Deenbandhu Chhotu Ram University of Science & Technology, Murthal (Sonepat)
Scheme of Studies & Examinations under Choice Based Credit System
Programme: B.Tech. in Aeronautical Engineering; Year – 3rd(Semester – VI); Session: 2020-21

S. No.	Course Code	Course Title	Teaching Schedule			Marks of Class Work	Examination Marks		Total	Credit	Duration of Exam
			L	T	P		Theory	Practical			
1	AER 302 C	Vibration & Aero Elasticity	3	1	0	25	75	-	100	4	3
2	AER 304 C	Computational Fluid Dynamics	3	1	0	25	75	-	100	4	3
3		Professional Elective-I	3	1	0	25	75	-	100	4	3
4		Professional Elective-II	3	1	0	25	75	-	100	4	3
5		**Open Elective- I**	3	0	0	25	75	-	100	3	3
6	AER 306 C	Computational Fluid Dynamics lab	0	0	2	25	-	75	100	1	3
7	AER 308 C	In-house Project	0	0	6	100	-	-	100	3	3
Total			**15**	**4**	**8**	**250**	**375**	**75**	**700**	**23**	

List of Professional Elective- I & II Courses			List of Open Elective-I Courses (Any One)		
S. No.	**Course Code**	**Course Title**	**S. No.**	**Course Code**	**Course Title**
1	AER 322C	Space Dynamics	1	HUM201C	Professional Communication for Engineers (Except for BT and BME)
2	AER 324C	Helicopter Dynamics	2	HUM	Soft Skills and Inter-personal Communication
3	AER 326C	Wind Turbines	3	MGT	Human Resource Management
4	AER 328C	Experimental Aerodynamics	4	HUM	Values, Ethics and IPR
5	ME 322C	Robotics and Automation	5	HUM	Introduction to German Language
			6	HUM	Introduction to French language

NOTES:

1. In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 5 questions selecting at least one question from each unit.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.
3. For students admitted in B.Tech. 1st Year (C-Scheme) in 2019 & onwards and all trailing students:
   Examinations and evaluations of students shall be conducted, covering the entire syllabus, as per guidelines "AICTE Examination Reforms". Students shall be informed about these reforms.

Department: Aeronautical Engineering

Subject: VIBRATION & AERO ELASTICITY

Subject Code: AER 302C

Study Scheme				Evaluation Scheme			Total Marks
Lectures per week				Internal Assessment	External Assessment (Examination)		
L	T	P	Credits	Max. Marks	Max. Marks	Exam Duration	
3	1	-	4	25	75	3 hours	100

UNIT – I

Introduction and Undamped Free and Transient Vibrations:

TOPIC NO 1 Definitions and terminology,
TOPIC NO 2 simple harmonic motion ,
TOPIC NO 3 combinations of two simple harmonic motions,
TOPIC NO 4solution of second order differential equations,
TOPIC NO 5 complex numbers,
TOPIC NO 6 classical solution, energy solution,
TOPIC NO 7 summery of procedures for determining natural frequency,
TOPIC NO 8 transient, response, equivalent systems

UNIT – II

Damped Free and Transient Vibrations-Single Degree Of Freedom:

TOPIC NO 9 Introduction,
TOPIC NO 10 viscous damping,
TOPIC NO 11 critical damping,
TOPIC NO 12 over damping,
TOPIC NO 13 under damping,
TOPIC NO 14 equivalent dampers,
TOPIC NO 15 coulomb damping.

UNIT – III

Steady State Forced Vibrations –Single Degree Of Freedom :

TOPIC NO 16 Introduction,
TOPIC NO 17 sources of excitation,
TOPIC NO 18 impressed harmonic force, impressed force due to unbalance excitation,
TOPIC NO 19 transverse critical speed of a single disk,
TOPIC NO 20 motion excitation, transmissibility and isolation,
TOPIC NO 21 summary of simple harmonic excitation, commercial isolator materials

Introduction to Aero elasticity:

TOPIC NO 22 Definition and historical background,
TOPIC NO 23 static and dynamic aero elastic phenomenon,
TOPIC NO 24 integration of aerodynamic,
TOPIC NO 25 elastic and inertia forces,
TOPIC NO 26 influence of aero elastic phenomenon on aircraft design,
TOPIC NO27 comparison of critical speeds.

