Floating Characteristics, Trim Tabs, Stick Force Gradient, Stick Free Neutral Point, Restrictions on Aft CG. Balancing Methods.	
Unit -IV	**07 Hrs**
Static Directional Stability and Control: Definitions, Static Directional Rudder Fixed, Rudder Power, Stick Free Directional Stability, Rudder Directional Control, Rudder Lock and Dorsal Fin **Static Lateral Stability and Control:** Definition of Roll Stability, Estimation of Dihedral Effect, Effect of Wing Sweep Flap and Power, Lateral Control and Aileron Balancing.	
Unit -V	**08 Hrs**
Dynamic Stability: Definitions of Longitudinal, Lateral and Dynamic Lateral Stability, Basics of Phugoid Motion & Short Period Motion (Without Derivation), Airplane Equations of Motion, Aerodynamic Forces and Moments Representation. **Dynamic Derivatives and Stability Criteria:** Due to Forward Speed, Pitching Velocity, Change of Angle of Attack, Roll and Yaw Rate, Flying qualities in pitch, Cooper-Harper Scale. Dutch roll and Spiral instability, Auto-rotation and Spin, Coupling between Rolling and Yawing Moment, Adverse Yaw Effects, Aileron Reversal. Roll-Pitch-Yaw Inertial Coupling.	

Course Outcomes: At the end of this course the student will be able to :	
CO1:	Estimate and Evaluate the Performance of propeller powered and Jet powered airplane
CO2:	Analyse the static stability characteristics of the airplane
CO3:	Understand and Analyse Dynamic stability conditions for the longitudinal, lateral and directional stability of aircrafts
CO4:	Design the aircraft components based on performance stability requirements

Reference Books	
1	Introduction to Flight, J D Anderson Jr, 5th Edition, 2005, McGraw-Hill Book Co., ISBN-9780072990713
2	Flight Stability and Automatic Control, Nelson, R.C., 2nd Edition, 1997, McGraw-Hill Book Co., ISBN-978-0070462731
3	Performance, Stability, Dynamics and Control of Airplanes, Bandu N. Pamadi, 2nd Edition Series, 2004, AIAA ISBN- 978-1563475832
4	Airplane Performance stability and Control, Perkins, C.D and Hage, R.E., 2nd Edition, 1988,John Wiley Son Inc, New York, ISBN- 978-0471680468
5	Dynamics of Flight Stability and Control, Bernard Etkin, 2nd Edition, 1982, John Wiley & Sons ISBN- 978-047103418

Scheme of Evaluation

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Assignment/Presentation/Project (A). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for Assignment/Presentation/Project is 10.

Total CIE is 30(Q) +50(T) +10(A) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**	**2**	**1**	**2**	**-**	**1**	**2**	**2**	**-**	**-**	**1**
CO2	**3**	**3**	**2**	**1**	**2**	**-**	**1**	**2**	**3**	**-**	**-**	**1**
CO3	**3**	**3**	**2**	**1**	**2**	**-**	**1**	**2**	**3**	**-**	**-**	**1**
CO4	**3**	**3**	**2**	**1**	**2**	**-**	**1**	**2**	**3**	**1**	**1**	**1**

High-3 : Medium-2: Low-1

Semester: VII						
VIBRATION ENGINEERING (Theory & Practice)						
Course Code	**:**	**18AS73**		**CIE**	**:**	**100+50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100 +50 Marks**
Hours	**:**	**39L+32.5P**		**SEE Duration**	**:**	**3.00+3.00 Hours**

Course Learning Objectives: To enable the students to:	
1	Understand and classify the principle of vibrations
2	Analyse and solve the problems associated with damped and un-damped free vibrations
3	Evaluate and study the response of mechanical systems for different types of excitation.
4	Evaluate the behaviour of two degrees of freedom and multi degrees of freedom system using different methodologies.

Unit-I	**08 Hrs**
Introduction: Types of vibrations, Definitions, Derivations for spring mass systems, Simple Harmonic Motion (S.H.M.), Work done by harmonic force, Principle of super position applied to SHM, Beats phenomenon, Fourier series applied to vibration problems, Numerical on Fourier series, superposition of SHM and beats.	
Unit – II	**08 Hrs**
Damped and Undamped Vibrations: Methods of Analysis, Natural frequencies of simple systems, Springs in series and parallel, Torsional and transverse vibrations and Problems. Derivations for over, critical and under damped systems, Logarithmic decrement and Problems.	
Unit -III	**08 Hrs**
Forced Vibrations (1DOF): Introduction, Analysis of forced vibration with constant harmonic excitation - Magnification factor, rotating and reciprocating unbalances, excitation of support (relative and absolute amplitudes), force and motion transmissibility, Energy dissipated due to damping and Problems.	

Unit -IV	**08 Hrs**
Systems with two degrees of Freedom: Principle modes of vibrations, Normal mode and natural frequencies of systems (without damping) – Masses on tightly stretched strings, double pendulum, torsional systems, combined rectilinear and angular systems, Undamped dynamic vibration absorber and Problems.	
Unit -V	**07 Hrs**
Numerical Methods for multi degree freedom of systems: Introduction, Maxwell's reciprocal theorem, Influence coefficients, Rayleigh's method, Dunkerley's method, Stodola method, Holzer's method, Orthogonality of principal modes.	

LABORATORY EXPERIMENTS
1. Free Vibration of Single Degrees of freedom System 2. Forced Vibration of Single Degrees of Freedom System 3. Vibration Behaviour of Single Pendulum 4. Laplace Solution for Single DOF 5. Laplace Solution for MDOF 6. Response of MDOF system using ODE 45 7. Response of MDOF using State Space approach 8. Modal Response Analysis of MDOF 9. Base excitation of MDOF system 10. Response of rotating masses 11. Random and Shock test using electro dynamic shaker 12. Sine sweep testing on cantilever plate

Course Outcomes: At the end of this course the student will be able to :	
CO1:	State and classify the principle of vibrations
CO2:	Analyse and solve the problems associated with damped and un-damped vibrations
CO3:	Demonstrate the effect of external excitation on a 1D system and identify their critical parameters
CO4:	Evaluate a Multi DOF system for modes of vibration and appreciate the effect of dampers

Reference Books	
1	Mechanical Vibrations, Singiresu S. Rao,6th Edition, 2003, Pearson, ISBN: 978-0134361307
2	Principles of Vibration, Benson H Tongue, 2nd Edition, 2002, Oxford University Press, ISBN: 978-0195106619
3	Theory of Vibration with Applications, Thomson, W.T., 5th Edition, 28 August 1997, Pearson , 978-0136510680
4	Fundamentals of Mechanical Vibrations, Kelly, Har/Dsk Edition, 2000, McGraw Hill Publications, ISBN: 978-0079116611

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.
Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Scheme of Continuous Internal Evaluation (CIE); Practical Test for 50 Marks
The Laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average marks (AM) over number of weeks is considered for 30 marks. At the end of the semester a test (T) is conducted for 10 marks. The students are encouraged to implement additional innovative experiments (IE) in the lab and are rewarded for 10 marks. Total marks for the laboratory is 50.
Total CIE is 30(AM) +10 (T) +10 (IE) =50 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part A and Part B. Part A consists of objective type questions for 20 marks covering the complete syllabus. Part B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

Scheme of Semester End Examination (SEE); Practical Exam for 50 Marks
SEE for the practical courses will be based on experiment conduction with proper results, is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

Semester End Evaluation (SEE): Theory (100 Marks) + Practical (50 Marks) = Total 150 Marks

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**	**3**	**3**	**1**	**3**	**1**					**2**
CO2	**3**	**3**	**3**	**3**	**1**							**2**
CO3	**2**	**2**	**3**	**3**								**1**
CO4	**3**	**3**	**3**	**3**		**1**	**2**					**1**

High-3 : Medium-2: Low-1

SEMESTER : VII						
INTERNSHIP						
Course Code	**:**	**18AS74**		**CIE Marks**	**:**	**50**
Credit L:T:P	**:**	**0:0:2**		**SEE Marks**	**:**	**50**
Hours/week	**:**	**4**		**SEE Duration**	**:**	**3.00 Hours**

GUIDELINES

1) The duration of the internship shall be for a period of 6/8 weeks on full time basis after IV semester final exams and before the commencement of VII semester.
2) The student must submit letters from the industry clearly specifying his / her name and the duration of the internship on the company letter head with authorized signature.
3) Internship must be related to the field of specialization of the respective UG programme in which the student has enrolled.
4) Students undergoing internship training are advised to report their progress and submit periodic progress reports to their respective guides.
5) Students have to present the internship activities carried out to the departmental committee and only upon approval by the committee, the student can proceed to prepare and submit the hard copy of the final internship report. However, interim or periodic reports as required by the industry / organization can be submitted as per the format acceptable to the respective industry /organizations.
6) The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be Ivory color for UG circuit Programs and Light Blue for Non-Circuit Programs.
7) The broad format of the internship final report shall be as follows
    - Cover Page
    - Certificate from College
    - Certificate from Industry / Organization
    - Acknowledgement
    - Synopsis
    - Table of Contents
    - Chapter 1 - Profile of the Organization: Organizational structure, Products, Services, Business Partners, Financials, Manpower, Societal Concerns, Professional Practices,
    - Chapter 2 - Activities of the Department
    - Chapter 3 - Tasks Performed: summaries the tasks performed during 8-week period
    - Chapter 4 – Reflections: Highlight specific technical and soft skills that you acquired during internship
    - References & Annexure

Course Outcomes:

After going through the internship the student will be able to:

CO1: Apply engineering and management principles
CO2: Analyze real-time problems and suggest alternate solutions
CO3: Communicate effectively and work in teams
CO4: Imbibe the practice of professional ethics and need for lifelong learning.

Scheme of Continuous Internal Evaluation (CIE):

The evaluation committee shall consist of Guide, Professor/Associate Professor and Assistant Professor. The committee shall assess the presentation and the progress reports in two reviews.

The evaluation criteria shall be as per the rubrics given below:

Reviews	Activity	Weightage
Review-I	Explanation of the application of engineering knowledge in industries, ability to comprehend the functioning of the organization/ departments,	45%

Review-II	Importance of resource management, environment and sustainability presentation skills and report writing	55%

Scheme for Semester End Evaluation (SEE):
The SEE examination shall be conducted by an external examiner (domain expert) and an internal examiner. Evaluation shall be done in batches, not exceeding 6 students per batch.

Semester: VII						
AIRCRAFT SYSTEMS & INSTRUMENTATION (Theory & Practice)						
Course Code	**:**	**18AS75**		**CIE**	**:**	**100+50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100 +50 Marks**
Hours	**:**	**39L+32.5P**		**SEE Duration**	**:**	**3.00+3.00 Hours**

Course Learning Objectives: To enable the students to:	
1	List the various aspects of design of aircraft systems involved in an aircraft.
2	Demonstrate the technical attributes of all the subsystems of an aircraft.
3	Explain the significance of each systems and its subsystems for developing an airplane.
4	Demonstrate the integration of the systems with the airplane.

Unit-I	**09 Hrs**
Aircraft Power Generation Systems: **Aircraft Electrical System:** Aircraft Power Generation & Distribution System. Components of Aircraft Electrical System – Aircraft battery, Aircraft Generators (AC/DC Generators), Aircraft Alternators: Theory of operation Alternator regulation, Fundamentals of Constant speed drives (CSD) and Variable Speed Constant Frequency (VSCF) Integrated Drive Generators (IDG). **Aircraft Hydraulic & Pneumatic Systems** Components of a typical Hydraulic system, Working of Hydraulic system, Power packs, Hydraulic actuators. Aircraft, Landing gear and Wheel Braking and Anti-Skid & Shimmy System. Pneumatic system and its components, **Electrical, Hydraulic & Pneumatic system Instruments**	
Unit – II	**10 Hrs**
Air Data Systems: Pitot-static Sensing probes, Air Speed Indicator, Altimeter, Vertical speed indicator, Angle of Attack Sensing & indication, Mach meter, Air Data Computer and its functioning with respect to FBW system, Aerodynamic Alerting Systems. **Flight Control Systems:** Primary and secondary flight controls, Conventional Flight control linkage System, Power Assisted and fully powered flight controls. Fly By Wire Control System & Fly By Light control system.	
Unit -III	**08 Hrs**
Gyroscopic Instruments & Magnetic Reference Heading System: Type of Gyroscopes, Principles of Mechanical, MEMS and Optical Gyroscopes, Properties of Mechanical Gyroscope-Rigidity & Precession, limitations of gyroscope, Artificial Horizon, Errors due to acceleration and turning, Turn and Bank indicator. Terrestrial magnetism, Aircraft magnetism, Direct Reading Compasses, Magnetic Heading Reference System – Remote Indicating Compass System - Flux Detector Valve, Direction Indicator, Block Diagram.	

Unit -IV	**06 Hrs**
Aero Engine Systems: Types of Starting and Ignition systems, Engine starting sequence, Engine Oils and a typical Engine Lubricating system. Engine Fuel System & functioning of a typical engine fuel control unit. **Aero Engine Instruments:** Pressure measurements & indicating systems, pressure switches, Temperature measurements & Indicating systems.	
Unit -V	**06 Hrs**
Air-conditioning and Pressurisation Systems: Cockpit & Cabin Temperature control system, De-icing systems, Cold air units, Compact heat exchangers: Cockpit and Cabin Pressurization valves: filters: air bottles: capsules and bellows: indication and warnings. systems, sensor units	

LABORATORY EXPERIMENTS
1. Characteristic Curve of Variable Displacement Hydraulic Pump. 2. Study of Application of 4/3 Directional Control Valve (Tandem & Closed Centre). 3. Study of Operation of Hydraulic Motor Using 4/3 Directional Control Valve. 4. Study of Operation of Accumulator Using 4/3 Directional Control Valve. 5. Study of Application of Pressure Switch Using 4/2 Directional Control Valve. 6. Study of Position Dependent Control of a Double Acting Cylinder with Mechanical Limit Switches. 7. Study of Logical Control of Pneumatic circuit with 'AND' & 'OR' function using Electro pneumatics **Part – II : Aircraft Instrumentation Lab** 8. **(A)** Measurement of Aircraft Pressure, using Sensor Test Bed. **(B)** Measurement of Aero-engine RPM using Sensor Test Bed. **(C)** Measurement of Aero-engine Temperature using Sensor Test Bed. 9. Measurement of Fuel Flow & Quantity of Fuel Consumed in Aero-Engine using Fuel Flow Transmitter using sensor Test Bed. 10. Study of Gyroscopic Behaviour of Rotating Masses and Verification of Gyroscopic Relationship (Using Electromechanical Gyroscope using Table Top Model). 11. Measurement of Roll & Pitch with Artificial Horizon and Calibration of Magnetic Compass Using Magnetometer. **Part – III : Air Data System Lab** 9. 12. Measurement of Air Data Parameters Using Air Data test Set.

Course Outcomes: At the end of this course the student will be able to :	
CO1:	Categorise the various systems required for designing a complete airplane
CO2:	Comprehend the complexities involved during development of flight vehicles.
CO3:	Explain the role and importance of each systems for designing a safe and efficient flight vehicle
CO4:	Demonstrate the different integration techniques involved in the design of an air vehicle

Reference Books	
1	E.H.J.Pallet, Aircraft Instruments, 1st Revised Edition, 1992, Prentice Hall of India, ISBN-9780273015390
2	Moir, I. and Seabridge, A.,Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration, 3rd Edition, 2008, Wiley Publications, ISBN- 978-0470059968
3	Harris, D., Ground Studies for Pilots: Flight Instruments and Automatic Flight Control Systems, sixth edition 2004, Blackwell Science, ISBN: 978-0632059515
4	Moir, I. and Seabridge, Civil Avionics Systems, AIAA (American Institute of Aeronautics & Astronautics) Wiley; 2 edition (October 14, 2013), ISBN: 978-1118341803

Continuous Internal Evaluation (CIE): Total marks: 100+50=150
Theory – 100 Marks
CIE is executed by way of quizzes (Q), tests (T) and Self-Study(S). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for Self-study is 20. The total CIE for theory is 100.

Laboratory- 50 Marks
The Laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average of marks over number of weeks is considered for 40 marks. At the end of the semester a test is conducted for 10 marks. Total marks for the laboratory is 50.

