GANDHI INSTITUTE OF TECHNOLOGY AND MANAGEMENT (GITAM)

(Deemed to be University)

VISAKHAPATNAM * HYDERABAD * BENGALURU

Accredited by NAAC with A^{++} Grade

GITAM School of Technology

CURRICULUM AND SYLLABUS

4 Year Undergraduate Programme
UAERO01: B.Tech. Aerospace Engineering

w.e.f. 2023-24 admitted batch

(Updated on 31^{st} July 2023)

Academic Regulations

Applicable for the Undergraduate Programmes in the Schools of Business, Humanities & Social Sciences, Science, Technology

https://www.gitam.edu/academic-regulations

Vision

To become a global leader in higher education.

Mission

To impart futuristic and comprehensive education of global standards with a high sense of discipline and social relevance in a serene and invigorating environment.

Quality Policy

To achieve global standards and excellence in teaching, research, and consultancy by creating an environment in which the faculty and students share a passion for creating, sharing and applying knowledge to continuously improve the quality of education.

VISION AND MISSION OF THE SCHOOL

VISION

To become a global leader in holistic engineering education and research

MISSION

1. To impart a strong academic foundation and practical education through a flexible curriculum, state-of-the-art infrastructure, and best learning resources
2. To actively pursue academic and collaborative research with industries and research institutions, both in India and abroad
3. To build a congenial and innovative eco system by enabling the latest technologies, thus helping the students, to solve the challenges of societal importance.
4. To provide our students with the appropriate leadership, management, communication skills and professional ethics for career success and to continuously impact the global lives.

UAERO01: B.Tech. Aerospace Engineering
(w.e.f. academic year 2023-24 admitted batch)

Programme Educational Objectives (PEOs)

PEO 1 To demonstrate their expertise in solving contemporary problems through design, analysis, implementation and evaluation of hardware and software systems

PEO 2 To engage in the Aerospace Engineering profession locally and globally by contributing ethically to the competent and professional practice of Engineering or other professional careers.

PEO 3 To adapt to a constantly changing world through professional development and sustained learning

PEO 4 To exhibit leadership and entrepreneurship skills by incorporating organizational goals and providing facilities for peer members with defined objectives

PEO 5 To develop communication skills and show a commitment to teamwork necessary to function productively and professionally on multidisciplinary teams

Mapping of the Mission of the School with the PEOs

	PEO1	PEO2	PEO3	PEO4	PEO5
M1	H	H	M	L	L
M2	M	H	M	L	M
M3	M	M	M	L	L
M4	L	M	H	H	M

H – High, M – Medium, L – Low

Programme Outcomes (POs) and Programme Specific Outcomes (PSOs):

At the end of the Programme the students would be able to:

PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems, reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	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 the public health and safety, and the cultural, societal, and environmental considerations.
PO4	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.
PO5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	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.
PO7	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.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	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.

PO12 Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1 Design and develop electrical, control and power systems for engineering applications in the fields of electrical appliances, industrial automation, power distribution and allied interdisciplinary areas.

PSO2 Demonstrate the use of modern tools and techniques for solving contemporary real-world problems in electrical and electronics engineering

PSO3 Research and devise appropriate technologies for implementation of the electrical and power systems as an entrepreneur/researcher with professional ethics & concern for societal wellbeing

Curriculum Structure

(Flexible Credit System)

UNIVERSITY CORE (UC)								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
CSEN1001	1	IT Productivity Tools^	0	0	2	0	0	1*
CLAD1001	1	Emotional Intelligence & Reasoning Skills (Soft Skills 1)	0	0	2	0	0	1
CLAD1011	1	Leadership Skills & Quantitative Aptitude (Soft Skills 2)	0	0	2	0	0	1
CLAD1021	1	Verbal Ability & Quantitative Ability (Soft Skills 3)	0	0	2	0	0	1
CLAD1031	1	Practicing Verbal Ability & Quantitative Aptitude (Soft Skills 4)	0	0	2	0	0	1
CLAD20XX	2	Soft skills 5A/5B/5C	0	0	2	0	0	1
CLAD20XX	2	Soft skills 6A/6B/6C	0	0	2	0	0	1
DOSP10XX	1	Sports 1#	0	0	0	2	0	2*
DOSL10XX	1	Club Activity#	0	0	0	2	0	2*
DOSL10XX	1	Community Service#	0	0	0	0	2	2*
ENVS1001	1	Environmental Studies^	3	0	0	0	0	3*
FINA3001	3	Personal Financial Planning#	0	0	2	0	0	1*
LANG1012	1	Communication Skills In English – Intermediate	0	0	4	0	0	2
LANG1022	1	Communication Skills In English – Advanced	0	0	4	0	0	2
MFST1001	1	Health and Wellbeing#	0	0	2	0	0	1*
POLS1001	1	Indian Constitution and History	2	0	0	0	0	2*
PHPY1001	1	Gandhi for the 21st Century	2	0	0	0	0	2*
VEDC1001	1	Venture Development	0	0	0	2	0	2
* Pass/Fail courses # Opt any two courses among the five ^ Online/Swayam/NPTEL Courses								

Soft skills courses 5 and 6								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
CLAD2001	2	Preparation for Campus Placement-1 (Soft skills 5A)	0	0	2	0	0	1
CLAD2011	2	Preparation for Higher Education (GRE/ GMAT)-1 (Soft skills 5B)	0	0	2	0	0	1
CLAD2021	2	Preparation for CAT/ MAT – 1 (Soft skills 5C)	0	0	2	0	0	1
CLAD2031	2	Preparation for Campus Placement-2 (Soft skills 6A)	0	0	2	0	0	1
CLAD2041	2	Preparation for Higher Education (GRE/ GMAT)-2 (Soft skills 6B)	0	0	2	0	0	1
CLAD2051	2	Preparation for CAT/ MAT – 2 (Soft skills 6C)	0	0	2	0	0	1

Sports Courses								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
DOSP1001	1	Badminton	0	0	0	2	0	2
DOSP1011	1	Chess	0	0	0	2	0	2
DOSP1021	1	Carrom	0	0	0	2	0	2
DOSP1031	1	Football	0	0	0	2	0	2
DOSP1041	1	Volleyball	0	0	0	2	0	2
DOSP1051	1	Kabaddi	0	0	0	2	0	2
DOSP1061	1	Kho Kho	0	0	0	2	0	2
DOSP1071	1	Table Tennis	0	0	0	2	0	2
DOSP1081	1	Handball	0	0	0	2	0	2
DOSP1091	1	Basketball	0	0	0	2	0	2
DOSP1101	1	Tennis	0	0	0	2	0	2
DOSP1111	1	Throwball	0	0	0	2	0	2

Club Activity Courses								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
DOSL1001	1	Club Activity (Participant)	0	0	0	2	0	2
DOSL1011	1	Club Activity (Member of the Club)	0	0	0	2	0	2
DOSL1021	1	Club Activity (Leader of the Club)	0	0	0	2	0	2
DOSL1031	1	Club Activity (Competitor)	0	0	0	2	0	2
Community Service courses								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
DOSL1041	1	Community Services – Volunteer	0	0	0	0	2	2
DOSL1051	1	Community Services – Mobilizer	0	0	0	0	2	2

FACULTY CORE (FC)								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
CHEM1001	1	Chemistry	2	1	2	0	0	4
CSEN1011	1	Problem Solving and Programming with C	0	0	6	0	0	3
CSEN1021	1	Programming with Python	0	0	6	0	0	3
CSEN1031	1	Artificial Intelligence Applications	0	0	2	0	0	1
EECE1001	1	Basic Electrical and Electronics Engineering	2	1	2	0	0	4
HSMCH102	1	Universal Human Values	3	0	0	0	0	3
INTN2333	2	Internship 1	0	0	0	0	1	1
INTN3444	3	Internship 2	0	0	0	0	1	3
MATHXXXX	X	Mathematics Basket 1	2	0	0	0	0	2
MATHXXXX	X	Mathematics Basket 2	2	0	0	0	0	2
MATHXXXX	X	Mathematics Basket 3	2	0	0	0	0	2
MATHXXXX	X	Mathematics Basket 4	2	0	0	0	0	2
MATHXXXX	X	Mathematics Basket 5	2	0	0	0	0	2
MATHXXXX	X	Mathematics Basket 6	2	0	0	0	0	2
MATH2361	2	Probability and Statistics	3	0	0	0	0	3
MECH1011	1	Engineering Visualization and Product Realization	0	0	4	0	0	2
MECH1041	1	Technology Exploration & Product Engineering	0	0	4	0	0	2
MECH1001	1	Design Thinking	0	0	2	0	0	1
PHYS1001	1	Physics	2	1	2	0	0	4
PHYSXXXX	1	Physics Basket	3	1	0	0	0	4
PROJ2999	2	Capstone Project – Introduction	0	0	0	0	2	2
PROJ3999	3	Capstone Project – Final	0	0	0	0	6	6
PROJ2888	2	Project Exhibition 1	0	0	0	0	1	1
PROJ3888	3	Project Exhibition 2	0	0	0	0	1	1
VIVA3555	3	Comprehensive Examination	1	0	0	0	0	1
XXXXXXXX	X	Management Basket	3	0	0	0	0	3
BTEN1001	1	Introduction to Biotechnology-I	2	0	0	0	0	2
BTEN1021	1	Introduction to Biotechnology-II	2	0	0	0	0	2

Mathematics Basket								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
MATH1001	1	Single Variable Calculus	2	0	0	0	0	2
MATH1011	1	Several Variable Calculus	2	0	0	0	0	2
MATH2371	2	Difference Equations	2	0	0	0	0	2
MATH1031	1	Differential Equations	2	0	0	0	0	2
MATH2281	2	Numerical techniques	2	0	0	0	0	2
MATH1021	1	Transform Techniques	2	0	0	0	0	2
MATH2381	2	Operations Research	2	0	0	0	0	2
MATH2301	2	Complex Variables	2	0	0	0	0	2
MATH1041	1	Discrete Mathematics	2	0	0	0	0	2
MATH1051	1	Graph Theory	2	0	0	0	0	2
MATH2311	2	Number Theory	2	0	0	0	0	2
MATH2291	2	Linear Algebra	2	0	0	0	0	2
MATH2341	2	Probability Theory and Random Variables	2	0	0	0	0	2
MATH2321	2	Random Processes	2	0	0	0	0	2
MATH2351	2	Optimization Methods	2	0	0	0	0	2
MATH2331	2	Computational Methods	2	0	0	0	0	2
MATH1061	1	Introduction to Mathematics – I	2	0	0	0	0	2
MATH1071	1	Introduction to Mathematics – II	2	0	0	0	0	2
MATH2361	2	Probability and Statistics	3	0	0	0	0	3
Physics Basket								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
PHYS1001	1	Physics	2	1	2	0	0	4
PHYS1011	1	Mechanics and Properties of Matter	3	1	0	0	0	4
PHYS1021	1	Principles of Quantum Mechanics	3	1	0	0	0	4
PHYS1031	1	Physics of Semi Conducting devices	3	1	0	0	0	4
PHYS1041	1	Mechanics and Modern Physics	3	1	0	0	0	4
Management Basket								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
FINA1031	1	Principles and Practice of Banking	3	0	0	0	0	3
HRMG1021	1	Human Resource Management	3	0	0	0	0	3
MKTG3011	3	Sales and Distribution Management	3	0	0	0	0	3
MKTG1001	1	Marketing Management	3	0	0	0	0	3
OPTS2001	2	Production and Operations Management	3	0	0	0	0	3
HRMG2001	2	Organizational Behavior	3	0	0	0	0	3
HRMG1001	1	Principles and Practice of Management	3	0	0	0	0	3

Programme Core (PC)								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
AERO1011	1	Aeromodelling Workshop	0	0	2	0	0	1
AERO1001	1	Introduction to Aerospace Engineering	2	0	0	0	0	2
MECH2001	2	Engineering Mechanics	2	1	0	0	0	3
AERO2011	2	Engineering Thermodynamics	3	0	0	0	0	3
AERO2021	2	Engineering Fluid Mechanics	3	0	2	0	0	4
AERO2001	2	Solid Mechanics	3	0	2	0	0	4
AERO2071	2	Aerospace Materials Engineering	3	0	2	0	0	4
AERO1031	1	Computer Aided Aircraft Drawing	0	0	2	0	0	1
AERO2041	2	Aerodynamics – I	3	0	2	0	0	4
AERO2031	2	Mechanics of Aerospace Structures	3	0	2	0	0	4
AERO2061	2	Aircraft Propulsion	3	0	2	0	0	4
AERO3001	3	Aerodynamics –II	3	0	0	0	0	3
AERO3011	3	Analysis of Aerospace Structures	3	0	0	0	0	3
AERO2051	2	Flight Mechanics	3	0	0	0	0	3
AERO3021	3	Aerospace Propulsion	3	0	0	0	0	3
AERO1021	1	Computational Methods	3	0	0	0	0	3
AERO2081`	2	Design Practice for Aerospace Engineering	2	0	2	0	0	3

Programme Elective (PE)								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
AERO1041	1	Astronomy	3	0	0	0	0	3
AERO3031	3	Computational Aerodynamics	2	0	2	0	0	3
AERO2091	2	Wind Tunnel Techniques	3	0	0	0	0	3
AERO3041	3	Boundary Layer Theory	3	0	0	0	0	3
AERO2101	2	Industrial Aerodynamics	3	0	0	0	0	3
AERO2111	2	Flapping Wing Aerodynamics	3	0	0	0	0	3
AERO3051	3	Hypersonic Aerodynamics	3	0	0	0	0	3
AERO3061	3	Introduction to Finite Element Analysis	2	0	2	0	0	3
AERO3071	3	Advanced Aerospace Structures	3	0	0	0	0	3

AERO3081	3	Vibrations and Acoustics	3	0	0	0	0	3
AERO3091	3	Theory of Elasticity	3	0	0	0	0	3
AERO3101	3	Mechanics of Composite Materials	3	0	0	0	0	3
AERO3111	3	Aero Elasticity	3	0	0	0	0	3
AERO3121	3	Aerodynamics of Turbomachinery	3	0	0	0	0	3
AERO2131	2	Theory of Cryogenics	3	0	0	0	0	3
AERO2141	2	Rockets and Missiles	3	0	0	0	0	3
AERO3131	3	Flight Dynamics	3	0	0	0	0	3
AERO3141	3	Space Technology	3	0	0	0	0	3
AERO3151	3	Space Mechanics	3	0	0	0	0	3
AERO3161	3	Satellite Attitude and Control	3	0	0	0	0	3
AERO3171	3	Guidance and Control	3	0	0	0	0	3
AERO2121	2	Experimental Techniques	3	0	0	0	0	3
AERO2151	2	Aircraft Systems and Instrumentation	3	0	0	0	0	3
AERO2161	2	Airport Planning and Management	3	0	0	0	0	3
AERO2171	2	Air Transportation Systems	3	0	0	0	0	3
AERO3181	3	Helicopter Aerodynamics	3	0	0	0	0	3
AERO3191	3	Avionics	3	0	0	0	0	3
# Opt eligible PC/PE courses from other programmes as an open elective course and earn 24 credits								

PROGRAMME STRUCTURE

BTech Programme consists of courses which could be grouped under University Core (UC), Faculty Core (FC), Major/Programme Core (PC), Major/Programme Electives (PE) and Open Electives (OE) as the below breakup.

Category	Credits	% of Program (in credits)
University Core (UC)	12	8%
Faculty Core (FC)	57	35%
Programme Core (PC)	52	33%
Programme Electives (PE)	15	9%
Open Electives (OE)	24	15%
Total	**160**	

Courses offered under University Core are common to all undergraduate level programmes offered by GITAM. Courses offered under Faculty core are common to all BTech programmes offered by GITAM and are meant to acquaint the student with general engineering principles in all disciplines of engineering. Based on the chosen BTech Programme, the student shall complete courses under Program Core (specific to be chosen branch of engineering).

Each course is assigned a certain number of credits depending upon the number of contact hours (lectures/tutorials/practical) per week. In general,

- **Theory:** A student attending classroom lecture/ tutorial/ skill development activity of 50 minutes' duration per week, spread over the entire semester is awarded one credit.
- **Practical:** A student attending a minimum of 100 minutes per week of laboratory session/ practical is awarded - one credit.
- **Project Work:** A student working for 50 minutes of project work per week with 3 hours of work performed independent of the instructor during the entire semester is awarded - one credit
- **Internship:** 8 hours in a day for four weeks is required for earning internship credits

CO PO Mapping

Course Code	Course Name	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
LANG1012	Communication Skills In English – Intermediate									L	M		M			
LANG1022	Communication Skills In English – Advanced									L	H					
CLAD1001	Soft Skills 1 - Emotional Intelligence & Reasoning Skills								H	M	M		L			
CLAD1011	Soft Skills 2 - Leadership Skills & Quantitative Aptitude								H	L	M		L			
CLAD1021	Soft Skills 3 - Verbal Ability & Quantitative Ability								L	M	M		L			
CLAD1031	Soft Skills 4 - Practicing Verbal Ability & Quantitative Aptitude								L	M	H	L	L			
CLAD1041	Soft Skills 5A - Preparation for Campus Placement								L		H		M			
	Soft Skills 5B -								M		H		L			

	Preparation For Higher Education (GRE/ GMAT)															
	Soft Skills 5C - Preparation for CAT/ MAT								M		H		L			
CLAD1051	Soft Skills 6A – Preparation for Campus Placement								M	M	H		H			
	Soft Skills 6B – Preparation For Higher Education (GRE/ GMAT)								M		H		L			
	Soft Skills 6C– Preparation for CAT/ MAT								M		H		M			
VEDC1001	Venture Development								M	M	M	H	L			
DOSP10XX	Sports 1								M	L			H			
DOSL10XX	Club Activity								L	M			H			
POLS1001	Indian Constitution and History								L		L		M			
PHPY1001	Gandhian Values/ Ethics								H		L		M			
DOSL10XX	Community Service								M		L		H			
ENVS1001	Environmental Studies			L				H					M			
FINA3001	Financial and Tax Literacy / Personal Financial Planning								H	L	L		M			
MFST1001	Health and Wellbeing									M		L	M			
CSEN1001	IT Productivity Tools				M	H							L			
MATHXX	Maths Basket 1	H	M													
MATHXX	Maths Basket 2	L	H	M												
MATHXXX	Maths Basket 3	L	H	M												
MATHXXX	Maths Basket 4	L		H	M											
MATHXXX	Maths Basket 5	L		H	M											
MATHXXX	Maths Basket 6	L			H	M										
MATH2361	Probability and Statistics	L			H	M									L	
PHYS1001	Physics	H	M						L							
PHYS1XXX	Physics Basket	M	H						L							
CHEM1001	Chemistry		H					M	L							
MECH1011	Engineering Visualization and Product Realization	L	M	H			L									
MECH1041	Technology				H	M	L									

	Exploration & Product Engineering															
MECH1001	Design Thinking	L		M	H		L							L		
EECE1001	Basic Electrical and Electronics Engineering	H	M	L										L		
CSEN1011	Problem Solving and Programming with C		H	L		M								M		
CSEN1021	Programming with Python		M			H						L	L		M	
CSEN1031	Applications of Artificial Intelligence	M				H	L						L	L	M	
XXXXXX	Management Basket								L	M	M		H			
INTN2333	Internship 1									L	H		M		M	
INTN3444	Internship 2									L	H		M		M	
VIVA3555	Comprehensive Examination									L	H		M			
PROJ2999	Capstone Project - Introduction			M						M	H	H	L			M
PROJ3999	Capstone Project - Final			M						M	H	H	L			M
HSMCH102	Universal Human Values								H		L		M			
PROJ2888	Project Exhibition 1	M								M	H	H	L			M
PROJ3888	Project Exhibition 2	M								M	H	H	L			M
AERO1001	Introduction to Aerospace Engineering	L	M	L	M	L	M	M	L	M	M	L	L	H	H	M
AERO1011	Aeromodelling Workshop	M	M	M	L	M	M	M	L	M	M	L	L	H	H	M
AERO2001	Solids Mechanics	M	H	M	M	L	H	M	L	M	M	L	L	H	H	M
AERO2011	Engineering Thermodynamics	M	H	M	M	L	H	M	L	M	M	L	L	H	H	M
AERO2021	Engineering Fluid Mechanics	M	H	M	M	L	H	M	L	M	M	L	L	H	H	M
AERO2031	Mechanics of Aerospace Structures	H	H	M	M	L	H	M	L	M	M	L	L	H	H	M
AERO2041	Aerodynamics - I	H	H	M	H	M	H	M	L	M	M	L	L	H	H	M
AERO2051	Flight Mechanics	H	H	M	H	M	H	L	L	M	M	L	L	H	H	M
AERO3001	Aerodynamics -II	H	H	L	H	L	H	L	L	M	M	L	L	H	H	M
AERO3011	Analysis of Aerospace Structures	H	H	L	H	M	H	M	L	M	M	L	L	H	H	M
AERO2061	Aircraft Propulsion	H	H	M	H	L	H	L	L	M	M	L	L	H	H	M
AERO1021	Computational Methods	H	H	M	H	H	H	M	L	M	L	L	L	H	H	M

AERO3021	Aerospace Propulsion	H	H	L	H	L	H	L	L	M	M	L	L	H	H	M
AERO2071	Aerospace Materials Engineering	H	H	M	H	L	H	M	L	M	M	L	L	H	H	M
AERO1031	Computer Aided Aircraft Drawing	M	L	M	M	M	M	L	L	M	H	L	L	H	H	M
AERO2081	Design Practice for Aerospace Engineering	M	L	M	M	L	H	L	L	M	H	L	L	H	H	M
AERO3031	Computational Aerodynamics	H	H	M	H	H	H	M	L	M	H	L	L	H	H	M
AERO2091	Wind Tunnel Techniques	H	M	L	M	L	H	L	L	M	H	L	L	H	H	M
AERO3041	Boundary Layer Theory	M	H	L	H	L	M	L	L	M	M	L	L	H	H	M
AERO2101	Industrial Aerodynamics	H	M	L	H	L	M	L	L	M	M	L	L	H	H	M
AERO2111	Flapping Wing Aerodynamics	M	M	L	H	L	M	L	L	M	M	L	L	H	H	M
AERO2121	Experimental Techniques	H	M	L	M	L	H	L	L	M	M	L	L	H	H	M
AERO3051	Hypersonic Aerodynamics	M	H	L	H	L	M	L	L	M	M	L	L	H	H	M
AERO3061	Introduction to Finite Element Analysis	H	H	M	H	H	H	M	L	M	H	L	L	H	H	M
AERO3071	Advanced Aerospace Structures	H	H	L	H	L	M	L	L	M	M	L	L	H	H	M
AERO3081	Vibrations and Acoustics	H	M	L	H	L	M	L	L	M	M	L	L	H	H	M
AERO3091	Theory of Elasticity	H	M	L	H	L	M	L	L	M	M	L	L	H	H	M
AERO3101	Mechanics of Composite Materials	H	M	M	H	L	H	L	L	M	M	L	L	H	H	M
AERO3111	Aero Elasticity	H	M	L	H	L	H	L	L	M	M	L	L	H	H	M
AERO3121	Aerodynamics of Turbomachinery	M	H	L	H	L	M	L	L	M	M	L	L	H	H	M
AERO2131	Theory of Cryogenics	M	M	L	H	L	M	L	L	M	M	L	L	H	H	M
AERO2141	Rockets and Missiles	H	M	L	H	L	H	L	L	M	M	L	L	H	H	M
AERO3131	Flight Dynamics	H	H	M	M	M	H	L	L	M	M	L	L	H	H	M
AERO3141	Space Technology	H	M	L	H	M	H	L	L	M	M	L	L	H	H	M
AERO3151	Space Mechanics	H	M	L	M	M	H	L	L	M	M	L	L	H	H	M
AERO3161	Satellite Attitude and Control	M	H	L	H	M	H	L	L	M	M	L	L	H	H	M
AERO3171	Guidance and Control	H	M	L	H	M	H	L	L	M	M	L	L	H	H	M
AERO2151	Aircraft Systems and	H	M	L	M	L	H	L	L	M	M	L	L	H	H	M

	Instrumentation															
AERO2161	Airport Planning and Management	L	L	L	M	L	L	L	L	M	H	H	L	H	H	M
AERO2171	Air Transportation Systems	M	L	L	M	L	L	L	L	M	H	L	L	H	H	M
AERO3181	Helicopter Aerodynamics	M	M	L	H	L	M	L	L	M	M	L	L	H	H	M
AERO3191	Avionics	H	M	L	M	M	H	L	L	M	M	L	L	H	H	M

Syllabus

University Core

CSEN1001	IT Productivity Tools	L	T	P	S	J	C
		0	0	2	0	0	1*
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	Familiarity with Computer system and its operation.						

Course Description:

This course introduces all software tools that improve the productivity of a student in enhancing his learning experience with all the activities taken up as part of his coursework.

Course Educational Objectives:

- To enable the learner, the skill in preparing technical documents of professional quality using docs, sheets and forms.
- To involve the student in designing and creating of websites and acquaint the student with the skill of processing audio, images, documents etc.
- To create awareness in analyzing data using pivot tables, query manager etc.
- To create awareness in composing emails, mail merge, e-mail merge etc.
- To provide the exposure to work with collaborative tools.

List of Experiments:

1. Create a typical document consisting of text, tables, pictures, multiple columns, with different page orientations.
2. Create a technical paper / technical report consisting of table of contents, table of figures,table of tables, bibliography, index, etc.
3. Compose and send customized mail / e-mail using mail-merge.
4. Create / modify a power point presentation with text, multimedia using templates withanimation.
5. Create spreadsheet with basic calculations with relative reference, absolute reference, andmixed reference methods.
6. Simple report preparation using filtering tool / advanced filtering commands / pivot tables in spreadsheet application.
7. Analyse the results of a examination student wise, teacher wise, course wise, institute-wise.
8. Collecting and consolidating data using collaborative tools like google docs, sheets, forms.
9. Create charts / pictures using online tools like: www.draw.io or smart draw
10. Create a website of his interest.