UNIT – IV

Divergence Of Lifting Surfaces:

TOPIC NO 28 The phenomenon of divergence,
TOPIC NO 29 divergence of 2-D wing section,
TOPIC NO 30 divergence of an idealized cantilever wing,
TOPIC NO 31 solution based on semi-rigid assumptions,
TOPIC NO 32 solution to generalized coordinates method of successive approximation,
TOPIC NO 33 use of numerical methods.

Steady State Aero elastic Problems In General:

TOPIC NO 34 Loss and reversal of aileron control,
TOPIC NO 35 2-D and general case,
TOPIC NO 36 lift distribution on a rigid and elastic wing,
TOPIC NO 37 effect on static longitudinal stability of airplane,

Co. 1965 TEXT BOOKS:

1. "Mechanical vibrations: Austin H. Church, John Wiley & sons 1963
2. "Vibration problems in engineering: S. Timoshenko Van Nostrand Co.,.John Wiley Publishers 1974
3 Mechanical Vibrations: V.P.Singh, Dhanpat Rai and Co. Pvt. Ltd., Delhi 2012

REFERENCE BOOKS:

1. An introduction to the Theory of Aeroelasticity: Y.C.Fung, Dover Publications.1963
2. Aeroelasticity:R.L.Bisplinghoff Holt Ashley R.L.Halfman, Addison Wesley 19 Publishing

Subject: COMPUTATIONAL FLUID DYNAMICS
Subject Code: AER 304C

Study Scheme				Evaluation Scheme			Total Marks
Lectures per week				Internal Assessment	External Assessment (Examination)		
L	T	P	Credits	Max. Marks	Max. Marks	Exam Duration	
3	1	-	4	25	75	3 hours	100

UNIT – I

Introduction:

TOPIC NO 1 Differential and integral relations for conservation of mass,
TOPIC NO 2 linear momentum, angular momentum and energy for a control volume,
TOPIC NO3 Incompressible N-S equations,
TOPIC NO 4 Vorticity-stream function formulations,
TOPIC NO 5 Equations in general orthogonal coordinate systems,
TOPIC NO 6 A body-fitted coordinate systems
TOPIC NO 7 Types Of Equations:
TOPIC NO 8 Classification of partial differential equations,
TOPIC NO 9 Linear/Nonlinear partial differential equations, Elliptic,
TOPIC NO 10 parabolic, hyperbolic partial differential equations, System of first order partial differential equations,
TOPIC NO 11 Initial and Boundary Conditions.

UNIT – II

Finite Difference Techniques:

TOPIC NO 12 Finite difference approximations,
TOPIC NO 13 Discretization using Taylor series,
TOPIC NO 14 Discretization using Orthogonal Polynomials,
TOPIC NO 15 Truncation error estimates, finite volume method.

Methods For Parabolic Equations:

TOPIC NO 16 Parabolic partial differential equation,
TOPIC NO 17 Finite difference formulation,
TOPIC NO 18 Explicit and Implicit methods,
TOPIC NO 19 Von Neumann stability analysis,
TOPIC NO 20 Consistence analysis,
TOPIC NO 21 Solution of tridiagonal systems

UNIT – III

Hyperbolic Equations And Panel Method:

TOPIC NO 22 Solution of hyperbolic equations- Burgers equation,
TOPIC NO 23 Two and three-dimensional panels,
TOPIC NO 24 Panel singularities, Panel method for Two dimensional non-lifting bodies,
TOPIC NO 25 Two and three-dimensional source panels,
TOPIC NO 26 Two-dimensional vortex lattice and Vortices panel methods,
TOPIC NO 27 Panel method for compressible subsonic and supersonic flows,
TOPIC NO 28 Time-split methods,