Semester End Evaluation (SEE): Total marks: 100+50=150
Theory – 100 Marks
SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

Laboratory- 50 Marks
Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks

CO-PO Mapping												
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**	**PO 12**
CO1	**3**	**1**	**3**	**1**	**3**	**1**	**1**	**1**	**-**	**-**	**-**	**2**
CO2	**3**	**2**	**3**	**1**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**1**
CO3	**3**	**3**	**3**	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**2**
CO4	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**1**

High-3 : Medium-2 : Low-1

Semester: VII						
FATIGUE & FRACTURE MECHANICS **Group-F: Professional Elective** **(Theory)**						
Course Code	**:**	**18AS7F1**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**3:0:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: To enable the students to:	
1	Identify the various possible mechanisms of occurrence of fracture in materials and structures.
2	Interpret the behaviour of a crack growth under various loading conditions in brittle and ductile materials.
3	Demonstrate the various methods of arresting a potential crack in structures.
4	Analyse the effect of fatigue fracture on the life of a structure

Unit-I	**08 Hrs**
Fundamentals of Fracture Mechanics: Introduction to fracture Mechanics, Types and Characteristics of Brittle & Ductile Fractures, Brittle-Ductile transition, Fracture mechanics approach to design - Energy approach, Stress Intensity approach, Time dependent crack growth & damage tolerance, Crack in a structure, Modes of cracking, Fracture Toughness.	
Unit -II	**08 Hrs**
Linear Elastic Fracture Mechanics (LEFM): Griffith's Energy balance criterion, Energy release rate (ERR), Stability of crack growth-R curve, Stress intensity factor (SIF), Direction of crack propagation, mixed mode fracture, SIF for different geometries, Relationship between K and G, Experimental determination of Kc, Crack-tip plasticity Correction factor for plasticity effects.	
Unit -III	**08 Hrs**
Elastic–Plastic Fracture Mechanics: Introduction, J-integral, Relation between J-integral and CTOD, crack resistance curve, Experimental determination of Kc and J, Constraints effects in Fracture.	
Unit -IV	**07 Hrs**
Fatigue of Structures: S.N. curves, Stress-life approach, Strain-life approach, Mean stress effects, Goodman, Gerber and Soderberg relations, Neuber's stress concentration factors - Plastic stress concentration factors - Notched S.N. curves.	
Unit -V	**08 Hrs**
Statistical Aspects of Fatigue Behaviour: Low cycle and high cycle fatigue - coffin - Manson's relation - Transition life - cyclic strain hardening and softening -Cycle counting techniques, Paris law, Miner's rule, Damage rule for irregular loads, Variable amplitude loading.	

Course Outcomes: At the end of this course the student will be able to :	
CO1:	Demonstrate the phenomenon of formation of cracks in different structural materials.
CO2:	Develop solutions to estimate the size of the cracks and its effect under different loading conditions.
CO3:	Extend the life of a structure by applying various methods of crack arresting techniques.
CO4:	Evaluate the fracture strength of materials by incorporating different testing methods for different loading environments.

Reference Books	
1	T.L. Anderson , Fracture Mechanics – Fundamentals and Application, 4th Edition, 2017, CRC press, ISBN- 9781498728140
2	David Broek, Martinus Nijhoff,, Elementary Engineering Fracture Mechanics, 5th Edition, 1999, London, ISBN 978-94-009-4333-9
3	Jayatilake , Fracture of Engineering Brittle Materials, 2nd Edition, 2001, Applied Science, London ISBN-9780853348252

4	Jaap Schijve, Fatigue of Structures and Materials, 2004, Kluwer Academic publishers, , ISBN-0792370139

Scheme of Evaluation

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Assignment/Presentation/Project (A). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for Assignment/Presentation/Project is 10.

Total CIE is 30(Q) +50(T) +10(A) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**1**	**2**	**1**	**1**	**1**	**1**	**1**				**1**
CO2	**3**	**2**	**3**	**3**	**1**	**1**	**1**	**1**				**2**
CO3	**3**	**2**	**3**	**3**	**3**	**1**	**3**	**3**				**2**
CO4	**3**	**3**	**3**	**3**		**2**	**1**	**2**				**2**

High-3 : Medium-2: Low-1

Semester: VII						
SYSTEMS ENGINEERING **Group-F: Professional Elective** **(Theory)**						
Course Code	**:**	**18AS7F2**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39 L**		**SEE Duration**	**:**	**3.00 Hours**
Course Learning Objectives: To enable the students to						
1.	Understand the Life Cycle of Systems.					
2.	Explain the role of Stake holders and their needs in organizational systems.					
3.	Develop and Document the knowledge base for effective systems engineering processes.					
4.	Apply available tools, methods and technologies to support complex high technology systems.					
5.	Create the frameworks for quality processes to ensure high reliability of systems.					

UNIT-I	**06 Hrs**
System Engineering and the World of Modem System: What is System Engineering?, Origins of System Engineering, Examples of Systems Requiring Systems Engineering, System Engineering viewpoint, Systems Engineering as a Profession, The power of Systems Engineering, problems. **Structure of Complex Systems:** System building blocks and interfaces, Hierarchy of Complex systems, System building blocks, The system environment, Interfaces and Interactions. **The System Development Process:** Systems Engineering through the system Life Cycle, Evolutionary Characteristics of the development process, The system engineering method, Testing throughout system development, problems.	
UNIT – II	**10 Hrs**
Systems Engineering Management: Managing systems development and risks, Work breakdown structure (WBS), System Engineering Management Plan (SEMP), Risk Management, Organization of Systems Engineering, Systems Engineering Capability Maturity Assessment, Systems Engineering standards, Problem. **Needs Analysis:** Originating a new system, Operations analysis, Functional analysis, Feasibility analysis, Feasibility definition, Needs validation, System operational requirements, problems. **Concept Exploration:** Developing the system requirements, Operational requirements analysis, Performance requirements formulation, Implementation concept exploration, Performance requirements validation, problems.	
UNIT – III	**10 Hrs**
Concept Definition: Selecting the system concept, Performance requirements analysis, Functional analysis and formulation, Concept selection, Concept validation, System Development planning, System Functional Specifications, problems **Advanced Development:** Reducing program risks, Requirements analysis, Functional Analysis and Design, Prototype development, Development testing, Risk reduction, problems.	
UNIT – IV	**07 Hrs**
Engineering Design: Implementing the System Building blocks, requirements analysis, Functional analysis and design, Component design, Design validation, Configuration Management, problems. **Integration and Evaluation:** Integrating, Testing and evaluating the total system, Test planning and preparation, System integration, Developmental system testing, Operational test and evaluation, problems.	
UNIT – V	**06 Hrs**
Production: Systems Engineering in the factory, Engineering for production, Transition from development to production, Production operations, Acquiring a production knowledge base, problems. **Operations and support**: Installing, maintenance and upgrading the system, Installation and test, In-service support, Major system upgrades: Modernization, Operational factors in system development, problems.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the Life Cycle of Systems.
CO2:	Explain the role of Stake holders and their needs in organizational systems.
CO3:	Develop and Document the knowledge base for effective systems engineering processes.
CO4:	Apply available tools, methods and technologies to support complex high technology systems.
CO5:	Create the frameworks for quality processes to ensure high reliability of systems.

Reference Books:	
1.	Systems Engineering – Principles and Practice, Alexander Kossoaikoff, William N Sweet, 2012, John Wiley & Sons, Inc, ISBN: 978-81-265-2453-2
2.	Handbook of Systems Engineering and Management, Andrew P. Sage, William B. Rouse, 1999, John Wiley & Sons, Inc., ISBN 0-471-15405-9
3.	General System Theory: Foundation, Development, Applications, Ludwig von Bertalanffy, 1973, Penguin University Books, ISBN: 0140600043, 9780140600049.
4.	Systems Engineering and Analysis, Blanchard, B., and Fabrycky, W., 5th edition, 2010, Prentice Hall, Saddle River, NJ, USA

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20. **Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.**

Semester End Evaluation (SEE): Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part A and Part B. Part A consists of objective type questions for 20 marks covering the complete syllabus. Part B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	-	-	-	1	-	-	-	-	-	1
CO2	-	2	3	-	1	-	-	1	-	-	2	-
CO3	-	3	-	-	-	2	2	1	-	3	2	-
CO4	-	-	2	1	-	-	-	-	-	-	-	-
CO5	1	1	-	2	-	1	2	-	3	-	-	-

High-3 : Medium-2: Low-1

Semester: VII						
SPACE DYNAMICS **Group-F: Professional Elective** **(Theory)**						
Course Code	**:**	**18AS7F3**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**3:0:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: To enable the students to:	
1	Develop an understanding of celestial mechanics required to predict the behaviour of various celestial bodies
2	Obtain a detailed knowledge of orbital mechanics and its solutions with applications to geocentric orbits and interplanetary transfers
3	Examine the effect of perturbations on the performance of a satellite in its orbit
4	Familiarize with various types of Interplanetary Trajectories in space domain

Unit-I	**10 Hrs**
Understanding Astronomy: Reference Frame & Coordinate System: Position of the Earth's Surface, The Celestial Sphere, The Ecliptic, Geocentric Reference Frames, Heliocentric Reference Frames, Vernal Equinox Motion, Velocity Vector, Time & Calendar: Sidereal Time, Solar Time, Mean Solar Time, Standard Time, Ephemeris Time & Atomic Time, The Year, The Julian Date, The Earth and its Shape, The Earth's Atmosphere.	
Unit -II	**08 Hrs**
Fundamentals of Orbital Mechanics : Two Body Motion, Circular & Escape Velocity, Orbit Equation, Kepler's Equation, Motion in Various Orbits, Position & Velocity, Orbit Determination & Satellite Tracking.	
Unit -III	**07 Hrs**
Rigid Body Dynamics : Choice of Origin, Angular Momentum & Energy, Principal Body Axis Frame, Parallel Axis Theorem, Euler's Equation, Orientation Angles.	
Unit -IV	**07 Hrs**
Satellite Attitude Dynamics: Torque Free Axisymmetric Rigid Body, General Torque Free Rigid Body **Attitude Control:** Spinning & Non-Spinning Spacecraft, Yo-Yo Mechanism, Gravity Gradient Satellite, Dual Spin Spacecraft.	
Unit -V	**07 Hrs**
Satellite Launching & Injection : Launch Vehicle Ascent Trajectories, Injection of a Satellite: General Aspects of Injection, Dependence of Orbital Parameters, Launch Vehicle Performances, Orbital Deviations due to Injection Errors.	

Course Outcomes: At the end of this course the student will be able to	
CO1:	Comprehend the fundamental behaviour of various planets through celestial mechanics
CO2:	Extend the knowledge of orbital mechanics to achieve space flight
CO3:	Study the attitude characteristics of satellites in space under various celestial environments
CO4:	Estimate and reduce the perturbations encountered by a satellite during injection operations

Reference Books	
1	Rocket Propulsion and Spaceflight Dynamics, J.W.Cornelisse, H.F.R. Schoyer, and K.F. Wakker, , 1st Edition, 2000, Pitman Publishing, ISBN-13: 978-0273011415
2	Spaceflight Dynamics, William E.Wiesel, 2nd Edition, 1997, McGraw-Hill, 2001, I SBN-13: 978-0070701106
3	Orbital Mechanics, Vladimir A. Chobotov, 3rd Edition, 2002, AIAA Education Series, Published by AIAA, ISBN 978-1-56347-537-5

4	Spacecraft Mission Design, Charles D.Brown, 2nd Edition, 2001, AIAA Education Series, ISBN-13: 978-1563472626

Scheme of Evaluation

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Assignment/Presentation/Project (A). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for Assignment/Presentation/Project is 10.

Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**	**3**	**1**	**1**	**3**	**2**	**2**				**1**
CO2	**2**	**3**	**3**	**3**	**1**	**1**	**1**	**1**				**2**
CO3	**1**		**3**	**3**								**2**
CO4	**3**	**3**	**3**	**3**		**2**	**1**	**2**				**2**

High-3 : Medium-2: Low-1

Semester: VII						
OPTICAL FIBER COMMUNICATION **Group-F: Professional Elective** **(Theory)**						
Course Code	**:**	**18AS7F4**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**3:0:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: To enable the students to:	
1	Understand the various fundamentals of Optical Fiber communications.
2	Demonstrate the technical attributes of Optical Fiber communications and its implantation in the industry as well as in the aircraft.
3	Explain the significance of each system and its subsystems for developing an Optical Fiber communication system
4	Demonstrate the integration of the Optical Fiber communication systems with the airplane.

Unit-I	**08 Hrs**
Fundamentals of Optics : Reflection and Refraction, Phase Velocity and Group Velocity, Polarization of Light, **Optical Fiber & Transmission:** Fiber Structure, Ray Propagation in Fibers, Optical Wave guides, Optical Fiber Signal Attenuation and Dispersion, Modes of a Step-Index Optical Fiber, Comparison between Multi-Mode and Single-Mode Fibers, Power Distribution and Non-linear optical Effects	
Unit -II	**07 Hrs**
Lasers : Basic Concepts, Conditions for Laser Oscillations, Wave–Particle Duality, Laser Rate Equations-Ruby Laser, Semiconductor Lasers, The PN Junctions, Spontaneous and Stimulated Emission at the PN Junction, Direct and Indirect Band-Gap Semiconductors, Semiconductor Laser Diode	
Unit -III	**10 Hrs**
Optical Modulators and Modulation Schemes: Power Spectral Density, Digital Modulation Schemes, Optical Modulators, Optical Realization of Modulation Schemes. **Optical Receivers:** Photodetector Performance Characteristics, Common Types of Photodetectors, Direct Detection Receivers, Receiver Noise, Coherent Receivers, **Optical Amplifiers :** Optical Amplifier Model, Amplified Spontaneous Emission in Two-Level Systems, Semiconductor Optical Amplifiers, Semiconductor Optical Amplifiers,	
Unit -IV	**07 Hrs**
Transmission System Design: Fiber Loss-Induced Limitations, Dispersion-Induced Limitations, ASE-Induced Limitations. **Performance Analysis :** Optimum Binary Receiver for Coherent Systems, Homodyne Receivers, Heterodyne Receivers, Direct Detection	
Unit -V	**07 Hrs**
Channel Multiplexing Techniques : Polarization-Division Multiplexing, Wavelength-Division Multiplexing, OFDM, Time-Division Multiplexing. **Nonlinear Effects in Fibers :** Origin of Linear and Nonlinear Refractive Indices, Fiber Dispersion, Self-Phase Modulation, Combined Effect of Dispersion and SPM.	

Course Outcomes: At the end of this course the student will be able to :	
CO1:	Explain the various systems/components required for Optical Fiber communication.
CO2:	Comprehend the complexities involved during development of Optical Fiber communications.
CO3:	Explain the role and importance of each systems for designing an efficient Optical Fiber communications.
CO4:	Demonstrate the integration of the Optical Fiber communication systems with the airplane.

Reference Books	
1	Shiva Kumar & M Jamal Deen, Fiber Optic Communication- Fundamentals & Applications, 2014 edition, John Wiley & Sons Ltd, ISBN:978-0-470-51867-0
2	Casimer DeCustis, Hand Book of Fiber Optic Data Communication, 3ed 2008, Academic Press, ISBN: 978-0-12-374216-2
3	Ivan P. Kaminow, Tingye Li, Alan E. Willner, Optical Fiber Telecommunications V B - Systems and Networks, 2008, Academic Press, ISBN: 978 0 12 374172 1.
4	Le Nguyen Binh, Optical Fiber Communications Systems , 2010, CRC Press, International Standard Book Number-13: 978-1-4398-0621-0

Scheme of Evaluation

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Assignment/Presentation/Project (A). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for Assignment/Presentation/Project is 10.

Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**1**	**3**	**1**	**3**	**1**	**1**	**1**	**-**	**-**	**-**	**2**
CO2	**3**	**2**	**3**	**1**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**1**
CO3	**3**	**3**	**3**	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**2**
CO4	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**1**

High-3 : Medium-2: Low-1

Semester: VII						
HYPERSONIC AERODYNAMICS **Group-G: Professional Elective** **(Theory)**						
Course Code	**:**	**18AS7G1**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**3:0:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: To enable the students to:	
1	Outline all the important aspects required to understand the hypersonic flight regime
2	Understand various theories and establish equations specific to hypersonic flow conditions
3	Formulate the governing equations instrumental in determining the flow properties involving viscous behaviour of fluid
4	Thoroughly comprehend the concepts of rarefied gas dynamics and their effect on crafts in outer atmosphere

Unit-I	**08 Hrs**
Fundamentals of Hypersonic Flows : Qualitative aspects of hypersonic flow, Physical phenomena in hypersonic flows: Thin shock layers, Entropy layer, Viscous interaction, High temperature flows, Low-density flows, Recapitulation, Hypersonic flight path-velocity altitude map, Stagnation region flow field properties.	
Unit -II	**08 Hrs**
Inviscid Hypersonic Flows : Basic Hypersonic Relations, Hypersonic Similarity Parameter, Hypersonic Expansion-Wave Relations, Newtonian Flow, Modified Newtonian Law, Centrifugal Force Corrections to Newtonian Theory, Tangent-Wedge Tangent-Cone Methods, Shock-Expansion Method.	
Unit -III	**08 Hrs**
Solutions for Hypersonic Inviscid Flow fields : Basic Governing Equations, Mach Number Independence, Hypersonic Small-Disturbance Equations, Hypersonic Similarity, Hypersonic Equivalence Principle and Blast-Wave Theory, Thin Shock-Layer Theory, Method of Characteristics.	
Unit -IV	**07 Hrs**
Viscous Hypersonic Flow : Governing Equations for Viscous Flow: Navier–Stokes Equations, Similarity Parameters and Boundary Conditions, Boundary-Layer Equations for Hypersonic Flow, Hypersonic Transition, Hypersonic Aerodynamic Heating, Entropy-Layer Effects on Aerodynamic Heating.	
Unit -V	**08 Hrs**
Rarefied Gas Dynamics : The Conception of Rarefied Gas Dynamics, Molecular Model of Gases, Mean Free Path of Molecules, Division of Flow Regimes, Non-equilibrium Phenomena and Rarefied Gas Dynamics, Similarity Criteria, Collision Frequency and Mean Free Path, Velocity and Speed Distribution Functions: Mean Velocities.	

Course Outcomes: At the end of this course the student will be able to :	
CO1:	Comprehend the important aerodynamic features distinguishing hypersonic flight regime
CO2:	Utilize different theories to build basic equations specific to high speed flow regimes
CO3:	Establish fundamental governing equations to determine the significant hypersonic flow properties
CO4:	Analyze the effect of free molecular flow on the construction of an hypersonic vehicle operating in exosphere

Reference Books	
1	Hypersonic and High Temperature Gas Dynamics, John David Anderson , 2nd Edition, 2006, AIAA Education Series, USA, ISBN 978-1-56347-780-5
2	Hypersonic Aerothermodynamics, John J. Bertin, 1994 AIAA Education Series, USA., ASIN B01A68GUDG
3	Introduction to Hypersonic flow, Cherni C. G, 1st Edition, 1961Academic Press, New York, ISBN

	9781483271682
4	Hypersonic Flow Theory, Hayes W. D and Probstein R F, 2nd Edition, 1966, Academic Press, New York
5	Elements of Hypersonic Aerodynamics, Cox R. N, Crabtree L. P, 1st Edition, 1965, Academic press,New York, ASIN B003RNTS9G

Scheme of Evaluation

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Assignment/Presentation/Project (A). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for Assignment/Presentation/Project is 10.

Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**	**3**	**1**	**1**	**3**	**2**	**2**				**1**
CO2	**2**	**3**	**3**	**3**	**1**	**1**	**1**	**1**				**2**
CO3	**1**		**3**	**3**								**2**
CO4	**3**	**3**	**3**	**3**		**2**	**1**	**2**				**2**

High-3 : Medium-2: Low-1

Semester: VII						
THEORY OF AEROELASTICITY **Group-G: Professional Elective** **(Theory)**						
Course Code	**:**	**18AS7G2**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**3:0:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: To enable the students to:	
1	Understand classical Aeroelastic problems arising due to fluid structure interaction.
2	Understand the underlying principles of static aeroelasticity.
3	Understand the significance of unsteady aerodynamics on the aircraft structures.
4	Comprehend solution of dynamic instability and aeroelastic response problems.

Unit-I	**10 Hrs**
Introduction to Aeroelasticity: Vibration and its forces, Flexibility effect on aerodynamics, structure and aerodynamic interaction, Aeroelasticity, Classificatin of Aeroelasticity, Collar's triangle, Simple definition on Static aeroelasticity: Divergence, load distribution, control effectiveness, control system reversal, Simple definition on Dynamic aeroelasticity: Flutter, buffeting, dynamic response.	
Unit -II	**09 Hrs**
Static Aeroelasticity: Divergence: Torsional Wing Box, Divergence of A Two Dimensional Rigid Aerofoil With Spring Attachment, Static Aeroelastic Behaviour Of Fixed Root Flexible Wing, Divergence Prediction Using Dynamic Method, Numericals On Divergence. **Control effectiveness and Reversal**: Effect of wing Flexibility on Control Effectiveness, Rolling Effectiveness of a Flexible Wing- Steady Roll Case, and Determination of Reversal Speed for Steady Roll Case, Problems On Control Reversal.	
Unit -III	**07 Hrs**
Unsteady Aerodynamics: Quasi Steady Aerodynamics, Unsteady Aerodynamics, Aerodynamic lift and moment for a harmonically oscillating Aerofoil, Oscillatory aerodynamic derivatives, Aerodynamic damping and stiffness, Unsteady Aerodynamics Related to Gusts**.**	
Unit -IV	**07 Hrs**
Dynamic aeroelasticity: Fluter*:* Simplified Unsteady Aerodynamic Model, Binary Aeroelastic Model, General Form of the aeroelastic Equations, Eigenvalue Solution of Flutter Equations, Aeroelastic behaviour of the Binary Model, Aeroelastic behaviour of a Flexible Wing, Flutter speed prediction for binary systems.	
Unit -V	**06 Hrs**
Dynamic Aeroelasticity: Gusts and Turbulence: Types of Gust, Assumption in modelling Gust, Gust response in time domain – Flexible Aircraft, equations of motions, Definition of Continuous turbulence and harmonic gust velocity component, FRF for flexible aircraft response in Heave/Pitch per Harmonic gust velocity.	

Course Outcomes: At the end of this course the student will be able to :	
CO1:	Identify the type and parameters influencing different classical Aeroelastic problems.
CO2:	Formulate mathematical model for solution of common static Aeroelastic problems
CO3:	Realize the effect of unsteady aerodynamics on the behavior of Aeroelastic systems
CO4:	Understand the dynamic behavior of aircraft structures to identify dynamic instabilities

Reference Books	
1	A Modern Course in Aeroelasticity, Dowell, E. H., Crawley, E. F., Curtiss Jr., H. C., Peters, D. A., Scanlan, R. H., and Sisto, F., 3rd Edition, 1995, Kluwer Academic Publishers,. (TL574.A37.M62)
2	Aeroelasticity, Bisplinghoff, R., Ashley, H., and Halfman, R. L., 1st Edition, 1996, Dover

	Publications, ISBN-13: 978-0486691893
3	An Introduction to the Theory of Aeroelasticity, Fung, Y. C., 1st Edition, 1955, Dover Publications, ISBN 9780486495057
4	Aircraft structures for Engineering students, Megson THG, 3rd Edition, 1999, Edward Arnold, ISBN-13: 978-0470349373
5	Jan R. Wright, Jonathan E. Cooper, Introduction to Aircraft Aeroelasticity and Loads, 1st Edition, 2007, AIAA, ISBN-13: 978-1563479359

Scheme of Evaluation

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Assignment/Presentation/Project (A). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for Assignment/Presentation/Project is 10.

Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**	**3**	**1**	**1**	**3**	**2**	**2**				**1**
CO2	**2**	**3**	**3**	**3**	**1**	**1**	**1**	**1**				**2**
CO3	**1**	**2**	**3**	**3**	**1**							**2**
CO4	**3**	**3**	**3**	**3**	**2**	**2**	**1**	**2**				**2**

High-3 : Medium-2: Low-1

Semester: VII						
ROTORCRAFT DYNAMICS **Group-G: Professional Elective** **(Theory)**						
Course Code	**:**	**18AS7G3**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**3:0:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: To enable the students to	
1	Understand the basic concepts associated with rotor aerodynamics
2	Classify the types of rotor and determine their behaviour in various configurations
3	Interpret the performance of the helicopter along various axes
4	Apply the basic concepts of trim in achieving the stability of an helicopter

Unit-I	**08 Hrs**
Fundamentals of Rotor Aerodynamics: Momentum Analysis in Axial: Flow near a Hovering Rotor, Conservation Laws applied to the Hovering Rotor, Disc Loading and Power Loading, Forward Flight: Induced Velocity, Axial Climb and Decent, Working States of Rotor in Axial Flight, Autorotation, Induced Inflow Ratio, Application of Momentum Theory to Coaxial, Tandem and Ducted Fan Rotor Design.	
Unit -II	**08 Hrs**
Blade Element Analysis: Blade Element Analysis in Hover and Axial Flight: Integrated Rotor Thrust and Power, Untwisted Blades and Uniform Flow, Linearly Twisted Blades and Uniform Flow, Torque Power Approximation, Tip Loss Factor, Blade Element Momentum Theory: Analytical Approach, Circulation Theory of Lift, Weighted Solidity: Thrust, Power and Torque, Tip Losses.	
Unit -III	**08 Hrs**
Rotating Blade Motion: Types of Rotors, Equilibrium about Flapping and Lead/Lag Hinge, Equations of Motion for Flapping Blades, Blade Flapping: Longitudinal and Lateral, Rotor Control using Swash plates, Concepts of Blade Feathering.	
Unit -IV	**07 Hrs**
Helicopter Performance: Hovering and Axial Climb Performance, Forward Flight Performance: Induced and Blade Profile Power, Climb Power, Tail Rotor Power, Total Power, Optimum Speed, Maximum Level Speeds, Rotor Limits Envelop.	
Unit -V	**08 Hrs**
Helicopter Trim, Stability and Control: Trim, Treatment of Stability and Control, Static Stability, Dynamic Stability, Hingeless Rotor and Control, Autostabilization.	

Course Outcomes: At the end of this course the student will be able to :	
CO1:	Apply the knowledge of blade element momentum theory to determine the aerodynamic characteristics of the rotor blade
CO2:	Study the behavior of the helicopter under various blade configurations
CO3:	Estimate the performance parameters of a helicopter
CO4:	Evaluate the stability and control characteristics of a helicopter under various conditions

Reference Books	
1	Principles of Helicopter Aerodynamics, Gordon Leisshman J, 2002, Cambridge University Press, ISBN 9780521523967
2	Basic Helicopter Aerodynamics, John M. Seddon , Simon Newman, 3rd Revised Edition, 2011, Wiley-Blackwell; ISBN-13: 978-0470665015
3	Helicopter Dynamics, Bramwell, 2nd Edition, 2001, Butterworth-Heinemann, ISBN-13: 978-0750650755
4	The Helicopter, History, Piloting & How it Flies, John Fay, 4th Revised edition, 1990, Sterling Book House 2007, ISBN 978-0715389409

Scheme of Evaluation

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Assignment/Presentation/Project (A). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for Assignment/Presentation/Project is 10.

Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**2**	**3**	**2**		**1**						**2**
CO2	**2**	**2**	**2**	**3**								**1**
CO3	**3**	**3**	**3**	**1**								**2**
CO4	**3**	**2**	**3**	**3**		**1**	**1**	**1**				**1**

High-3 : Medium-2: Low-1

Semester: VII						
AIRCRAFT MAINTENANCE, REPAIR & OVERHAUL **Group-G: Professional Elective** **(Theory)**						
Course Code	**:**	**18AS7G4**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**3:0:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: To enable the students to	
1	Comprehend the fundamentals of maintenance and certification.
2	Acquire the knowledge of documentation for maintenance.
3	Understand the Aircraft Maintenance, safety and trouble shooting.

Unit-I	**08 Hrs**
Fundamentals of Maintenance & Certification Types of maintenance, Redesign, Failure rate pattern, Other maintenance considerations. Aviation industry certification requirements, Type certificate (FAA form 8110.9), Airworthiness certificate (FAA form 8100-2), Aviation maintenance certifications, General, Airframe, Power plant, Avionics courses	
Unit -II	**08 Hrs**
Documentation for Maintenance Manufacturers documentation, Airplane maintenance manual, Fault insulation manual, Illustrated parts catalogue, structural repair manual, wiring diagram manual, Master minimum equipment, Federal Aviation regulation (FAR), Advisory circulars, Airworthiness direction ATA document standards, Technical policies and procedure manuals (TPPM).	
Unit -III	**08 Hrs**
Aircraft Management Maintenance Structure, Role of aviation management, Line supervisory management, Management areas of concern in airlines, Manager of overhaul shops, Line maintenance control centre flight line (prefight & post flight), Aircraft Logbook, Maintenance crew skill requirements	
Unit -IV	**08 Hrs**
Hanger Maintenance (on Aircraft) & Material Support Introduction, organization of hanger maintenance, Non- routine item, parts availability, cannibalization, Types of shops- sheet metal shop, Aircraft interior shop, Engine shop, Avionics shop, ground support equipment, outsourcing of shop maintenance work, operation of overhaul shops, Material support, Material management inventory control, Support functions of material, Parts ordering, Storage, Issue, control and handling, Parts receiving quality control, calibration program, stock level adjustments, shelf life, exchanges, warranty & modifications of parts	
Unit -V	**07 Hrs**
Maintenance Safety & Trouble shooting Safety regulations, occupational safety and health standards maintenance safety program, Airlines safety management, General safety rules, Accident & injury reporting, Hazardous materials storage and handling aircraft furnishing practices trouble shooting, Knowledge of malfunctions.	

Course Outcomes: At the end of this course the student will be able to :	
CO1:	Maintain the aircraft maintenance manual and logbook.
CO2:	Understand the quality control and calibration techniques
CO3:	Incorporate the safety regulations and rules for aircraft maintenance schedule
CO4:	Understand and design shop floor management principles

Reference Books	
1	Aviation Maintenance Management, Harry A Kinnison, Tariq Siddiqui, Mc Graw Hill education, 2012, Private Ltd, ISBN: 9780071805032
2	Aircraft maintenance and repair, Kroes, Watkins, Delp, Mc Graw Hill, 2013 McGraw-

	Hill Education, 7th edition, 2013, ISBN: 978-0071801508
3	Aircraft Repair Manual, Larry Reithmaier, Palmar Books, Marquette, 1992, ISBN: 978-0932882028
4	Aircraft Maintenance, Brimm. DJ, Bogges, HE, Pitman publishing corp, London, 1952,. ASIN: B000NQ539E

Scheme of Evaluation

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Assignment/Presentation/Project (A). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for Assignment/Presentation/Project is 10.

Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**2**	**3**	**2**		**1**						**2**
CO2	**2**	**2**	**2**	**3**								**1**
CO3	**3**	**3**	**3**	**1**								**2**
CO4	**3**	**2**	**3**	**3**		**1**	**1**	**1**				**1**

High-3 : Medium-2: Low-1

Semester: VII						
ADVANCED AVIONICS **Group-G: Professional Elective** **(Theory)**						
Course Code	**:**	**18AS7G5**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**3:0:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: To enable the students to	
1	Understand the various advances made in the field of display systems, flight management system, avionics architectures.
2	Explain the significance of each avionics system and its subsystems
3	Understand the technologies involved in integration of various avionics systems
4	Develop the understanding of Certification process for avionics components as well as system.

Unit-I	**08 Hrs**
Emerging Technologies in Aircraft Systems : Technological advances in Cockpit display systems, Head Up Displays, Head Mounted Displays and Retinal Scanning Displays. Speech Recognition & Synthesis Systems, Terrain Awareness systems, Automatic Dependent Surveillance – Broadcast (ADS-B), Traffic Alert & Collision & Avoidance System (TCAS-II); Fly-By-Wire Flying Control, System; Electrical Flying Control System	
Unit -II	**08 Hrs**
Evolution of Avionics – Safety & Certification: Elements of Certification process for Civil & Military Avionics**,** System safety concepts, Elements of Civil aviation system safety process, System safety assessment and verification. Elements of Mil - std - 882 system safety standards. in Avionics Certification process (Role of RTCA DO – 160, RTCA – 178B/C, EUROCAE ED-12B/C, RTCA DO – 254/ EUROCAE ED 80)	
Unit -III	**08 Hrs**
Fault -Tolerant Avionics: Definitional Frame Work, Fault-Tolerant Options, Design Approach, System Level Fault -Tolerance, Fault-Tolerant Hardware Design Principles, Software - Implemented Fault-Tolerance. **Electronics Hardware Reliability:** Design for reliability, RMA, Risk Assessment, Electronic Component Management Plan	
Unit -IV	**07 Hrs**
Flight Management Systems: Navigation, Flight Planning, Trajectory Prediction, Performance Computations, Guidance. **Vehicle Health Management Systems:** Definition of Integrated Vehicle health management, Evolution of VHM Standards, Key Technologies, Example of VHM system.	
Unit -V	**08 Hrs**
Integration of Avionics Systems - Avionics Data Buses & Architectures: ARINC-429, Mil-Std-1553, AFDX (ARINC-664 Pt-7), Genesis Platform Concept - Examples of IMA (Boeing 787), Genesis Platform Characteristics	

Course Outcomes: At the end of this course the student will be able to :	
CO1:	Explain the various developments in the field of Avionics.
CO2:	Comprehend the complexities involved during certification and reliability assessment processes.
CO3:	Explain the role and importance of Flight management systems, Fly-by-wire Flying control system and Vehicle health management system.
CO4:	Explain the nuances of technologies involved in the integration of the various avionics systems.