Textbooks:

1. Katherin Murray, 'Microsoft Office 365 Connect and collaborate virtually anywhere, anytime', Microsoft Press, ISBN: 978-0-7356-5694-9
2. EXCEL 2021 The Comprehensive Beginners to Advanced Users Guide to Master Microsoft Excel 2021. Learn the Essential Functions, New Features, Formulas, Tips and Tricks, and Many More
3. https://drawio-app.com/tutorials/video-tutorials/
4. Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and WebGraphics Fourth Edition ISBN-13: 978-1449319274

References/Online Resources:

1. https://www.coursera.org/learn/introduction-to-computers-and-office-productivity-software
2. https://www.coursera.org/projects/analyze-data-pivot-tables-crosstabs-google-sheets
3. https://www.coursera.org/learn/excel-advanced#syllabus
4. https://www.coursera.org/learn/how-to-create-a-website
5. https://support.microsoft.com/en-us/office
6. https://www.diagrams.net/
7. https://edu.google.com/

Course Outcomes:

1. Create / alter documents / Technical Paper / Project report with text, pictures, graphs ofdifferent styles.
2. Create / modify power point presentations with text, multimedia and to add animationusing / creating templates.
3. Perform basic calculations / retrieve data / createpivot tables / chart using a spreadsheetapplication.
4. Create simple diagrams / charts using online tools like: www.draw.io .
5. Manage documents, presentations, spreadsheets and websites in collaborative mode.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS12	PSO1	PSO2	PSO3
CO1					2				1	1					
CO2					2				1	1					
CO3	2	1	1		2				1	1					
CO4					2				1	1					
CO5					2				3	3					

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : September 6, 2021

ACADEMIC COUNCIL: 21st AC(September 17, 2021

SDG No. & Statement: 4 Quality Education

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

The students can perform simple document preparation to complex calculations in isolated mode and collaborative mode that are useful throughout their career.

CLAD1001	EMOTIONAL INTELLIGENCE & REASONING SKILLS (SOFT SKILLS 1)	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

Emotional intelligence is a set of skills that are thought to contribute to the appraisal of emotions in oneself and others. It can also help contribute to the effective regulation of emotions as well as feelings (Salovey & Mayer, 1990). In terms of emotional intelligence, self-awareness and self- management have to do with our ability to relate to ourselves. Social awareness and relationship management have to do with our ability to relate to others. Similarly, the ability to solve questions on Analytical Reasoning and Data Sufficiency is a critical area tested in almost all competitive examinations and admission tests. Upon completion, students should be able (1) to deal with theirown emotions as well as the emotions of others and relate better with both. Using better knowledgeof EI, students will also be able to set more meaningful goals for themselves, choose suitable time management techniques that work best for them and work in teams more effectively. (2) to apply different concepts, ideas, and methods to solve questions in reasoning and data sufficiency

Course Educational Objectives:

- Use EI to relate more effectively to themselves, their colleagues and to others. Apply self-awareness and self-assessment (SWOT) to better understand and manage their own emotions. Apply social awareness to empathize with others and build stronger relationships with others.
- Set meaningful goals based on their strengths and weaknesses and apply time management techniques, such as Q4 organizing to put first things first.
- Manage conflicts and work in teams in an emotionally intelligent manner.
- Solve questions on non-verbal and analytical reasoning, data sufficiency and puzzles

List of Activities & Tasks for Assessment:

Unit	Topics	Hours
1	Self-Awareness & Self-Regulation: Introduction to Emotional Intelligence, *Self-Awareness:* Self-Motivation, Accurate Self-Assessment (SWOT Analysis),Self-Regulation: *Self Control, Trustworthiness & Adaptability*	3
2	Importance, Practising Social Awareness, Building Relationships, Healthy andUnhealthy Relationships, Relationship Management Competencies-Influence, Empathy, Communication, Types of Conflicts, Causes, Conflict Management	3

3	Social Media: Creating a blog, use of messaging applications, creating awebsite to showcase individual talent, creation of a LinkedIn Profile	2
4	Goal Setting & Time Management: Setting SMART Goals, Time Wasters, Prioritization, Urgent Vs Important, Q2 Organization	3
5	Teamwork: Team Spirit, Difference Between Effective and Ineffective Teams, Characteristics of High Performance Teams, Team Bonding, Persuasion, Team Culture, Building Trust, Emotional Bank Account	4
6	Verbal Reasoning: Introduction, Coding-decoding, Blood relations, Ranking Directions, Group Reasoning	6
7	Analytical Reasoning: Cubes and Dices, Counting of Geometrical figures	3
8	Logical Deduction: Venn diagrams, Syllogisms, Data Sufficiency, Binary logic	4
9	Spatial Reasoning: Shapes, Paper Cutting/Folding, Mirror images, Water images and Rotation of figures	2

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, Career Launcher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Students will be able to relate more effectively to themselves, their colleagues and to others
2. Students will be able to set their short term and long term goals and better manage their time
3. Students will be able to manage conflicts in an emotionally intelligent manner and work inteams effectively
4. Students will be able to solve questions based on non-verbal and analytical reasoning, datasufficiency and puzzle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									3	3		2			
CO2	2	2	2	3	2	1	2		3	3		3			
CO3	2		2	3					3	2	2	2			
CO4	2	2	2	3		1					2	3			
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-201**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Emotional Intelligence and reasoning skills are essential for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

CLAD1011	LEADERSHIP SKILLS & QUANTITATIVE APTITUDE (SOFT SKILLS 2)	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

Communication Skills is having the ability to convey information to others so that messages are understood, and outcomes delivered. Some essential qualities of Communication Skills include understanding the needs of others, clearly communicating messages, adapting the communication style, and using a range of communication methods. Presentation Skills is having the ability to confidently deliver an engaging messageto a group of people which achieves the objectives. Some essential qualities of Presentation Skills include a thorough preparation of content, structuring content logically, managing nerves, engaging your audience, delivering presentation objectives, positively influencing the audience, and responding to audience needs.Tackling questions based on numbers, arithmetic, data interpretation and puzzles requires the application of different rules and concepts of numerical computation, numerical estimation, and data estimation.

Course Educational Objectives:

- Learn and apply, through different individual and group activities, different ideas, and skills tocommunicate in a positive and impressive manner.
- Apply the goal setting process (based on SWOT) and Q2 organizing for effective time management.
- Apply different concepts in numbers, numerical computation, and numerical estimation to solvequestions that often appear in various competitive examinations and admission tests.
- Apply different concepts for tackling questions based on data interpretation, progression and series thatare frequently given in various competitive examinations and admission tests.

List of Activities & Tasks for Assessment:

Unit	Topics	Hours
1	Communication Skills: The Communication Process, Elements of Interpersonal Communication, Non-Verbal Communication: Body Language, Posture, Eye Contact, Smile, Tone of Voice, Barriers to Communication. Effective Listening Skills: Active Listening, Passive	5

	Listening, Asking Questions, Empathizing, Being Non-Judgmental, Being Open Minded, Mass Communication: Design of Posters, Advertisements, notices, writing formal and informal invitations	
2	Focus on Audience Needs, focus on the Core Message, Use Body Language andVoice, Start Strongly, Organizing Ideas & Using Visual Aids: SPAM Model, EffectiveOpening and Closing Techniques, Guy Kawasaki's Rule (10-20-30 Rule), Overcoming Stage Fear, Story Telling	3
3	Problem Solving & Decision Making: Difference Between the Two, Steps in RationalApproach to Problem Solving: Defining the Problem, Identifying the Root Causes, Generating Alternative Solutions, Evaluating and Selecting Solutions, Implementingand Following-Up, Case Studies	3
4	Group Discussion: Understanding GD, Evaluation Criteria, Nine Essential Qualities for Success, Positive and Negative Roles, Mind Mapping, structuring a Response, Methods of Generating Fresh Ideas	4
5	Number Theory: Number System, Divisibility rules, Remainders and LCM & HCF	3
6	Numerical Computation and Estimation - I: Chain Rule, Ratio Proportions, Partnerships & Averages, Percentages, Profit-Loss & Discounts, Mixtures, Problem on Numbers & ages	6
7	Data Interpretation: Interpretation and analysis of data in Tables, Caselets, Line- graphs, Pie-graphs, Boxplots, Scatterplots and Data Sufficiency	3
8	Mental Ability: Series (Number, Letter and Alphanumeric), Analogy (Number, Letter and Alphanumeric) and Classifications	3

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, Career Launcher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Students will be able to communicate 'one-on-one' and 'one-on-many' confidently using both verbal and non-verbal messages and deliver impressive talks/ presentations to a group both with and without the use of PPTs and create posters, advertisements, etc.
2. Students will be able to apply the rational model of problem solving and decision makingin their problem solving and decision-making efforts.
3. Students will be able to solve questions based on numbers and arithmetic given in

various competitive examinations

4. Students will be able to solve questions based on data interpretation, progressions, and series.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						2			2	3		2			
CO2	2	2	3	2		3	3		3	3		2			
CO3	2	2	2	2		2						3			
CO4	2	2	2	2		2									
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Leadership and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

<table>
<tr><td rowspan="2">CLAD1021</td><td rowspan="2">VERBAL ABILITY & QUANTITATIVE ABILITY
(SOFT SKILLS 3)</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

Vocabulary is an important part of verbal ability. An understanding of word formation, prefixes, suffixes, and roots is necessary to remember and use a vast repository of words. Approaching words through word families and other ways of groupings is an effective way of gaining mastery over vocabulary. Understanding and getting acquainted with the different rules and exceptions in the use of grammar and structure, especially from the relevant examination point of view, is crucial to cracking questions given in many competitive tests. Similarly, improving reading comprehension skills and test taking abilities in this area takes time and effort, especially given the fact that most students do not possess strong reading habits. In so far as quantitative aptitude is concerned, students need to develop a strong foundation on the basic mathematical concepts of numerical estimation, geometry, mensuration, data sufficiency, etc. to be able to crack different round 1 tests of major recruiters and admission tests of top Indian and foreign universities.

Course Educational Objectives:

- List and discuss the different word formation methods, word denotation, connotation, collocation, etc. and introduce selected high frequency words, their antonyms, synonyms, etc.
- Apply different advanced reading skills to solve questions based on author's tone, main ideas and sub-ideas, inferences, Para jumbles, etc. that are frequently asked in various competitive exams and admission tests.
- Solve different types of questions based on vocabulary, such as word analogy; structure, grammar, and verbal reasoning; introduce common errors and their detection and correction.
- Solve questions on numerical estimation, mensuration, data sufficiency based on quantitative aptitude. This includes questions on time and work, time and distance, pipes and cisterns, lines and angles, triangles, quadrilaterals, polygons and circles, 2- & 3-dimensional mensuration.

List of Activities & Tasks for Assessment:

1. **Vocabulary Builder:** Understanding Word Formation, Prefixes, Suffixes and Roots, Etymology, Word Denotation, Connotation and Collocation, Synonyms and Antonyms

2. **Reading Comprehension:** Advanced Reading Comprehension: Types of RC passages,

Types of Text Structures, Types of RC Questions: Distinguishing Between Major Ideas and Sub Ideas, Identifying the Tone and Purpose of the Author, Reading Between the Lines and Beyond the Lines, Techniques for Answering Different Types of Questions

3. **Para Jumbles:** Coherence and Cohesion, Idea Organization Styles, Concept of Mandatory Pairs and Its Application: Transitional Words, Antecedent-Pronoun Reference, Article Reference, Cause and Effect, Chronological Order, General to Specify, Specify to General, Idea-Example, Idea-Explanation, Etc.
4. **Grammar Usage:** Rules Governing the Usage of Nouns, Pronouns, Adjectives, Adverbs, Conjunctions, Prepositions and Articles
5. **Numerical Computation and Estimation - II:** Time and Work, Pipes and Cisterns, Time and Distance, Problems on Trains, Boats and Streams, Races and Games of Skill, Simple Interest& Compound Interest
6. **Geometry:** Lines and Angles, Triangles, Quadrilaterals & Polygons, and Circles
7. **Mensuration:** 2-Dimensional Mensuration (Triangles, Quadrilaterals and Circles), 3-Dimensional Mensuration (Cubes, Cuboids, Cylinder, Cone, Sphere)

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, Career Launcher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. List and discuss word formation methods, selected high frequency words, their antonyms, synonyms, etc.
2. Analyze reading passages and quickly find out the correct responses to questions asked, including para jumbles, by using reading skills like skimming, scanning, reading between the lines, etc.
3. Solve different types of questions based on vocabulary, structure, grammar and verbal reasoning
4. Solve questions on numerical estimation, mensuration, data sufficiency based on quantitative aptitude

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									1	3		2			
CO2				2		2				2		3			
CO3									1	2		3			
CO4	2	2	3			2						1			
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

<table>
<tr><td rowspan="2">CLAD1031</td><td rowspan="2">PRACTICING VERBAL ABILITY & QUANTITATIVE APTITUDE (SOFT SKILLS 4)</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

A sound knowledge of the rules of English grammar, structure and style and its application in detecting errors in writing are important areas of Verbal Ability frequently tested as a part of the written test in many competitive examinations and admission tests of major recruiters and universities respectively. This module focuses on all important areas of grammar and structure commonly asked in major tests, such as GMAT, CAT, XLRI, CRT, etc. Similarly, in the area of Quantitative Aptitude, different kinds of questions are asked from Combinatorics (Permutations & Combinations, Probability], Cryptarithmetic & Modular Arithmetic (Cryptarithmetic, Application of base system (7, 24), Clocks (Base 24), Calendars (Base 7), and Mental Ability (Number series, Letter series & Alpha numeric series, Analogies (Numbers, letters), Classifications, Algebra (Exponents, Logarithms, Problems related to Equations, Special Equations, and Statistics) . This module focuses on all these areas by building on what the students already learnt in their earlier studies.

Course Educational Objectives:

- Apply the rules of grammar to solve questions in Error Detection, Sentence Correction and Sentence Improvement.
- Apply the rules of structure to solve questions in Error Detection, Sentence Correction and Sentence Improvement, Fill-in-blanks and Cloze Passages.
- Explain methods of solving problems in Combinatorics (Permutations & Combinations, Probability], Cryptarithmetic & Modular Arithmetic (Cryptarithmetic, Application of basesystem (7, 24), Clocks (Base 24), Calendars (Base 7)]
- Explain how to solve questions in Mental Ability (Number series, Letter series & Alpha numeric series, Analogies, Numbers, letters, Classifications] and Algebra (Exponents, Logarithms, Problems related to Equations, Special Equations, Statistics)

List of Activities & Tasks for Assessment:

1. Error Detection: Pronouns, Conjunctions, Prepositions and Articles
2. Error Detection: Tenses and their Uses
3. Sentence Correction: Subject-Verb Agreement, Antecedent-Pronoun Agreement, Conditional Clauses
4. Sentence Correction: Modifiers (Misplaced and Dangling) & Determiners, Parallelism & WordOrder, and Degrees of Comparison
5. Combinatorics: Permutations & Combinations, Probability

6. Crypt arithmetic & Modular Arithmetic: Crypt arithmetic, Application of Base System (7, 24),Clocks (Base 24), Calendars (Base 7)
7. Algebra: Exponents, Logarithms, Word-problems related to equations, Special Equations,Progressions, Statistics

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, Career Launcher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Identify and correct errors in English grammar and sentence construction
2. Identify and correct errors in Structure, Style and Composition
3. Solve problems in Combinatorics, Cryptarithmetic, and Modular Arithmetic
4. Solve problems in Mental Ability and Algebra

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									1	3		1			
CO2									1	3		1			
CO3		2	3	2		2						2			
CO4		3	2	2		2						2			
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

CLAD2001	PREPARATION FOR CAMPUS PLACMENT -1 (SOFT SKILLS 5A)	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The course addresses all relevant areas related to campus placements and readies them to ace their upcoming/ ongoing recruitment drives. Specifically, it focuses on students' career preparedness, interview skills, test preparedness, etc.

Course Educational Objectives:

Prepare the students for their upcoming/ ongoing campus recruitment drives.

List of Activities & Tasks for Assessment:

1. Career Preparedness: Resume & Cover Letter Writing, Interview Skills: Elevator Pitch, Making the First Impression, Being Other-Oriented, Being Positive and Curious, communicating with Confidence and Poise, Frequently Asked Questions & How to Answer Them, Pitfalls to Avoid, Etc. Etiquette: Hygiene, Courtesy, Culture differences, Workplace, use of cell phone, Profanity, Slang, Protocol.
2. Verbal Ability: Practicing Reading Comprehension, Error Detection, Sentence Completion, MCQs, FIBs, Para jumbles, Cloze Test, Critical Reasoning.
3. Quantitative Aptitude: Number Systems, Algebra, Geometry, Data Handling, Data Sufficiency, Word Problems
4. Reasoning: Logical and Verbal Reasoning

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and MeenakshiUpadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMSetc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Write a power resume and covering letter
2. Answer interview questions with confidence and poise
3. Exhibit appropriate social mannerisms in interviews
4. Solve placement test questions on verbal ability, quantitative aptitude and reasoning

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									3	2		1			
CO2						3			2			1			
CO3						2			1	3		3			
CO4		3		2		2			1			3			
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Quantitative aptitude, reasoning, verbal and language skills practiced during the preparation for campus placement tests provide essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

CLAD2011	PREPARATION FOR HIGHER EDUCATION (GRE/ GMAT)-1 (SOFT SKILLS 5B)	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The course offers a special track for students who aspire to go abroad in pursuit of their higher education for which a GRE/ GMAT score is a prerequisite. It covers all four topical areas of these tests and includes fully solved mock tests as well.

Course Educational Objectives:

- Prepare the students to solve questions from all four broad areas of GRE/ GMAT
- Orient the students for GRE/ GMAT through mock tests

List of Activities & Tasks for Assessment:

1. Verbal Reasoning: Reading Comprehension, Sentence Equivalence, TextCompletion, Sentence Correction, Critical Reasoning
2. Quantitative Reasoning: Arithmetic, Algebra, Geometry, Data Analysis
3. Analytical Writing Assessment: Issue/ Argument
4. Integrated Reasoning

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and MeenakshiUpadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMSetc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Solve questions from all four broad areas of GRE/ GMAT
2. Practice answering several mock tests

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2	2	2					3			3			
CO2		2	2	2					3			3			
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Quantitative aptitude, reasoning, verbal and language skills practiced during the preparation for GRE/GMAT tests provide essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

<table>
<tr><td rowspan="2">CLAD2021</td><td rowspan="2">PREPARATION FOR CAT/ MAT – 1
(SOFT SKILLS 5C)</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

The course offers a special track for UG students who aspire to go for higher education in business management in India for which cracking CAT/ MAT/ other related test is mandatory. It covers all four topical areas of these tests and includes fully solved mock testsas well.

Course Educational Objectives:

- Prepare the students to solve questions from all four relevant areas of CAT/ XAT/MAT, etc.
- Orient the students for CAT/ XAT, etc. through mock tests

List of Activities & Tasks for Assessment:

1. Quantitative Ability: Arithmetic, Algebra, Geometry, Mensuration, Calculus, Trigonometry
2. Data Interpretation: Data Interpretation and Data Sufficiency
3. Logical Reasoning: Data Management, Deductions, Verbal Reasoning and Non-Verbal Reasoning
4. Verbal Ability: Critical Reasoning, Sentence Correction, Para Completion, Para Jumbles, Reading Comprehension

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, Career Launcher andIMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Solve questions from all four relevant areas of CAT/ MAT as listed above
2. Practice test-cracking techniques through relevant mock tests

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2		2			3	3	3	3			
CO2	2	2	2	2		1			2		2	3			
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Quantitative aptitude, reasoning, verbal and language skills practiced during the preparation for CAT/ MAT tests provide essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

CLAD2031	PREPARATION FOR CAMPUS PLACEMENT-2 (SOFT SKILLS 6A)	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course builds on the previous course and focuses on all four major areas of campus placements, including career preparedness, mock interviews, verbal ability, quantitative aptitude, and logical reasoning.

Course Educational Objectives:

- To comprehensively prepare all eligible and aspiring students for landing their dream jobs.
- To sharpen the test-taking skills in all four major areas of all campus drives

List of Activities & Tasks for Assessment:

1. Career Preparedness II: Mock Interviews, Feedback and Placement Readiness
2. Verbal Ability II: Practising Reading Comprehension, Error Detection, Sentence Completion, MCQs, FIBs, Para jumbles, Cloze Test, Critical Reasoning
3. Quantitative Aptitude II: Number Systems, Algebra, Geometry, Data Handling,Data Sufficiency, Word Problems
4. Reasoning II: Logical and Verbal Reasoning

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMSetc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Demonstrate career preparedness and confidence in tackling campus interviews
2. Solve placement test questions of a higher difficulty level in verbal ability, quantitative aptitude and logical reasoning.
3. Practice test-taking skills by solving relevant questions accurately and within time.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									2	3		2			
CO2	2	2	2	3		3			2	2	3	2			
CO3	2	2	2	3		2			1		2	3			
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Quantitative aptitude, reasoning, verbal and language skills practiced during the preparation for campus placement tests provide essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

<table>
<tr><td rowspan="2">CLAD2041</td><td rowspan="2">PREPARATION FOR HIGHER EDUCATION (GRE/GMAT)-2 (SOFT SKILLS 6B)</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

The course offers a special track for students who aspire to go abroad in pursuit of theirhigher education for which a GRE/ GMAT score is a prerequisite. It covers all four topical areas of these tests at a higher difficulty-level and includes fully solved mock tests as well.

Course Educational Objectives:

- Prepare the students to solve higher level questions from all four broad areas of GRE/ GMAT
- Orient the students for GRE/ GMAT through mock tests

List of Activities & Tasks for Assessment:

1. Verbal Reasoning II: Reading Comprehension, Sentence Equivalence, Text Completion, Sentence Correction, Critical Reasoning
2. Quantitative Reasoning II: Arithmetic, Algebra, Geometry, Data Analysis
3. Analytical Writing Assessment II: Issue/ Argument
4. Integrated Reasoning II

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and MeenakshiUpadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMSetc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Solve higher level questions from all four broad areas of GRE/ GMAT
2. Practice answering several mock tests

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2		3		2			2	2	2	2			
CO2		2		2		2			2	2	2	2			
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Quantitative aptitude, reasoning, verbal and language skills practiced during the preparation for GRE/GMAT tests provide essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

<table>
<tr><td rowspan="2">CLAD2051</td><td rowspan="2">PREPARATION FOR CAT/ MAT – 2
(SOFT SKILLS 6C)</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

The course offers a special track for UG students who aspire to go for higher education in business management in India for which cracking CAT/ MAT/ other related test is mandatory. It covers all four topical areas of these tests at a higher level of difficulty and includes fully solved mock tests as well.

Course Educational Objectives:

- Prepare the students to solve all types of questions from all four relevant areas of CAT/ XAT/ MAT, etc.

List of Activities & Tasks for Assessment:

1. Quantitative Ability II: Arithmetic, Algebra, Geometry, Mensuration, Calculus, Trigonometry
2. Data Interpretation II: Data Interpretation and Data Sufficiency
3. Logical Reasoning II: Data Management, Deductions, Verbal Reasoning and Non-Verbal Reasoning
4. Verbal Ability II: Critical Reasoning, Sentence Correction, Para Completion, Para Jumbles, Reading Comprehension

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and MeenakshiUpadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMSetc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Solve higher difficulty level questions from all four relevant areas of CAT/ MAT aslisted above
2. Practice test-cracking techniques through relevant mock tests

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3		3					3	3	3	2			
CO2	1	2		2					2	3	2	2			
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Quantitative aptitude, reasoning, verbal and language skills practiced during the preparation for CAT/ MAT tests provide essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

DOSL1001	CLUB ACTIVITY – PARTICIPANT	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course recognizes student participation in multiple activities organized by various student organizations that pursue specific co-curricular and extra-curricular interests. These activities allow students to engage in and identify and pursue their personal interests and hobbies.

Course Educational Objectives:

- Create opportunities for students to participate in a variety of non-academic experiences
- Interact with and learn from peers in a setting without an external performance pressure
- Allow exploration of interesting activities and reflection about these experiences
- Learn to manage time effectively

List of Student Club Activities:

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multi media, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

List of Activities:

1. Participation in various club-based activities
2. Weekly reflection paper
3. Portfolio (on social media using an Instagram account)
4. Two learning papers (one per semester)

Textbooks:

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students (Cal Newport)

References:

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. YouTube- Introduction to various club activities

Course Outcomes:

Upon successful completion of the course, student will be able to

1. Identify personal interest areas
2. Learn from diverse perspectives and experiences
3. Gain exposure to various activities and opportunities for extra-curicular activities
4. Learn to manage time effectively
5. gain confidence

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								3	3	2	3	2			
CO2									3	3		2			
CO3									3	3	2	3			
CO4									3	3		3			
CO5								3	3	3		2			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

This course recognizes student participation in non-academic events and activities which focus on inclusive partnerships and collaborations with all stakeholders by using all sustainable means to promote lifelong learning.

<table>
<tr><td rowspan="2">DOSL1011</td><td rowspan="2">CLUB ACTIVITY – MEMBER OF THE CLUB</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>2</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course encourages and acknowledges student members' work in organizing events and activities organized by various student organizations that pursue specific co-curricular and extra- curricular interests. These activities allow students to actively learn from the process of conceptualizing and organizing such activities as part of a team.