UNIT – IV

Methods For Elliptic Equations:

TOPIC NO 29 Elliptic partial differential equation,
TOPIC NO 30 Finite difference Discretization,

TOPIC NO 31 Iterative schemes (Point Jacobi, Gauss Seidel, SOR, SLOR)

TOPIC NO 32 Applications to literalized subsonic potential flow

Grid Generation Techniques:

TOPIC NO 33 Structured and Unstructured grids,

TOPIC NO 34 Boundary fitted grids,

TOPIC NO 35 Elliptic grid, generation,

TOPIC NO 36 Algebraic grid generation,

TEXT BOOKS:

1. "Fluid Mechanics", Frank M White, Tata McGraw Hill Education Private Limited; 1979
2. "Computational Fluid Dynamics", John D. Anderson, Jr., McGraw Hill; 1995

REFERENCE BOOKS:

1. "Computational Fluid Dynamics", T. K. Bose, Wiley Eastern Limited; 1988
2. "An Introduction to Theoretical and Computational Aerodynamics", Jack Moran, John Wiley and Sons ; 1984

Subject: SPACE DYNAMICS

Subject Code: AER 322C

Study Scheme				Evaluation Scheme			Total Marks
Lectures per week				Internal Assessment	External Assessment (Examination)		
L	T	P	Credits	Max. Marks	Max. Marks	Exam Duration	
3	-	-	4	25	75	3 hours	100

UNIT – I

Principle Of Rocket Propulsion

TOPIC NO 1 Thrust, specific impulse,
TOPIC NO 2 exhaust velocity, energy and efficiency,
TOPIC NO 3 Tsiolkovsky's rocket equation,
TOPIC NO 4 orbits, optimizing a multistage rocket,
TOPIC NO 5 optimizing the rocket engines,
TOPIC NO 6 strap-on boosters, Solar system, the planets,
TOPIC NO 7 reference frames and coordinate systems,
TOPIC NO 8 celestial sphere, the ecliptic,
TOPIC NO 9 geocentric reference frames, velocity vector.

Launch Vehicle Dynamics

TOPIC NO 10 Range in the absence of gravity,
TOPIC NO 11 Vertical motion the Earth's gravitational field,
TOPIC NO 12 Vehicle velocity, Range,
TOPIC NO 13 Inclined motion in a gravitational field,
TOPIC NO 14 Constant pitch angle,
TOPIC NO 15 The flight path at constant pitch angle,
TOPIC NO 16 Motion in the atmosphere,
TOPIC NO 17 Aerodynamics forces, Dynamic pressure,
TOPIC NO 18 The gravity turn, Basic launch dynamics,
TOPIC NO 19 Airless bodies, Typical Earth- launch trajectories,
TOPIC NO 20 The vertical segment of the trajectory,
TOPIC NO 21 The gravity turn or transition trajectory,
TOPIC NO 22 constant pitch or the vacuum
TOPIC NO 23 Orbital injection,
TOPIC NO 24 Actual launch vehicle trajectories,

UNIT – II

Space Flight:

TOPIC NO 25 Introduction, differential equations,
TOPIC NO 26 Lagrange's equation, orbit equation,
TOPIC NO 27 space vehicle trajectory,
TOPIC NO 28 Kepler's laws, introduction to earth and planetary trajectory,
TOPIC NO 29 general equations of motion for atmospheric entry,
TOPIC NO 30 application to ballistic entry.
TOPIC NO 31 Entry heating, lifting entry with application to Space Shuttle.

UNIT – III

The Earth Satellite Operations:

TOPIC NO 32 The Hohmann transfer,
TOPIC NO 33 inclination-change maneuver,
TOPIC NO 34 launch to rendezvous,
TOPIC NO 35 decay life time, earth oblateness effect,
TOPIC NO 36 low thrust orbit transfer.