Reference Books	
1	Ian Moir, Allan Seabridge & Malcolm Jukes - Civil Avionics Systems, 2nd edition, 2013, John Wiley & Sons Ltd, ISBN-978-1-118-53672-8
2	Ian Moir & Allan Seabridge – Military Avionics Systems, 2017, John Wiley & Sons Ltd, ISBN-978-81-265-6855-0
3	Cary R Spitzer, Uma Ferrell, Thomas Ferrell - Digital Avionics Hand Book, 2017, Taylor & Francis Group & CRC Press, ISBN-978-1-138-07698-3
4	Ian Moir and Allan Seabridge - Design and Development of Aircraft Systems, First Edition, 2013, John Wiley & Sons Ltd, ISBN-978-1-119-94119-4.

Scheme of Evaluation

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Assignment/Presentation/Project (A). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for Assignment/Presentation/Project is 10.

Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**1**	**3**	**1**	**3**	**1**	**1**	**1**	**-**	**-**	**-**	**2**
CO2	**3**	**2**	**3**	**1**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**1**
CO3	**3**	**3**	**3**	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**2**
CO4	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**1**

High-3 : Medium-2: Low-1

Semester: VII						
UNMANNED AERIAL VEHICLES (Group H: Global Elective)						
Course Code	**:**	**18G7H01**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**3:0:0:0**		**SEE**	**:**	**100 Marks**
Hours	**:**	**39L**		**SEE Duration:**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Get an overview of the history of UAV systems
2	Understand the importance of aerodynamics, propulsion, structures and avionics in the design of UAV
3	Demonstrate ability to address the various mission payloads - on-board & off-board, propulsion systems, integration with manned systems
4	Comprehend the importance of guidance and navigation of a UAV

Unit-I	**07 Hrs**
Overview of Unmanned Aerial Vehicles and Systems: History of UAVs, Need of unmanned aerial systems, Overview of UAV Systems-System Composition, Classification of UAVs based on size, range and endurance, Basic working of fixed, rotary and flapping UAVs, Applications of UAVs.	
Unit – II	**08 Hrs**
Aerodynamics of Unmanned Aerial Vehicles: Airfoil nomenclature and its characteristics, Basic aerodynamics equations, Aircraft polar, Types of drag, Aerodynamics of rotary and flapping wings, Airframe configurations-HTOL, VTOL and Hybrids.	
Unit -III	**08 Hrs**
Structures of UAV: Mechanic loading, Load calculation, Materials used for UAV (general introduction), Selection criteria for structure, Types of structural elements used in UAV their significance and characteristics. **UAV Propulsion Systems:** Thrust Generation, Powered Lift, Sources of Power for UAVs- Piston, Rotary, Gas turbine engines, electric or battery powered UAVs.	
Unit -IV	**08 Hrs**
Payloads of UAVs : Non-dispensable Payloads- Electro-optic Payload Systems, Radar Imaging Payloads, Electronic Warfare Payloads, Dispensable Payloads and other payloads. **Launch and Recovery Systems for UAVs:** UAV Launch Methods for Fixed-Wing Vehicles- Rail Launchers, Pneumatic Launchers, Hydraulic/Pneumatic Launchers, Zero Length RATO Launch of UAVs, UAV Recovery Systems-Conventional Landings, Vertical Net Systems, Parachute Recovery, VTOL UAVs, Mid-Air Retrieval, Shipboard Recovery.	
Unit -V	**08 Hrs**
UAV Navigation and Guidance Systems: Navigation, Dead Reckoning, Inertial, Radio Navigation, Satellite–Way point Navigation, UAV Guidance, Types of guidance, UAV communication systems, Ground control station, Telemetry, UAS future.	

Course Outcomes: At the end of this course the student will be able to :	
CO1	Appraise the evolution of UAVs and understand the current potential benefits of UAVs
CO2	Apply the principles of Aerospace Engineering in design and development of UAVs
CO3	Determine and evaluate the performance of UAV designed for various Missions and applications
CO4	Appreciate the guidance and navigation systems for enabling the versatility of UAV systems

Reference Books	
1	Unmanned Aircraft Systems UAV design, development and deployment, Reg Austin, 1st Edition, 2010, Wiley, ISBN 9780470058190.
2	Introduction to UAV Systems, Paul G Fahlstrom, Thomas J Gleason, 4th Edition, 2012, Wiley, ISBN: 978-1-119-97866-4

3	Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy, Kimon P. Valavanis, 1st Edition,2007, Springer ISBN 9781402061141
4	Flight Stability and Automatic Control, Robert C. Nelson, 2nd Edition, October 1, 1997, McGraw-Hill, Inc, ISBN 978-0070462731.
5	Design of Unmanned Air Vehicle Systems, Dr. Armand J. Chaput, 3rd Edition, 2001, Lockheed Martin Aeronautics Company, ISBN: 978-1-60086-843-6

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20. **Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.**

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	1	1	3	2	2				1
CO2	2	3	3	3	1	1	1	1				2
CO3	1		3	3								2
CO4	3	3	3	3		2	1	2				2

High-3 : Medium-2 : Low-1

Semester: VII						
BIOINFORMATICS (Group H: Global Elective)						
Course Code	**:**	**18G7H02**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**3:0:0:0**		**SEE**	**:**	**100 Marks**
Hours	**:**	**39L**		**SEE Duration:**	**:**	**3.00 Hrs**

Course Learning Objectives: The students will be able to	
1	Acquire the knowledge of biological database and its role in insilico research
2	Understand the essential algorithms behind the biological data analysis such as Dynamic programming, Dot plotting, Evolutionary and Clustering algorithms along with their implementation.
3	Use various tools and techniques for the prediction of linear & non-linear structures of both macro and micro molecules and study the dynamics of macromolecules and High Throughput Virtual Studies.
4	Perform annotation of unknown DNA and Protein sequences and explore the principles of molecular modelling
5	Apply the knowledge towards analyzing the sequences using programming languages and Drug development

Unit-I	**08 Hrs**
Biomolecules and Introduction to Bioinformatics: Introduction to Biomolecules. Structure, Types and Functions of Carbohydrates, Lipids, Nucleic Acids and Proteins. Genetic code, Codon degeneracy, Genes and Genomes. Introduction to Bioinformatics, Goals, Scope, Applications in biological science and medicine. Biological databases – Sequence, structure, Special Databases and applications - Genome, Microarray.	
Unit – II	**08 Hrs**
Sequence analysis: Introduction, Types of sequence alignments, Pairwise sequence alignment, Multiple sequence alignment, Alignment algorithms Needleman & Wunch, Smith & Waterman and Progressive global alignment, Database Similarity Searching- Scoring matrices – BLOSSUM and PAM, Basic Local Alignment Search Tool (BLAST), and FASTA. Next Generation Sequencing – Alignment and Assembly. **Molecular Phylogenetics:** Introduction, Terminology, Forms of Tree Representation. Phylogenetic Tree Construction Methods - Distance-Based, Character-Based Methods and Phylogenetic Tree evaluation	
Unit –III	**09 Hrs**
Predictive and structural bioinformatics: Gene prediction programs – ab initio and homology based approaches. ORFs for gene prediction. Detection of functional sites and codon bias in the DNA. Predicting RNA secondary structure, Protein structure basics, structure visualization, comparison and classification. Protein structure predictive methods using protein sequence, Protein identity based on composition. Structure prediction - Prediction of secondary structure.	
Unit –IV	**07 Hrs**
PERL: Introduction to Perl, writing and executing a Perl program, Operators, Variables and Special variables. Object Oriented Programming in Perl–Class and object, Polymorphism, inheritance and encapsulation. Data Types – Scalar, Array and Associative array. Regular Expressions (REGEX), Components of REGEX - Operators, Metacharacters and Modifiers.	
Unit –V	**07 Hrs**
BioPERL: Introduction to BioPerl, BioPerl Modules, Applications of BioPerl – Sequence retrieval from Database and submission of sequence to online Database, Indexing and accessing local databases, Sequence alignments BioPerl and Sequence Analysis - Pair wise and Multiple sequence alignment, Parsing BLAST and FASTA results.	

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

CO1	Demonstrate the knowledge of retrieval of the biological data in the essential formats and its analysis.
CO2	Analyse the gene, protein and RNA data to find the degree of similarities and identifying the patterns
CO3	Apply the drug designing methods for screening and inventing the new targets and drugs
CO4	Predict the structure of a compound and design the molecule.

Reference Books	
1	Essential Bioinformatics, Jin Xiong, 2006, Cambridge University Press, ISBN: 978-05-216-00828.
2	Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins; D. Andreas Baxevanis and B. F; Francis Ouellette. 2009; Wiley-IEEE; 3rd edn; ISBN: 978-81-265-21920.
3	Bioinformatics: Sequence and Genome Analysis; D W Mount; 2014; CSHL Press; 2nd edn; ISBN: 9780879697129.
4	Computational Systems Biology; A Kriete and R Eils; 2006; Academic Press; Illustrated edn; ISBN: 978- 01-208-87866.

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20. **Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.**

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	-	-	-	-	-	-	-	1	-	1
CO2	3	2	2	1	-	-	-	-	-	1	-	1
CO3	3	3	2	2	-	-	-	-	-	1	-	1
CO4	3	3	3	3	-	-	-	-	-	1	-	1

High-3 : Medium-2 : Low-1

Semester: VII						
INDUSTRIAL SAFETY AND RISK MANAGEMENT (Group H: Global Elective)						
Course Code	**:**	**18G7H03**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**3:0:0:0**		**SEE**	**:**	**100 Marks**
Hours	**:**	**39L**		**SEE Duration:**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Select appropriate risk assessment techniques
2	Analyze public and individual perception of risk
3	Relate safety, ergonomics and human factors
4	Carry out risk assessment in process industries

Unit-I	**08 Hrs**
Introduction: Introduction to industrial safety engineering, major industrial accidents, safety and health issues, key concepts and terminologies, Hazard theory, Hazard triangle, Hazard actuation, Actuation transition, Causal factors, Hazard recognition.	
Unit – II	**08 Hrs**
Risk assessment and control: Individual and societal risks, Risk assessment, Risk perception, Acceptable risk, ALARP, Prevention through design. **Hazard Identification Methods:** Preliminary Hazard List (PHL): Overview, methodology, worksheets, case study. Preliminary Hazard Analysis (PHA): Overview, methodology, worksheets, risk index, example.	
Unit –III	**08 Hrs**
Hazard analysis: Hazard and Operability Study (HAZOP): Definition, Process parameters, Guide words, HAZOP matrix, Procedure, Example. Failure Modes and Effects Analysis (FMEA): Introduction, system breakdown concept, methodology, example.	
Unit –IV	**08 Hrs**
Application of Hazard Identification Techniques: Case of pressure tank, system breakdown structure, safety ontology, Accident paths, HAZOP application, risk adjusted discounted rate method, probability distribution, Hiller's model	
Unit –V	**07 Hrs**
Safety in process industries and case studies: Personnel Protection Equipment (PPE): Safety glasses, face shields, welding helmets, absorptive lenses, hard hats, types of hand PPE, types of foot PPE, types of body PPE. Bhopal gas tragedy, Chernobyl nuclear disaster, Chemical plant explosion and fire.	

Course Outcomes: At the end of this course the student will be able to :	
CO1	Recall risk assessment techniques used in process industry.
CO2	Interpret the various risk assessment tools.
CO3	Use hazard identification tools for safety management.
CO4	Analyze tools and safety procedures for protection in process industries.

Reference Books	
1	Functional Safety in the Process Industry: A Handbook of practical Guidance in the application of IEC61511 and ANSI/ISA-84, Kirkcaldy K.J.D Chauhan, 2012, North corolina, Lulu publication, ISBN:1291187235
2	Safety Instrumented Systems Verification Practical probabilistic calculations, Goble and William M., 2005, Pensulvania ISA publication, ISBN:155617909X
3	Industrial safety and risk Management, Laird Wilson and Doug Mc Cutche, 1st Edition, 2003, The University of alberta press,Canada, ISBN: 0888643942.
4	Industrial Safety, Health and Environment Management Systems, R K Jain, Sunil S Rao, 4th Edition, 2005, Khanna Publishers, New Delhi, ISBN: 8174092102

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20. **Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.**

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	3	-	1	-	1	1	1	-	-	1	-
CO2	2	3	1	-	1	1	-	-	-	-	-	-
CO3	3	2	1	1	2	-	1	-	-	1	1	-
CO4	3	-	1	-	-	-	-	-	1	-	1	-

High-3 : Medium-2 : Low-1

Semester: VII						
WEB PROGRAMMING (Group H: Global Elective)						
Course Code	**:**	**18G7H04**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**3:0:0:0**		**SEE**	**:**	**100 Marks**
Hours	**:**	**39L**		**SEE Duration:**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Understand the standard structure of HTML/XHTML and its differences.
2	Adapt HTML and CSS syntax & semantics to build web pages.
3	Learn the definitions and syntax of different web programming tools such as JavaScript, XML and Ajax to design web pages.
4	Design and develop interactive, client-side, server-side executable web applications using different techniques such as CSS, JavaScript, XML and Ajax.

Unit-I	**07 Hrs**
Introduction to Web, HTML and XHTML: Fundamentals of Web(Internet, WWW, Web Browsers and Web Servers, URLs, MIME, HTTP, Security, the Web Programmers Toolbox), XHTML: Basic syntax, Standard structure, Basic text markup, Images, Hypertext Links, Lists, Tables, Forms, Frames. **HTML 5:** Core HTML attributes, headings, paragraphs and breaks, quotations, preformatted text, lists, horizontal rules, block-level elements, text-level elements The audio Element; The video Element; Organization Elements; The time Element, Syntactic Differences between HTML and XHTML.	
Unit – II	**08 Hrs**
CSS (Cascading Style Sheet) Introduction, Levels of style sheets, Style specification formats, Selector forms, Property value forms, Font properties, List properties, Color, Alignment of text, The box model, Background images, The and tags, Conflict resolution. **The Basics of JavaScript:** Overview of JavaScript; Object orientation and JavaScript; General syntactic characteristics; Primitives, operations, and expressions; Screen output and keyboard input; Control statements.	
Unit –III	**09 Hrs**
JavaScript (continued): Object creation and modification; Arrays; Functions; Constructor; Pattern matching using regular expressions; Errors in scripts. **JavaScript and HTML Documents:** The JavaScript execution environment; The Document Object Model; Element access in JavaScript; Events and event handling; Handling events from the Body elements, Button elements, Text box and Password elements; The DOM 2 event model; The navigator object.	
Unit –IV	**08 Hrs**
Dynamic Documents with JavaScript: Introduction to dynamic documents; Positioning elements; Moving elements; Element visibility; Changing colors and fonts; Dynamic content; Stacking elements; Locating the mouse cursor; Reacting to a mouse click; Slow movement of elements; Dragging and dropping elements. **Introduction to PHP:** Origins and uses of PHP; overview of PHP; General syntactic characteristics; Primitives, Operations and Expressions; Output; Control statements; Arrays; Functions; Pattern Matching; Form Handling;Cookies; Session Tracking.	
Unit –V	**07 Hrs**
XML: Introduction; Syntax; Document structure; Document Type definitions; Namespaces; XML schemas; Displaying raw XML documents; Displaying XML documents with CSS; XSLT style sheets. **Ajax:** Overview of Ajax; Basics of Ajax: The Application; The Form Document; The Request Phase; The Response Document; The Receiver Phase.	

Course Outcomes: At the end of this course the student will be able to :	
CO1	Understand the basic syntax and semantics of HTML/XHTML.
CO2	Apply HTML/XHTML tags for designing static web pages and forms using Cascading Style Sheet.
CO3	Develop Client-Side Scripts using JavaScript and Server-Side Scripts using PHP and utilize the concepts of XML & Ajax to design dynamic web pages.
CO4	Develop web based applications using PHP, XML and Ajax.