Course Educational Objectives:

- Create opportunities for students to learn from organizing club activities
- Learn teamwork, leadership, planning and management of events and activities
- Learn to appreciate multiple perspectives, cultures, and individual capabilities
- Learn to manage time effectively

List of Student Club Activities:

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multi media, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

List of Activities:

1. Be a member of a club and organize activities in that particular interest area
2. Learn from diverse perspectives and experiences
3. Learn to design and execute extra-curricular activities
4. Develop management skills through hands on experience
5. Explore different managerial roles and develop competencies

Textbooks:

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students (Cal Newport)

References:

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. Youtube- Introduction to various club activities

Course Outcomes:

Upon successful completion of the course, student will be able to

- Be a member of a club and organize activities in that particular interest area
- Learn from diverse perspectives and experiences
- Learn to design and execute extra-curricular activities
- Develop management skills through hands on experience
- Explore different managerial roles and develop competencies

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								3	3	3		3			
CO2									3	2		3			
CO3								3	3	2					
CO4										2	3	3			
CO5								2				3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:

SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

SDG17 : Strengthen the means of implementation and revitalize the global partnership for sustainable development

SDG Justification:

This course recognizes student participation in community service endeavours focussing on sustainable development, service to communities. This allows students to develop empathy, citizenship behaviour and inclusive community values.

DOSL1021	CLUB ACTIVITY – LEADER OF THE CLUB	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course encourages and recognizes student members' work in leading the student organizationsthrough various leadership roles. As leaders they work not just to organize events and activities in specific co-curricular and extra-curricular interests, but also lead the teams that form the core members of the clubs. These activities allow students to learn and practice leadership and management skills through real world experience.

Course Educational Objectives:

- Create opportunities for students to learn from organizing club activities
- Learn teamwork, leadership, planning and management of events and activities
- Learn to appreciate multiple perspectives, cultures, and individual capabilities
- Learn to manage time effectively

List of Student Club Activities:

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multimedia, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

List of Activities:

1. Be the leader of the club and implement the charter, vision and mission of the club
2. Learn from diverse perspectives and experiences
3. Learn to lead the team, design and execute extra-curricular activities
4. Develop management skills through hands on experience
5. Explore different managerial roles and develop competencies

Textbooks:

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students(Cal Newport)

References:

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. Youtube- Introduction to various club activities

Course Outcomes:

Upon successful completion of the course, student will be able to

- Be the leader of the club and implement the charter, vision and mission of the club
- Learn from diverse perspectives and experiences
- Learn to lead the team, design and execute extra-curricular activities
- Develop management skills through hands on experience
- Explore different managerial roles and develop competencies

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								3	3	3		3			
CO2									3	2		3			
CO3								3	3	2					
CO4										2	3	3			
CO5								2				3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:

SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

SDG17 : Strengthen the means of implementation and revitalize the global partnership for sustainable development

SDG Justification:

This course recognizes student participation in community service endeavours focussing on sustainable development, service to communities. This allows students to develop empathy, citizenship behaviour and inclusive community values.

DOSL1031	CLUB ACTIVITY – COMPETITOR	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course encourages and recognizes student members' work in leading the student organizationsthrough various leadership roles. As leaders they work not just to organize events and activities in specific co-curricular and extra-curricular interests, but also lead the teams that form the core members of the clubs. These activities allow students to learn and practice leadership and management skills through real world experience.

Course Educational Objectives:

- Create opportunities for students to learn from organizing club activities
- Learn teamwork, leadership, planning and management of events and activities
- Learn to appreciate multiple perspectives, cultures, and individual capabilities
- Learn to manage time effectively

List of Student Club Activities:

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multimedia, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

List of Activities:

1. Be the leader of the club and implement the charter, vision and mission of the club
2. Learn from diverse perspectives and experiences
3. Learn to lead the team, design and execute extra-curicular activities
4. Develop management skills through hands on experience
5. Explore different managerial roles and develop competencies

Textbooks:

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students (Cal Newport)

References:

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. Youtube- Introduction to various club activities

Course Outcomes:

Upon successful completion of the course, student will be able to

1. Be the leader of the club and implement the charter, vision and mission of the club
2. Learn from diverse perspectives and experiences
3. Learn to lead the team, design and execute extra-curricular activities
4. Develop management skills through hands on experience
5. Explore different managerial roles and develop competencies

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								3	3	3		3			
CO2									3	2		3			
CO3								3	3	2					
CO4										2	3	3			
CO5								2				3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:

SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

SDG17 : Strengthen the means of implementation and revitalize the global partnership for sustainable development

SDG Justification:

This course recognizes student participation in community service endeavours focussing on sustainable development, service to communities. This allows students to develop empathy, citizenship behaviour and inclusive community values.

<table>
<tr><td rowspan="2">DOSL1041</td><td rowspan="2">COMMUNITY SERVICES - VOLUNTEER</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course recognizes student participation in Community service activities organized by various student organizations and other Government and non-government organizations that exist for providing service to communities. These activities allow students to develop empathy, citizenship behavior and community values.

Course Educational Objectives:

- To help students develop empathy and citizenship behavior
- Enable students to develop an altruistic attitude and community development sensibility
- Allow exploration of community service activities and reflect about these experiences
- Learn to work in small and large teams for achieving community objectives

List of Community Service Activities:

1. Community Health Services
2. Swachh Bharat Abhiyan and other Cleanliness drives
3. Tree Plantation and similar environmental conservation initiatives
4. Rain water harvesting awareness and implementation
5. Fundraising and visits to Orphanages, Old-age homes, etc.
6. Health and disease awareness programs
7. Working with NGOs
8. Disaster mitigation and management training and relief work
9. Rural Upliftment projects
10. Campus awareness and action projects (cleanliness, anti-ragging, blood donation, etc)
11. Community investigations and surveys for development research
12. Educational support for underprivileged (remedial classes, coaching, training, etc)
13. Service camps
14. Advocacy and information literacy initiatives
15. Other activities serving local communities

List of Activities:

1. Participation in various community service activities
2. Weekly reflection paper
3. Portfolio (on social media using an instagram account)
4. Two learning papers (one per semester)

Text Books:

1. Soul of a citizen: living with conviction in Challenging times (author: Paul Rogat Loeb)
2. Community Services intervention: Vera Lloyd

References:

1. A path appears: Transforming lives, creating opportunities (Nicholas Kristof and SherylWuDunn)
2. The story of My Experiments with Truth (author: M. K. Gandhi)

Course Outcomes:

1. Experience of volunteering in a variety of Community service activities
2. Gaining empathy for lesser privileged sections of society by experience
3. Understanding the process of generating community awareness
4. Understanding Disaster management and relief through training and experience
5. Developing environmental and sustainability awareness

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								3	3	3		3			
CO2									3	2		3			
CO3								3	3	2					
CO4										2	3	3			
CO5								2				3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:

SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

SDG17 : Strengthen the means of implementation and revitalize the global partnership for sustainable development

SDG Justification:

This course recognizes student participation in community service endeavours focussing on sustainable development, service to communities. This allows students to develop empathy, citizenship behaviour and inclusive community values.

<table>
<tr><td rowspan="2">DOSL1051</td><td rowspan="2">COMMUNITY SERVICES - MOBILIZER</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course recognizes student leadership in mobilizing community service activities as members of various student organizations or other Government and non-government organizations that existfor providing service to communities. These activities allow students to develop leadership, management skills, empathy, citizenship behavior and community values.

Course Educational Objectives:

- To help students understand leadership in a community environment
- Enable students to develop an altruistic attitude and community development sensibility
- Allow deep understanding of community service through practical experience
- Learn to lead small and large teams for achieving community objectives

List of Community Service Activities:

1. Community Health Services
2. Swachh Bharat Abhiyan and other Cleanliness drives
3. Tree Plantation and similar environmental conservation initiatives
4. Rain water harvesting awareness and implementation
5. Fundraising and visits to Orphanages, Old-age homes, etc.
6. Health and disease awareness programs
7. Working with NGOs
8. Disaster mitigation and management training and relief work
9. Rural Upliftment projects
10. Campus awareness and action projects (cleanliness, anti-ragging, blood donation, etc)
11. Community investigations and surveys for development research
12. Educational support for underprivileged (remedial classes, coaching, training, etc)
13. Service camps
14. Advocacy and information literacy initiatives
15. Other activities serving local communities

List of Activities:

1. Organizing and leading teams in various community service activities
2. Fortnightly reflection paper

3. Portfolio (on social media using an instagram account)
4. Two learning papers (one per semester)

Textbooks:

1. Soul of a citizen: living with conviction in Challenging times (author: Paul Rogat Loeb)
2. Community Services intervention: Vera Lloyd

References:

1. A path appears: Transforming lives, creating opportunities (Nicholas Kristof and SherylWuDunn)
2. The story of My Experiments with Truth (author: M. K. Gandhi)
3. List of student run and other Government and non- government community service organizations

Course Outcomes:

1. Experience of mobilizing and executing Community service activities
2. Providing opportunities for community service volunteering for other fellowstudents
3. Understanding the process of mobilizing cash, kind and volunteer support
4. Building leadership and management skills
5. Building empathy and citizenship behavior

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								3	3	3		3			
CO2									3	2		3			
CO3								3	3	2					
CO4										2	3	3			
CO5								2				3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:

SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

SDG17 : Strengthen the means of implementation and revitalize the global partnership for sustainable development

SDG Justification:

This course recognizes student participation in community service endeavours focussing on sustainable development, service to communities. This allows students to develop empathy, citizenship behaviour and inclusive community values.

<table>
<tr><td rowspan="2">DOSP1001</td><td rowspan="2">BADMINTON</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>2</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Badminton - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Badminton: Grips - Racket, shuttle
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Badminton Gameplay: Service, Forehand, Backhand
7. Preparatory Drills and Fun Games
8. Game Variations: Singles/ Doubles/ Mixed

References:

1. Handbook of the Badminton World Federation (BWF)

Course Outcomes:

1. Learn to play Badminton
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									3	2		3			
CO2												2			
CO3												2			
CO4							2		3	3	2				
CO5						2	2		3			3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1011	CHESS	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Chess - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Chess: Pieces & functions, basic play
4. Chess board moves & terminology
5. Chess Gameplay: Openings, castling, strategies & tactics
6. Preparatory Drills and Fun Games
7. Game Variations & Officiating

References:

1. International Chess Federation (FIDE) Handbook

Course Outcomes:

1. Learn to play Chess
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									3	2		3			
CO2												2			
CO3												2			
CO4							2		3	3	2				
CO5						2	2		3			3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1021	CARROM	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Carrom - History and development
2. Rules of the Game, Board components & dimensions
3. Fundamental Skills - Carrom: - Striking
4. Gameplay – General
5. Preparatory Drills and Fun Games
6. Game Variations: Singles/ Doubles/ Mixed
7. Preparatory Drills and Fun Games

References:

1. Indian Carrom Federation Handbook - Laws

Course Outcomes:

1. Learn to play Carrom
2. Understanding of the fundamental concepts such as rules of play, game variations

3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									3	2		3			
CO2												2			
CO3												2			
CO4							2		3	3	2				
CO5						2	2		3			3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1031	FOOTBALL	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Football - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Kicking, heading, ball control, Keeping
4. Movement, throwins, tackling, defense, scoring, defense
5. Gameplay- Formations, passing, FKs, CKs, PK, tactics
6. Preparatory Drills and Fun Games
7. Game Variations: Small sided games, 7v7, 11v11

References:

1. FIFA Laws of the Game

Course Outcomes:

1. Learn to play Football
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									3	2		3			
CO2												2			
CO3												2			
CO4							2		3	3	2				
CO5						2	2		3			3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1041	VOLLEYBALL	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Volley - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Striking, Ball control, Lifting
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Preparatory Drills and Fun Games
7. Gameplay: Jumps, strikes, layoffs, attack, defense

References:

1. FIVB - Official Volleyball Rules

Course Outcomes:

1. Learn to play Volleyball
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									3	2		3			
CO2												2			
CO3												2			
CO4							2		3	3	2				
CO5						2	2		3			3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1051	KABADDI	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Kabaddi - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Raiding, catching
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Preparatory Drills and Fun Games
7. Gameplay: Chain system movement

References:

1. Amateur Kabaddi Federation of India (AKFI) - Official Rules

2. Rules of Kabaddi - International Kabaddi Federation

Course Outcomes:

1. Learn to play Kabaddi
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1									3	2		3				
CO2												2				
CO3												2				
CO4							2		3	3	2					
CO5						2	2		3			3				

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1061	KHO KHO	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Kho Kho - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills: Sitting, giving Kho, Pole dive
4. Sports Specific fitness and warmup drills
5. Stances and footwork: Running, sitting
6. Gameplay: Running strategies, ring method, chain method
7. Preparatory Drills and Fun Games

References:

1. Khelo India Official Rulebook of Kho Kho

Course Outcomes:

1. Learn to play Kho Kho
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1									3	2		3				
CO2												2				
CO3												2				
CO4							2		3	3	2					
CO5						2	2		3			3				

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1071	TABLE TENNIS	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Table Tennis - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - TT: Grips - Racket, ball
4. Stances and footwork
5. TT Gameplay- Forehand, Backhand, Side Spin, High Toss. Strokes-Push, Chop, Drive, Half Volley, Smash, Drop-shot, Balloon, Flick, Loop Drive.
6. Preparatory Drills and Fun Games
7. Game Variations: Singles/ Doubles/ Mixed

References:

1. Handbook of the International Table Tennis Federation (ITTF)

Course Outcomes:

1. Learn to play Table Tennis
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1									3	2		3				
CO2												2				
CO3												2				
CO4							2		3	3	2					
CO5						2	2		3			3				

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1081	HANDBALL	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Handball - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Handball: Throwing, Ball control, Movement
4. Sports Specific fitness and warmup drills
5. Stances and footwork: Jumps, dribbles, catching, throws
6. Gameplay: Shots, throws, movements, attack, defense
7. Preparatory Drills and Fun Games

References:

1. International Handball Federation - Rules of the Game & Regulations

Course Outcomes:

1. Learn to play Handball
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1									3	2		3				
CO2												2				
CO3												2				
CO4							2		3	3	2					
CO5						2	2		3			3				

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1091	BASKETBALL	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Basketball - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Passing, Receiving, Dribbling
4. Sports Specific fitness and warmup drills
5. Stances and footwork: Jumps, dribbles, catching, throws
6. Preparatory Drills and Fun Games
7. Gameplay: Shots, throws, movements, attack, defense

References:

1. FIBA Basketball Official Rules

Course Outcomes:

1. Learn to play Basketball
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1									3	2		3				
CO2												2				
CO3												2				
CO4							2		3	3	2					
CO5						2	2		3			3				

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1101	TENNIS	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Tennis - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Tennis: Grips - Racket, ball
4. Stances and footwork
5. Gameplay- Forehand, Backhand, Service, volley, smash
6. Preparatory Drills and Fun Games
7. Game Variations: Singles/ Doubles/ Mixed

References:

1. Handbook of the International Tennis Federation (ITF)

Course Outcomes:

1. Learn to play Tennis
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1									3	2		3				
CO2												2				
CO3												2				
CO4							2		3	3	2					
CO5						2	2		3			3				

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1111	THROWBALL	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Throwball - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Throwing, Receiving
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Preparatory Drills and Fun Games
7. Gameplay: Shots, throws, movements, control

References:

1. World Throwball Federation - Rules of the Game

Course Outcomes:

1. Learn to play Throwball
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									3	2		3			
CO2												2			
CO3												2			
CO4							2		3	3	2				
CO5						2	2		3			3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

ENVS1001	ENVIRONMENTAL STUDIES	L	T	P	S	J	C
		3	0	0	0	0	3*
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The course enables the students to adapt eco-centric thinking and actions rather than human-centric thinking on natural resources, their utilization and conservation. The course also focuses on the importance of ecosystems, biodiversity and their degradation led to pollution. This course helps in finding solutions through application of control measures to combat pollution and legal measures to achieve sustainable development.

Course Educational Objectives:

- To impart knowledge on natural resources and its associated problems.
- To familiarize learners about ecosystem, biodiversity, and their conservation.
- To introduce learners about environment pollution.
- To acquaint learners on different social issues such as conservation of water, green buildingconcept.
- To make learners understand about the present population scenario, its impacts and role ofinformational technology on environment and human health.
- To make learners understand about the importance of field visit.

UNIT 1 Multidisciplinary nature of environmental studies & Natural Resources 10 hours

Multidisciplinary nature of environmental studies Definition, scope and importance. Need for public awareness. Natural resources and associated problems. Uses and over exploitation of Forest resources, Water resources, Mineral resources, Food resources, Energy resources. Role of an individual in conservation of natural resources.

Activity:

1. Planting tree saplings
2. Identification of water leakage in house and institute-Rectify or report
3. Observing any one day of a week as Car/bike/vehicle free day.

UNIT 2 Ecosystem and biodiversity 10 hours

Ecosystem: Structure components of ecosystem: Biotic and Abiotic components. Functional components of an ecosystem: Food chains, Food webs, Ecological pyramids, Energy flow in the ecosystem (10% law), Ecological succession.

Biodiversity: Definition, Biogeographical classification of India, Values of biodiversity: consumptive use, productive use, social, ethical, aesthetic. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching, man wildlife conflicts. Conservation of biodiversity: In – situ and Ex-situ

Activity:

1. Visit to Zoological Park-Noting different ecosystem
2. Biodiversity register- Flora and fauna in the campus

UNIT 3 Environmental Pollution 10 hours

Definition Causes, effects, and control measures of: -Air pollution. Water pollution. Soil pollution. Marine pollution. Noise pollution. Nuclear hazards. Solid waste Management: Causes, effects, and control measures. Role of an individual in prevention of pollution. Pollution case studies.

Activity:

1. Visit to treatment plant and documentation.
2. Documentation of segregation of solid waste-Dry and Wet

UNIT 4 Social Issues and the Environment 10 hours

From Unsustainable to Sustainable development Urban problems related to energy. Water conservation, rainwater harvesting, watershed management. Environmental ethics: Issues and possible solutions. Green building concept.

Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies.

Activity:

1. Observing zero hour at individual level-documentation.
2. Eco friendly idols.
3. Rainwater harvesting-creating storage pits in nearby area.

UNIT 5 **Human Population and the Environment and Environment Protection Act and Field work** **10 hours**

Population growth, variation among nations. Environment and human health. HIV/AIDS, Human rights. Value Education. Women and Child Welfare. Role of Information Technology in Environment and human health. Environment Legislation. Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife Protection Act. Environmental Protection Act, Issues involved in enforcement of environmental legislation.

Activity:

1. Visit to a local polluted site-industry/agriculture
2. Identifying diseases due to inappropriate environmental conditions

Text Book(s):

1. Erach Bharucha. Textbook of environmental studies for undergraduates courses- Universities Press,India Private Limited. 2019.
2. Kaushik A and Kaushik C.P. Perspectives in Environmental Studies. New Age InternationalPublishers Edition-VI. 2018.
3. Dave D Katewa S.S. Textbook of Environmental Studies, 2nd Edition. Cengage Learning India. 2012.

Additional Reading:

1. Benny Joseph. Textbook of Environmental Studies 3rd edition, McGraw Hill Publishing company limited. 2017.

Reference Book(s):

1. McKinney M.L., Schoch R.M., Yonavjak L. Mincy G. Environmental Science: Systems andSolutions. Jones and Bartlett Publishers. 6th Edition. 2017.
2. Botkin D.B. Environmental Science: Earth as a Living Planet. John Wiley and Sons. 5th edition. 2005.

Journal(s):

1. https://www.tandfonline.com/loi/genv20
2. https://library.lclark.edu/envs/corejournals

Website(s):

https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf From Climate Science to Action | Coursera

Course Outcomes:

After the completion of the course student will be able to

1. List different natural resources and their uses
2. Summarize the structure and function of terrestrial and aquatic ecosystems.
3. Identify causes, effects, and control measures of pollution (air, water & soil).

4. Function of green building concept.
5. Adapt value education

CO-PO Mapping:

	Programme Objectives (POs)												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2												2		
CO2		2				1							2		
CO3			1						1					1	
CO4				2							2				1
CO5	1													1	
CO6					2							1			1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN: BOS

BOS: 04-07-22 **ACADEMIC COUNCIL:14-07-22**

SDG No. & Statement:

1. SDG-6-Clean water and Sanitation
2. SDG-7-Affordable and clean energy
3. SDG-13 - Climate change
4. SDG-14 - Life below water
5. SDG-15 - Life on Land

SDG Justification:

1. The learner will understand the importance of clean water and sanitation through this course and apply in their daily activities – SDG-6

2. The learner will make use of renewable resources to reduce pollution achieves SDG-7

3. The learner will understand present situation in climate change and takes appropriate steps to combat climate change – SDG-13

4. The learner will understand the existence of life below water – SDG-14

5. The learner will understand to promote sustainable terrestrial ecosystem – SDG15

<table>
<tr><td rowspan="2">FINA3001</td><td rowspan="2">PERSONAL FINANCIAL PLANNING</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td><td>0</td><td>1*</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Risk Management in Personal financing
Fundamentals of Investing
Saving Money for the future
Personal and Family Financial Planning
Introduction to Personal Finance</td></tr>
</table>

Course Description:

Personal Financial Planning is one of the most significant factors in our lives. It is essential that funds are available as and when required at various stages of life. Unavailability of funds at critical stages of our life leads to financial distress and leads to many medical and non- medical problems. There are certain planned and unplanned events in our life. On the one hand,education of our children, their marriage, our retirement etc. are some of the planned events ofour life, but at the same time, some medical urgency, accident or death of an earning member might be some unplanned events. Many of these events are beyond our control, but the availability of funds can be planned to avoid any financial distress. In other words, we cannot stop the rain but can plan for an umbrella.
This course looks at the many challenges an individual faces in a complex financial environment and the rising uncertainties of one's life. It focuses on achieving long-term financial comfort of individual and family through goal setting, developing financial and life strategies, acquiring personal financial planning knowledge and managing risk throughout one's life.

Course Educational Objectives:

- To build students' ability to plan for long-term financial comfort of individual andfamily through goal setting, developing financial and life strategies.
- To provide students with knowledge on terms, techniques to evaluate investment avenues.
- To build the skill set of the student to enable them to file their tax returns.

UNIT 1 Basics of Financial Planning

Financial Planning Meaning, Need, Objectives, Financial Planning Process, Time Value of Money and its application using excel (NP)

UNIT 2 Risk and Insurance Management

Need for insurance, Requirement of insurance interest, Role of insurance in personal finance, Steps in insurance planning, Life and Non-life insurance products, Life insurance needs analysis (NP)

UNIT 3 Investment Products and Measuring Investment Returns

Investment Products: Small Saving Instruments, Fixed Income Instruments, Alternate Investments, Direct Equity
Measuring Investment Returns: Understanding Return and its concept, Compounding concept, Real vs Nominal Rate of Return, Tax Adjusted Return, Risk-Adjusted Return (NP)

UNIT 4 Retirement Planning

Introduction to the retirement planning process, estimating retirement corpus, Determining the retirement corpus, Retirement Products (NP)

UNIT 5 Tax Planning

Income Tax: Income tax principles: Heads of Incomes, Exemptions and Deductions, Types of Assesses, Rates of Taxation, Obligations for Filing and Reporting, Tax aspects of Investment Products, Wealth Tax

Textbooks:

1. National Institute of Securities Management (NISM) Module 1 & XA
2. Madhu Sinha, Financial Planning, 2 Edition, McGraw Hill India
3. Simplified Financial Management by Vinay Bhagwat, The Times Group

References:

1. Personal Financial Planning (Wealth Management) by S Murali and K R Subbakrishna, Himalaya Publishing House.
2. Mishra K.C., Doss S, (2009). Basics of Personal Financial Planning 1e. NationalInsurance Academy, New Delhi: Cengage Learning.
3. Risk Analysis, Insurance and Retirement Planning by Indian Institute of Banking andFinance.

Course Outcomes:

1. Describe the financial planning process and application of time value of money
2. Application of life and non-life insurance products in financial planning
3. Understand the investment avenues and analysis of investment returns
4. Understand the retirement planning and its application
5. Describe and analysis the Tax Planning

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	0	0	1	0	0	1	1	1	0	3	1	1	3
CO2	2	2	0	0	1	1	1	1	0	1	1	3	1	1	2
CO3	3	2	1	0	1	0	0	1	0	1	1	3	2	2	3
CO4	3	2	0	1	1	0	1	1	0	1	1	2	2	3	2
CO5	3	3	0	1	1	1	2	1	0	1	1	1	2	2	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 01-02-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

Goal 4: Quality education

Goal 12: Responsible consumption and Production

SDG Justification:

Goal 4: This course enables the students to attain their financial literacy that builds in the discipline of saving and improves their lifelong learnings.

Goal 12: This course ensures sustainable consumption and helps in providing them their life long financial requirements .

<table>
<tr><td rowspan="2">LANG1012</td><td rowspan="2">COMMUNICATION SKILLS IN ENGLISH – INTERMEDIATE</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description

Communication Skills in English (Intermediate) is the second of the three-level graded courses for the developmental enhancement of communication skills in English. Based on the learning outcomes set in the beginner-level syllabus, this course focuses on giving learners more exposure to the use of language for communicative purposes and equipping them with next level skills (ref. Bloom's taxonomy) and practice in complexity and cognitive engagement. This course also includes the inferential level of comprehension (listening and reading) that involves analysis and application of language skills and decision-making skills while speaking/writing with an awareness of social and personality-based communication variations. This course emphasizesguided writing through adequate pre- and post-context building tasks. The focus is on the stimulation and application of critical thinking in addition to schematic review for communication in real-life situations.