Satellite Attitude Dynamics:

TOPIC NO 37 Torque –Free-axisymmetric rigid body,
TOPIC NO 38 The general torque free rigid body,

TOPIC NO 39 semi-rigid space craft, attitude control,
TOPIC NO 40 Spinning and Non spinning space craft.
TOPIC NO 41 The Yo-Yo mechanism,
TOPIC NO 42 gravity gradient satellite,
TOPIC NO 43 the dual spin space craft.

Satellite Attitude Dynamics:

TOPIC NO 37 Torque –Free-axisymmetric rigid body,
TOPIC NO 38 The general torque free rigid body,
TOPIC NO 39 semi-rigid space craft, attitude control,
TOPIC NO 40 Spinning and Non spinning space craft.
TOPIC NO 41 The Yo-Yo mechanism,
TOPIC NO 42 gravity gradient satellite,
TOPIC NO 43 the dual spin space craft.

UNIT – IV

Interplanetary Missions:

TOPIC NO44 Basic concepts, 2-D interplanetary trajectories,
TOPIC NO 45 Hohmann trajectories, launch opportunities,
TOPIC NO 46 fast interplanetary trajectories,
TOPIC NO 47 3-D interplanetary trajectories,
TOPIC NO 48 launch of interplanetary spacecraft, and trajectory about target planet

TEXT BOOKS:

1. ""Space Flight Dynamics" : William E. Wiesel , 1st Ed Mcgraw Hill 1989
2. ""Rocket and spacecraft propulsion" : Martin J.L. Turner, 2nd Ed., Springer publishers 2005
3. "Introduction to flight" : John D Anderson Jr., 6th Ed., Tata Mc Graw Hill 2011

REFERENCE BOOKS:

1. "Rocket Propulsion and Spacecraft Dynamics": J.W. Cornelisse, H.F.R.Schoyer,4th Ed. Pitman publisher

Subject: HELICOPTER DYNAMICS
Subject Code: AER 324C

Study Scheme				Evaluation Scheme			Total Marks
Lectures per week				Internal Assessment	External Assessment (Examination)		
L	T	P	Credits	Max. Marks	Max. Marks	Exam Duration	
3	-	-	4	25	75	3 hours	100

UNIT – I

Introduction:

TOPIC NO 1 Historical development of helicopter and overview,
TOPIC NO 2 Classification based on main rotor configuration and tail rotor configuration.
TOPIC NO 3 Comparative analysis,
TOPIC NO 4 Major components of conventional helicopter,
TOPIC NO 5 Composite structure.

Basic Concepts and Helicopter Controls:

TOPIC NO 6 Rigid, semi-rigid and articulated rotors,
TOPIC NO 7 Feathering, flapping and lead-lag motion,
TOPIC NO 8 Rigid, Semi-rigid and articulated helicopter control system,
TOPIC NO 9 Collective and cyclic pitch control,
TOPIC NO 10 Yaw control, Throttle control,
TOPIC NO 11 Anti-torque control, Solidity,
TOPIC NO 12 Tip-speed ratio, In-flow ratio,
TOPIC NO 13 Figure of merit

UNIT – II

Aerodynamics Of Main Rotor:

TOPIC NO 14 Coning of rotor, Dissymmetry of lift,
TOPIC NO 15 Precession, Coriolis effect,
TOPIC NO 16 Compressibility effects,
TOPIC NO 17 Retreating blade stall, Reverse flow region,
TOPIC NO 18 Flapping, feathering and lead-lag motion,
TOPIC NO 19 Autorotation, Schrenk's diagram,
TOPIC NO 20 Various types of auto motive landings.