Reference Books	
1	Programming the World Wide Web – Robert W. Sebesta, 7th Edition, Pearson Education, 2013, ISBN-13:978-0132665810.
2	Web Programming Building Internet Applications – Chris Bates, 3rd Edition, Wiley India, 2006, ISBN: 978-81-265-1290-4.
3	Internet & World Wide Web How to H program – M. Deitel, P.J. Deitel, A. B. Goldberg, 3rd Edition, Pearson Education / PHI, 2004, ISBN-10: 0-130-89550-4
4	The Complete Reference to HTML and XHTML- Thomas A Powell, 4th Edition, Tata McGraw Hill, 2003, ISBN: 978-0-07-222942-4.

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20. **Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.**

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**-**	**2**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**1**
CO2	**-**	**-**	**2**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**2**	**-**	**-**	**2**
CO4	**-**	**-**	**3**	**-**	**2**	**-**	**-**	**-**	**2**	**-**	**-**	**2**

High-3 : Medium-2 : Low-1

Semester: VII						
SOLID WASTE MANAGEMENT AND STATUTORY RULES (Group H: Global Elective)						
Course Code	**:**	**18G7H05**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**3:0:0:0**		**SEE**	**:**	**100 Marks**
Hours	**:**	**39L**		**SEE Duration:**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Impart the knowledge of present methods of solid waste management system and to analyze the drawbacks.
2	Understand various waste management statutory rules for the present system.
3	Analyze different elements of solid waste management and design and develop recycling options for biodegradable waste by composting.
4	Identify hazardous waste, e-waste, plastic waste and bio medical waste and their management systems.

Unit-I	**08 Hrs**
Introduction: Present solid waste disposal methods. Merits and demerits of open dumping, incineration, pyrolysis, composting, sanitary landfill. Scope and importance of solid waste management. Definition and functional elements of solid waste management. **Sources**: Sources of Solid waste, types of solid waste, composition of municipal solid waste, generation rate, Problems. **Collection and transportation of municipal solid waste:** Collection of solid waste- services and systems, Municipal Solid waste (Management and Handling) 2016 rules with amendments. Site visit to collection system.	
Unit – II	**08 Hrs**
Composting Aerobic and anaerobic composting - process description, process microbiology, Vermicomposting, Site visit to compost plant, Numerical problems. **Sanitary land filling**: Definition, advantages and disadvantages, site selection, methods, reaction occurring in landfill- Gas and Leachate movement, Control of gas and leachate movement, Site visit to landfill site.	
Unit –III	**08 Hrs**
Hazardous waste management: Definitions, Identification of hazardous waste, Classification of hazardous waste, onsite storage, collection, transfer and transport, processing, disposal, Hazardous and other wastes (Management and Transboundary Movement) Rules, 2016 with amendments. Site visit to hazardous landfill site	
Unit –IV	**08 Hrs**
Bio medical waste management: Classification of bio medical waste, collection, transportation, disposal of bio medical waste, Biomedical waste management (Management & Handling Rules) 2016 with amendments. Site visit to hospital to observe biomedical waste collection and transportation system and visit to biomedical waste incineration plant.	
Unit –V	**07 Hrs**
E-waste management: Definition, Components, Materials used in manufacturing electronic goads, Recycling and recovery integrated approach. e-waste (Management) Rules 2016 and amendments. Site visit to e- waste treatment plant. **Plastic waste management:** Manufacturing of plastic with norms. Plastic waste management. Plastic manufacture, sale & usage rules 2009 with amendments.	

Course Outcomes: At the end of this course the student will be able to :	
CO1	Understand the current solid waste management system and statutory rules.
CO2	Analyse drawbacks in the present system and provide recycling and disposal options for each

	type of waste in compliance to rules.
CO3	Distinguish Hazardous waste, Biomedical waste, E waste and to provide scientific management system.
CO4	Evaluate and monitor the Biomedical waste, Hazardous waste, E waste, Plastic and Municipal waste management as per the rules laid by Ministry of Environment, Forest and Climate change.

Reference Books	
1	Integrated Solid Waste Management, George.C. Tchobanoglous, International edition ,1993, McGraw hill publication. ISBN 978-0070632370
2	Electronic waste management, R.E. Hester, Roy M Harrison, , Cambridge, UK, 2009, RSC Publication, ISBN 9780854041121
3	Solid Waste Management Rules 2016 , Ministry of Environment, Forest and Climate Change Notification, New Delhi, 8th April 2016
4	Hazardous and other wastes (Management and Transboundary Movement) Rules, 2016, Ministry of Environment, Forest and Climate Change Notification, New Delhi, 04th April, 2016.
5	Biomedical waste management (Management & Handling Rules) 2016,. Ministry of Environment & Forest Notification, New Delhi, amendment on 28th March, 2016.
6	E-waste (Management) Rules 2016, Ministry of Environment, Forest and Climate Change Notification, New Delhi, 23rd March , 2016.
7	Plastic Waste (Management and Handling) Rules, 2011 as amended in 2018, Ministry of Environment, Forest and Climate Change Notification, New Delhi, 27th March , 2018

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20. **Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.**

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	-	-	-	2	2	1	-	1	-	2
CO2	2	2	2	2	-	1	2	1	-	-	-	-
CO3	1	-	2	2	-	1	2	1	-	1	-	-
CO4	2	-	-	3	-	1	2	1	-	-	-	1

High-3 : Medium-2 : Low-1

Semester: VII						
IMAGE PROCESSING AND MACHINE LEARNING (Group H: Global Elective)						
Course Code	**:**	**18G7H06**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Hours	**:**	**40 L**		**SEE Duration:**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Understand the major concepts and techniques in image processing and Machine Learning
2	To explore, manipulate and analyze image processing techniques
3	To become familiar with regression methods, classification methods, clustering methods.
4	Demonstrate image processing and Machine Learning knowledge by designing and implementing algorithms to solve practical problems

Unit-I	**08 Hrs**
Introduction to image processing: Introduction to image processing, Applications of image processing, Components of an image processing system, Fundamental steps in image processing, Image formation and representation, Color imagery, basic definitions, Pixels, Image resolution, PPI and DPI, Bitmap images, Lossless and lossy compression, Image file formats, Color spaces, Bezier curve, Ellipsoid, Gamma correction, Examples of zooming and shrinking in image processing Advanced image concepts.	
Unit – II	**08 Hrs**
Basics of Python, Scikit image & Advanced Image Processing using Open CV: Basics of python, variables & data types, data structures, control flow & conditional statements, uploading & viewing an image, Image resolution, gamma correction, determining structural similarities.	
Unit –III	**08 Hrs**
Advanced Image processing using Open CV Blending Two Images, Changing Contrast and Brightness Adding Text to Images Smoothing Images, Median Filter, Gaussian Filter, Bilateral Filter, Changing the Shape of Images, Effecting Image Thresholding, Calculating Gradients, Performing Histogram Equalization	
Unit –IV	**08 Hrs**
Image Processing using Machine Learning Feature mapping using SIFT algorithm, Image registration using the RANSAC algorithm, Image classification using Artificial Neural Networks, Image classification using CNNs, Image classification using machine learning Approaches.	
Unit –V	**08 Hrs**
Real time use CASES Exhaustive vs. Stochastic Search, Shapes, Contours, and Appearance Models. Mean-shift tracking; Contour-based models, finding palm lines, Face Detection / Recognition, Tracking movements.	

Course Outcomes: At the end of this course the student will be able to :	
CO1	Gain knowledge about basic concepts of Image Processing
CO2	Identify machine learning techniques suitable for a given problem
CO3	Write programs for specific applications in image processing
CO4	Apply different techniques for various applications using machine learning techniques.

Reference Books	
1	Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods Pearson Education, 3rd Edition, ISBN 978-81-317-2695-2.
2	Practical Machine Learning and Image Processing: For Facial Recognition, Object Detection, and Pattern Recognition Using Python, Himanshu Singh, 1st Edition, Apress, ISBN:978-1-4842-4149-3

3	Pattern Recognition and Machine Learning, Christopher Bishop, 1st Edition Springer, 2008, ISBN: 978-0387-31073-2
4	Computer Vision: A modern Approach, David Forsyth and Jean Ponce, 2nd Edition, Prentice Hall India 2004, ISBN: 978-0136085928

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20. **Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.**

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
CO2	**-**	**3**	**-**	**1**	**2**	**-**	**-**	**1**	**2**	**-**	**-**	**1**
CO3	**3**	**-**	**2**	**1**	**3**	**-**	**-**	**1**	**1**	**1**	**-**	**1**
CO4	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**1**	**1**	**1**	**-**	**1**

High-3 : Medium-2 : Low-1

Semester: VII						
RENEWABLE ENERGY SOURCES AND STORAGE SYSTEM (Group H: Global Elective)						
Course Code	**:**	**18G7H07**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Hours	**:**	**39 L**		**SEE Duration:**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Understand Concepts of nonconventional energy sources and allied technology required for energy conversion.
2	Analyse the Basics of battery working and sizing of battery for a given application.
3	Design aspects of solar and wind power systems.
4	Energy storage techniques

UNIT-I	**08 Hrs**
Basics of Renewable Energy: Energy balance of the earth, Solar radiation, wind energy, geothermal energy. **Geothermal Energy** – principles, technical description, heat supply by hydro-geothermal systems, heat supply by deep wells, geothermal generation, economic and environmental analysis. **Biomass Energy:** Biomass Production, Energy Plantation, Biomass Gasification, Theory of Gasification, Gasifier and Their Classifications, Updraft, Downdraft and Cross-draft Gasifiers, Applications of Biomass Gasifier. **Tidal Energy:** Introduction, Tidal Energy Resource, Tidal Power Basin, Advantages and Disadvantages of Tidal Power.	
Unit – II	**08 Hrs**
Photo Voltaic Systems: PV Cell, Module and array; Equivalent electrical circuit, Open –circuit voltage and short circuit current, I-V and P-V curves, Array design, Peak power Tracking, System Components, **Grid Connected Solar PV Power System:** Introduction to grid connected PV system, Configuration of Grid-connected solar PV system, Components of Grid –connected solar PV systems, Grid connected PV system Design for small power Applications, Grid- connected PV system design for power plants.	
Unit -III	**08 Hrs**
Wind Power: Introduction, site selection, Advantages and Disadvantages, Wind power installations in the world. **Wind Speed and Energy:** Speed and Power Relations, Power Extracted from the wind. Rotor-Swept Area, Air Density, Global Wind Patterns, Wind Speed Distribution, Weibull Probability, Distribution, Mode and Mean Speeds, Root Mean Cube Speed, Mode, Mean, and RMC Speeds, Energy Distribution, Digital Data Processing, Effect of Hub Height, Importance of Reliable Data, Wind Speed Prediction, Wind Energy Resource Maps. **Wind Power Systems:** System Components, Tower, Turbine, Blades, Speed Control, Turbine Rating, Power vs Speed and TSR.	
Unit –IV	**08 Hrs**
Wind Power Systems: Maximum Energy Capture, Maximum Power Operation Constant-TSR Scheme, Peak-Power-Tracking scheme, System-Design Trade-offs, Turbine Towers and Spacing, Number of Blades, Rotor Upwind or Downwind, Horizontal vs. Vertical Axis. **System Control Requirements**: Speed Control, Rate Control. **Environmental Aspects**: Audible Noise, Electromagnetic Interference (EMI), Effects on Birds.	
Unit –V	**07 Hrs**
Energy storage **Batteries:** Different types of batteries, Equivalent Electrical Circuit, Battery charging, Battery management **Flywheels**: Energy Relations, Components, Benefits over battery **Other Storage devices:** Superconducting magnetic energy storage, Compressed air, Pumped storage hydropower, Hydrogen Energy storage	

Course Outcomes: At the end of this course the student will be able to :	
CO1	Understand the concepts of power generation from various renewable sources.
CO2	Design the Size of the battery required for solar PV applications.
CO3	Design main components of solar and wind power systems.
CO4	Execute projects in renewable power generation.

Reference Books	
1	Renewable energy: Technology, Economics and Environment, Martin Kaltschmitt, Wolfgang Streicher Andreas Wiese, Springer Publication, 2007, ISBN 978-3-540-70947-3
2	Solar photo voltaic Technology and systems, Chetan Singh Solanki, third edition(2013), PHI , Learning private limited New Delhi ISBN: 978-81-203-4711-3
3	Wind and solar power system design, Analysis and operation, Mukund R. Patel, 2nd Edition. CRC Group ,Taylor and Francis group, New Delhi ,ISBN 978-0-8493-1570-1
4	Power System Energy Storage Technologies, Paul Breeze, Academic Press, 2018, ISBN 978-0-12-812902-9

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20. **Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.**

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	3	2	-	-	-	-	-	1	-	1
CO2	3	3	2	1	1	2	-	-	-	1	-	1
CO3	3	2	2	2	2	2	2	1	-	1	-	1
CO4	3	3	3	3	2	3	1	1	1	3	1	3

High-3 : Medium-2 : Low-1

Semester: VII						
MEMS & APPLICATIONS (Group H: Global Elective)						
Course Code	**:**	**18G7H08**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Hours	**:**	**39 L**		**SEE Duration:**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Understand the rudiments of Micro fabrication techniques.
2	Identify and associate the various sensors and actuators to applications.
3	Analyze different materials used for MEMS.
4	Design applications of MEMS to disciplines.

Unit-I	**06 Hrs**
Overview of MEMS & Microsystems: MEMS and Microsystems, Typical MEMS and micro system products, Evolution of micro fabrication, Microsystems and microelectronics, Multidisciplinary nature of Microsystems, Design and manufacture, Applications of Microsystems in automotive, healthcare, aerospace and other industries. **Working Principle of Microsystems**: Biomedical and biosensors. Micro sensors: Acoustic, Chemical, Optical, Pressure, Thermal.	
Unit – II	**09 Hrs**
Micro actuation: Using thermal forces, shape memory alloys, Piezoelectric crystals and electrostatic forces. MEMS with micro actuators: Microgrippers, micromotors, microvalves and micropumps, microaccelerometers, microfluidics**.** **Introduction to Scaling:** Scaling in Geometry, Scaling in Rigid body dynamics, Scaling in Electrostatic forces, scaling in electromagnetic forces and scaling in fluid mechanics.	
Unit –III	**09 Hrs**
Materials for MEMS and Microsystems: Substrates and wafers, Active substrate materials, Silicon as substrate material, Silicon Compounds, Si-Piezoresistors, GaAs, Quartz, Piezoelectric Crystals, Polymers and packaging materials. Three level of Microsystem packaging, Die level packaging, Device level packaging, System level packaging. Interfaces in microsystem packaging. Essential packaging technologies: die preparation, Surface bonding, Wire bonding, Sealing, 3D packaging.	
Unit –IV	**08 Hrs**
Microsystem Fabrication Process: Introduction to microsystems, Photolithography, Ion Implantation, Diffusion, Oxidation, CVD,PVD-Sputtering, Deposition by Epitaxy, Etching, LIGA process: General description, Materials for substrates and photoresists, Electroplating and SLIGA process.	
Unit –V	**07 Hrs**
Micro Sensors, Actuators, Systems and Smart Materials: An Overview Silicon Capacitive Accelerometer, Piezo resistive Pressure sensor, Fibre-optic sensors, Conductometric Gas Sensor, Electrostatic Comb drive, Magnetic Microrelay, Portable blood analyzer, Piezo electric Inkjet Print head, Micromirror array for Video projection, Micro-PCR Systems, Smart materials and systems.	

Course Outcomes: At the end of this course the student will be able to :	
CO1	Understand the operation of micro devices, micro systems and their applications.
CO2	Apply the principle of material science to sensor design.
CO3	Analyze the materials used for sensor designs.
CO4	Conceptualize and design micro devices, micro systems.

Reference Books	
1	MEMS & Microsystems Design and Manufacture, Tai-Ran Hsu, 2nd Edition, 2002, Tata McGraw Hill Education, New Delhi, ISBN-13:978-0-07-048709-3.

2	Micro and Smart Systems, G.K. Ananthasuresh, K.J .Vinoy, K.N. Bhat, V.K. Aatre, 2015, Wiley Publications, ISBN-:978-81-265-2715-1.
3	Foundations of MEMS, Chang Liu, 2012, Pearson Education Inc., ISBN-13:978-0-13-249736-7.
4	Smart Material Systems and MEMS, Vijay K Varadan, K. J. Vinoy, S. Gopalakrishnan, 2006, Wiley-INDIA, ISBN-978-81-265-3170-7.