Course Educational Objectives

- Train learners to listen to short audio texts with familiar content actively; guided activity like question-making and responding to others' questions based on the audio text would help learners engage in transactional dialogue; extended activities like extrapolating/critiquing the responses would help learners enhance their schematic thinking. (Bloom's Taxonomy Level/s: 2 & 4)
- Equip learners with strategies to read actively and critically and understand the writers' viewpoints and attitude by providing reading comprehension tasks using authentic texts such as op-ed articles from newspapers, and reports on contemporary problems. (Bloom'sTaxonomy Level/s: 4 & 5)
- Help learners understand various aspects and techniques of effective presentations (group/individual) through demonstration and modelling, enabling them to develop their presentation skills by providing training in using the tips and strategies. Learners would be encouraged to observe and express opinion on teacher-modelling. Reflection on issues like anxiety, stage-fear, confidence, and levels of familiarity with topic and audience would be addressed. Practice would be given on tone, pitch, clarity and other speech aspects. Detailed peer feedback and instructor's feedback would cover all the significant aspects. (Bloom's Taxonomy Level/s: 2 & 4)
- Enable learners to become aware of the structure and conventions of academic writing through reading, demonstration, scaffolding activities, and

discussion. Corrective individual feedback would be given to the learners on their writing. (Bloom's Taxonomy Level/s: 2 & 3)

List of Tasks and Activities

S. No.	Tasks	Activities
1	Listening to subject related short discussions/explanations/ speech for comprehension	Pre-reading group discussion, Silent reading (Note-making), Modelling (questioning), Post-reading reflection /Presentation
2	Asking for information: asking questions related tothe content, context maintaining modalities	Group role-play in a context (i.e. Identifying the situation and different roles and enacting theirroles)
3	Information transfer: Visual to verbal (unfamiliarcontext); demonstration by teacher, learners' task(guided with scaffolding), learners' task (free), presentation and feedback	Pre-reading game/modelling, discussion in smallgroups, individual writing, and feedback
4	Introducing officials to peers and vice versa - Formal context	AV support, noticing, individual performance (3-4), pair work (in context), teacher modelling, group work for Introducing self and others in a formal context
5	Vocabulary in context: Find clues in a text and usethem to guess the meaning of words/phrases. Apply the newly learnt vocabulary in communication (speaking and writing).	Comprehending verbal communication: Identifying the contextual clues in oral and written texts; guessing the meaning of words/phrases in context while reading texts andlistening to discussions/talks
6	Follow the essentials of lectures, talks, discussions, reports and other forms of academicpresentations and mark individual and group presentations aided with images, audio, video, tabular data, etc.	Making power point presentation aided with images, audio, video, etc. with a small group bylistening to academic lectures/talks/ discussions,etc.
7	Collaborative work (speaking and writing) in small groups of 3 or 4 learners: discussing a general/discipline-specific topic: creating outline,assigning specific roles to members of the group;and group presentation followed by peer and instructor feedback	Pre-task modelling (peer/teacher), general discussion on structure, group work (collaboration), feedback
8	Independent reading of different text types using appropriate reference sources by adapting suitable reading styles and speed. Focus on active reading for vocabulary: low-frequency collocations and idiomatic expressions.	Brain-storming, mapping of key terms (content specific), reading and note-making (individual),oral questioning, discussion

9	Role-play (specific social and academic situations): planning (making notes), understanding nuances of speaking in context,coordinating with situational clues and fellow speakers/participants	Peer discussion for outline, A-V support, observing (teacher modelling), role play (guided), role-play (free), feedback
10	Writing a short reflective report of an event - incident/meeting/celebration	Writing a report on meetings/celebrations/events etc. by actively involved in such events and giving a short oral presentation.
11	Formal Group Discussion on topics of current interest and relevance; focus on effective participation, reflection on control over argument/counter argument, and adherence tothe conventions of formal GD	Noticing strategies from AV modelling, teacher scaffolding thoughopen-house discussion, Note-making(Group work), Group Discussion (free), post-performance discussion,Feedback
12	Speaking spontaneously on topics of interest and writing short structured essays on the same topicsadopting appropriate academic conventions and grammatical accuracy. Make sure to write accurate paragraph and essay by following: cohesion and coherence, topic sentence, introduction and conclusion	Reading for task preparation, note-making, reflection and corrective peer andteacher feedback. Practice paragraph and essay writing in groups; maintain rubrics of writing

Reference Books

1. P. Kiranmayi Dutt, Geetha Rajeevan. (2007). Basic Communication Skills. FoundationBooks. CUP
2. Harmer, J. (1998). How to teach English. Longman
3. Sanjay Kumar & Pushp Lata. (2018). Communication Skills: A Workbook. OUP.
4. Cambridge IGCSE: English as a Second Language Teacher's Book Fourth Edition.By Peter Lucantoni. CUP (2014).
5. Cambrdige Academic English: An Integrated Skills Course for EAP (Upper Intermediate)By Martin Hewings, CUP (2012)
6. Richards, J.C. and Bohlke, D. (2012). Four Corners-3. Cambridge: CUP.
7. Headway Academic Skills: Reading, Writing, and Study Skills Student's Book, Level-2 bySarah Philpot. OUP
8. Latham-Koenig, C. & Oxenden, C. (2014). American English File. Oxfor: OUP.
9. McCarthy, M. & O' Dell. F. (2016). Academic Vocabulary in Use. Cambridge: CUP

Online Resources

1. https://www.grammarly.com/blog/
2. https://www.nationalgeographic.org/education/
3. https://www.bbc.co.uk/teach/skillswise/english/zjg4scw
4. https://www.englishclub.com/
5. https://www.oxfordlearnersdictionaries.com/
6. https://dictionary.cambridge.org/
7. learnenglishteens.britishcouncil.org
8. https://freerice.com/categories/english-vocabulary

9. http://www.5minuteenglish.com/
10. https://breakingnewsenglish.com/
11. https://www.digitalbook.io/
12. https://librivox.org/

Course Outcomes

- Understand the speaker's point of view in fairly extended talks on general or discipline-specifictopics, and follow simple lines of argument in discussions on familiar contemporary issues. (Bloom's Taxonomy Level/s: 3)

- "Read and demonstrate understanding of articles and reports on limited range of contemporaryissues in which the writers adopt particular stances. Also provide samples of written communication containing fairly complex information and reasons for choices/opinions/stances. (Bloom's Taxonomy Level/s: 2 & 3)"

- Make short presentations on a limited range of general topics using slides, and engage in small group discussions sharing experiences/views on familiar contemporary issues and give reasons for choices/opinions/plans. (Bloom's Taxonomy Level/s: 3 & 4)

- Write clear, fairly detailed text (a short essay) on a limited range of general topics, and subjects of interest, and communicate clearly through email/letter to seek/pass on information or givereasons for choices/opinions/plans/actions. (Bloom's Taxonomy Level/s: 3)

- Reflect on others' performance, give peer feedback on fellow learners' presentations, responsesto writing tasks and reading comprehension questions. (Bloom's Taxonomy Level/s: 5)

CO-PO Mapping:

	PO 1	PO 2	PO3	PO 4	PO 5	PO6	PO 7	PO8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PO 16	PSO 1	PSO 2	PSO3	PSO4
CO1	3	3	3	3	2	1	1	1	2	1	2	1	1	1	1	2	3	1	1	1
CO2	2	2	2	3	3	2	1	1	2	2	1	1	2	1	1	1	3	2	2	1
CO3	2	3	2	3	3	1	3	2	2	2	2	1	2	1	1	2	3	2	2	1
CO4	2	3	3	3	3	1	2	1	2	2	1	1	2	1	1	1	3	2	1	1
CO5	3	3	2	3	3	1	3	2	1	2	1	2	2	1	1	2	3	1	2	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:	
BOS :	**ACADEMIC COUNCIL:**
SDG No. & Statement:	

SDG 16 Peace and Justice Strong Institutions. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
SDG Justification: By relating to people with empathy, employing creative problem-solving strategies and engaging meaningfully in a diverse world will create inclusive societies for sustainable development.

LANG1022	COMMUNICATION SKILLS IN ENGLISH – ADVANCED	L	T	P	S	J	C
		0	0	4	0	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description

Communication Skills in English (Advanced) is the third of the three-level graded courses for the developmental enhancement of communication skills in English. Based on the learning outcomes set in the upper-intermediate syllabus, this course focuses on giving learners exposure to higher levels of skills/input processing (ref. Bloom's taxonomy) and practice in terms of complexity and cognitive engagement. This course includes an advanced level of comprehension i.e. anaytical, evaluative, and extrapolative processing (listening and reading). It involves problem-solving, logical reasoning, and decision-making skills in terms of the application of the learning (speaking/writing) with an awareness of social and personality-based variations in communication. This course provides opportunities for activity-based practice of advanced oraland written communicative skills besides building awareness of the finer nuances of language usefor various purposes. This course emhasizes free writing through meaningfully engaging pre- and post-context-building tasks. There is ample scope for applying critical thinking through simulated activities for effective communication in real-life situations.

Course Objectives

1. Enable learners to listen actively, become aware of tone and attitude in speech, and demonstrate their comprehension of fairly complex lines of argument presented by a variety of speakers in talks/presentations/discussions. (Bloom's Taxonomy Level/s: 2 & 4)

2. Enable learners to become aware of tone and attitude in written texts, and demonstrate theircomprehension of fairly complex lines of argument and points of view presented in a variety of texts by equipping them with upper intermediate to advanced level reading skillsand strategies.

3. Make effective presentations, engage in formal group discussions, and write structured essays/ short reports to highlight the significance of actions/decisions/experiences, and sustain views by providing relevant evidence and argument.

4. Equip learners with the skills and strategies to communicate effectively in speech and writing using the language with a degree of fluency, accuracy and spontaneity, and fairly good grammatical control adopting a level of formality appropriate to the context. Encourage learners to apply their knowledge of language and their communication skills in real life situations.

List of Activities & Tasks for Assessment

S.No.	Tasks	Activities	CO
1	Evaluative and extrapolative reading of a longtext/short text on a current topic related to technology and society, identifying and questioning the author's intention, post- reading discussion in small groups, maintaining group dynamics, arriving at aconsensus. Understanging and inferring the meaning.	Pre-reading group discussion, silent reading (Note-making), modelling (questioning), post-reading reflectionand brief presentation of thoughts/ideas/opinions on the themeof the text	3
2	Debate in pairs based on listening to two recorded contemporary speeches by well-known leaders in different fields. Peer feedback and instructor feedback.	Pre-recorded audio/video for listening,student checklist for noticing keywords/concepts, pre-task orientation (by teacher), pair work, feedback	1
3	Information transfer: Visual to verbal (unfamiliar context); demonstration by teacher, learners' task (guided with scaffolding), learners' task (free), presentation, question-answer (among students), modification, editing, proofreading,and feedback before the final version is done	Pre-reading game/modelling, discussion in small groups, independent writing and feedback	4
4	Expressing opinion on a short argumentative text (e.g. a journal article or a newspaper editorial) and justifying one's opinion/stance; focus on the use of appropriate conventions offormal and polite speech, and managing bias	Listening to group discussions/debates,reading news-paper articles on current issues and expressing opinions in favour or against the topic (in GDs, debates or writing argumentative essays).	3
5	Collaborative writing in groups of 3 -4 on topics that would require data collection andreading followed by recorded peer-reflectionand peer-feedback, group presentation and feedback	Pre-task modelling (peer), general discussion on structure, group work(collaboration), presentation, peer feedback, Open-class discussion	5
6	Writing a statement of purpose Discuss all details about the student academic and professional background, highlighting the student accomplishments,	Reading & discussion of sample statement of purposes. Discuss the content in groups and know whether all mentioned details are present. Do practice writing after lecture and discussion.	2

	goals, and how a student fit to the education applied to.	Make sure to adopt a proper writing style.	

7	Mind-mapping for advanced reading, making correlations across texts, extending the author'spoint of view	Reading texts on abstract topics and comprehending the author's perspectiveby inferring the unknown words' meaning in the context and making notes using mind-map strategy and presenting it orally.	3
8	Handling question and answer sessions after presentations: justifying arguments, taking counter-arguments, agreeing and disagreeingwith rationale	Listening to some lectures, talks, and presentations in the academic seminarsand adapting some strategies to handlethe Q&A sessions using polite and formal expressions to agree or disagree with the statements.	1
9	Learn resume and cover letter format & introduce different interview modes. Modelling an interview: with a panel of fourjudges (peers)	Pre-task activity for orientation/strategies (controlled/guided), Model interview (AV support), Group work (role play), Interview in pair (one-to-one), Interview in group (many -to-one), oral corrective feedback (peer/teacher)	2
10	Speaking on abstract and complex topics beyond his/her own area of interest/field ofstudy, using the language flexibly and effectively.	Reading texts on abstract topics and comprehending the author's perspectives. Similarly, listening to talks and discussions on an abstract topic of other discipline and making short oral presentation by sharingviews and opinions.	3
11	Self-reflection on own speech in context(recorded): tone, pitch, relevance, content; extending the reflections/ideas toothers	Listening to selected general discussions (audios and videos) and observing the language production. Recording own speech on some generaltopic and providing a critical review (self-reflection) on it by focusing on the tone, expressions and relevance ofthe content, etc.	1

12	Collaborative and individual tasks: planning, preparing (preparing an outline, structure, setting objectives, and presenting the plan of action) and executing a mini-project, and submitting a brief report on the same peer and instructor feedback after the planning stage and on completion of the mini project	Pre-task modelling (peer/teacher), general discussion on structure, groupwork (collaboration), oral correction, task distribution, presentation, feedback	5

Reference Books

1. Latham-Koenig, C. & Oxenden, C. (2014). American English File-5. Oxford: OUPRichards,
2. J.C. and Bohlke, D. (2012). Four Corners-4. Cambridge: CUP.
3. Cambrdige Academic English: An Integrated Skills Course for EAP (Advanced) By Martin Hewings and Craig Thaine, CUP (2012)
4. Berlin, A. (2016). 50 Conversation Classes: 50 Sets of Conversation Cards With an Accompanying Activity Sheet Containing Vocabulary, Idioms and Grammar. Poland: CreateSpace Independent Publishing Platform
5. Zemach, D. E., Islam, C. (2011). Writing Paragraphs: From Sentence to Paragraph. Germany: Macmillan Education.
6. Stewart, J. P., Fulop, D. (2019). Mastering the Art of Oral Presentations: Winning Orals, Speeches, and Stand-Up Presentations. United Kingdom: Wiley.
7. Kroehnert, Gary. (2010). Basic Presentation Skills. Sidney: McGraw Hill.
8. Cunninghum, S. & Moor, P. (nd). Cutting Edge (Advanced) With Phrase Builder. Longman Publishers. CUP
9. McCarthy, M & O'Dell, F. (2017). English Idioms in Use (Advanced). Cambridge: CUP. Online

Resources

1. https://www.grammarly.com/blog/
2. https://www.nationalgeographic.org/education/
3. https://www.bbc.co.uk/teach/skillswise/english/zjg4scw
4. https://www.englishclub.com/
5. https://www.oxfordlearnersdictionaries.com/
6. https://dictionary.cambridge.org/
7. learnenglishteens.britishcouncil.org
8. https://freerice.com/categories/english-vocabulary
9. http://www.5minuteenglish.com/
10. https://breakingnewsenglish.com/
11. https://www.digitalbook.io/

12. https://librivox.org/

Course Outcomes

- Listen to extended lectures, presentations, and discussions on a wide range of contemporary issues and demonstrate understanding of relatively complex lines of argument. (Bloom's Taxonomy Level/s: 2)
- Make presentations using suitable AV aids and engage in formal group discussions on a wide range of topics of contemporary interest, demonstrating awareness of standard/widely accepted conventions. (Bloom's Taxonomy Level/s: 3)
- Read and demonstrate understanding of the writer's stance/viewpoint in articles and reports on a wide range of contemporary issues and discipline-specific subjects. (Bloom's Taxonomy Level/s: 2 & 4)
- Write analytical essays on a wide range of general topics/subjects of interest, and engage in written communication (emails/concise reports) to exchange relatively complex information, giving reasons in support of or against a particular stance/point of view. (Bloom's Taxonomy Level/s: 3 & 4)

- Complete a mini project that necessitates the use of fairly advanced communication skills to accomplish a variety of tasks and submit a report in the given format. (Bloom's Taxonomy Level/s: 4 & 5

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PO16	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	3	3	1	2	2	2	3	2	2	1	1	1	2	3	3	1	1
CO2	2	3	2	3	3	1	3	3	3	3	2	2	2	1	1	2	3	3	1	1
CO3	2	3	1	3	3	2	1	1	2	1	2	2	1	1	1	2	3	3	2	1
CO4	3	3	3	3	3	2	1	1	3	2	2	2	1	1	1	1	3	3	2	1
CO5	3	3	3	3	3	3	2	2	3	3	2	2	3	1	1	1	3	3	2	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:	
BOS :	**ACADEMIC COUNCIL:**
SDG No. & Statement:	
SDG 16 Peace and Justice Strong Institutions. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.	
SDG Justification: By relating to people with empathy, employing creative problem-solving strategies and engaging meaningfully in a diverse world will create inclusive societies for sustainable development.	

MFST1001	HEALTH & WELLBEING	L	T	P	S	J	C
		0	0	2	0	0	1*
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The course provides the students a better understanding of the role of a proper diet in maintenance of human health. This course emphasizes the composition of the food, and will help to understand how toexercise, the role of sports and physical fitness in development of a good health. The course also focuses on the importance of emotional well-being and mindfulness. This course helps in teaching the role of yoga in maintenance of physical balance.

Course Educational Objectives:

- To provide an understanding of the relationship between food and nutrition
- To emphasize the role of exercise, sports and physical fitness in obtaining a good health
- To explain about the mindfulness and emotional well being
- To teach the role of yoga and meditation in maintaining the body balance

UNIT 1

Understand the relationship between Food and Nutrition and how food composition affects nutritional characteristics. Knowledge about regulatory principles in determining diets and recommended daily allowances. Understand how to create personalised diet/nutrition plans.

UNIT 2

Understand how exercise, activity and sports helps in developing good health. Experiential exposure to the role of proper, specific nutritional interventions along with structured activities on developing proper physical health. Practical exercises and assignments in sports and exercise regimes.

UNIT 3

Introduction to emotional wellbeing and mindfulness. Teaching of mindfulness practices to reduce stress, increase relaxation and improve mental wellbeing.

UNIT 4

Introduction to Yoga theory and how Yoga helps in maintaining balance in the body. Practice of Yoga and meditation to improve overall emotional and physical balance. Practical yoga exercises and meditation techniques

Course Outcomes:

By the end of the course, student will

1. Learn the role of nutrition and diet in maintaining a good health
2. understand how the exercise, sports and physical activities will improve health
3. learn mindfulness practices for reducing stress
4. know the importance of yoga and meditation

APPROVED IN:

BOS :01-02-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

PHPY1001	GANDHI FOR THE 21ST CENTURY	L	T	P	S	J	C
		2	0	0	0	0	2*
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides the students with basic knowledge on Gandhi's early life, transformations in South Africa and his entry into India's national movement. While going through the social-political, economic, and educational philosophies of Gandhi, the course analyses how his ideologies are relevant even in the 21st century.

Course Educational Objectives:

The objectives of the course are;

- To provide the students with the basic knowledge on Gandhi's life and his philosophies
- To understand the early influences and transformations in Gandhi
- To analyse the role of Gandhi in India's national movement
- To apply Gandhian Ethics while analysing the contemporary social/political issues
- To appreciate the conflict resolution techniques put forward by Gandhi and its significance in thecurrent scenario.

UNIT 1 MK Gandhi: Childhood and Education

M K Gandhi, Formative Years (1869-1893): Early childhood - study in England - Indian influences, early Western influences.

UNIT 2 From Mohan to Mahatma-South African Experiences

Gandhi in South Africa (1893-1914): South African Experiences - civil right movements in South Africa - invention of Satyagraha - Phoenix settlement- Tolstoy Farm - experiments in Sarvodaya, education, and sustainable livelihood.

UNIT 3 Gandhi and Indian National Movement

Gandhi and Indian National Movement (1915-1947): Introduction of Satyagraha in Indian soil -non- cooperation movement - call for women's participation - social boycott - Quit-India movement - fighting against un-touchability - Partition of India- independence.

UNIT 4 Gandhi and Sustainable Development

Gandhian Constructive Programs-Eleven Vows-Sarvodaya-Seven Social Sins-Gandhian Economics and Sustainable Development

UNIT 5 Gandhi and Contemporary Issues

Conflict Resolution Techniques of Gandhi-Ecological Challenges and Gandhian solutions-Gandhian Ethics-An Analysis

References:

1. Gandhi, M K. (1941). *Constructive Programme*. Ahmadabad: Navjivan Publishing House
2. Gandhi, M. K. (1948). *The Story of My Experiments with Truth*. Ahmadabad: Navjivan PublishingHouse
3. Gandhi, M K. (1968). *Satyagraha in South Africa*. Ahmadabad: Navjivan Publishing House.
4. Khoshoo, T N (1995). *Mahatma Gandhi: An Apostle of Applied Human Ecology*. New Delhi:TERI
5. Kripalani, J.B. (1970). *Gandhi: His Life and Thought*. New Delhi: Publications Division.
6. Narayan, Rajdeva (2011). *Ecological Perceptions in Gandhism and Marxism*. Muzaffarpur:NISLS
7. Pandey, J. (1998). *Gandhi and 21st Century*. New Delhi: Concept.
8. Weber, Thomas (2007).Gandhi as Disciple and Mentor. New Delhi: CUP

Course Outcomes:

After the successful completion of the course the students will be able to;

1. Understand the life of Gandhi
2. Appreciate the role of Gandhian non-violence and Satyagraha in India's freedom struggle.
3. Critically examine the philosophy of Gandhi on Education, Sarvodaya, and Satyagraha
4. Analyse the contemporary significance of Gandhian constructive programmes and eleven vows
5. Examine the possible solutions for some of the contemporary challenges like environmentalissues, moral degradation and ethical dilemmas.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	3	3	3	3	2	2	3	3	3	3
CO2	3	3	2	3	2	3	3	3	3	2	3	2	3	2	3
CO3	3	3	3	2	3	2	2	3	3	2	2	3	2	3	2
CO4	3	2	2	3	3	2	2	3	3	2	3	2	3	3	2
CO5	3	3	2	2	3	3	3	3	3	3	2	2	2	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :01-02-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG-4: Ensure Inclusive And Equitable Quality Education And Promote Lifelong Learning Opportunities For All.
Sdg-8: Promote Sustained, Inclusive And Sustainable Economic Growth, Full And Productive Employment And Decent Work For All

SDG Justification:

Statement: This course promotes the education for all the people without considering their religion, caste, gender and regional differences.

Statement: This course deals with the basic concepts of national income and employment to understand the national level scenario of how an economy is growing and providing employment.

POLS1001	Indian Constitution and History	L	T	P	S	J	C
		2	0	0	0	0	2*
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course analyzes the basic structure and operative dimensions of the Indian Constitution. It explores various aspects of the Indian political and legal system from a historical perspective highlighting the various events that led to the making of the Indian Constitution. The course also deals with various challenges faced by the constitution and its coping mechanisms. Broadly, the students would understand and explain the working of different institutions and political debates ensuing from the operation of the Indian constitution in action.

Course Educational Objectives:

- To introduce constitutional history of India.
- To explain the process of making Indian constitution
- To analyze Fundamental of Rights, Duties and other principles in constitution
- To create familiarity with political developments which shaped the constitution.

UNIT 1 India as a Nation 6 hours

Khilani, S. (2004). *Introduction, The Idea of India*, Chapter 1. New Delhi: Penguin Books, pp. 1-15.

Rowat, D. (1950). 'India: The Making of a Nation', International Journal, 5(2), 95-108. doi:10.2307/40194264

Brass, P. (2018). 'Continuities and Discontinuities between pre- and post-Independence India', Chapter 1.

The Politics of Idea since independence, New Delhi: Cambridge University Press. pp. 1-30.

UNIT 2 Understanding the Constitution 6 hours

Mehta, U.S. (2011). 'Constitutionalism' in *The Oxford Companion to Politics in India*, (ed) by Nirja Gopal Jayal, and Pratap Bhanu Mehta, New Delhi: Oxford University Press. pp. 15-27.

Austin, G. (2016), 'The Constituent Assembly: Microcosm in Action' *in The Indian Constitution: Cornerstone of a Nation*, New Delhi: Oxford University Press, pp. 1-25.

Beteille, Andre (2008): "Constitutional Morality," *Economic and Political Weekly*, Vol 43, Issue No 40

Prahladan, Vivek (2012): "Emergence of the Indian Constitution," *Economic and Political Weekly*, Vol 47, Issue No 07.

UNIT 3 The Preamble, Fundamental Rights and Directive Principles of State Policy 6 hours

Bhakshi, P.M. (2011). 'Preamble' in *The Constitution of India*, New Delhi: Universal Law. Pp. 1-5. Laxmikanth, M. (2017). 'Chapter IV: Preamble of the Constitution' in *Indian Polity*, Chennai: McGraw Hills.

Kumar, Virendra (2007): "Basic Structure of The Indian Constitution: Doctrine of Constitutionally Controlled Governance [From Kesavananda Bharati to I.R. Coelho]" *Journal of the Indian Law Institute*, Vol 49, No 3, pp 365-398.

Austin, G (2016), ' ' in *The Indian Constitution: Cornerstone of a Nation*, New Delhi: Oxford University Press, pp.63-105.

Reddy, S (1980). Fundamental Ness of Fundamental Rights and Directive Principles in the Indian Constitution. *Journal of the Indian Law Institute*, 22(3), pp. 399-407.