Performance During Hovering And Vertical:

TOPIC NO 21 The actuator-disc theory,
TOPIC NO 22 Working states of rotor,
TOPIC NO 23 Optimum rotor, Efficiency of rotor,
TOPIC NO 24 Ground effect on lifting rotor,
TOPIC NO 25 The effect of finite number of blades,
TOPIC NO 26 Induced velocity and induced power, Total power

UNIT – III

Performance During Forward Flight:

TOPIC NO 27 Blade forces and motion in forward flight,
TOPIC NO 28 Force, torque and flapping coefficient,
TOPIC NO 29 Induced velocity and induced power in forward flight – Mangler and Squire method,
TOPIC NO 30 Flight and wind tunnel test,

TOPIC NO 31 The vortex wake,
TOPIC NO 32 Aerofoil characteristics in forward flight,
TOPIC NO 33 Helicopter trim analysis,
TOPIC NO 34 Performance in forward flight.

UNIT – IV

Dynamic Stability And Control:

TOPIC NO 35 Longitudinal and lateral stability,
TOPIC NO 36 Equations of motion,
TOPIC NO 37 Stability characteristics,
TOPIC NO 38 Auto stabilization,
TOPIC NO 39 Control response.

Helicopter Vibrations:

TOPIC NO 40 Sources of vibration,
TOPIC NO 41 Active and passive methods for vibration control,
TOPIC NO 42 Fuselage response,
TOPIC NO 43 Measurement of vibration in flight.

TEXT BOOKS:

1. "Helicopter Dynamics", A.R.S. Bramwell, G. Done and D. Balmford, Butterworth Hienmann Publication 2001
2. "Helicopter Engineering", Lalit Gupta, Himalayan Publishing House 2009

REFERENCE BOOKS:

""Helicopter Engineering", Jacob Shapiro, McGraw Hill Publication

Subject Code HUM350C **Subject: Communication Skills for Professionals**

L	T	P	Credits
3	0	0	3

Class Work : 25
Examination : 75
Total : 100
Duration of Exam : 3 Hours

Unit 1

Mechanics of Report Writing:
Topic No. 1 Objectives of Report Writing;
Topic No. 2 Types of Reports on the basis of forms and content.
Topic No. 3 Introduction to Formats of Reports;
Topic No. 4 Structure of Reports: Front Matter,
Topic No. 5 Main Body, Back Matter.

Unit 2

Writing Business and Technical Report:
Topic No. 6 Preliminary Strategies for Report Writing:
Topic No. 7 Data Collection, Report Planning,Use of Illustrations,
Topic No. 8 Point Formation, Preparing Notes/Drafts. Using Appropriate Formats:
Topic No. 9 Memo Format, Letter Format,Manuscript Format, Printed Forms

Unit 3

Oral Communication and Soft Skills :
Topic No. 10 Group Discussions; Interviews for jobs: preparation and facing them.
Topic No. 11 Professional Presentations: Power Point Presentation, Oral Presentation.
Topic No. 12 Role of Kinesics (Body Language) in Communication.General
Topic No. 13 Etiquettes in Office areas, corporate lunch and dinner. Handling Telephone calls.

Unit 4

Resumes and Job application:
Topic No. 14 Writing of Resume--Chronological Resume and Functional
Topic No. 15 Resume.Request for Reference/Recommendation .
Topic No. 16 Writing Application Letters for Job;
Topic No. 17 Writing Covering letter.

Text/ Reference Books:

1. Sharma,Sangeeta, and Binod Mishra. Communication Skills for Engineers and Scientists. PHI,2009.
2. Tyagi,Kavita, and Padma Mishra. Advanced Technical Communication. PHI, 2011.
3. Rizvi, M. Ashraf. Effective Technical Communication. McGraw Hill Education, 2014.
4. Kumar, Sanjay, and PushpLata. Communication Skills. OUP, 2011.
5. Raman, Meenakshi and SangeetaSharma.Communication Skills. OUP,2011.
6. *Bhatnagar, Nitin, and MamtaBhatnagar. Communicative English for Engineers and Professionals. Pearson Education, 2013. (The soft copy of the book is available in the university library)
7. Mitra,Barun K. Personality Development and Soft Skills. OUP,2011.
8. Kaul, Asha. Business Communication. PHI, 2nd Edition.
9. Namee, Patrick Mc. Success in Interviews: How to Succeed in any Job Interview, Ist Edition.
10. Argenti, Paul. Corporate Communication.6th Edition. McGraw Hill Education, 2012.