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20. **Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.**

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**
CO2	**3**	**2**	**2**	**1**	**-**	**-**	**-**		**-**	**1**	**-**	**1**
CO3	**3**	**3**	**2**	**2**	**1**	**-**	**-**		**-**	**1**	**-**	**1**
CO4	**3**	**3**	**3**	**3**	**1**	**-**	**-**		**1**	**1**	**1**	**1**

High-3 : Medium-2 : Low-1

Semester: VII						
PROJECT MANAGEMENT (Group H: Global Elective)						
Course Code	**:**	**18G7H09**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**3:0:0:0**		**SEE**	**:**	**100 Marks**
Hours	**:**	**39L**		**SEE Duration:**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	To understand the principles and components of project management.
2	To appreciate the integrated approach to managing projects.
3	To explain different process groups and knowledge areas used to manage project.

Unit-I	**07 Hrs**
Introduction: What is project, what is project management, relationships among portfolio management, program management, project management, and organizational project management, relationship between project management, operations management and organizational strategy, business value, role of the project manager, project management body of knowledge.	
Unit – II	**09 Hrs**
Organizational influences & Project life cycle: Organizational influences on project management, project state holders & governance, project team, project life cycle. **Project Integration Management**: Develop project charter, develop project management plan, direct & manage project work, monitor & control project work, perform integrated change control, close project or phase.	
Unit –III	**09 Hrs**
Project Scope Management: Project scope management, collect requirements define scope, create WBS, validate scope, control scope. **Project Time Management**: Plan schedule management, define activities, sequence activities, estimate activity resources, estimate activity durations, develop schedule, control schedule.	
Unit –IV	**07 Hrs**
Project Cost management: Project Cost management, estimate cost, determine budget, control costs. **Project Quality management**: Plan quality management, perform quality assurance, control quality.	
Unit –V	**07 Hrs**
Project Risk Management: Plan risk management, identify risks, perform qualitative risk analysis, perform quantitative risk analysis, plan risk resources, control risk. **Project Procurement Management**: Project Procurement Management, conduct procurements, control procurements, close procurement.	

Course Outcomes: At the end of this course the student will be able to :	
CO1	Understand the concepts, tools and techniques for managing large projects.
CO2	Explain various knowledge areas and process groups in the project management framework.
CO3	Analyze and evaluate risks in large and complex project environments.
CO4	Develop project plans for various types of organizations.

Reference Books	
1	A Guide to the Project Management Body of Knowledge(PMBOK Guide), Project Management Institute, 5th Edition, 2013, ISBN: 978-1-935589-67-9
2	Project Planning Analysis Selection Financing Implementation & Review, Prasanna Chandra, 7th Edition, 2010, Tata McGraw Hill Publication, ISBN 0-07-007793-2.
3	Project Management A System approach to Planning Scheduling & Controlling, Harold Kerzner, 10th Edition, 2009, CBS Publishers and Distributors, ISBN 047027806.
4	Strategic Project Management Made Simple: Practical Tools for Leaders and Teams, Terry

	Schmidt, 1st Edition, 2009, John Wiley & Sons, ISBN: 978-0470411582

Continuous Internal Evaluation (CIE); Theory (100 Marks)
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Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2											
CO2	2	2		1	1							
CO3							1	1				
CO4	2		3		1							

High-3 : Medium-2 : Low-1

Semester: VII						
CYBER FORENSICS AND DIGITAL INVESTIGATIONS (Group H: Global Elective)						
Course Code	**:**	**18G7H10**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Hours	**:**	**39 L**		**SEE Duration:**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	To provide an understanding Computer forensics fundamentals and comprehend the impact of cybercrime and forensics.
2	Describe the motive and remedial measures for cybercrime, detection and handling.
3	Demonstrate and investigate the use of Tools used in cyber forensics.
4	Analyse areas affected by cybercrime and identify Legal Perspectives in cyber security.

Unit-I	**09 Hrs**
Introduction to Cybercrime: Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, Cybercrime Era: Survival Mantra for the Netizens. **Cyber offenses: How Criminals Plan Them**: How Criminals Plan the Attacks, Social Engineering, Cyberstalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.	
Unit – II	**08 Hrs**
Cybercrime: Mobile And Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for organizations, Organizational Measures for Handling Mobile devices, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.	
Unit –III	**07 Hrs**
Tools And Methods Used In Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks. **Phishing and Identity Theft**: Introduction, Phishing, Identity Theft (ID Theft).	
Unit –IV	**08 Hrs**
Understanding Computer Forensics: Introduction, Historical Background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber forensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Setting up a Computer Forensics Laboratory: Understanding the Requirements, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Anti-forensics.	
Unit –V	**07 Hrs**
Cybercrime And Cyber Security: The Legal Perspectives-Introduction, Why Do We Need Cyber laws: The Indian Context, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India, Digital Signatures and the Indian IT Act, Amendments to the Indian IT Act, Cybercrime and Punishment.	

Course Outcomes: At the end of this course the student will be able to :	
CO1	Interpret the basic concepts of cyber security, cyber law and their roles.
CO2	Articulate evidence collection and legal challenges.
CO3	Discuss tool support for detection of various attacks.
CO4	Demonstrate through use of proper tools knowledge on the cyber security, Cybercrime and

	forensics

Reference Books	
1	Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives, Sunit Belapure and Nina Godbole, , Wiley India Pvt Ltd, ISBN: 978-81-265-21791, 2013.
2	Introduction to information security and cyber laws, Dr. Surya Prakash Tripathi, Ritendra Goyal, Praveen Kumar Shukla, KLSI. Dreamtech Press, ISBN: 9789351194736, 2015.
3	Cybersecurity: Managing Systems, Conducting Testing, and Investigating Intrusions, Thomas J. Mowbray, Copyright © 2014 by John Wiley & Sons, Inc, ISBN: 978 -1-118 84965 -1
4	Cyber Forensics, Technical Publications, I. A. Dhotre, 1st Edition, 2016, ISBN-13: 978-9333211475

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20. **Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.**

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	-	-	-	-	-	-	3	1	-	-
CO2	1	2	-	2	2	-	-	2	2	3	1	2
CO3	2	3	-	2	2	2	-	2	3	2	-	-
CO4	3	2	3	2	3	1	-	2	3	2	1	1

High-3 : Medium-2 : Low-1

Semester: VII						
ROBOTICS AND AUTOMATION (Group H: Global Elective)						
Course Code	**:**	**18G7H11**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Hours	**:**	**39 L**		**SEE Duration:**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Understand the concepts of robotics and automation.
2	Impart the knowledge of robotic programming and robotic operation control
3	Selection and analysis of robot configuration and kinematics
4	Importance of automation manufacturing techniques and processing industries
5	Development of automation system for manufacturing and processing industries

Unit-I	**06 Hrs**
Introduction - Basics of kinematics, Anatomy of robot, Robot configuration, Robot joints, Sensors and drive system, Control modes, Specification of robots, Robot programming methods.	
Unit – II	**09 Hrs**
Robot Kinematics - Position and orientation of objects, Objects coordinate frame, Rotation matrix, Euler angles roll, pitch and yaw angles coordinate transformations, Joint variables and position of end effector, Homogeneous transformation. **D-H parameters** and conventions, D-H matrix, Direct kinematic and inverse analysis of planar and 3 DoF robots.	
Unit –III	**10 Hrs**
Trajectory planning - Introduction, Path versus trajectory, Joint-space versus Cartesian-space descriptions, Basics of trajectory planning, Joint-space trajectory planning, Third-order and Fifth-order polynomial trajectory planning. **Automation in Production Systems** - Manufacturing support systems, Automation principles and strategies, Levels of Automation, Production Concepts and Mathematical models, Numericals.	
Unit –IV	**08 Hrs**
Machine Vision - Object recognition by features, Basic features used for object identification, Moments, Template matching, Discrete Fourier descriptors, Computed Tomography (CT), Depth measurement with vision systems, Scene analysis versus mapping, Range detection and Depth analysis, Stereo imaging, Scene analysis with shading and sizes, Specialized lighting, Image data compression, Intraframe spatial domain techniques, Interframe coding, Compression techniques, Colour images, Heuristics, Applications of vision systems	
Unit –V	**06 Hrs**
Flexible Manufacturing Systems - Introduction to FMS - concepts, integration in the data processing systems, FMS scheduling. Case studies. Material Handling systems - Conveyors - AGVs – industrial robots in material handling – Automated Storage and retrieval system. Distributed data processing in FMS - Database Management System and their applications in CAD/CAM and FMS – distributed systems in FMS - Integration of CAD and CAM	

Course Outcomes: At the end of this course the student will be able to :	
CO1	Understand the characteristics and working principle of robots.
CO2	Apply the related mathematical model to formulate the kinematics and trajectory planning of industrial robot.
CO3	Analyse the machine vision for effective Flexible Manufacturing Systems.
CO4	Develop model and integrate drives for industrial robots and automation systems.

Reference Books

1	Mohsen Shahinpoor, "A Robot Engineering Textbook", Harper & Row Publishers, 3rd Edition, New York, ISBN:006045931X
2	John J. Craig, "Introduction to Robotics", Pearson Education International, 3rd Edition, ISBN:109876543, 1-13-123629-6
3	Mikell P Groover, "Automation, Production Systems, and Computer-integrated Manufacturing", Pearson Publishing, 3rd Edition, 2014, ISBN 978 81 203 3418 2
4	Joseph Talavage, "Flexible Manufacturing Systems in Practice Design: Analysis and Simulation", CRC Press, 1987, ISBN 9780824777180

Continuous Internal Evaluation (CIE); Theory (100 Marks)
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Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	1	-	-	1	-	-	-	2	-	2
CO2	3	3	1	3	1	1	-	-	-	2	-	2
CO3	2	-	2	-	1	1	-	-	2	-	-	2
CO4	3	3	2	3	1	1	-	2	3	-	3	2

High-3 : Medium-2 : Low-1

Semester: VII						
SPACE TECHNOLOGY AND APPLICATIONS **(Group H: Global Elective)**						
Course Code	**:**	**18G7H12**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**3:0:0:0**		**SEE**	**:**	**100 Marks**
Hours	**:**	**39L**		**SEE Duration:**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Define the earth environment and its behaviour, launching vehicles for satellites and its associated concepts.
2	Analyse satellites in terms of technology, structure and communications.
3	Use satellites for space applications, remote sensing and metrology.
4	Apply the space technology, technology mission and advanced space systems to nation's growth.

UNIT-I	**08 Hrs**
Earth's environment: Atmosphere, ionosphere, Magnetosphere, Van Allen Radiation belts, Interplanetary medium, Solar wind, Solar- Earth Weather Relations. **Launch Vehicles:** Rocketry, Propellants, Propulsion, Combustion, Solid, Liquid and Cryogenic engines, Control and Guidance system, Ion propulsion and Nuclear Propulsion.	
UNIT-II	**07 Hrs**
Satellite Technology: Structural, Mechanical, Thermal, Power control, Telemetry, Telecomm and Quality and Reliability, Payloads, Classification of satellites. **Satellite structure:** Satellite Communications, Transponders, Satellite antennas.	
UNIT-III	**08 Hrs**
Satellite Communications: LEO, MEO and GEO orbits, Altitude and orbit controls, Multiple Access Techniques. **Space applications:** Telephony, V-SAT, DBS system, Satellite Radio and TV, Tele-Education, Tele-medicine, Satellite navigation, GPS.	
UNIT-IV	**08 Hrs**
Remote Sensing: Visual bands, Agricultural, Crop vegetation, Forestry, water Resources, Land use, Land mapping, geology, Urban development resource Management, and image processing techniques. **Metrology:** Weather forecast (Long term and Short term), weather modelling, Cyclone predictions, Disaster and flood warning, rainfall predictions using satellites.	
UNIT-V	**08Hrs**
Space Missions: Technology missions, deep space planetary missions, Lunar missions, zero gravity experiments, space biology and International space Missions. **Advanced space systems:** Remote sensing cameras, planetary payloads, space shuttle, space station, Inter-space communication systems.	

Course Outcomes: At the end of this course the student will be able to :	
CO1	Explain different types of satellites, orbit and associated subsystems.
CO2	Apply the basics of launching vehicles, satellites and sub systems for space applications.
CO3	Analyze the applications of satellite in the area of communication, remote sensing, metrology etc.
CO4	Study technology trends, satellite missions and advanced space systems.

Reference Books	
1	Atmosphere, weather and climate, R G Barry, Routledge publications, 2009, ISBN- 10 :0415465702.
2	Fundamentals of Satellite Communication, K N Raja Rao, PHI, 2012, ISBN: 9788120324015.
3	Satellite Communication, Timothy pratt, John Wiley, 1986 ISBN: 978-0- 471- 37007 -9,

	ISBN 10: 047137007X.
4	Remote sensing and applications, B C Panda, VIVA books Pvt. Ltd., 2009, ISBN: 108176496308.

Continuous Internal Evaluation (CIE); Theory (100 Marks)
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Semester End Evaluation (SEE); Theory (100 Marks)
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CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1	---	---	---	---	---	---	---	---	1	---
CO2	2	2	1	1	---	---	---	---	---	---	1	---
CO3	2	2	1	---	---	---	---	---	---	---	1	---
CO4	2	2	1	---	---	---	---	---	---	---	1	---

High-3 : Medium-2 : Low-1

Semester: VII						
INTRODUCTION TO ASTROPHYSICS (Group H: Global Elective)						
Course Code	**:**	**18G7H13**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Hours	**:**	**39 L**		**SEE Duration:**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Familiarize with the various celestial bodies and the laws governing their behavior
2	Understand the fundamental concepts of relativity and establish the relation between light and matter
3	Study the methods used to identify and investigate the nature of different stellar bodies
4	Determine the characteristic features of any star by understanding its spectral properties
5	Contemplate the complex system of the milky way galaxy and its components

Unit-I	**07 Hrs**
Fundamental concepts in Astronomy: Origin of the Universe, Major constituents of the universe, Cosmic Microwave Radiation (CMR) background, Geocentric Universe, Retrograde Motion of planets, Brief introduction to the Copernican Revolution, Positions of the Celestial Sphere: Altitude-Azimuth Coordinate System, Equatorial Coordinate System, Solar System, Planets - laws of motion of planets, inner planets, outer planets,	
Unit – II	**08 Hrs**
Theory of Special Relativity: Galilean Transformations, Failure of Galilean Transformations, Lorentz Transformations, Derivation, Time & Space in Special Relativity, Momentum & Energy in Relativity, Doppler Effect for light (Red & Blue Shift), The equivalence principle, the principle of minimal gravitational coupling, Schwarzschild spacetime, Past-Present-Future (Light Cone diagram).	
Unit –III	**08 Hrs**
Stellar Astrophysics: Blackbody radiation, Connection between Color and Temperature, Stellar Parallax, Magnitude Scale, Life cycle of stars (Birth, Life & Death), Hertzsprung-Russel Diagram, Classification of Binary Stars, Mass Determination using Visual Binaries, Eclipsing Spectroscopic Binaries, Formation of Spectral Lines, Schrodinger's time-dependent and independent equations, Boltzmann-Saha Equation, Chandrashekar's Limit, black holes (qualitatively).	
Unit –IV	**08 Hrs**
Light and Matter: Dispersion of light (Prism & Grating), Spectral Lines, de-Broglie's Wavelength and Frequency, Heisenberg's Uncertainty Principle, Broadening of Spectral lines **Spectral Characterization of Stars:** Description of the Radiation Field, Stellar Opacity, Transfer Equation, Profile of Spectral Lines, Optical Telescopes, Radio Telescopes (Case Studies)	
Unit –V	**08 Hrs**
Galaxy Astronomy: The Milky way Galaxy, Counting the Stars, Historical Models, Differential & Integrated Star Counts, Extrasolar planets, Methods of detection of extrasolar planets, Distance to the Galactic Centre, Galactic Coordinate System, Classification of Galaxies, Introduction to Elliptical galaxies, Irregular galaxies, Dwarf galaxies.	

Course Outcomes: At the end of this course the student will be able to :	
CO1	Contemplate the nature of our universe by identifying and studying the behavior of celestial bodies.
CO2	Explain the usefulness of the theory of relativity, light and matter in establishing the fundamental

	behavior of stellar bodies.
CO3	Utilize various techniques to discover the components of our universe and conclude their celestial properties.
CO4	Interpret the spectral properties of any astronomical body to illustrate its properties.
CO5	Inspect the milky way galaxy to identify the proponents and their characteristic features.

Reference Books	
1	Carroll Bradley W, and Dale A Ostlie, An Introduction to Modern Astrophysics. Reading, 2nd Edition, 1995, MA: Addison-Wesley Pub, ISBN: 9780201547306.
2	Padmanabhan, T, Theoretical Astrophysics, Vols.1-3, 2005, Cambridge University Press, ISBN-9780521016278.
3	Shu F, The Physical Universe, New Edition, 1982, University of California, ISBN- 978-0935702057.
4	Harwit M, Astrophysical Concepts, 3rd Edition, 2000, Springer-verlag, ISBN- 978-0387949437.
5	Shapiro, Stuart L, and Saul A Teukolsky, Black Holes, White Dwarfs, and Neutron Stars, 1st Edition, 1983, Wiley, ISBN: 9780471873167.