Bhatia, Gautam (2017): "The Supreme Court's Right to Privacy Judgement," *Economic and Political Weekly*, Vol 52, Issue No 44

UNIT 4 Citizenship 6 hours

Jayal, N.G. (2019). 'Reconfiguring citizenship in contemporary India' in *South Asia Journal of SouthAsian Studies*, pp.33-58.

Roy, Anupama. (2010). 'Chapter I: Enframing the citizen in contemporary times' in *Mapping Citizenship in India*, New Delhi: Oxford University Press.

Das, Veena (2010): "State, Citizenship and the Urban Poor," *Citizenship Studies,* Vol 15, pp 319-333.Valerian Rodrigue

UNIT 5 Separation and Distribution of Powers 6 hours

Pal, Ruma. (2016). 'Separation of Powers' in *The Oxford Handbook of the Indian Constitution*, (ed) by Sujit Choudhry, Madhav Khosla, and Pratap Bhanu Mehta, Delhi: Oxford University Press.

Bakshi, P. (1956). 'Comparative Law: Separation of Powers in India'. *American Bar Association Journal, 42*(6), 553-595.

Rao, P. (2005). 'Separation of Powers in a Democracy: The Indian Experience'. *Peace Research, 37*(1),113-122.

Kumar, Ashwani (2019): "Constitutional Rights, Judicial Review and Parliamentary Democracy,"

Economic and Political Weekly, Vol 51, Issue 15

Tillin, Louise. (2015). 'Introduction' in *Indian Federalism*. New Delhi: Oxford University Press. pp.1-30.

Chakrabarty, Bidyut and Rajendra Kumar Pandey. (2008). *Federalism' in Indian Government andPolitics*, New Delhi: Sage Publications. pp. 35-53.

Arora, B. and Kailash, K. K. (2018). 'Beyond Quasi Federalism: Change and Continuity in IndianFederalism', in *Studies in Indian Politics*, pp. 1-7.

Agrawal, Pankhuri (2020): "COVID-19 and dwindling Indian Federalism," *Economic and PoliticalWeekly,* Vol 55, Issue No 26

Recommended Readings:

De, Rohit. (2018). *A People's Constitution – The Everyday Life of Law in the Indian Republic*, USA:Princeton University Press.

Granville Austin, *The Indian Constitution: Cornerstone of a Nation*, Oxford University Press, Oxford, 1966.

Lahoti, R.C. (2004). *Preamble: The Spirit and Backbone of the Constitution of India*. Delhi: EasternBook Company.

Rajeev Bhargava (ed), *Ethics and Politics of the Indian Constitution*, Oxford University Press, NewDelhi, 2008.

Subhash C. Kashyap, *Our Constitution*, National Book Trust, New Delhi, 2011.Tillin, Louise. (2015). *Indian Federalism*. New Delhi: Oxford University Press.

Zoya Hassan, E. Sridharan and R. Sudarshan (eds), *India's Living Constitution: Ideas, Practices,Controversies*, Permanent Black, New Delhi, 2002.

Course Outcomes:

On the successful completion of the course students would be able to:

1. Demonstrate an understanding of the Constitution of India and how constitutional governance iscarried out in India
2. Interpret knowledge of the Fundamental Rights and Duties of the Citizens as well as theObligation of the state towards its citizens
3. Correlate familiarity with key political developments that have shaped the

Constitution andamended it from time to time.

4. Equip themselves to take up other courses in law after having done a foundation course on IndianConstitution

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	2	2	3	3	2	3	1	2	1	2	1	2
CO2	1	1	2	1	2	2	3	2	3	1	2	1	1	2	1
CO3	1	2	1	2	2	2	3	1	3	1	1	1	2	1	2
CO4	1	1	1	2	2	2	3	1	3	1	1	1	1	1	2
CO5	1	1	1	2	2	2	3	2	3	1	2	1	1	1	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :01-02-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG-16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

SDG Justification:

The course primarily talks about evolution of the constitutional institutions. Since the SDG-16 talks about the quality of the institutions, it is applicable here.

VEDC1001	VENTURE DEVELOPMENT	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

India as part of its “Make in India” initiative has been focusing on creating incubation centers within educational institutions, with an aim to generate successful start-ups. These start-ups will become employment creators than employment seekers, which is the need of the hour for our country. This common course (university core) for all the disciplines is a foundation on venture development. It is an experiential course that starts with students discovering their deeper self in terms of how they might contribute to society by creating exciting new products and services that can become the basis of real businesses. The students learn about the emerging areas of knowledge that are the foundations of any successful company. They will learn how to develop insight into the problems and desires of different types of target customers, and from this, to identify the design drivers for a specific innovation. Students will learn specific design methods for new products and services. The students will learn that as important as the product or service itself, is a strategy for monetizing the innovation – for generating revenue, structuring the operating costs, and creating the operating profit needed to support the business, hire new employees, and expand forward. This course is aimed to be the beginning of what might be the most important journey of personal and career discovery so far in a student’s life, one with lasting impact. This is not just a course, but potentially, an important milestone in life that a student remembers warmly in the years to come.

Course Educational Objectives:

Students have the opportunity to:

- Discover who they are – Values, Skills, and Contribution to Society
- Understand how creativity works and permeates the innovation process
- Learn the basic processes and frameworks for successful innovation.
- Gain experience in going through the innovation process.
- Conduct field research to test or validate innovation concepts with target customers.

UNIT 1 PERSONAL DISCOVERY 4 hours

Personal Values, Excite & Excel, Build a Team, Define Purpose, Mission Statement

UNIT 2 IDEATION 10 hours

Ideation & Impact, User Insights - Frameworks, Customer Interviews, Interpreting Results

UNIT 3 SOLUTION DISCOVERY 8 hours

Concept Design, Competitive Analysis, Product Line Strategy, Prototyping Solutions, Reality Check

UNIT 4 BUSINESS MODEL DISCOVERY 4 hours

Understand the Industry, Types of Business Model, Define Revenue Models, Define Operating Models, Define Customer Journey, Validate Business Model

UNIT 5 DISCOVERY INTEGRATION

Define Company Impact, Create Value, Tell Your Story

L – 15; Total Hours – 30

Textbooks:

1. Meyer and Lee, “Personal Discovery through Entrepreneurship”, The Institute for Enterprise Growth, LLC. Boston, MA., USA.

References:

1. Adi Ignatius (Editor-in-Chief), “Harvard Business Review”, Harvard Business Publishing, Brighton, Massachusetts,2021

Course Outcomes:

1. Identify one’s values, strengths and weaknesses and their will to contribute to the society
2. Formulate an idea and validate it with customers
3. Demonstrate prototyping and analyse the competition for the product
4. Create business models for revenue generation and sustainability of their business
5. Come up with a pitch that can used as the basis for actually starting a company based on an impactful innovation and societal impact

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						3	1	3	3	3		3			
CO2		3		3	1	3	2	1	3	3	1	3			
CO3	1	3	3		3		3		3	1	3	3			
CO4					1	1	3	3	3	1	3	1			
CO5					3	3			3	3	3	3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :<< date >> **ACADEMIC COUNCIL: <<date>>**

SDG No. & Statement:

4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

17. Strengthen the means of implementation and revitalize the global partnership for sustainable development.

SDG Justification:

4. The course involves identifying one’s personal values and working on real-life problems, thus forming the base to work on their passions even past the collegiate life.

17. The course is developed in collaboration with North-eastern University, USA and the training for the champions is being by North-eastern University.

Faculty Core

CHEM1001	CHEMISTRY	L	T	P	S	J	C
		2	1	2	0	0	4
Pre-requisite	Nil						
Co- requisite	Nil						
Preferable exposure	Nil						

Course Description:

This course enables the students to gain knowledge on various aspects of Water and its treatment, electrochemical energy systems, Construction of batteries, renewable energy sources, Semiconductors, Steel, Cement and Polymers, Corrosion and its control, nanomaterials, Analytical instruments, and applications. The knowledge gained in this course can be applied to the latest developments in technology.

Course Educational Objectives:

1. To impart knowledge on various aspects of water and its treatment.
2. To study about electrochemical energy systems, renewable energy sources, solar cells, and their applications.
3. To gain knowledge on materials such as steel, cement, and polymers
4. To create awareness on corrosion and its control.
5. To introduce different types of nanomaterials.
6. To expose the students to latest instrumental techniques such as scanning electronic microscope (SEM) & transmission electron microscope (TEM).

UNIT 1 Water and its treatment 9 Hours

Water and its treatment: Introduction – hardness of water – Causes of hardness - Types of hardness: temporary and permanent – expression and units of hardness. Estimation of hardness of water by complexometric method. Potable water and its specifications. Steps involved in treatment of water – Disinfection of water by chlorination and ozonization-industrial water treatment- Boiler feed water and its treatment -internal conditioning– Calgon and Phosphate conditioning. External treatment of water – Ion exchange process. Desalination of water – Reverse osmosis.

UNIT 2 Electrochemical Energy Systems 9 Hours

Battery Technology: Basic concepts, battery characteristics, classification of batteries, Important applications of batteries, Classical batteries-dry/Leclanche cell, Modern batteries-zinc air, Lead-acid storage battery, lithium cells- Lithium-ion cell, Li MnO_2 cell. Fuel cells- Introduction - classification of fuel cells – hydrogen and oxygen fuel cell, propane, and oxygen fuel cell- Merits of fuel cell. **Renewable energy sources – Types of renewable energy sources. Semiconductors:** Definition, types of semiconductors: doping- n type and p – type semiconductors and applications. - **Solar cells:** Introduction, harnessing solar energy, Photovoltaic cell, solar water heaters.

UNIT 3 Engineering materials and Polymer Chemistry 8 Hours

Steel – Types of Steel, chemical composition – applications of alloy steels

Cement: Portland cement, constituents, Manufacture of Portland Cement, chemistry of setting and hardening of cement (hydration, hydrolysis, equations).

Polymer Chemistry: Concept of polymerization – Types of Polymerizations, Chain growth polymerization – mechanisms of free radical and cationic polymerizations, Thermoplastic resins and Thermosetting resins: examples- Polyethylene, Styrene, Nylon 6,6 and Bakelite. and applications, Conducting polymers:– Examples – and applications.

UNIT 4 Corrosion and its control 8 Hours

Corrosion and Its Prevention: Electrochemical theory of corrosion, Corrosion due to dissimilar metal cells (galvanic cells), Corrosion due to differential aeration cells, Uniform corrosion, pitting corrosion and stress corrosion cracking, Effect of pH, temperature and dissolved oxygen on corrosion rate. Corrosion prevention and control by cathodic protection- protective coatings- paints.

UNIT 5 Nanomaterials and Analytical Instrumental Techniques 8 Hours

Nanomaterials: Introduction to nanomaterial: nanoparticles, nanocluster, carbon nanotube (CNT) and nanowires. Chemical synthesis of nanomaterials: sol-gel method. Characterization: Principle and applications of scanning electron microscope (SEM) and transmission electron microscope (TEM)

Analytical Instrumental Techniques

Review of electromagnetic spectrum, Quantization of energy. Absorption of radiation: Beer-Lambert's law. Principle and applications of pH metry, potentiometry, conductometry, IR and UV-spectroscopy with examples.

Text Books:

1. P.C. Jain and M. Jain, Engineering Chemistry, 15/e, Dhanapat Rai & Sons, Delhi (2014).
2. B.K. Sharma, Engineering Chemistry, Krishna Prakashan, Meerut.
3. O G Palanna, Engineering Chemistry, Tata McGraw Hill Education Private Limited, (2009).

References:

1. Sashi chawla, A Textbook of Engineering Chemistry, Dhanapath Rai and sons, (2003)
2. B.S Murthy and P. Shankar, A Text Book of NanoScience and NanoTechnology, University Press (2013).
3. S.S. Dara, A Textbook of Engineering Chemistry, S.Chand & Co, (2010)
4. N.Krishna Murthy and Anuradha, A text book of Engineering Chemistry, Murthy Publications (2014).
5. K. Sesha Maheshwaramma and Mridula Chugh, Engineering Chemistry, Pearson India Edn services, (2016).

Course Outcomes:

After the completion of the course, the student will be able to

1. List the important purification methods of water.
2. Illustrate the principles and applications of batteries, solar energy.
3. Explain the importance of materials such as steel, cement, and polymers

4. Identify different protective coatings.
5. Analyze the importance of nano materials and the principles of SEM and TEM.

CHEMISTRY LABORATORY

List of Experiments:

1. Determination of Mohr's salt by potentiometric method
2. Determination of strength of an acid by pH metric method
3. Determination of conductance by conductometric method
4. Determination of viscosity of a liquid
5. Determination of surface tension of a liquid
6. Determination of sulphuric acid in lead-acid storage cell
7. Determination of chromium (VI) in potassium dichromate
8. Determination of copper in a copper ore
9. Determination of Zinc by EDTA method.
10. Estimation of active chlorine content in Bleaching powder
11. Preparation of Phenol-Formaldehyde resin
12. Preparation of Urea-Formaldehyde resin
13. Thin layer chromatography
14. Preparation of TiO2/ZnO nano particles
15. SEM analysis of nano materials

Textbooks:

1. Mendham J, Denney RC, Barnes JD, Thosmas M and Sivasankar B Vogel's Quantitative Chemical Analysis 6/e, Pearson publishers (2000).
2. N.K Bhasin and Sudha Rani Laboratory Manual on Engineering Chemistry 3/e, Dhanpat Rai Publishing Company (2007).

Course Outcomes:

After the completion of the laboratory course, the student will be able to

1. explain the functioning of the instruments such as pH, Conductometric and Potentiometric methods.
2. identify different ores (Cr & Cu) and their usage in different fields (industry, software devices, electronic goods).
3. experiment with the physical parameter of organic compounds.
4. compare the viscosities of oils.
5. list the preparation of polymers and nano materials.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2	2	2	3	1	1	2	2	3	1	3	2
CO2	3	2	1	1	3	3	3	2	1	1	3	3	1	3	3
CO3	3	2	1	1	2	3	2	2	1	1	2	3	3	1	2
CO4	3	2	2	1	2	3	3	2	2	1	2	3	3	2	2
CO5	2	2	1	2	3	3	2	2	1	2	3	2	3	1	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">CSEN1011</td><td rowspan="2">PROBLEM SOLVING AND PROGRAMMING WITH C</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>6</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Nil</td></tr>
<tr><td>Co-requisite</td><td colspan="7">Nil</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Familiarity with Computer system and its operation.</td></tr>
</table>

Course Description:
The course is designed to enable the student to write programs for problem solving. After an introduction to program logic design using algorithms and flowcharts, converting the logic into programs is taught. The features of structured programming are explained with the C programming language as an example. This course lays the foundation both for developing program logic and for writing programs in C according to the developed logic.

Course objectives:
1. Familiarize the student with the steps involved in writing and running a compiled program.
2. Enable the student to build program logic with algorithms and flowcharts.
3. Explain with the features and constructs of C programming such as data types, expressions, loops, functions, arrays, pointers, and files.
4. Demonstrate the handling of variables and input-output operations in C.
5. Train the student to convert program logic into C language code using a top-down approach.

Module I: Introduction to Computer Problem-Solving 12Hours
Introduction, the Problem-Solving Aspect, Top-Down Design, Introduction to the idea of an algorithm, Introduction to Flowchart using Raptor tool.
Introduction to C Language – Structure of a C Program, Keywords, Identifiers, Data Types (int, float, char, unsigned int) and Variable declaration, Constants, Input / Output function. Operators, Expressions, Precedence and Associativity, Expression Evaluation, Type conversions.
Exercises: Construct a flowchart and write a program to
- Develop a calculator to convert time, distance, area, volume and temperature from one unit to another.
- Calculate simple and compound interest for various parameters specified by the user
- To enter marks of five subjects and calculate total, average and percentage.
- Calculate net salary of employee given basic,da,hra,pf and lic
- retrieve remainder after division of two numbers without using mod operator
- Convert an upper-case character to a lower-case character.
- Swap two numbers
- Enter two angles of a triangle and find the third angle.
- Check Least Significant Bit (LSB) of a number
- Input any number from user and check whether nth bit of the given number is set (1) or not (0)(hint: Use bitwise operators)

Module II: Control Structures 15 Hours

- **Control Structures:** Selection Statements (making decisions) – if, if-else, nested if, else if ladder and switch statements. Repetition statements (loops)-while, for, do-while statements, Nested Loops.
- Unconditional statements-break, continue, goto.
- Pointers – Pointer variable, pointer declaration, Initialization of pointer, accessing variables through pointers, pointers to pointers, pointers to void.

Exercises: Construct a Flowchart and Write a Program to

- Check whether the triangle is equilateral, isosceles, or scalene triangle.
- Check whether entered year is a leap year or not
- Find minimum among three numbers.
- Check whether a number is divisible by 5 and 11 or not.
- Check whether a number is positive, negative or zero using switch case.
- Design a calculator that performs arithmetic operations on two numbers using switch case
- Find Roots of a Quadratic Equation
- Find factorial of a number
- Check whether number is a palindrome or not
- Check whether number is perfect or not
- Convert a decimal number to binary number
- To find the sum of the series [1-X^2/2!+X^4/4! ....].
- Print following patterns

```
*
*
* *
* * *
* * * *
A
B B
C CC
D D D D
E E E EE
1
2 3
4 5 6
7 8 9 10
```

- Calculate the greatest common divisor of two numbers
- Generate first n numbers in the Fibonacci series
- Generate n prime numbers
- Swap two numbers using pointers.
- Performs all the five arithmetic operations using Pointers.

Module III: Functions 15 Hours

Functions-Designing Structured Programs, user defined function- function definition, function prototype, function call, Types of functions. Parameter Passing by value, parameter passing by address, Recursive functions. Dynamic Memory allocation Functions, pointers to functions. Storage classes-auto, register, static, extern.

Exercises: Write a program using functions to

- Print even and odd numbers in a given range
- Find power of a number
- Return maximum of given two numbers
- To print all strong numbers between given interval using functions.
- Check whether a number is prime, Armstrong or perfect number using functions.
- Demonstrate call by value and call by reference mechanisms.
- Find power of any number using recursion.
- Generate Fibonacci series using recursion
- Find product of two numbers using recursion
- Find the sum of digits of a number. Number must be passed to a function using pointers.
- Find GCD (HCF) of two numbers using recursion.
- Find LCM of two numbers using recursion.

Module IV: Arrays and Strings 15 Hours

Arrays – Declaration and Definition of Array, accessing elements in array, Storing values in array, linear search, binary search, bubble sort, Two – dimensional arrays, multidimensional arrays. Arrays and Pointers, Pointer Arithmetic and arrays, array of pointers, Passing array to function.
Strings – Declaration and Definition of String, String Initialization, unformatted I/O functions, arrays of strings, string manipulation functions, string and pointers.

Exercises: Write a program to

- Find minimum and maximum element in an array
- Implement linear search.
- Sort an array in descending order.
- Given a two-dimensional array of integers and a row index, return the largest element in that row.
- Find transpose of a matrix.
- Perform multiplication of two matrices
- Count total number of vowels and consonants in a string.
- Reverse the given string without using String handling functions.
- Sort strings in dictionary order
- To perform addition of two matrices.
- Read an array of elements of size ‘n’ and find the largest and smallest number using functions
- find total number of alphabets, digits or special character in a string using function

Module V: Structures and Files 15Hours

Structures–Declaration, initialization, accessing structures, operations on structures, structures containing arrays, structures containing pointers, nested structures, self-referential structures, arrays of structures, structures and functions, structures and pointers, unions.
Files – Concept of a file, Opening and Closing files, file input / output functions (standard library input / output functions for text files)

Exercises: Write a program to

- Store information of a student using structure
- Add two complex numbers by passing structures to a function

- Store information of 10 students using structures
- Store Employee information using nested structure
- Read file contents and display on console.
- Read numbers from a file and write even and odd numbers to separate file.
- Count characters, words and lines in a text file.

Textbooks(s)

- B. A. Forouzan and R. F. Gilberg, Computer Science: A Structured Programming Approach Using C, 3/e, Cengage Learning

Reference Book(s)

1. Jeri R Hanly, Elliot B Koffman, Problem Solving and Program Design in C, 7/e, Pearson Education, 2012.
2. B.W. Kernighan and Dennis M. Ritchie, The C Programming Language, 2/E, Pearson education, 2015.
3. B. Gottfried, Programming with C, 3/e, Schaum's outlines, McGraw Hill (India), 2017.
4. P. Dey and M Ghosh, Programming in C, 2/e, Oxford University Press, 2011.

Additional Exercises:

1. Given numbers x, y, and target, return whichever of x and y is closer to the target. If they have the same distance, return the smaller of the two
2. There are three friends Ram, Raheem and Robert. Ram's age is 20, Raheem is aged three times more than his friend Ram. After 8 years, he would be two and a half times of Ram's age. After further 8 years, how many times would he be of Rams age? Robert's age is 25 now. Now program your computer to determine the final ages of all the three people after 16 years and also show who is elder.
3. Given an actual time and an alarm clock time, both in "military" format (such as 0730 for 7:30am), print how many more minutes before the alarm rings. But if the time is after the alarm, print "Alarm already went off".
4. Let there be a scenario where you and your friend are going to a restaurant. You have lunch there every fourth day, and he has his lunch there every sixth day. How many days before you meet again for lunch at the same restaurant?
5. Two friends Suresh and Ramesh have **m** red candies and **n** green candies respectively. They want to arrange the candies in such a way that each row contains equal number of candies and also each row should have only red candies or green candies. Help them to arrange the candies in such a way that there are maximum number of candies in each row.
6. On a chessboard, positions are marked with a letter between a and h for the column and a number between 1 and 8 for the row. Given two position strings, return true if they have the same colour.
7. Given two strings s0 and s1, return whether they are anagrams of each other.
8. Write a program to encrypt and decrypt a password which is alphanumeric
9. Given a string, return the string with the first and second half swapped. If the string has odd length, leave the middle character in place.
10. Given an array of integers, return the second-largest element.
11. Given lists of integers people, jobs, profits. Each person i in people have people[i] amount of strength, and performing job j requires jobs[j] amount of strength and nets profits[j] amount of profit. Given that each person can perform at most one job, although a job can be assigned to more than one person, return the maximum amount of profit that can be attained.

12. Mr. Roxy has arranged a party at his house on the New Year's Eve. He has invited all his friends - both men and women (men in more number). Your task is to generate the number of ways in which the invitees stand in a line so that no two women stand next to each other. Note that the number of men is more than the number of women and Roxy doesn't invite more than 20 guests. If there are more than 20 guests or an arrangement as per the given constraints is not possible, print 'invalid'.
13. Two friends have entered their date of birth and they want to know who is elder among them. Make a structure named Date to store the elements day, month and year to store the dates.

Case Study:

1. Create a structure containing book information like accession number, name of author, book title and flag to know whether book is issued or not. Create a menu in which the following functions can be done: Display book information, Add a new book, Display all the books in the library of a particular author, Display the number of books of a particular title, Display the total number of books in the library, Issue a book (If we issue a book, then its number gets decreased by 1 and if we add a book, its number gets increased by 1)

2. Ranjan is maintaining a store. Whenever a customer purchases from the store, a bill is generated. Record the customer name, amount due, the amount paid, mobile number with purchased items in file. At the end of day print the total income generated by store.

3. Contact Management System- Create structure to store Contact information like name, gender,mail,phone number and address. Users can add new contact and can also edit and delete existing contact. (Hint: Use Files to store data)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS12	PSO1	PSO2	PSO3
CO1	2	3	2		1				2			2	3	2	2
CO2	2	2	2		1				2			2	2	2	2
CO3	2	3	2		1				2			2	2	2	2
CO4	2	3	2		1				2			2	3	2	2
CO5	2	2	2		1				2			2	2	2	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : September 6, 2021 **ACADEMIC COUNCIL: 21st AC(September 17, 2021)**

SDG No. & Statement: 4 Quality Education, Decent Work and Economic Growth

4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

SDG Justification:

Learning various problem-solving techniques will lead to become a good problem solver.

CSEN1021	PROGRAMMING WITH PYTHON	L	T	P	S	J	C
		0	0	6	0	0	3
Pre-requisite	Nil						
Co-requisite	Nil						
Preferable exposure	Familiarity with Computer system and its operation.						

Course Educational objectives:

1. To elucidate problem solving through python programming language
2. To introduce function-oriented programming paradigm through python
3. To train in development of solutions using modular concepts
4. To teach practical Python solution patterns

Module I: Introduction to Python 18 **Hours**

Python – Numbers, Strings, Variables, operators, expressions, statements, String operations, Math function calls, Input/output statements, Conditional If, while and for loops.

Exercises:

1. Accept input from user and store it in variable and print the value.
2. Use of print statements and use of (.format)for printing different data types.
3. Take 2 numbers as user input and add, multiply, divide, subtract, remainder and print the output (Same operations on floating point input as well)
4. Conversion of one unit to another (such as hours to minutes, miles to km and etc)
5. Usage of mathematical functions in python like math.ceil, floor, fabs, fmod, trunc, pow, sqrt etc.
6. Building a mathematical calculator that can perform operations according to user input. Use decision making statement.
7. Accepting 5 different subject marks from user and displaying the grade of the student.
8. Printing all even numbers, odd numbers, count of even numbers, count of odd numbers within a given range.
9. a) Compute the factorial of a given number. b) Compute GCD of two given numbers. c) Generate Fibonacci series up to N numbers.
10. Check whether the given input is a) palindrome b) strong c) perfect
11. Compute compound interest using loop for a certain principal and interest amount

Module II: Functions **18 Hours**

User defined Functions, parameters to functions, recursive functions. Lists, Tuples, Dictionaries, Strings.