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Get acquainted with multiple forms and formats of various technical and business reports
2. Develop competence for report writing with a focus on its complex writing techniques and procedures.
3. Develop their speaking skills with professional proficiency.
4. Equip themselves for Letter Writing Skills.

Note:

1. In Semester Examinations, the paper setter will set two questions from each unit (total 8 questions in all), covering the entire syllabus. Students will be required to attempt only five questions, selecting atleast one question from each unit.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator, mobile phones or other electrical/ electronic items will not be allowed in the examination.

3. For students admitted in B.Tech. 1st Year (C-Scheme) in 2019 & onwards and all trailing students:

Examinations and evaluations of students shall be conducted, covering the entire syllabus, as per guidelines "AICTE Examination Reforms". Students shall be informed about these reforms.

Subject : COMPUTATIONAL FLUID DYNAMICS Lab.
Subject Code: AER 306C

Study Scheme				Evaluation Scheme			Total Marks
Lectures per week				Internal Assessment	External Assessment (Examination)		
L	T	P	Credits	Max. Marks	Max. Marks	Exam Duration	
0	0	2	1	25	75	3 hours	100

S. No. **LIST OF EXPERIMENTS**

1. To study Point relaxation method for Laplace equation for the flow over airfoil
2. To study Successive Line Relaxation for the Laplace equation over airfoil
3. To study Structural grid generation over NACA 0012
4. To study Relaxation method for subsonic full potential equation for flow over airfoil with zero angle of attack
5. To study Lifting subsonic incompressible potential flow over airfoil
6. To study Two dimensional Panel method for subsonic incompressible flow over NACA 0012
7. To study Zoukowski transformation for subsonic incompressible flows

NOTE:

1. **Students have to perform all the experiments from the above list. Additional two/three experiments may be set by the department as per the scope of the syllabus.**

Subject: INHOUSE PROJECT
Subject Code: AER 308C

Study Scheme				Evaluation Scheme			Total Marks
Lectures per week				Internal Assessment	External Assessment (Examination)		
L	T	P	Credits	Max. Marks	Max. Marks	Exam Duration	
0	0	6	3	25	75	3 hours	100

In-house Project is a group activity with a batch size of 4-5 students. The expected outcome of this course is the development of capability to employ technical knowledge obtained in the field of Engineering & Technology for societal use through an in-house project work involving design/ analysis/fabrication/ testing/ computer simulation/ case studies etc, augmented with creativity, innovation and ingenuity. Students may also choose to work on innovation or entrepreneurial activities resulting in start-up. Each group will work under the guidance of a faculty adviser.

After completion of the Project, the each group should prepare a comprehensive report to indicate what they have observed and learnt in the training period. The format of the cover page and the organization of the body of the report should be circulated by In-house Project coordinator.

At the end of the semester, the project will be evaluated through a panel of examiners consisting of three members. The chairman may constitute stream specific committees for the evaluation of the project. Each committee shall consist of three members as given below:

1. A senior faculty member (Chairman of the committee)
2. In-house Project coordinator (Member Secretary)
3. Respective In-house faculty adviser

The evaluation process will be as given below:

- The group will be required to submit two copies of his/her project report to the department for record (one copy each for the department and participating teacher).
- Project coordinator will be assigned the project load of maximum of 2 hrs. per week including his own guiding load of one hr. However, each faculty adviser will be assigned maximum of one period of teaching load irrespective of number of students/groups under him/her.
- The evaluation of In-house Project will be carried out on the basis of the following criteria:
  - Originality and relevance of the Project (20%)
  - Adequacy and quality of report (40%)
  - Presentation of the Project report (Quality of content /Effectiveness of presentation/Communication skill) 40%

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