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CO1	3	3	1	2	-	-	1	-	1	-	-	2
CO2	3	2	2	2	-	-	1	-	1	-	-	2
CO3	2	3	1	2	2	1	1	-	2	1	-	2
CO4	3	3	1	2	2	1	2	-	3	3	-	2

High-3 : Medium-2 : Low-1

Semester: VII						
MATERIALS FOR ADVANCED TECHNOLOGY AND SPECTROSCOPIC CHARACTERIZATION (Group H: Global Elective)						
Course Code	**:**	**18G7H14**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Hours	**:**	**40L**		**SEE Duration:**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Apply the basic concepts of Chemistry to develop futuristic materials for high-tech applications in the area of Engineering.
2	Impart sound knowledge in the different fields of material chemistry so as to apply it to the problems in engineering field.
3	Develop analytical capabilities of students so that they can characterize, transform and use materials in engineering and apply knowledge gained in solving related engineering problems.

Unit-I	**08 Hrs**

Coating and packaging materials

Surface Coating materials:

Synthesis and applications of Polymer coating materials: Teflon, Silicone films Polyvinyl chloride & its copolymers, Poly vinyl acetate, Poly ethylene-HDPE, LDPE, Polyurethane.

Properties required in a pigment and extenders.

Inorganic pigments-titanium dioxide, zinc oxide, carbon black, chromate pigments, molybdate orange, chrome green, ultramarine blue, iron blue, cadmium red.

Corrosion inhibiting pigments- zinc phosphate, zinc and barium chromate pigments, ceramic pigments, metal flake pigments, extenders.

Developments in new polymers such as dendrimers, biopolymers & biodegradable polymers.

Packaging materials:

Food products: Cellulosic and Polymeric packaging materials and their properties – including barrier properties, strength properties, optical properties. Glass, aluminum, tin, paper, plastics, composites.

Pharmaceutical products: Injectables and tablet packaging materials.

Unit – II	**08 Hrs**

Adhesives

Introduction-Classification of Adhesives-Natural adhesives, synthetic adhesives-drying adhesives, pressure sensitive adhesives, contact adhesives, hot adhesives. One-part adhesives, multi part adhesives. Adhesive Action. Development of Adhesive strength- Physical factors influencing Adhesive Action-surface tension, surface smoothness, thickness of adhesive film, elasticity and tensile strength. Chemical Factors Influencing Adhesive action - presence of polar groups, degree of polymerization, complexity of the adhesive molecules, effect of pH. Adhesive action- specific adhesive action, mechanical adhesive action, fusion adhesion. Development of adhesive strength- adsorption theory and diffusion theory. Preparation, curing and bonding Processes by adhesives-with reference to Epoxy, phenolics, Silicone, Polyurethane, Acrylic adhesives, Poly vinyl alcohol, Polyvinyl acetate.

Unit –III	**08 Hrs**

Optical fibre materials

Fiber Optics, Advantages of optical fiber communication over analog communication, Classification based on refractive index of the core- step index and graded index optical fibres, Classification based on core radius-single mode and multimode optical fibres, Fibre fabrication. -Methods to manufacture optical glass fibres. Double crucible method and preform methods. Manufacture of perform- Chemical Vapour Deposition (CVD), Modified vapour deposition (MCVD) Plasma activated vapour deposition (PCVD), Outside vapour deposition (OVD)-Vapour-phase axial deposition (VAD). Drawing the fibres from perform, coating and jacketing process.

Ion exchange resins and membranes

Ion exchange resins-Introduction, Types-cation and anion exchange resins, examples, physical properties, chemical properties-capacity, swelling, kinetics, stability, ion exchange equilibrium,

regeneration. Applications of ion exchange resins-softening of water, demineralization of water, advantages and disadvantages of ion exchange resins-calcium sulphate fouling, iron fouling, adsorption of organic matter, bacterial contamination. Ion exchange membranes, Types-anion and cation exchange membranes. Classification of ion exchange membranes based on connection way between charged groups and polymeric matrix-homogeneous and heterogeneous ion exchange membranes, examples. Fabrication of ion exchange cottons- anion exchange cotton and cation exchange cotton. Application of ion exchange membranes in purification of water by electro dialysis method.
Unit –IV **08 Hrs**
Spectroscopic Characterization of materials: Electromagnetic radiation, interaction of materials with electromagnetic radiation. UV- visible spectrophotometry**: Introduction**-Electronic transitions- factors influencing position and intensity of absorption bands-absorption spectra of dienes, polyene and α,β-unsaturated carbonyl compounds, Working of UV-Vis spectrophotometer, Theoretical calculation of λ_{max} by using Woodward-Fieser rules- for cyclic and α,β-unsaturated carbonyl compounds. IR Spectroscopy: Introduction, principle, molecular vibrations, vibrational frequency, number of fundamental vibrations, factors influencing fundamental vibrations, instrumentation of IR spectrophotometer, sampling techniques, application of IR spectroscopy in characterization of functional groups.
Unit –V **08 Hrs**
NMR spectroscopy: H^1 NMR Spectroscopy: Basic concepts- relaxation process. NMR spectrometer-FT NMR-Solvents used in NMR, internal standards-Chemical equivalence -Integrals and Integrations- chemical shift-Factors affecting chemical shifts- shielding and deshielding effects – chemical and magnetic equivalent – magnetic anisotropy-spin-spin splitting rules- Application of NMR on various compounds such as alkanes, alkenes, alkynes, alkyl halides, alcohols, ethers, amines, aldehydes, ketones, carboxylic acids, esters, amides & mono substituted aromatic compounds. Problems on prediction of structure of compounds. Application of NMR in magnetic resonance imaging (MRI).

Course Outcomes: At the end of this course the student will be able to :	
CO1	Identify sustainable engineering materials and understand their properties.
CO2	Apply the basic concepts of chemistry to develop futuristic materials for high-tech applications in different areas of engineering.
CO3	Analyze and evaluate the specific application of materials.
CO4	Design the route for synthesis of material and its characterization.

Reference Books	
1	Materials Science by G.K.Narula, K.S.Narula & V.K.Gupta. 38th Edtion, Tata McGraw-Hill Publishing Company Limited-2015, ISBN: 9780074517963
2	Solar Lighting by Ramachandra Pode and Boucar Diouf, Springer e-book, 2011, ISBN: 978-1-4471-2133-6 (Print) 978-1-4471-2134-3 (Online).
3	Spectroscopy of organic compounds by P.S.Kalsi, New Age International (P) ltd, Publisher, 2005, ISBN 13: 9788122415438
4	Food Packaging Materials. Mahadeviah M & Gowramma RV, Tata McGraw Hill Publishing Company Limited, 1996, ISBN :0074622382 9780074622384.

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Semester End Evaluation (SEE); Theory (100 Marks)

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CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	2	2	-	-	1	-	-
CO3	-	3	-	2	-	-	-	-	-	-	-	-
CO4	-	-	3	-	-	1	1	-	-	-	-	1

High-3 : Medium-2 : Low-1

Semester: VII						
APPLIED PSYCHOLOGY FOR ENGINEERS **(Group H: Global Elective)**						
Course Code	**:**	**18G7H15**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Hours	**:**	**39 L**		**SEE Duration:**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	To appreciate human behavior and human mind in the context of learner's immediate society and environment.
2	To understand the importance of lifelong learning and personal flexibility to sustain personal and Professional development as the nature of work evolves.
3	To provide students with knowledge and skills for building firm foundation for the suitable engineering professions.
4	To prepare students to function as effective Engineering Psychologists in an Industrial, Governmental or consulting organization.
5	To enable students to use psychological knowledge, skills, and values in occupational pursuits in a variety of settings that meet personal goals and societal needs.

Unit-I	**07 Hrs**
Introduction to Psychology: Definition and goals of Psychology: Role of a Psychologist in the Society: Today's Perspectives (Branches of psychology). Psychodynamic, Behavioristic, Cognitive, Humanistic, Psychological Research and Methods to study Human Behavior: Experimental, Observation, Questionnaire and Clinical Method.	
Unit – II	**09 Hrs**
Intelligence and Aptitude: Concept and definition of Intelligence and Aptitude, Nature of Intelligence. Theories of Intelligence – Spearman, Thurston, Guilford Vernon. Characteristics of Intelligence tests, Types of tests. Measurement of Intelligence and Aptitude, Concept of IQ, Measurement of Multiple Intelligence – Fluid and Crystallized Intelligence.	
Unit –III	**09 Hrs**
Personality: Concept and definition of personality, Approaches of personality- psychoanalytical, Socio- Cultural, Interpersonal and developmental, Humanistic, Behaviorist, Trait and type approaches. Assessment of Personality: Self- report measures of Personality, Questionnaires, Rating Scales and Projective techniques, its Characteristics, advantages & limitations, examples. Behavioral Assessment. Psychological Stress: a. Stress- Definition, Symptoms of Stress, Extreme products of stress v s Burnout, Work Place Trauma. Causes of Stress – Job related causes of stress. Sources of Frustration, Stress and Job Performance, Stress Vulnerability-Stress threshold, perceived control	
Unit –IV	**07 Hrs**
Application of Psychology in Working Environment: The present scenario of information technology, the role of psychologist in the organization, Selection and Training of Psychology Professionals to work in the field of Information Technology. Distance learning, Psychological consequences of recent developments in Information Technology. Type A and Type B Psychological Counseling - Need for Counseling, Types – Directed, Non- Directed, Participative Counseling.	
Unit –V	**07 Hrs**
Learning: Definition, Conditioning – Classical Conditioning, Basics of Classical Conditioning (Pavlov), the process of Extinction, Discrimination and Generalization. Operant Conditioning (Skinner expt). The basics of operant conditioning, Schedules of reinforcement. Cognitive – Social approaches to learning – Latent Learning, Observational Learning, Trial and Error Method, Insightful Learning.	

Course Outcomes: At the end of this course the student will be able to :	
CO1	Understand the application of psychology in engineering and technology and develop a route to accomplish goals in their work environment.
CO2	Define learning and compare and contrast the factors that cognitive, behavioral, and

	Humanistic theorists believe influence the learning process.
CO3	Develop understanding of psychological attributes such as intelligence, aptitude, creativity, resulting in their enhancement and apply effective strategies for self-management and self-improvement.
CO4	Apply the theories into their own and others' lives in order to better understand their personalities and experiences.

Reference Books	
1	Understanding Psychology Feldman R. S, IV edition, (1996) McGraw Hill India
2	Psychology Robert A. Baron, III edition (1995) Prentice Hall India.
3	Organizational Behaviour , Stephen P Robbins Pearson Education Publications, 13th Edition, ISBN – 81-317 – 1132 – 3
4	Organisational Behaviour : Human Behaviour at Work ,John W.Newstrem and Keith Davis. Tata McGraw Hill India, 10th Edition, ISBN 0-07-046504-5

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CO2	3	2	2	1	-	-	-	-	-	1	-	1
CO3	3	3	2	2	-	-	-	-	-	1	-	1
CO4	3	3	3	3	-	-	-	-	-	1	-	1

High-3 : Medium-2 : Low-1

Semester: VII						
ADVANCED COURSE IN ENTREPRENEURSHIP (Group H: Global Elective)						
Course Code	**:**	**18G7H16**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Hours	**:**	**39 L**		**SEE Duration:**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Acquire additional knowledge and skills for developing early customer traction into a repeatable business.
2	Learn the tools and methods for achieving sustainable growth, such as by refining their product or service and business models, building brand strategy, making a sales and financial plan
3	Develop brand strategy and create digital presence, Develop channel strategy for customer outreach.
4	Leverage social media to reach new customers cost effectively, Develop strategies to increase revenues and expand markets

Unit-I	**07 Hrs**
Intro to building Products & Value Proposition: Diagnose: Where are you today on the Product Life Cycle? Assess your Start-up's attractiveness **Competition & testing:** Conduct a Competition Analysis Identify your Competitive Advantage	
Unit – II	**06 Hrs**
Market Validation: Market validation, Customer Usability Interviews, Analyzing Customer feedback **Delivering Value:** Enlist marketing channels, Identify partners for your venture, Create a Sales plan	
Unit –III	**07 Hrs**
Customer acquisition & growth channels: Types of Marketing Channels: Targeting Blogs, Unconventional PR, Search Engine Marketing, Search Engine Optimization, Social ads, display ads and existing platforms, Email Marketing, Viral Marketing, Affiliate programs, Magazines, Newspaper, Radio and TV ads, Offline Ads, Trade Shows	
Unit –IV	**10 Hrs**
Business model: Reiterate and Refine your Business Model Canvas, Choose the right business model for your start-up **Financial Planning:** Forecasting sales and revenue projections, Cash-flow statement	
Unit –V	**09 Hrs**
Leveraging Technologies and Available Platforms: Identify the technology needs of your venture, Choose the key technologies and platforms for banking, accounting, sales, legal, and human resource management, Technology as a differentiator and a competitive weapon	

Experiential Learning: Student teams will present their practice ventures: business model, business plan, growth achieved, and key learnings to their classmates, faculty, and other entrepreneurs

Course Outcomes: At the end of this course the student will be able to :	
CO1	Develop strategies to increase revenues and expand markets, Explore licensing and franchising for business expansion.
CO2	Leverage technologies and platforms for growth stage companies, Develop key metrics to track progress.
CO3	Basics of registering a company, Understanding business regulations and compliances.
CO4	Advanced concepts of business finance, Financial planning.

Reference Books	
1	Running Lean: Iterate from Plan A to a Plan That Works. O'Reilly Media, Maurya, A., 2012.
2	Entrepreneurship. Roy, R., 2012. Oxford University Press
3	Intellectual Property Law in India. Gupta, T. S., 2011. Kluwer Law International
4	Flow: The Psychology of Optimal Experience. Czikszentmihalyi, M., 2008. Harper Perennial Modern Classics

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CO2	3	2	2	1	-	-	-	-	-	1	-	1
CO3	3	3	2	2	-	-	-	-	-	1	-	1
CO4	3	3	3	3	-	-	-	-	-	1	-	1

High-3 : Medium-2 : Low-1

Semester : VIII						
MAJOR PROJECT						
Course Code	**:**	**18ASP81**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**0:0:16**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**32**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1.	Acquire the ability to make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
2.	Acquire the skills to communicate effectively and to present ideas clearly and coherently to a specific audience in both written and oral forms.
3.	Acquire collaborative skills through working in a team to achieve common goals.
4.	Self-learn, reflect on their learning and take appropriate action to improve it.
5.	Prepare schedules and budgets and keep track of the progress and expenditure.

Major Project Guidelines:

1. The project topic, title and synopsis have to be finalized and submitted to their respective internal guide(s) before the beginning of the 8th semester.
2. The detailed Synopsis (approved by the department ***Project Review Committee***) has to be submitted during the 1st week after the commencement of 8th semester.

Batch Formation:

- Students are free to choose their project partners from within the program or any other program.
- Each student in the team must contribute towards the successful completion of the project. The project may be carried out In-house / Industry / R & D Institution.
- ***The project work is to be carried out by a team of two to four students , in exceptional cases where a student is placed in a company and offered an internship through the competitive process or student is selected for internship at national or international level through competitive process*****,** the student can work independently.
- ***The students are allowed to do either a project for full 5 days in the industry or full 5 days in the college.***
- ***In case the project work is carried out outside Bengaluru, such students must be available during Project Evaluation process scheduled by the respective departments and they must also interact with their guide regularly through Email / Webinar / Skype etc.***

Project Topic Selection:

The topics of the project work must be in the ***field of respective program areas or in line with CoE's(Centre of Excellence) identified by the college*** or **List of project areas as given by industry/Faculty. The projects as far as possible should have societal relevance with focus on sustainability.**

Students can select courses in ***NPTEL*** from the discipline of ***Humanities and Social Sciences, Management, Multidisciplinary and Design Engineering.*** The course chosen could be either of ***4w/8w/12w*** duration. The students need to enrol for a course, register for the exam and submit the e-certificate to the department, as and when it is released by NPTEL. ***The same will be considered as one of the components during project evaluation of phase 2 and phase 5.***

Project Evaluation:

- Continuous monitoring of project work will be carried out and cumulative evaluation will be done.