Exercises:

- Create a function which accepts two inputs from the user and compute ${}^{n}C_{r}$
- Recursive function to compute GCD of 2 numbers
- Recursive function to find product of two numbers
- Recursive function to generate Fibonacci series
- Program to print a specified list after removing the 0th, 4th and 5th elements.
  Sample List : ['Red', 'Green', 'White', 'Black', 'Pink', 'Yellow']
  Expected Output : ['Green', 'White', 'Black']
- Program to get the difference between the two lists.
- Program to find the second smallest number and second largest number in a list.
- Given a list of numbers of list, write a Python program to create a list of tuples having first element as the number and second element as the square of the number.
- Given list of tuples, remove all the tuples with length K.
  Input : test_list = [(4, 5), (4,), (8, 6, 7), (1,), (3, 4, 6, 7)], K = 2
  Output : [(4,), (8, 6, 7), (1,), (3, 4, 6, 7)]
  Explanation : (4, 5) of len = 2 is removed.
- Program to generate and print a dictionary that contains a number (between 1 and n) in the form (x, x*x).
  Sample Input: (n=5) :
  Expected Output : {1: 1, 2: 4, 3: 9, 4: 16, 5: 25}
- Program to remove a key from a dictionary
- Program to get the maximum and minimum value in a dictionary.
- Program to perform operations on string using unicodes ,splitting of string,accessing elements of string using locations
- Program for Counting occurrence of a certain element in a string, getting indexes that have matching elements.For ex -.In Rabbit count how many times b has occurred . Example-I have to go to a doctor and get myself checked. Count the number of occurrences of 'to'.
- Program for replacing one substring by another For example - Rabbit - Replace 'bb' by 'cc'
- Program to Acronym generator for any user input (ex-input is Random memory access then output should be RMA).Example - Random number (RN)
- Python function that accepts a string and calculates the number of uppercase letters and lowercase letters.
- Program to count the number of strings where the string length is 2 or more and the first and last character are same from a given list of strings

  Sample List : ['abc', 'xyz', 'aba', '1221'] Expected Result : 2

Module III: Files and Packages **18 Hours**

Files—Python Read Files, Python Write/create Files, Python Delete Files.

Pandas -- Read/write from csv, excel, json files, add/ drop columns/rows, aggregations, applying functions.

Exercises

- read an entire text file.
- read the first n lines of a file.
- append text to a file and display the text.
- Read numbers from a file and write even and odd numbers to separate files.
- Count characters, words and lines in a text file.
- To write a list to a file.
- Given a CSV file or excel file to read it into a data frame and display it.
- Given a data frame, select rows based on a condition.
- Given is a data frame showing the name, occupation, salary of people. Find the average salary per occupation.
- To convert Python objects into JSON strings. Print all the values.
- Write a Pandas program to read specific columns from a given excel file.

Module IV: Operations in database with suitable libraries **18 Hours**

SQLite3: CRUD operations (Create, Read, Update, and Delete) to manage data stored in a database.

Matplotlib -- Visualizing data with different plots, use of subplots. User defined packages, define test cases.

Exercises

Special commands to sqlite3 (dot-commands)
Rules for "dot-commands"
Changing Output Formats
Querying the database schema
Redirecting I/O
Writing results to a file
Reading SQL from a file
File I/O Functions
The edit() SQL function
Importing CSV files
Export to CSV
Export to Excel

Reference - https://www.sqlite.org/cli.html

Matplotlib can be practiced by considering a dataset and visualizing it.
It is left to the instructor to choose appropriate dataset.

Module V: Regular Expressions **18 Hours**

Regular expression: meta character, regEx functions, special sequences, Web scrapping, Extracting data.

Exercises

Write a Python program to check that a string contains only a certain set of characters (in this case a-z, A-Z and 0-9).
Write a Python program that matches a string that has an a followed by zero or more b's
Write a Python program that matches a string that has an a followed by one or more b's
Write a Python program that matches a string that has an a followed by zero or one 'b'
Write a Python program that matches a string that has an a followed by three 'b'
Write a Python program to find sequences of lowercase letters joined with an underscore

Write a Python program to test if a given page is found or not on the server.
Write a Python program to download and display the content of robot.txt for en.wikipedia.org.
Write a Python program to get the number of datasets currently listed on data.gov
Write a Python program to extract and display all the header tags from en.wikipedia.org/wiki/Main_Page
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Textbooks(s)

1. Programming with python, T R Padmanabhan, Springer
2. Python Programming: Using Problem Solving Approach, Reema Thareja, Oxford University Press

Reference Book(s)

1. Programming with python, T R Padmanabhan, Springer
2. Python Programming: Using Problem Solving Approach, Reema Thareja, Oxford University Press
3. Python for Data Analysis, Wes McKinney, O.Reeilly

Course Outcomes:
After completion of this course the student will be able to

- Define variables and construct expressions.
- Utilize arrays, storing and manipulating data.
- Develop efficient, modular programs using functions.
- Write programs to store and retrieve data using files.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS12	PSO1	PSO2	PSO3
CO1	2	3	2		1				2			2	3	2	2
CO2	2	2	2		1				2			2	2	2	2
CO3	2	3	2		1				2			2	2	2	2
CO4	2	3	2		1				2			2	3	2	2
CO5	2	2	2		1				2			2	2	2	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : September 6, 2021 **ACADEMIC COUNCIL: 21st AC(September 17, 2021)**

SDG No. & Statement: 4 Quality Education

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Learning a programming language like Python students can get decent jobs in different fields.

CSEN1031	ARTIFICIAL INTELLIGENCE APPLICATIONS	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	CSEN1011: Problem Solving and Programming with C CSEN1021: Programming with Python						
Co- requisite	Nil						
Preferable exposure	Programming						

Course Description:

The surge in the production of data has led to the development of various technologies. The term "Artificial Intelligence (AI)" has become ubiquitous in everyday applications from virtual assistants to self-driving cars. Several applications such as Healthcare, Finance, Bioinformatics etc. are benefitting from the advances in the domain. The global market for artificial intelligence is going to face a phenomenal growth over the coming years with organizations across the world capitalizing on the disruptive technologies that AI is offering. This course introduces the recent applications of AI namely, Virtual Assistants, Computer Vision, along with trending topics such as Deep Learning and Reinforcement Learning. The idea of the course is to introduce the basic concepts of AI as well as latest trends in the domain. This course is envisaged to provide a basic understanding on latest developments of AI to all disciplines engineering undergraduates.

Course Educational Objectives:

1. Provide introduction to basic concepts of artificial intelligence.
2. Explore applications of AI
3. Explore the scope, advantages of intelligent systems
4. Experiment with different machine learning concept
5. Exposure to AI-intensive computing and information system framework

UNIT 1 **2 Hours**

Introduction to Artificial intelligence: Basics of AL Agents and Environment, The Nature of Environment.

List of Experiment(s):

Implementation of toy Problems (8-Puzzle, Wumpus World, Vacuum-clean Example, etc)

UNIT 2 **2 Hours**

Applications of AI: Game Playing, [Deep Blue in Chess, IBM Watson in Jeopardy, Google's Deep Mind in AlphaGo]

List of Experiment(s):

1. Implementation of (Sudoku, Crossword Puzzle, or Wumpus World, etc)

UNIT 3 **2 Hours**

Conceptual introduction to Machine Learning: Supervised, Unsupervised, and Semi-Supervised Learning.

List of Experiment(s):

1. Supervise - Perform Data Labelling for various images using object recognition

UNIT 4 **2 Hours**

Reinforcement Learning, Introduction to Neural Networks, Deep Learning

List of Experiment(s):

1. Explore the effect of different hyperparameters while implementing a Simple Fully Connected Neural Network. (https://playground.tensorflow.org)

UNIT 5 **2 Hours**

Image Processing & Computer Vision: Introduction to Image processing, Image Noise, Removal of Noise from Images, Color Enhancement, Edge Detection.

List of Experiment(s):

1. Lobe.ai - Build custom models using the visual tool for Object recognition and sentiment analysis that can convert facial expressions into emoticons

UNIT 6 **2 Hours**

Segmentation. Feature Detection & Recognition. Classification of images. Face recognition, Deep Learning algorithms for Object detection & Recognition.

List of Experiment(s):

1. Teachable Machine Brain.JS In Browser Object Recognition through
2. Haar Cascade Object detection for Eye and Face in Python using Open CV

UNIT 7 **2 Hours**

Conceptual introduction to Natural Language Processing: Speech Recognition & Synthesis: Speech Fundamentals, Speech Analysis, Speech Modelling.

List of Experiment(s):

1. Sentiment Analysis and Polarity detection

UNIT 8 **2 Hours**

Speech Recognition, Speech Synthesis, Text-to-Speech, Sentiment Analysis, Segmentation and recognition.

List of Experiment(s):

1. Text to Speech recognition and Synthesis through APIs

UNIT 9 **2 Hours**

Introduction to o Chatbot, Architecture of a Chatbot. NLP in the cloud, NL Interface, How to Build a Chatbot, Transformative user experience of chatbots, Designing Elements of a chatbot, Best practices for chatbot development. NLP components. NLP wrapper to chatbots. Audiobots and Musicbots.

List of Experiment(s):

1. Building a Chatbot using IBM Watson visual studio
2. Building a Chatbot using Pandora bots
3. Build a virtual assistant for Wikipedia using Wolfram Alpha and Python

UNIT 10 **2 Hours**

Smart Applications: Smart Manufacturing, Smart Agriculture, Smart Healthcare, Smart Education, Smart Grids, Smart Transportation and Autonomous Vehicles, Smart Homes, Smart Cities

List of Experiment(s):

1. Build a smart application specific to the domain of the student.

Textbooks:

1. Tom Markiewicz& Josh Zheng, Getting started with Artificial intelligence, Published by O'Reilly Media,20l7
2. Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach.

References:

1. Aurtlien Giron. Hands on Machine Learning with Scikit-Learn and TensorFlow concepts,Tools, and Techniques to Build intelligent Systems , Published by O'Reilly Mcdia,20l 7
2. Build an AI Assistant with wolfram alpha and Wikipedia in python.https://medium .com/@salisuwy/build-an-ai-assistant-with-wolfram-alpha-and-wikipedia-in-python-d9bc8ac838fe.
3. Joseph Howse, Prateek Joshi, Michael Beyeler - Opencv Computer Vision Projects withPython-Publishing (201 6).
4. Curated datasets on kaggle https://www.kaggle.com/datasets.

Course Outcomes:

1. Able to grasp the concepts of artificial intelligence, machine learning, natural language processing, image processing
2. Recognize various domains in which Al can be applied
3. Implement the methods in processing an image:
4. Implement simple of chatbots
5. identify smart applications:

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2		1				2			2	3	2	2
CO2	2	2	2		1				2			2	2	2	2
CO3	2	3	2		1				2			2	2	2	2
CO4	2	3	2		1				2			2	3	2	2
CO5	2	2	2		1				2			2	2	2	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : September 6, 2021

ACADEMIC COUNCIL: 21st AC(September 17, 2021)

SDG No. & Statement:

SDG Justification:

EECE1001	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	S	J	C
		2	1	2	0	0	4
Pre-requisite	Nil						
Co- requisite	Nil						
Preferable exposure	Nil						

Course Description:

This course introduces the fundamental principles and building blocks of electrical and electronics engineering. The first three units cover the electric circuit laws, theorems, and principles of electrical machines. The last two units cover semiconductor devices and their applications.

Course Educational Objectives:

1. To impart the analysis and design aspects of DC networks in electrical and electronic circuits
2. To explain the basic concepts of AC networks used in electrical and electronic circuits.
3. To demonstrate the importance and operating principles of electrical machines (transformers, motors and generators)
4. To impart the knowledge about the characteristics, working principles and applications of semiconductor diodes, Metal Oxide Semiconductor Field Effect Transistors (MOSFETs).
5. To expose basic concepts and applications of Operational Amplifier and configurations.

UNIT 1 **7 Hours**
DC Circuits: Basic circuit elements and sources, Ohms law, Kirchhoff's laws, series and parallel connection of circuit elements, Node voltage analysis, Mesh current analysis, Superposition, Thevenin's and maximum power transfer theorem.

UNIT 2 **8 Hours**
AC Circuits: Alternating voltages and currents, AC values, single phase RL, RC, RLC series circuits, power in AC circuits, Power Factor, three phase systems-Star and Delta Connection-Three phase power measurement.

UNIT 3 **9 Hours**
Electrical Machines: Construction, working principle and application of DC machines, Transformers, single phase and three phase Induction motors, special machines-Stepper motor, Servo motor and BLDC motor.

UNIT 4 **8 Hours**
Semiconductor Devices: p-n Junction diode - Basic operating principle, current-voltage characteristics, rectifier circuits (half-wave, full-wave, rectifier with filter capacitor), Zener

diode as Voltage Regulator; Metal oxide semiconductor field effect transistor (MOSFET): Operation of NMOS and PMOS FETs, MOSFET as an amplifier and switch.

UNIT 5 **8 Hours**

Operational Amplifiers: The Ideal Op-amp, The Inverting Configuration, The closed loop gain, Effect of Finite open-loop gain, The Noninverting Configuration, The closed loop gain, Characteristics of Non-Inverting Configuration, Difference amplifiers, A Single Op-amp difference amplifier. Adders, subtractors, integrators, differentiators, filter circuits using Opamps,

Basic Electrical and Electronics Engineering Laboratory

List of Experiments:

1. Verification of Kirchhoff's Laws.
2. Verification of DC Superposition Theorem.
3. Verification of Thevenin's Theorem.
4. Verification of Maximum power transfer Theorem.
5. Load test on DC generator.
6. Load test on single phase transformer.
7. Measurement of voltage, current and power factor of single phase RL, RC series circuits.
8. Measurement of voltage, current and power factor of single phase RLC series circuit.
9. Measurement of power in a three phase circuit.
10. Current Voltage Characteristics of a p-n Junction Diode/LED.
11. Diode Rectifier Circuits.
12. Voltage Regulation with Zener Diodes.
13. Design of a MOSTFET amplifier and MOSFET inverter/NOR gate
14. Inverting and Non-inverting Amplifier Design with Op-amps.
15. Simulation experiments using PSPICE
    a) Diode and Transistor Circuit Analysis.
    b) MOSFET Amplifier design.
    c) Inverting and Noninverting Amplifier Design with Op-amps.

Textbooks:

1. D. P. Kothari, I. J. Nagrath, Basic Electrical and Electronics Engineering, 1/e, McGraw Hill Education (India) Private Limited, 2017.
2. B. L. Theraja, Fundamentals of Electrical Engineering and Electronics, 1/e, S. Chand Publishing, New Delhi, 2006.
3. Adel S. Sedra and Kenneth C. Smith, Microelectronic Circuits 6/e, Oxford University Press, 2014.

References:

1. S.K. Bhattacharya, Basic Electrical and Electronics Engineering, Pearson Education,

2011.
2. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2/e, Pearson Education, 2008.
3. R. K. Rajput, Basic Electrical and Electronics Engineering, University Science Press, New Delhi, 2012.

Course Outcomes:

After completion of this course, the student will be able to

1. predict and analyse the behaviour of an electrical circuit (L3).
2. analyse the performance quantities such as losses, efficiency and identify applications of DC machines (L4).
3. explain the use of transformers in transmission and distribution of electric power and other applications (L2).
4. demonstrate the operation and applications of various electronic devices (L2).
5. construct Inverting and Noninverting configurations of Op-amp (L3).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:
SDG3: Good Health and Well Being: Understanding the fundamentals of electrical and electronics systems can help in designing systems, to promote good health and well being

SDG5: Gender Equality: Acquiring the interdisciplinary knowledge help overcome the gender barriers in workplace

SDG8: Descent Work and Economic: The learners of this course can get descent work and earn financial benefits and they can work in interdisciplinary areas

SDG12: Responsible Consumption and Production: Use of right and energy efficient electric and electronic components and devices results in reasonable consumption and production
SDG Justification:

HSMCH102	UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	Nil						
Co- requisite	Nil						
Preferable exposure	Nil						

Course Description:

During the Induction Program, students would get an initial exposure to human values through Universal Human Values – I. This exposure is to be augmented by this compulsory full semester foundation course.

Course Educational Objectives:

The objective of the course is fourfold:

1. Development of a holistic perspective based on self- exploration about themselves (human being), family, society, and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society, and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

COURSE TOPICS: The course has 28 lectures and 14 practice sessions in 5 modules:

UNIT 1 Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I.
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration.
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority.
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

UNIT 2 Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'.
2. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility.
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).
4. Understanding the characteristics and activities of 'I' and harmony in 'I'.
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
6. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available tome. Identifying from one's own life.
Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

UNIT 3 Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

UNIT 4 Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfilment among the four orders of nature-recyclability and self-regulation in nature.
3. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space.

4. Holistic perception of harmony at all levels of existence.
5. Include practice sessions to discuss human being as cause of imbalance in nature (film “Home” can be used), pollution, depletion of resources and role of technology etc.

UNIT 5 Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. Case studies of typical holistic technologies, management models and production systems
6. Strategy for transition from the present state to Universal Human Order:
    a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
    b. At the level of society: as mutually enriching institutions and organizations
7. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. To discuss the conduct as an engineer or scientist etc.

Text Books:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

References:

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)

13. Gandhi - Romain Rolland (English)

Lectures hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them. Tutorial hours are to be used for practice sessions.

While analysing and discussing the topic, the faculty mentor’s role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one’s own self and do self- observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up “ordinary” situations rather than” extra-ordinary” situations.

Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials)would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses.

This course is to be taught by faculty from every teaching department, including HSS faculty.

Teacher preparation with a minimum exposure to at least one 8- day FDP on Universal Human Values is deemed essential.

ASSESSMENT:
This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation.

Example:
Assessment by faculty mentor: 10 marks
Self-assessment: 10 marks
Assessment by peers: 10 marks
Socially relevant project/Group Activities/Assignments: 20 marks Semester End Examination:

50 marks
The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

Course Outcomes:
By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to- day settings in real life, at least a beginning would be made in this direction.

This is only an introductory foundational input. It would be desirable to follow it up by

a. faculty-student or mentor-mentee programs throughout their time with the institution
b. Higher level courses on human values in every aspect of living. E.g. as a professional

INTN2333	INTERNSHIP 1	L	T	P	S	J	C
		0	0	0	0	1	1
Pre-requisite	Completion of minimum of four semesters						
Co- requisite							
Preferable exposure							

Course Educational Objectives:

1. The course is designed to expose the students to expected industry skills and industry environment and to take up onsite assignment as trainees or interns.

Contents: **1 Week**

One week of work at industry site. Supervised by an expert at the industry.

Mode of Evaluation: Internship Report, Presentation and Project Review

Course Outcomes:

At the end of this internship the student should be able to:

1. Have an exposure to industrial practices and to work in teams
2. identify skill set required to participate activity in real-time projects relevant to the industry
3. Understand the impact of engineering solutions in a global, economic, environmental and societal context
4. formulate technical background required to participate in Internship 2

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">INTN3444</td><td rowspan="2">INTERNSHIP 2</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Completion of minimum of six semesters</td></tr>
<tr><td>Co- requisite</td><td colspan="7"></td></tr>
<tr><td>Preferable exposure</td><td colspan="7"></td></tr>
</table>

Course Educational Objectives:

1. The course is designed to expose the students to industry environment and to take up onsite assignment as trainees or interns.

Contents: **1 Week**

Four weeks of work at industry site. Supervised by an expert at the industry

Mode of Evaluation: Internship Report, Presentation and Project Review

Course Outcomes:

At the end of this internship the student should be able to:

1. Have an exposure to industrial practices and to work in teams
2. Communicate effectively
3. Understand the impact of engineering solutions in a global, economic, environmental and societal context
4. Develop the ability to engage in research and to involve in life-long learning
5. Comprehend contemporary issues
6. Engage in establishing his/her digital footprint

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

MATH1001	SINGLE VARIABLE CALCULUS	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**NIL**						

Course Description:

This course is designed to impart knowledge on differentiation and integration of function, emphasizing their inter-relationship and applications to engineering.

Course Educational Objectives:

1. To familiarize the students in the concepts the derivatives and its underlying concepts like limits and continuity.
2. To explain the concept of derivative and calculation of extreme values of extreme values of various functions.
3. To impart knowledge on integration for the computation of areas, arc lengths.
4. To demonstrate various techniques of integrations.

UNIT 1 Limits and continuity of single and several variables 6 Hours

Limit of a Function and Limit Laws, The Precise Definition of a Limit, One-Sided Limits, Continuity (Without proofs). Functions of Several Variables, Limits and Continuity in Higher Dimensions (Without proofs)

UNIT 2 Derivatives and applications 7 Hours

The Derivative as a Function, Differentiation Rules, The Chain Rule, Extreme Values of Functions on Closed Intervals, Monotonic Functions (Without proofs)

UNIT 3 Integrals and applications 7 Hours

The Definite Integral, The Fundamental Theorem of Calculus, Indefinite Integrals and the Substitution Method, Definite Integral Substitutions and the Area between Curves, Arc Length (Without proofs)

UNIT 4 Techniques of integration 6 Hours

Using basic Integration Formulas, Integration by Parts, Trigonometric Integrals, Trigonometric Substitutions, Integration of Rational Functions by Partial Fractions (Without proofs)

Textbooks:

1. Joel Hass, Christopher Heil, Maurice D. Weir, Thomas' Calculus, Fourteenth edition, Pearson Addison Wesley (2018).

References:

1. Erwin Kreyszig, Advanced Engineering Mathematics,10/e, John Wiley & Sons, 2018.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.
3. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.
4. Hyghes-Hallett, Gleason, McCallum et al. Single Variable Calculus (6th Edn) John Wiley and Sons New York, 2013.

Course Outcomes:

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

- determine limit, one sided limit, continuity of single and several variable functions.
- solve problems in a range of mathematical applications using differentiation
- solve problems in a range of mathematical applications using integration
- apply the fundamental theorem of calculus.
- evaluate integrals using various techniques.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusion and equitable quality education and promote lifelong opportunities for all

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

<table>
<tr><td rowspan="2">MATH1011</td><td rowspan="2">SEVERAL VARIABLE CALCULUS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">MATH1001</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Engineering and Science</td></tr>
</table>

Course Description:

This course is designed to impart knowledge on calculus of functions of more variables which are useful in modelling and analyzing physical phenomena involving continuous change of variables or parameters and have applications across all branches of engineering.

Course Educational Objectives:

1. To teach basic concepts of partial derivatives.
2. To explain the evaluation of double integrals and its applications.
3. To demonstrate the evaluation and applications of triple integrals.
4. To acquaint the knowledge of line and surface integrals and applications.

UNIT 1 Partial derivatives and applications 7 Hours

Partial Derivatives of a Function of Two Variables and More Than Two Variables, Second-order Partial derivatives, The Chain Rule for Functions of Two and Three variables, Extreme Values and Saddle Points, Lagrange Multipliers, Taylor's Formula for Two Variables (Without proofs)

UNIT 2 Double integrals 6 Hours

Double and iterated Integrals over Rectangles, Double Integrals over General Regions, Area by Double Integration: Area of bounded region in a plane, Double Integrals in Polar Form. (Without proofs)

UNIT 3 Triple integrals 5 Hours

Triple Integrals in Rectangular Coordinates: Triple Integrals, Volume of a Region in Space, Finding limits of integration, Triple Integrals in Cylindrical and Spherical Coordinates. (Without proofs)

UNIT 4 Integrals and Vector fields 8 Hours

Vector Fields and Line Integrals: Line Integrals of Vector Fields, Line Integrals with Respect to dx, dy, or dz, Work Done by a Force over a Curve in Space, Green's Theorem in the Plane: Tangential form, Using Green's Theorem to Evaluate the Line Integral and Verification, Surface Integrals: Surface Integrals of Vector Fields, Stokes' Theorem (Without proofs)

Textbooks:

1. Joel Hass, Christopher Heil, Maurice D. Weir, Thomas' Calculus, Fourteenth edition, Pearson Addison Wesley (2018).

References:

1. Erwin Kreyszig, Advanced Engineering Mathematics,10/e, John Wiley & Sons, 2018.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.
3. Hyghes-Hallett, Gleason, McCallum et al. Multivariable Variable Calculus (6th Edn) John Wiley and Sons New York, 2013.
4. James Stewart. Multivariate Calculus, Concepts and Contexts. (3rd Edn) Thomson/Brooks/Cole, Canada, 2005.

Course Outcomes:

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

- utilize functions of several variables in optimization.
- employ the tools of calculus for calculating the areas.
- calculate volumes using multiple integrals.
- determine the work done using vector calculus
- determine the rate of flow of a fluid using vector calculus

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4
Ensure inclusion and equitable quality education and promote lifelong opportunities for all

SDG Justification:
Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2371	DIFFERENCE EQUATIONS	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**Engineering and Science**						

Course Description:

Difference equations is the study of equation which involves the difference of a discrete function. In this course, the student can form a difference equation, solving linear higher order difference equations using analytical techniques, simultaneous linear difference equations and also find the solution of linear higher order difference equations and simultaneous difference equations using Z-transforms.

Course Educational Objectives:

1. Student is able to know how to find the order of a difference equation and complementary function of a difference equation.
2. Student is able to know how to find the particular solution of a difference equation and also find the solutions of simultaneous linear difference equations.
3. Student is able to know how to find Z-transforms a discrete function using properties and using to basic theorems.
4. Student is able to know how to find the inverse Z-transforms a function and also using convolution theorem.
5. Student is able to know how to find the solution of a difference equation using Z-transforms

UNIT 1 **Difference equations - I** **5 Hours**

Introduction, definition of order, and solution of difference equation, formation of difference equations, linear difference equations, complementary function, rule for finding complementary function.

UNIT 2 **Difference equations-II** **5 Hours**

Particular integrals, Rule for finding particular integrals, simultaneous linear difference equations.

UNIT 3 **Z-transforms** **5 Hours**

Introduction, Definition, some standard Z-transforms, linear property, damping rule, Shifting U_n to the **right and to the left, Multiplication by n, two basic theorems.**

UNIT 4 **Inverse Z-transforms** **5 Hours**

Convergence of Z-transforms, evaluation of inverse Z-transforms, properties, convolution theorem.

UNIT 5 Applications of Z-transforms 5 Hours

Solving difference equations and simultaneous linear difference equations with constant coefficients by Z-transforms.

Textbooks:

1. "Higher Engineering Mathematics" by B.S. Grewal published by Khanna Publishers

References:

1. Advanced Engineering mathematics by Irvin Kreyszig

Course Outcomes:

1. Able to find the order of a difference equation and complementary function of a difference equation.
2. Able to find the particular solution of a difference equation and also find the solutions of simultaneous linear difference equations.
3. Able to find Z-transforms a discrete function using properties and using to basic theorems.
4. Able to find the inverse Z-transforms a function and also using convolution theorem.
5. Able to find the solution of a difference equation using Z-transforms

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH1031	DIFFERENTIAL EQUATIONS	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**Engineering and Science**						

Course Description:

This course is designed to impact the knowledge on ordinary, partial differential equations and their applications.

Course Educational Objectives:

6. To familiarize the students with the basic concepts of ordinary differential equations.
7. To demonstrate the evaluation and applications of first order differential equations.
8. To explain the evaluations of linear homogeneous and non-homogeneous differential equations.
9. To familiarize the students with the basic concepts of partial differential equations.
10. To explain the concepts of first order partial differential equations.
11. To demonstrate the evaluation of differential equations using math software's

UNIT 1 First Order Ordinary Differential Equations 5 Hours

Order and Degree of an Ordinary Differential Equation (ODE), ODE's of first order and first degree, Variable separable method, Linear Equations, Bernoulli's Equations.

UNIT 2 Linear Ordinary Differential Equations of High Order 6 Hours

Definitions, Complete Solution, Operator D, Complimentary function, Inverse operator, Rules for finding particular integral (e^{ax}, sinbx/cosbx, x^m& $e^{ax}v(x)$)

UNIT 3 Applications of Linear Ordinary Differential Equations of Higher Order 5 Hours

Method of Variation of Parameters, Simple Harmonic Motion, Oscillations of a Spring

UNIT 4 Introduction to Partial Differential Equations 5 Hours

Introduction, Formation of Partial Differential Equation(PDE), Solutions of a PDE, Equations solvable by direct integration, Linear equations of the first order.

UNIT 5 Partial Differential Equations of Second Order 5 Hours

Homogeneous linear equations with constant coefficients, Rules for finding the complementary function and particular integral, Working procedure to solve the equations.

Textbooks:

1. Simmons, G.F., Differential Equations with Applications and Historical Notes, Second Edition, McGraw-Hill, Inc., 1991.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.

References:

1. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, 1984
2. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, International Edition, 1967.
3. Erwin Kreyszig, Advanced Engineering Mathematics,10/e, John Wiley & Sons, 2018.

Course Outcomes:

1. Form and find the solution of an ordinary differential equation.
2. Apply the concept of differential equations to solve real world problems.
3. Evaluate linear homogeneous and non homogeneous differential equations
4. Form and find the solution of a partial differential equations of first order.
5. Evaluate second order partial differential equations and solution of differential equations using computational tool.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4
Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:
Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

<table>
<tr><td rowspan="2">MATH2281</td><td rowspan="2">NUMERICAL TECHNIQUES</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Engineering and Science</td></tr>
</table>

Course Description:

This course is designed to enhance problem solving skills of engineering students using a powerful problem-solving tool namely numerical Techniques. The tool is capable of handling large systems of equations, nonlinearities and complicated geometries that are common in engineering practice but often impossible to solve analytically.

Course Educational Objectives:

1. To familiarize the students with numerical solutions of nonlinear and systems of linear equations.
2. To get exposed to finite differences and interpolation.
3. To demonstrate the numerical differentiation and integration.
4. To explain the numerical solutions of ordinary differential equations

UNIT 1 Solution of algebraic and transcendental equations 6 Hours

Regula-falsi method and Newton- Raphson method. **Solution of linear system of equations**-Iterative methods: Gauss Jacobi method, Gauss Seidel method, and finding the eigenvalues of a matrix by Power method.

UNIT 2 Interpolation 5 Hours

Difference operators (shifting, delta, del) and difference tables, Newton's forward and backward interpolation formulae, Divided difference formula, and Lagrange's interpolation formula.

UNIT 3 Numerical Differentiation and Numerical Integration 5 Hours

Numerical Differentiation: Derivatives using forward, and backward difference formulae.
Numerical Integration: Trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8th rules.

UNIT 4 Numerical solutions of ordinary differential equations - 1 5 Hours

Picard's method, Taylor's series method, Euler's method, and Modified Euler's method

UNIT 5 Numerical solutions of ordinary differential equations - 2 5 Hours

Runge-Kutta method (second and fourth order), Predictor-Corrector methods-Adams-Bashforth and Milne's methods.

Text Books:

1. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2018.

References:

1. M.K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 5/e, New Age International(P) Limited, 2007.
2. S.S. Sastry, Introductory methods of Numerical Analysis,4/e,PHI Learning Publications,2009.
3. H.C Saxena, Finite Differences and Numerical Analysis, Chand and Company Pvt. Ltd., New Delhi.

Course Outcomes:

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

1. analyze how root finding techniques can be used to solve practical engineering problems.
2. apply various interpolation techniques to solve practical problems .
3. apply numerical differentiation and integration whenever and wherever routine methods are not applicable .
4. solve differential equations using various numerical methods .
5. know the strengths and weaknesses of the various methods and be able to decide which ones are appropriate for a particular problem

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH1021	TRANSFORM TECHNIQUES	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	**MATH1031**						
Co- requisite	**NIL**						
Preferable exposure	**Engineering and Science**						

Course Description:

This course is designed to impact the knowledge on (Laplace, Fourier) transforms and applications of these transforms on differential equations.

Course Educational Objectives:

1. To introduce and explain the concepts of Laplace transforms and properties.
2. To demonstrate the evaluation of Laplace transforms of special functions and additional properties.
3. To impart knowledge on obtaining Fourier series
4. To introduce and explain the concepts of Fourier transforms and properties.
5. To explain the evaluation of Fourier transforms of various function and then applications to boundary value problem.
6. To demonstrate and understand the transform techniques using available software

UNIT 1 Laplace transforms 5 Hours

Introduction, transforms of elementary functions, properties of Laplace transforms, transforms of derivatives, transforms of Integrals, Multiplication by t^n, Division by t.

UNIT 2 Applications of Laplace transforms 5 Hours

Evaluation of integrals by Laplace transforms, Inverse transforms, Solution of Differential equations.

UNIT 3 Fourier Series 6 Hours

Introduction, Conditions for a Fourier expansion, Functions having points of discontinuity, Change of interval.

UNIT 4 Half-Range Fourier Series 3 Hours

Even and odd functions, Half range sine series, and Half range cosine series.

UNIT 5 Fourier transforms 7 Hours

Introduction, Fourier sine & cosine integrals, Fourier transforms, Properties of Fourier transforms-linear, change of scale & shifting property.

Text Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2018.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.

References:

1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
2. George B. Thomas, Maurice D. Weir and Joel R. Hass, Thomas' Calculus, 13/e, Pearson Publishers, 2014.
3. Glyn James, Advanced Modern Engineering Mathematics, 4/e, Pearson Publishers, 2011.

Course Outcomes:

At the end of the course students will be able to

1. find Laplace transform of a function along with properties.
2. evaluate the Laplace transform of special functions.
3. apply the Laplace transform for solving differential equations (continuous systems)
4. evaluate the Fourier transform of a function along with properties and solve boundary value problems by Fourier transforms.
5. evaluate the engineering problems using transform techniques with the help of advanced math software

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4
Ensure inclusive and equitable quality education and promote lifelong opportunities for all

SDG Justification:
Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2381	OPERATIONS RESEARCH	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	NIL						
Co- requisite	NIL						
Preferable exposure	Engineering and Science						

Course Description:

Operations Research (OR), also known as management science, has become an indispensable tool in scientific management. Operations Research focuses on developing and analyzing strategic and tactical levels to aid in decision-making and decision-making on the operational level. The essential tools of OR are algorithms, procedures that create and improve solutions to a point at which optimal or, at least, satisfactory solutions have been found.

Course Educational Objectives:

This course is designed to:

1. introduce the fundamentals of Operations Research to the students at the undergraduate level
2. solve different types of optimization problems of various categories and applying modern methodologies in the area of optimization
3. help students to develop a deep understanding of the classical and numerical optimization techniques and problem-solving capabilities

UNIT 1 — Linear Programming — 4 Hours

Formulation of LPP, convex sets and their properties, slack and surplus variables, Basic solution, Basic feasible solution, non-degenerate and degenerate basic feasible solutions, optimal solution, General, Standard, and Canonical form of LPP.

UNIT 2 — Simplex Method — 8 Hours

Simplex method, Degeneracy in LPP, Artificial variables techniques-Two Phase method, Big M-method.

UNIT 3 — Duality — 5 Hours

Duality in linear programming, primal-dual relationships, weak duality theorem, strong duality theorem, and dual simplex method.

UNIT 4 — Integer Programming — 4 Hours

Gomory’s cutting plane method, Branch and Bound method for solving integer linear programming problems

UNIT 5 — Sensitivity Analysis — 5 Hours

Introduction to sensitivity analysis, variations in the price vector, variations in the requirement vector, addition of a new decision variable to the existing problem.

Textbooks:

1. Operations Research by S.D.Sarma, Kedarnath, Ramnath and company, 15th edition, 2008.
2. Operations Research An Introduction by Hamdy A. Taha, 8th edition, Pearson, 2007.

References:

1. Linear Programming by R K Gupta, Krishna Prakashan Mandir, 13th edition 2014.
2. Operations Research Theory and Applications by J K Sharma, 4th edition, Macmillan Publishers India Ltd, 2009

Course Outcomes:

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

1. understand the linear programming problem, its formation, and basic definitions of solutions
2. understand the simplex method, which is a very efficient algorithm to solve a linear programming problem
3. understand the dual primal relationship, properties of duality, and the dual simplex algorithm
4. find integer solutions to LPP by cutting plane methods
5. find variations in price and requirement vectors and retaining optimality

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2301	COMPLEX VARIABLES	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**Engineering and Science**						

Course Description:

This course is designed to familiarize the students with complex analysis, nature of a series, evaluation of integrals using Cauchy's theorem.

Course Educational Objectives:

- To explain the concept of complex functions and analytic functions.
- To explain the concept of conformal mapping.
- To explain the concept of Cauchy's theorem and residue theorem.
- To explain the convergence of series such as Taylor's and Laurent.
- To explain the concept of Cauchy's theorem and residue theorem.

UNIT 1 **Functions of a Complex variable** **6 Hours**

Limit and continuity, Differentiation, Analytic functions, Cauchy-Riemann equations, harmonic functions, finding harmonic conjugates- applications to flow problems.

UNIT 2 **5 Hours**

Geometrical representation of f(z) – Some standard transformations – Bilinear transformation - Conformal mappings. Special conformal transformations ($w = z^2$, $w= z+1/z$, $w = e^z$, $w= \cosh z$)

UNIT 3 **Complex Integration** **5 Hours**

Integration of complex functions - Cauchy's theorem - Cauchy's integral formula.

UNIT 4 **Series representation of analytic functions** **5 Hours**

convergent series of analytic functions, Laurent 's and Taylor series, zeros and singularities of an analytic function

UNIT 5 **Calculus of residues** **5 Hours**

Residue -Cauchy Residue theorem – Calculation of residues (All theorems without proof).

Text Books:

1. B.S.Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna Publishers, New Delhi, 2012.

References:

1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics Narosa Publishing House, New Delhi, 2014.
2. N. P. Bali and Manish Goyal, A Text Book of Engineering Mathematics, 8th Edition, Lakshmi Publications, New Delhi, 2012.

Course Outcomes:

1. Make use of differentiation and integration of complex functions in engineering problems.
2. Concept of conformal mappings .
3. Use Cauchy's theorem and Cauchy's integral formula to evaluate the line integrals
4. Apply Taylor's and Laurent's series to expand complex functions and know about the convergence region .
5. Evaluation of integrals using Residue theorem.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4
Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:
Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

<table>
<tr><td rowspan="2">MATH1041</td><td rowspan="2">DISCRETE MATHEMATICS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Engineering and Science</td></tr>
</table>

Course Description:

Discrete Mathematics introduces students to the mathematics of networks, social choice, and decision making. This course provides students with a hands-on exploration of the relevancy of mathematics in the real world. This course reflects the rigor taught in many entry-level mathematics courses.

Course Educational Objectives:

1. To introduce basics of mathematical logical operators and connectives
2. To impart knowledge on normal forms and rules of inference.
3. To impart knowledge on partially ordered and total ordered sets.
4. To familiarize closed form solution of linear recurrence relations by various methods.
5. To impart knowledge on basic concepts of algebraic structures.
6. To write program structures, and understand when programming is most applicable

UNIT 1 Logic Operators and Connectives 5 Hours

Negation, conjunction, disjunction, conditional and bi-conditional, well formed formulae, tautologies, equivalence of formulae, duality, tautological implications.

UNIT 2 Mathematical logic 5 Hours

Conjunctive and disjunctive normal forms- principal disjunctive and conjunctive normal forms, Rules of inference for propositional calculus (Rule P, Rule T and CP rule).

UNIT 3 Sets and Relations 5 Hours

Basic concepts of set theory, Power set, relations, properties of binary relations in a set, Equivalence relations, composition of binary relations, Partial ordering, Partially ordered set.Hasse diagram.

UNIT 4 Recurrence relations 5 Hours

Recurrence relations, solving linear recurrence relations by characteristic roots method, system of recurrence relations.

UNIT 5 Algebraic Structures 6 Hours

Algebraic Structures-Semi group, Monoid, Groups, subgroups, cosets (definition and examples) Lagrange's theorem on finite groups

Text Books:

1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, 1997.
2. Kenneth H. Rosen, Discrete Mathematics and Applications, Seventh edition, Tata McGrawHill,2012.

References:

1. Bhishma Rao, Mathematical Foundations of Computer Science, SciTech Publications (India) Pvt Ltd.
2. Discrete Mathematical Structures,Sixth edition-Kolman,Busby,Ross

Course Outcomes:

Upon successful completion of this course the student should be able to

1. Check the validity of a statement formula
2. analyze the concepts in set theory and relations
3. find a general solution of recurrence equation
4. build the algebraic structures and apply Lagrange's theorem on finite groups
5. Convert problem solving strategies to procedural algorithms

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4
Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:
Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH1051	Graph Theory	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**Engineering and Science**						

Course Description:

This course introduces basic concepts in Graph Theory, including properties and characterization of graph/trees and graph theoretic algorithms, which are widely used in Mathematical modelling and has got applications across Computer Science and other branches in Engineering.

Course Educational Objectives:

1. To introduce basics of group theory and its applications
2. To impart knowledge on basic concepts of paths and circuits
3. To impart knowledge on Trees, spanning trees, shortest spanning trees
4. To familiarize in the matrix representation of graphs
5. To transform scientific problems into generic computational models

UNIT 1 Basics of graphs 5 Hours

Finite and Infinite Graphs, Incidence and Degree, Isolated Vertex, Pendant Vertex, and Null Graph, complete graph, Bi-partite and complete Bi-partite graphs.

UNIT 2 Matrix representation of graphs 5 Hours

Adjacency Matrix, Incidence Matrix, Path Matrix (Definition and examples)

UNIT 3 Paths and circuits 6 Hours

Paths, and Circuits, Connected Graphs, Disconnected Graphs, and Components, Euler Graphs, Hamiltonian graphs (Definition, examples and without proofs)

UNIT 4 Trees 5 Hours

Trees and their properties, spanning trees, minimal spanning trees, Kruskal's algorithm for finding a minimal spanning tree.

UNIT 5 Applications of Trees and Fundamental circuits 5 Hours

Preorder, in order and post order traversals, Prefix and Postfix notations of an arithmetic expression, parsing trees.

Textbooks:

1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, 1997.

2. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, Prentice Hall of India, 2006.

References:

1. Bhishma Rao, Mathematical Foundations of Computer Science, SciTech Publications (India) Pvt Ltd.
2. Kenneth H. Rosen, Discrete Mathematics and Applications, Seventh edition, Tata McGrawHill,2012.

Course Outcomes:

Upon successful completion of this course the student should be able to

1. analyse the concepts in graph theory
2. apply graph theory concepts in core subjects such as data structures and network theory effectively
3. Identify different types of paths
4. Construct minimum spanning tree using some algorithms and identify tree traversals
5. Solve the graphical problems which are accessed in available software

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4
Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:
Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

<table>
<tr><td rowspan="2">MATH2311</td><td rowspan="2">NUMBER THEORY</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Engineering and Science</td></tr>
</table>

Course Description:

This course is designed to explain the basics and applications of number theory for the students of Computer Science. The core courses of these branches encounter with concepts like prime factorization, modular arithmetic, and quadratic reciprocities in number theory. The first unit of the course provide a strong platform for such encounters and the other units focuses on applications of number theory.

Course Educational Objectives:

1. To teach basic concepts of number theory focusing on Computational aspects.
2. To teach the concepts of factorization of integers.
3. To teach Format's theorem and quadratic residues.
4. To explain Chines remainder theorem and Euclidean algorithm.
5. To explain polynomial arithmetic.

UNIT 1 **Basic Concepts in Number Theory** **5 Hours**

Topics in elementary number theory, Divisibility, Greatest Common Divisor, Euclidean Algorithm

UNIT 2 **5 Hours**

Fundamental theorem of Arithmetic, Congruences, Properties of congruences, Linear congruences

UNIT 3 **5 Hours**

Fermat's theorem, Fermat's little theorem, Wilson's theorem

UNIT 4 **5 Hours**

Chinese remainder theorem, The functions $\tau \ and \ \sigma$, Euler Phi-function, Euler's theorem, Some properties of phi function

UNIT 5 **5 Hours**

The order of integer modulo n, Primitive roots for prime, Composite number having primitive roots

Textbooks:

1. Elementary Number Theory | 7th Edition by David Burton, Mc Graw Hill Education

References:

1. Basic Number Theory by S.B. Malik,S. Chand publishers

Course Outcomes:

Upon successful completion of this course the student should be able to

1. Apply concepts of number theory focusing on Computational aspects.
2. Analyze concepts of factorization of integers.
3. Explain Fermat's theorem and quadratic residues.
4. Analyse Chines remainder theorem and Euclidean algorithm.
5. Analyse the concept of polynomial arithmetic.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2291	LINEAR ALGEBRA	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**Engineering and Science**						

Course Description:

This course is designed to gain knowledge in the concepts of Linear Algebra focusing on basics of matrices, vector spaces and singular value decomposition to understand the basic concepts of Linear Algebra in the applications of image processing and machine learning.

Course Educational Objectives:

1. To familiarize with theory of matrices and tools for solving system of linear equations
2. To impart knowledge on Eigen values and Eigen vectors.
3. To teach basic concepts of vector spaces and their properties.
4. To explain the concepts of inner product spaces.
5. To familiarize with concept of singular value decomposition and its applications

UNIT 1 Fundamentals of Matrices 5 Hours

Introduction to Matrices and Rank of a matrix, Echelon form, solving system of linear equations.

UNIT 2 Eigen values and Eigen vectors 5 Hours

Eigen values and Eigen vectors, positive definite matrices, Linear dependence, and Linear independence.

UNIT 3 Vector Spaces 6 Hours

Vector space, linear combination of vectors, linear span, basis and dimension, linear Transformation.

UNIT 4 Inner Product Spaces 5 Hours

Inner Product Spaces, examples of inner product spaces, norm and length of a vector cauchy-schwarz's inequality.

UNIT 5 Singular value decomposition 5 Hours

Singular values, computing singular value decomposition and Introduction to principal component analysis.

Textbooks:

1. Higher Engineering Mathematics, B. S. Grewal.
2. Linear Algebra, Schaum's Outline,4th edition, Seymour Lipchutz,Marc Lipson

References:

1. Advanced Engineering Mathematics, 7th Edition, Peter V. O'Neil.
2. Advanced Engineering Mathematics, 2nd Edition, Michael. D. Greenberg.
3. Introduction to linear algebra, 5th Edition, Gilbert Strang.
4. Applied Mathematics (Vol. I & II), by P. N. Wartikar& J. N. Wartikar.
5. Digital Image Processing, R C Gonzalez and R E Woods.

Course Outcomes:

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

- solve the system of linear equations
- calculate Eigen values and Eigen vectors
- find the basis
- learn Singular value decomposition
- learn principal Component analysis

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems.

<table>
<tr><td rowspan="2">MATH2341</td><td rowspan="2">PROBABILITY THEORY AND RANDOM VARIABLES</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Engineering and Science</td></tr>
</table>

Course Description:

To expose the students to the basics of probability theory and random processes essential for modelling and quantifying uncertainties and noise in systems

Course Educational Objectives:

- To know about various random life length models and their uses in finding the reliability of different electronic devices.
- To learn about basic properties and characteristics of various random processes with reference to signal and trunk processes.

UNIT 1 Probability 5 Hours

Axioms of probability theory. Probability spaces. Joint and conditional probabilities. Bayes' Theorem- Independent events.

UNIT 2 Random Variable 5 Hours

Random variables and random vectors. Distributions and densities. Independent random variables. Functions of one and two random variables.

UNIT 3 Multiple Random Variables 6 Hours

Vector random variables, joint distribution and density functions, properties, conditional distribution and density, statistical independence, distribution and density of a sum of random variables, central limit theorem.

UNIT 4 Expected Value of a Function of Random Variables 6 Hours

Joint moments about the origin, joint central moments, jointly Gaussian random variables - two random variables case, N random variable case.

UNIT 5 Random Process 6 Hours

Temporal characteristics - the random process concept, stationarity and statistical independence, correlation functions, Gaussian random processes, Poisson random process.

Textbooks:

1. Peyton Z. Peebles, Probability, Random Variables and Random Signal Principles, 4/e, Tata McGraw Hill, 2002.
2. Athanasios Papoulis, S. Unnikrishnan Pillai, Probability, Random Variables and Stochastic Processes, 4/e, Tata McGraw Hill, 2002.

References:

1. Simon Haykin, Communication Systems, 4/e, Wiley Student Edition, 2006.
2. Henry Stark, John W. Woods, Probability and Random Processes with Application to Signal Processing, 3/e, Pearson Education, 2002.

Course Outcomes:

Upon successful completion of this course, the student should be able to

1. Analyze the outcomes of random experiments and develop the concept of random variables and obtain probabilities through them
2. define single random variables in terms of their PDF and CDF, and calculate moments such as the mean and variance
3. explore the random experiments specified by multiple random variables and study the Distribution of them
4. apply the fundamentals of probability theory and random processes to practical engineering problems
5. identify and interpret the key parameters that underlie the random nature of the problems

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2321	RANDOM PROCESSES	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**Engineering and Science**						

Course Description:

This course is designed to impart knowledge on random processes needed in applications such as signal processing, digital communications, speech processing, data modelling, etc.

Course Educational Objectives:

1. To familiarize the students in the concepts of probability and random variables.
2. To study Random Processes, its types, distribution, and density functions.
3. To study Gaussian and Poisson processes.
4. To apply random process to signal processing in communication systems.
5. To apply skills in analysing random phenomena which occur in Electrical and Electronics Engineering applications.

UNIT 1 Random Processes 6 Hours

Temporal characteristics - the random processes concept, Classification of random processes, stationarity and statistical independence. Time averages and Ergodicity.

UNIT 2 Correlation and Covariance functions 5 Hours

Auto correlation, Cross correlation, Properties. Covariance functions. Gaussian random processes, Poisson random processes

UNIT 3 Density functions 5 Hours

Probability density and joint probability density functions, Properties.

UNIT 4 Spectral densities functions - I 5 Hours

Spectral characteristics, the power density spectrum: Properties, relationship between power density spectrum and autocorrelation function.

UNIT 5 Spectral densities functions-II 5 Hours

Cross-power density spectrum, Properties, relationship between cross power spectrum and cross-correlation function.

Textbooks:

1. Peyton Z. Peebles, Probability, Random Variables and Random Signal Principles, 4/e, Tata McGraw Hill, 2002.

References:

1. Athanasios Papoulis, S. Unnikrishnan Pillai, Probability, Random Variables and Stochastic Processes, 4/e, Tata McGraw Hill, 2002.
2. Simon Haykin, Communication Systems, 4/e, Wiley Student Edition, 2006.
3. Henry Stark, John W. Woods, Probability and Random Processes with Application to Signal Processing, 3/e, Pearson Education, 2002.

Course Outcomes:

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

- solve the problems on multiple random variables, joint distribution and independence
- solve the problems Gaussian and Poisson processes
- understand the concept of random processes
- determine covariance and spectral density of stationary random processes
- characterize the random signals in communication systems with their autocorrelation and power spectral density functions

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4
Ensure inclusive and equitable quality education and promote lifelong opportunities for all.
SDG Justification:
Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2351	OPTIMIZATION METHODS	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**Engineering and Science**						

Course Description:

Optimization is the art of finding the best result under given conditions. In this fast-expanding world, an engineer has to use many Optimization methods, as it is the most significant in decision-making, design, manufacturing, maintenance, planning, and scheduling.