- The students are required to meet their internal guides once in a week to report their progress in project work.
- **Weekly Activity Report** (WAR) has to be maintained in the form of a diary by the project batch and the same has to be discussed with the Internal Guide regularly.
- In case of ***Industry project***, during the course of project work, the internal guides will have continuous interaction with external guides and will visit the industry at least twice during the project period.
- For CIE assessment the project groups must give a final seminar with the draft copy of the project report.
- The presentation by each group will be for 20-30 minutes and every member of the team needs to justify the contributions to the project.
- The project team is required to submit Hard copies of the detailed Project Report in the prescribed format to the department.
- For CIE 50% weightage should be given to the project guide and 50% weightage to the project evaluation committee.
- Before the final evaluations the project group is required to produce a No dues certificate from Industry, Central Library and Department.

Course Outcomes of Major Project:	
1	Apply knowledge of mathematics, science and engineering to solve respective engineering domain problems.
2	Design, develop, present and document innovative/multidisciplinary modules for a complete engineering system.
3	Use modern engineering tools, software and equipment to solve problem and engage in life-long learning to follow technological developments.
4	Function effectively as an individual, or leader in diverse teams, with the understanding of professional ethics and responsibilities.

CIE Assessment:

The following are the weightings given for the various stages of the project.

1. Selection of the topic and formulation of objectives 10%
2. Design and Development of Project methodology 25%
3. Execution of Project 25%
4. Presentation, Demonstration and Results Discussion 30%
5. Report Writing & Publication 10%

SEE Assessment:

The following are the weightages given during Viva Examination.

1. Written presentation of synopsis 10%
2. Presentation/Demonstration of the project 30%
3. Methodology and Experimental Results & Discussion 30%
4. Report 10%
5. Viva Voce 20%

Calendar of Events for the Project Work:

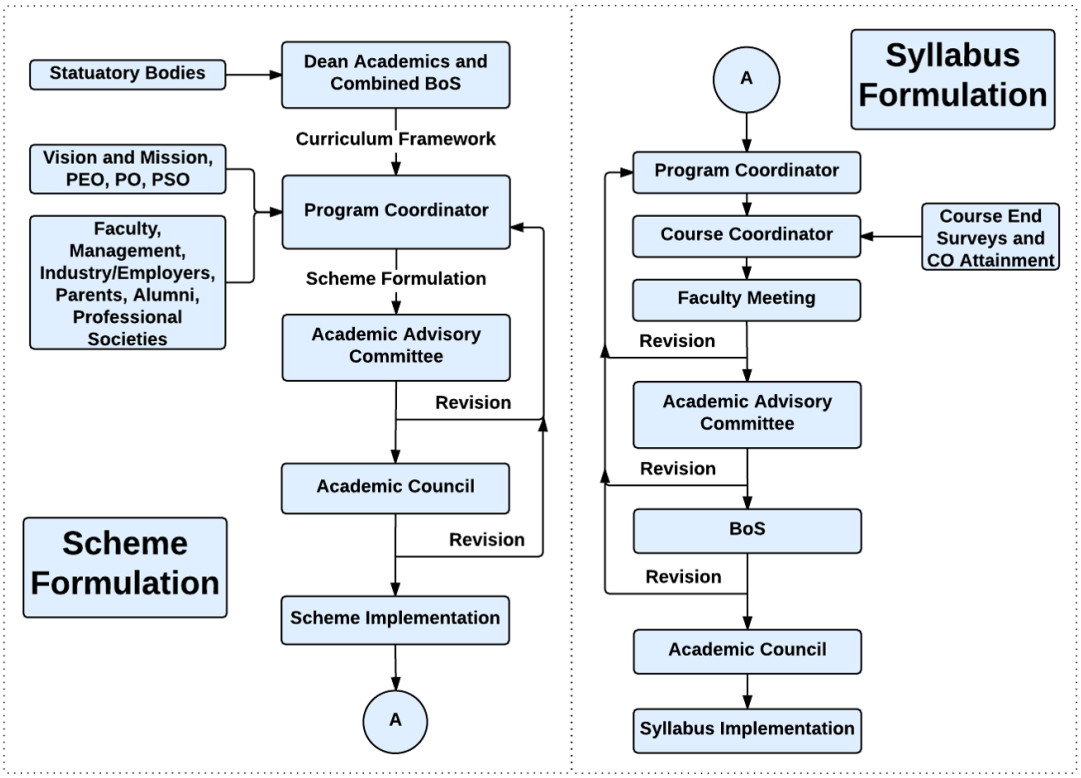
Week	Event
Beginning of 7th Semester	Formation of group and approval by the department committee.
7th Semester	Problem selection and literature survey
Last two weeks of 7th Semester	Finalization of project and guide allotment
II Week of 8th Semester	Synopsis submission and preliminary seminar

III Week	First visit of the internal guides to industry (In case of project being carried out in industry)
III to VI Week	Design and development of project methodology
VII to IX Week	Implementation of the project
X Week	Submission of draft copy of the project report
XI and XII Week	Second visit by guide to industry for demonstration. Final seminar by Department project Committee and guide for internal assessment. Finalization of CIE.

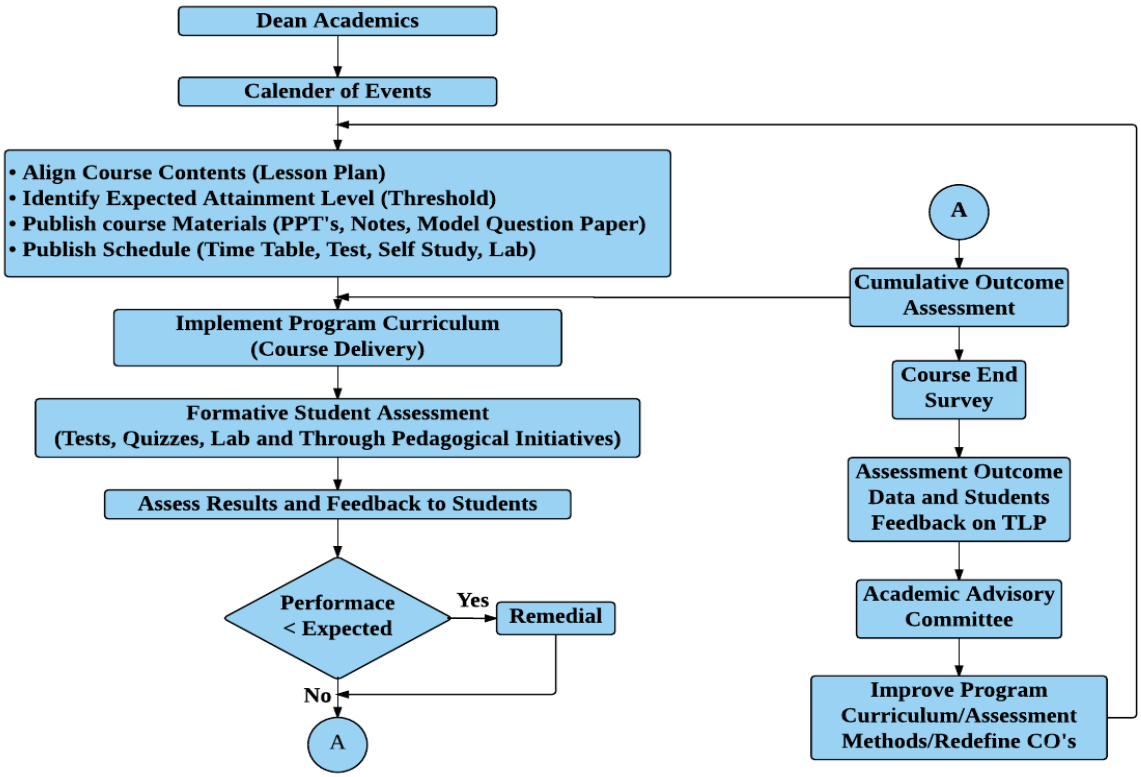
Evaluation Scheme for CIE and SEE

Scheme of Evaluation for CIE		**Scheme of Evaluation for SEE**	
Particulars	**%Marks**	**Particulars**	**%Marks**
Project Evaluation I	10%	Project Synopsis (Initial Write up)	10%
Project Evaluation II	25%	Project Demo / Presentation	30%
Project Evaluation III	25%	Methodology and Results Discussion	30%
Project Evaluation Phase-IV (Submission of Draft Project Report for Verification**)**	30%	Project Work Report	10%
Project Evaluation Phase-V (Project Final Internal Evaluation**)**	10%	Viva-voce	20%
Total	100	Total	100

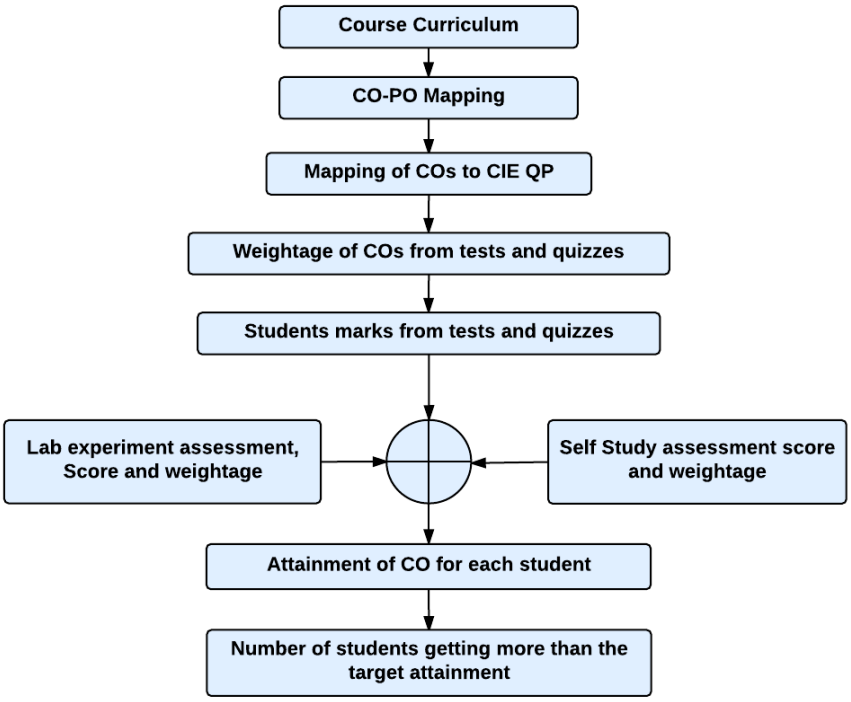
Curriculum Design Process



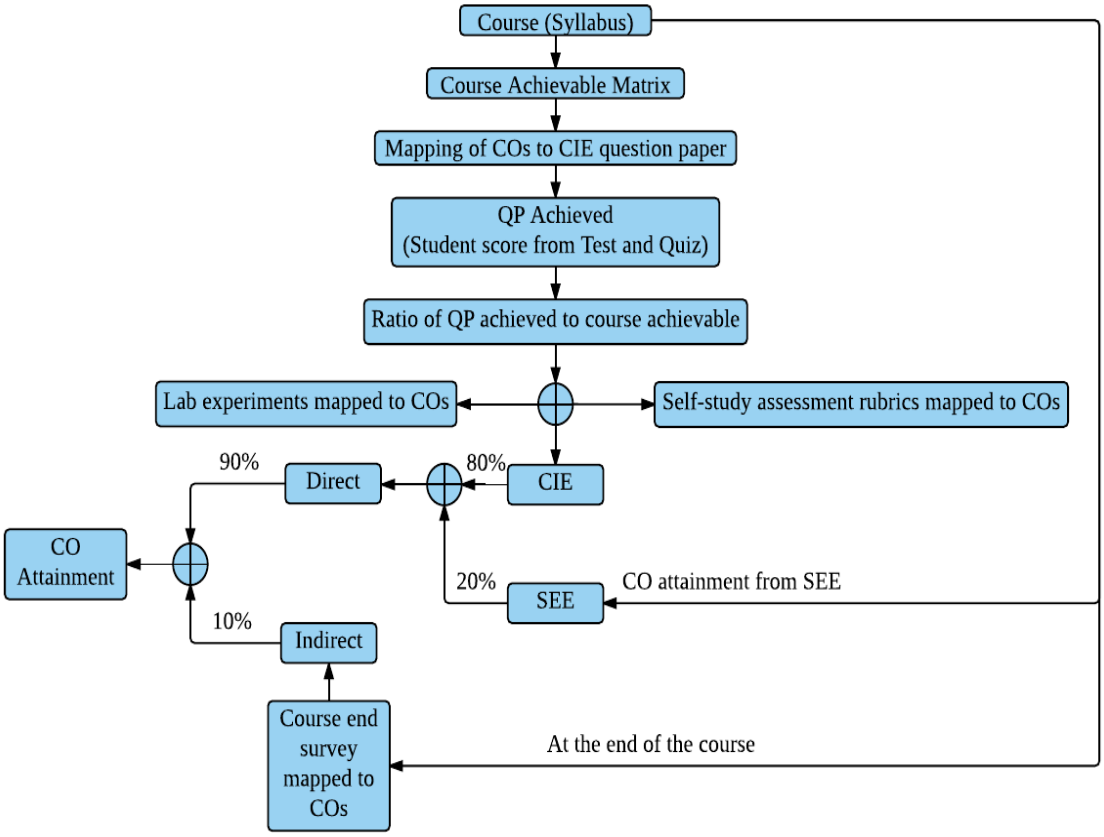
Academic Planning And Implementation



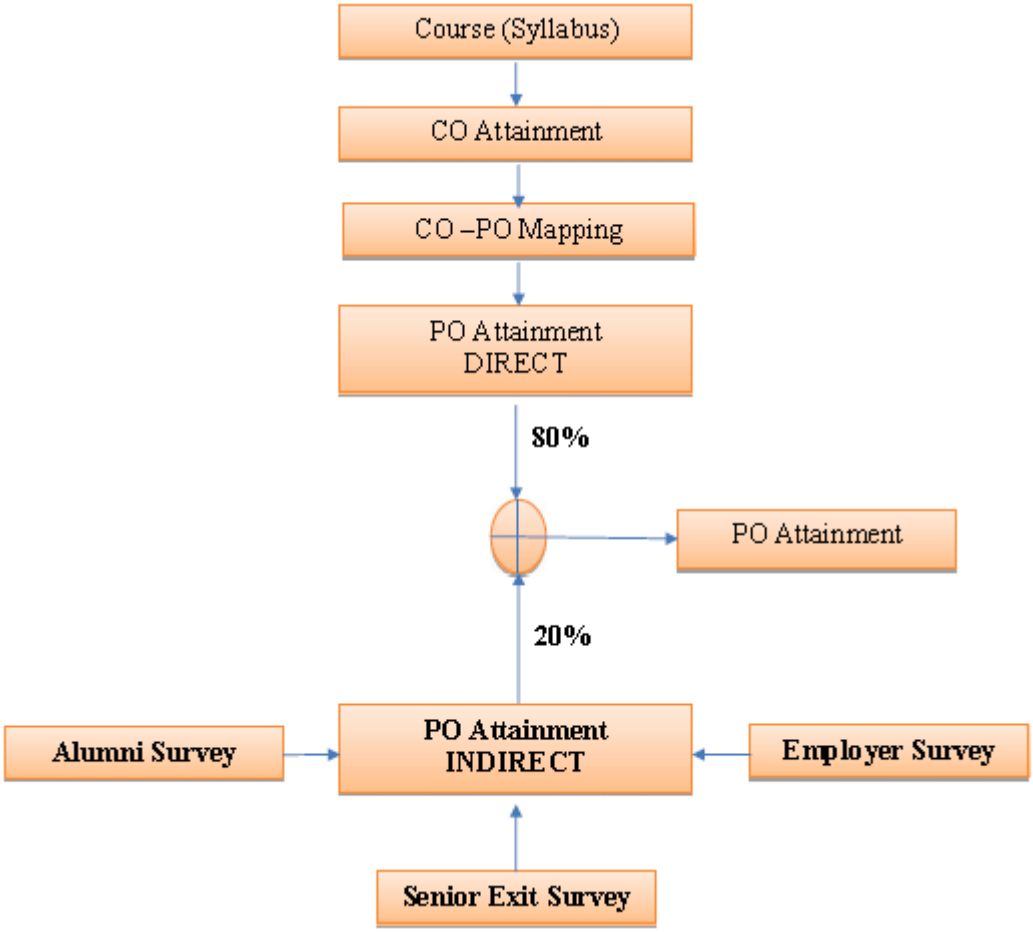
Process For Course Outcome Attainment



Final CO Attainment Process



Program Outcome Attainment Process



PROGRAM OUTCOMES (POs)

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation for the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex engineering activities, with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

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

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.