Course Educational Objectives:

This course is designed to:

- introduce various optimization methods for solving real-world problems
- find optimal solutions to transportation, assignment, and sequencing problems
- know project planning and scheduling
- study the network analysis techniques through CPM and PERT

UNIT 1 Transportation Problem 6 Hours

Introduction and LP formulation of Transportation Problem, feasible solution, basic feasible solution, finding Initial basic feasible solutions by North West corner rule, Least-cost entry method, Vogel's approximation method, Transportation Algorithm (MODI Method) to find an optimal solution.

UNIT 2 Assignment Problems 5 Hours

Introduction to Assignment Problem, Mathematical formulation, Hungarian Method for finding optimal solution, unbalanced assignment problem, Travelling Salesman Problem.

UNIT 3 Sequencing Problem 4 Hours

Introduction, Basic terminology, Algorithms to obtain optimal solutions for sequencing problems with n jobs and two machines and n jobs and k machines.

UNIT 4 Network Analysis in Project planning 4 Hours

Project, Project Planning, Project Scheduling, Project Controlling, Work breakdown structure, Network Techniques, terms used in network-activity, event, path, network, dummy activity, looping, Fulkerson's rule, network diagram, and activity on node diagram.

UNIT 5 PERT and CPM 7 Hours

Critical path method (CPM), Measure of activity, Critical path analysis, the four floats, subcritical and supercritical activities, slack, Programme evaluation and review technique (PERT), time estimates, frequency distribution curve for PERT

Text Books:

1. Operations Research by S.D.Sarma, Kedarnath, Ramnath and company, 15th edition, 2008.
2. Operations Research An Introduction by Hamdy A. Taha, 8th edition, Pearson, 2007.

References:

1. Linear Programming by R K Gupta, Krishna Prakashan Mandir, 13th edition 2014.
2. Operations Research Theory and Applications by J K Sharma, 4th edition, Macmillan Publishers India Ltd, 2009

Course Outcomes:

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

1. apply MODI method for finding optimal transportation cost
2. apply Hungarian Method for solving assignment problems and finding an optimal route to the salesman
3. understand the process of finding optimal sequencing for processing jobs on machines
4. understand the network terminology and construction
5. apply CPM and PERT techniques for project management

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2331	COMPUTATIONAL METHODS	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	NIL						
Co- requisite	NIL						
Preferable exposure	Engineering and Science						

Course Description:

This course is designed for Aerospace Engineering undergraduate students. It is designed for the students for the basic understanding of techniques for numerical solution of algebraic equations, differentiation, integration used to solve aerospace engineering application problems.

Course Educational Objectives:

1. Develop the mathematical skills in the areas of numerical methods.
2. Focus on the theory and applications of numerical methods in many engineering subjects which require solutions of linear systems, finding eigenvalues, eigenvectors, Interpolation, and applications, solving ODEs, PDEs.
3. Help in the foundation of computational mathematics for postgraduate courses, specialized studies, and research.
4. Train in developing the codes for implementing the numerical methods using any programming languages.
5. Formulate a mathematical model for a given engineering problem

UNIT 1 Mathematical Modeling of Engineering Problems 5 Hours

Approximations: Accuracy and precision, round-off and truncation errors, error problem with example problems. **Roots of Equations:** Formulations of linear and non-linear algebraic equations, solution with bisection, Newton-Raphson and Secant methods. Application to practical problems. **Algebraic Equations**: Formulation of linear algebraic equations from engineering problems, solution of these problems by Gauss elimination method, pitfalls of elimination and techniques for improving the solutions, Gauss Seidel iteration for solving sparse equations by avoiding storage of zero coefficients in matrix, convergence of iteration methods. LU decomposition methods for symmetric (Chelosky) matrices.

UNIT 2 Eigenvalues and Eigenvectors Problems 5 Hours

Formulation of equations to column, truss, spring-mass and friction problems. Solutions for the largest and smallest eigenvalues and corresponding eigenvectors. **Interpolation Methods:** Polynomial interpolation, Lagrange interpolation polynomials with equi- spaced data. **Regression or Curve Fitting:** Linear regression by least squares method.

UNIT 3 **Initial Value Problems** **6 Hours**

Ordinary differential equations, Euler, Heun's and Ralston methods. Runge- Kutta method of 2nd and 4th order, application to vibration and heat transfer problems. **Boundary Value Problems:** Linear and nonlinear ordinary differential equations, boundary value problems over semi-infinite domain, solution of nonlinear equations by finite difference method.

UNIT 4 **6 Hours**

Laplace Equations: Finite difference discretization of computational domain, different types of boundary conditions, solution to elliptic equations. **Parabolic Transient Diffusion Equations:** Explicit and implicit formulation, Crank Nicolson Method.

UNIT 5 **Numerical Integration** **6 Hours**

Trapezoidal, Simpson's 1/3 and 3/8 rule and Gauss quadrature method.

List of Computational Exercises:

1. Determine the real root for a given polynomial equation by (i) Bisection, (ii) Newton-Raphson until the approximate error falls below 0.5%.
2. Solve the system of simultaneous linear equations by
   i. Naïve -Gauss elimination
   ii. Gaussian elimination with partial pivoting
   iii. Gauss -Seidel method.
   iv. LU decomposition
3. Implement power method to find Eigenvalues and Eigenvectors for Spring mass system
4. Solve the parabolic partial differential equations by using explicit, implicit and semi-implicit methods
5. Solve the elliptic partial differential equations by finite difference techniques.
6. Finding the integral for a second-order polynomial using Gauss quadrature formula.
7. Solve numerical differentiation problems using Runge-Kutta 2nd and 4th order methods.
8. Find the integral by numerical methods such as Trapezoidal and Simpson's rule.

Textbooks:

1. S.P. Venkateshan, P. Swaminathan, Computational Methods in Engineering, 1/e, Ane Publisher, 2014.
2. S.C. Chapra, R.P. Canale, Numerical Methods for Engineers, 6/e, Tata McGraw-Hill, 2012.

References:

1. S.K. Gupta, Numerical Methods for Engineers, 1/e, New Age International, 2005

Course Outcomes:

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

1. Demonstrate understanding of common numerical methods and how they are used to

obtain approximate solutions to otherwise intractable mathematical problems.

2. Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
3. Analyse and evaluate the accuracy of common numerical methods.
4. Implement numerical methods using any programming language (matlab, scilab, python…)
5. Write efficient, well-documented code and present numerical results in an informative way.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4
Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:
Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

<table>
<tr><td rowspan="2">MATH1061</td><td rowspan="2">Introduction to Mathematics - I</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Engineering and Science</td></tr>
</table>

Course Description:

This course is designed to introduce the mathematics required for basic physics, engineering mathematics, and introductory engineering courses.

Course Educational Objectives:

- To explain the concepts of Trigonometry.
- To explain the basic concepts of differentiation and differential equations
- To teach the evaluation of definite and indefinite integrals.
- To explain the basic concepts of differential equations, multivariable and vector calculus

UNIT 1 : Representations , Co-ordinate systems and Trigonometry 3 Hours

Representations for Scalars, Vectors, Matrices and Tensors. Coordinate systems: cartesian and polar coordinate systems.
Trigonometry: Trigonometric functions, Periodicity, Trigonometric Ratio of Compound angles, multiple and sub multiple angles, transformations, brief introduction of inverse trigonometric, hyperbolic and inverse hyperbolic functions.

UNIT 2 Differential Calculus 3 Hours

Limits and Continuity: Definition of right hand limit, left hand limit, standard limits

(without proofs)**,** definition of continuity and simple illustrations.
Differentiation: Introduction, definition, differentiation of a function at a point and on an interval, derivative of a function, differentiation of sum, difference, product and quotient of functions, differentiation of algebraic, exponential, logarithmic functions, composite, implicit, parametric, hyperbolic, inverse hyperbolic functions, derivatives of first and second order.

UNIT 3 Integration 8 Hours

Indefinite Integrals: Integration as the inverse process of differentiation, standard forms, properties of integrals, integration by the method of substitution covering algebraic, trigonometric, exponential functions, integration by parts, logarithmic functions, inverse trigonometric functions.
Definite Integrals: Definition of a definite integral and its properties (without proof)

UNIT 4 Introduction to differential equations , Multivariable calculus, and Vector Calculus 8 Hours

Differential Equations : Order and degree of a ordinary differential equations, Formation of ordinary differential equations

Multivariable Calculus : Limits and continuity of functions of two or more variables, Partial derivates, Total derivates(without problems)

Vector Calculus : Gradient, Divergence and Curl (with simple problems), Introduction to line, surface and volume integrals (without problems) illustrated with Stokes, Gauss, and Green's theorems (Only statements).

Textbooks:

1. Text book for Intermediate Mathematics, Board of Intermediate Education, AP, Volumes IA, IB & IIA, 2018.
2. NCERT class XI and XII (part 1) Mathematics text books.
3. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.

References:

1. V. Venkateswara Rao, N. Krishna Murthy, B.V.S.Sharma, Intermediate Mathematics, S.Chand & Company Ltd., Volume I & II.
2. Chandrika Prasad, A first Course in Mathematics.
3. Text book for Intermediate Mathematics, Deepti Publications.

Course Outcomes:

After the completion of the course the student should be able to

- solve problems involving trigonometric functions
- understand the principles of differential calculus
- evaluate integration using various techniques
- understand the basic concepts of ordinary differential equations,
- understand the basic concepts of multivariable and vector calculus

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4
Ensure inclusive and equitable quality education and promote lifelong opportunities for all.
SDG Justification:
Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH1071	INTRODUCTION TO MATHEMATICS - II	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	NIL						
Co- requisite	NIL						
Preferable exposure	Engineering and Science						

Course Description:

This course is designed to introduce the mathematics required for basic physics, engineering mathematics, and introductory engineering courses.

Course Educational Objectives:

1. To describe the basic concepts of matrices
2. To introduce complex numbers and their properties.
3. To teach the techniques based on partial fractions
4. To explain the concepts of straight lines and circles
5. To impart knowledge on solid geometry.
6. To demonstrate the solution of a problem using computational

UNIT 1 **Matrices** **6Hours**

Matrices, determinants, definition, types of matrices, algebra of matrices, properties of determinants of 2 X 2, 3 X 3 matrices, inverse of a matrix, solving simultaneous linear equations in two and three variables using matrix inverse method, Cramer's rule and Gauss Jordan method. Eigenvalues and Eigenvector of matrices.

UNIT 2 **Complex Numbers** **6 Hours**

Complex number as an ordered pair of real numbers, representation of z ? (a, b) in the form (a + ib) conjugate complex numbers, modulus and amplitude of a complex number, geometrical representation of a complex number, Argand diagram.

UNIT 3 **Partial Fractions** **6 Hours**

Introduction, resolving g(x) into partial fractions when g(x) contains non repeated linear factors, repeated linear factors, repeated and non-repeated irreducible quadratic factors.

UNIT 4 **Co-ordinate Geometry** **6 Hours**

Straight lines: General equation of a straight line,line passing through the point of intersection of two given lines, angle between two intersecting lines, condition for perpendicularity and parallelism, length of the perpendicular from a point to a straight line, distance between two parallel lines (without proofs).

Circles: Equation of a circle, centre and radius, equation of a circle through three non collinear points, parametric equations of a circle.

Unit V Solid Geometry **6 hours**

Solid Geometry: Equation of a plane, Intersection of two planes, Equation of a sphere in spherical and cartesian coordinates, Intersection of a plane and a sphere.

Textbooks:

1. Textbook for Intermediate Mathematics, Board of Intermediate Education, AP, Volumes IB, IIA & IIB, 2018.
2. NCERT class XI and XII (part 1 & 2) Mathematics text books.

References:

1. V. Venkateswara Rao, N. Krishna Murthy, B.V.S. Sharma, Intermediate Mathematics, S. Chand & Company Ltd., Volume I & II.
2. Chandrika Prasad, A first Course in Mathematics.
3. Text book for Intermediate Mathematics, Deepti Publications.

Course Outcomes:

After the completion of the course the student should be able to

1. describe the properties of matrices
2. describe the properties of complex numbers
3. find a fractional function and resolve it into partial fractions
4. illustrate straight-line and circle properties and describe different regions in different co-ordinate systems
5. illustrate the procedure to solve a problem using math software

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2361	PROBABILITY AND STATISTICS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**Engineering and Science**						

Course Description:

Probability theory is important when it comes to evaluating statistics. This course treats the most common discrete and continuous distributions, showing how they use in decision and estimation problems, and constructs computer algorithms for generating observations from the various distributions.

Course Educational Objectives:

1. To familiarize the students with the foundations of probability and statistical methods
2. To impart concepts in probability and statistical methods in engineering applications.

UNIT 1 Data Science and Probability 10 Hours

Data Science: Statistics introduction, Population vs Sample, collection of data, primary and secondary data, types of variables: dependent and independent Categorical and Continuous variables, data visualization, Measures of central tendency, Measures of dispersion (variance).

Probability: Probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem (without proof).

UNIT 2 Random Variable and Probability Distributions 8 Hours

Random variables (discrete and continuous), probability density functions, probability distribution - Binomial, Poisson and normal distribution-their properties (mathematical expectation and variance).

UNIT 3 Correlation, Regression and Estimation 8 Hours

Correlation, correlation coefficient, rank correlation, regression, lines of regression, regression coefficients, principle of least squares and curve fitting (straight Line, parabola and exponential curves). **Estimation:** Parameter, statistic, sampling distribution, point estimation, properties of estimators, interval estimation.

UNIT 4 Testing of Hypothesis and Large Sample Tests 8 Hours

Formulation of null hypothesis, alternative hypothesis, the critical region, two types of errors, level of significance, and power of the test. Large Sample Tests: Test for single proportion, difference of proportions, test for single mean and difference of means. Confidence interval for parameters in one sample and two sample problems

UNIT 5 Small Sample Tests 6 Hours

Student t-distribution (test for single mean, two means and paired t-test), testing of equality of variances (F-test), $\chi2$ - test for goodness of fit, $\chi2$ - test for independence of attributes.

Textbooks:

1. Miller and Freunds, Probability and Statistics for Engineers,7/e, Pearson, 2008.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.

References:

1. S. Ross, A First Course in Probability, Pearson Education India, 2002.
2. W. Feller, An Introduction to Probability Theory and its Applications, 1/e, Wiley, 1968.

Course Outcomes:

Upon successful completion of this course, the student should be able to

1. classify the concepts of data science and its importance
2. apply discrete and continuous probability distributions
3. explain the association of characteristics through correlation and regression tools
4. identify the components of a classical hypothesis test
5. infer the statistical inferential methods based on small and large sampling tests

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 ACADEMIC COUNCIL: 17-09-2021

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

<table>
<tr><td rowspan="2">MECH1011</td><td rowspan="2">ENGINEERING VISUALIZATION AND PRODUCT REALIZATION</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Nil</td></tr>
<tr><td>Co- requisite</td><td colspan="7">3D Printing</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Fusion 360 Additional Modules</td></tr>
</table>

Course Description:

This course introduces basic engineering drawing concepts such as projections, sectional views, and utility of drafting and modelling packages. The course imparts the knowledge of modelling and assembling of components using CAD software. The course also includes preparation of 3D models using 3D printing. The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and always promote learning opportunities.

Course Educational Objectives:

1. To create awareness of engineering drawing as relevant to industry standards.
2. To improve visualization abilities essential for successful engineering design.
3. To impart 2D sketching and 3D modeling using the relevant software.
4. To teach assembly drawing and simulation of motion between mating components.
5. To introduce basic 3D printing software for preparing the products for printing.

List of experiments:

1. Manual Drawing: Introduction to Engineering graphics: Principles of Engineering Graphics and their significance, conventions in drawing lettering, BIS Conventions, Dimensioning, Sectional Views
2. Free hand sketching, Free hand sketching of isometric & orthographic views and interpretation of drawings.
3. Computer Aided Drafting, Introduction to CAD software: Basic draw and Modify commands in 2d
4. Introduction to 2D and 3D modelling using CAD packages
5. Assembly drawings, Assembly of individual 3D components, animation of motion
6. Coordinating multiple moving parts under joint constraints.
7. 3D printing, Introduction to 3D printing software, slicing.
8. Grading and rendering of simple geometries using software.

List of Projects:

Any one project among the following can be opted by the student and submitted:IC Engine Model (3D printed mini model)

- Belt Drive for a bike
- Four Wheel Drivable
- ATV Robot
- Toy making
- Carrom board
- Chess board and pieces model toy train,
- Avengers
- Building Bridges dams etc.,
- Wind Turbine Model etc
- Design of Radar and 3D Printing of Radar
- Models' Programmable logic Controllers –PLC
- Arduino Board Design and 3D Printing of Enclosures for Arduino Boards
- Design of mini mother boards

Text Books:

1. N D Bhatt, 'Engineering Drawing',53,Charotar Publishers, Gujarat India,2019,9789380358963
2. Lydia Sloan Cline,'Fusion 360 for Makers: Design Your Own Digital Models for 3D Printing and CNC Fabrication – Import, 5 June 2018 ',1,Make Comm**UNIT** y LLC,USA,2018,9781680456509

References:

1. Randy Shih,'Parametric Modeling with Autodesk Fusion 360 ',(Spring 2021 Edition),SDC Publications,Squibb Road Mission, KS,2021,1630574376, 9781630574376

Online Resources:

1. Introduction-to-parametric-modeling. 14, 2021, 1:27 p.m., https://www.ascented.com/courseware/product/autodesk-fusion-360--introduction-to-parametric-modeling
2. PP Song et al.,,'https://www.researchgate.net/publication/325189986_Research_and_Application_of_Autodesk_Fusion360_in_Industrial_Design', 2018,8

Course Outcomes:

1. Prepare drawings as per international standards.
2. Utilize Engineering visualization as Language of Engineers.
3. Sketch 2D models using CAD software
4. Sketch 3D models using CAD package.
5. Develop model for printing simple objects using 3D printer

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		1	1	2							3	1	1
CO2	3	3		2	1	3	1		2	1	1		2	2	1
CO3	2	3		3	1	2			2	1	2		3	2	1
CO4	2	3		3	1	3							3	2	2
CO5	3	3	3	3	3	3		2		3	3	1	3	2	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:
SDG 4 - ensure all-inclusive and thorough education with equity to all persons and always promote learning opportunities.
SDG-9 engineers build resilient infrastructure which promote inclusive and sustainable industrialization and foster innovation.
SDG Justification:
SDG 4-The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and always promote learning opportunities.
SDG 9-The modules and topics mentioned in this course are designed to ensure the engineers build resilient infrastructure which promote inclusive and sustainable industrialization and foster innovation.

<table>
<tr><td rowspan="2">MECH1041</td><td rowspan="2">TECHNOLOGY EXPLORATION & PRODUCT ENGINEERING</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-Requisite</td><td colspan="7">Engineering Visualization and Product Realization</td></tr>
<tr><td>Preferable Exposure</td><td colspan="7">Power tools and Basic Electronics</td></tr>
</table>

Course Description:
This is a fundamental engineering course that introduces the incoming students to hands-on product development experience using a combination of Mechanical Engineering and IoT concepts, programming with application of EVPR concepts and exposure to project planning.

Course Educational Objectives:
- Inculcate creativity, critical thinking and problem-solving skills with hands-on approach to all incoming freshmen.
- Emphasise product development using systems engineering approach.
- Impart multidisciplinary project-based skills with a combination of IoT, Programming, Simulation, Mechanisms and Machining.
- Involve Ideation to develop a variety of solutions to a problem statement rather than performing a standard job/experiment.
- Project planning and management to deliver the assigned project within the timeline.

SYLLABUS
- Manufacturing economics
- Evaluation of manufacturing strategies
- OBHS (Operational Behaviour, health, safety in hazardous environment)
- Power tools operations and safety – Angle grinder (Cutting, Grinding and Polishing), Driller and Jigsaw.
- Basics of Microprocessors and Microcontrollers
- General Introduction to Arduino, Node MCU, and Raspberry Pi.
- Basics of Electronics: General Introduction to the usage of Breadboard, Digital Multimeter, General Connections, Usage of Resistors, Capacitors, LEDs.
- Basics of Arduino & Node MCU coding – Libraries, board & port selection, baud rate, Basics of Troubleshooting, Cloud Interfacing etc.
- Usage and Applications of Basic Sensors: Ultrasonic, Voltage/Current, Temp/Humidity, Gas, IR
- Basics of Electromagnetism – Permanent Magnet DC Motor (PMDC), Brushless DC Motor (BLDC), Stepper and Servo Motors.
- Basics of Drawing/Circuit Simulation - Line diagram, Tinker CAD, Multisim, PROTEUS

- Basics of Mechanisms - Linear motion, Cam mechanism, Belt drive, gears
- Demonstration of Carpentry, Tin smithy, Fitting, Welding and Injection Moulding.
- Problem identification and understanding the needs of the users
- Project management and planning.

Project: All students must work in teams to complete a product/prototype of a given problem statement with the topics covered in the class.

Textbooks:

1. Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, Internet of Things, Wiley India, 2019
2. Simon Monk, Programming Arduino: Getting Started with Sketches, Mc Graw Hill Publications, 2011

References:

1. Essaid, a. (2019). 507 Mechanical Movements: Mechanisms and How They Work (Dover Science Books). (n.p.): Independently Published.

Course Outcomes

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

1. Perform basic mechanical operations with power tools.
2. Understand and apply IoT concepts to drive mechanical components.
3. Apply multidisciplinary skills to solve practical engineering problems.
4. Conceptualize and work towards the creation of physical products.
5. Think along the lines of innovation and entrepreneurship.

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1									1			3	2	1	1
CO2	3	3	3		1							2	1	1	1
CO3	2	3	3	1	1	1			3	2	3	1	2	1	1
CO4	3	3	3	1	1	1	1	1	1	3	3		2	1	1
CO5													2	1	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 21-04-2023 **ACADEMIC COUNCIL: 19-06-2023**

SDG No. & Statement:

SDG 4: Ensure all-inclusive and thorough education with equity to all persons and always promote learning opportunities.

SDG 9: Engineers build resilient infrastructure which promote inclusive and sustainable industrialization and foster innovation.

SDG Justification:

SDG 4: The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and always promote learning opportunities.

SDG 9: The modules and topics mentioned in this course are designed to ensure the engineers build resilient infrastructure which promote inclusive and sustainable industrialization and foster innovation.

<table>
<tr><td rowspan="2">MECH1001</td><td rowspan="2">DESIGN THINKING</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Nil</td></tr>
<tr><td>Co- requisite</td><td colspan="7">Nil</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Nil</td></tr>
</table>

Course Pre-requisite(s): Engineering Visualization and Product Realization

Course Description:

Design is a realization of a concept or idea into a configuration, drawing or product. Design Thinking is the cognitive and practical process by which design concepts are developed by designers. Innovation is a new idea or a new concept. Product development is the creation of a new or different product that offers new benefits to the end-user. This course introduces design thinking in product innovation.

Course Educational Objectives:

1. To familiarize the product design process
2. To introduce the basics of design thinking
3. To bring awareness on idea generation
4. To familiarize the role of design thinking in services design

Topic	Type
Each member of the group has to ask (vocally) the group members different questions about a product that they would like to design. Write down the questions and answers and submit as a word or pdf document.	Exercise
Each member of the group must ask (vocally) the group members questions about the product chosen in the previous experiment. This helps to gain indepth insights as well as new findings and information in order to grasp the problem or situation holistically or simply to find relevant questions for an interview. Write down the questions and answers and submit as a word or pdf document	Exercise
Identify relevant factors of influence that constitute the basis for a new or improved product or offer; then analyze it in a targeted manner. ➢ Make sure that you are sufficiently creative in the analysis process, because the focus is on technical "details". ➢ Boost the efficiency of the analysis process by avoiding empty runs. ➢ Make use of a standardized procedure in order to examine the problem and solution space again with the help of data.	Exercise
➢ Do research, talk with people, and have empathy to formulate profound stories. ➢ Summarize the results from the "understand" and "observe" phases and discuss with the team. ➢ Highlight unexpected results and generate new perspectives.	Exercise

➢ In general, share insights, ideas, and results (solutions) with others. ➢ Explore untapped market opportunities. ➢ Provide differentiated and new offers based on the user needs. ➢ Adapt a strategy to new market needs by understanding the competitive edge. ➢ Establish the right vision for the design challenge or a road map for stepby-step implementation and control mechanisms.	Exercise
➢ Find out at an early stage whether the basic need is satisfied and the product attracts interest on the market. ➢ Find out through iterative testing whether the user need is met with a minimally functional product and how the product should be enhanced. ➢ Find out through user feedback how much demand there is for the product before developing further details and features. ➢ Minimize the risk of investing in a solution for which there is little demand on the market, thus saving time, money, and energy.	Exercise
➢ Perform a true A/B test or several variants of a prototype in the form of a multi-variants test or as split testing. ➢ Do a quantitative evaluation. ➢ Carry out a qualitative survey and evaluate the number and content of feedbacks. ➢ Compare individual variants of a function or a prototype (e.g. buttons, visuals, arrangement).	Exercise
➢ Collect and appraise experiences made in the project in a structured manner. ➢ Learn from experience and make use of it in the next project. ➢ Facilitate a positive attitude toward mistakes and appreciate progress. ➢ Identify and document the findings; make them applicable and usable.	Exercise
Case Studies: Example : Software Prototyping, Additive Manufacturing; Design of Arduino Boards for various applications etc	Exercise

Text Books:

1. Pahl, Beitz, Feldhusen, Grote,'Engineering Design: a systematic approach',3rd,Springer Science & Business Media,London,2007,978-1846283185
2. Christoph Meinel,Larry Leifer,Hasso Plattner,'Design Thinking Understand – Improve – Apply',1st,Springer,Berlin, Heidelberg,2011,978-3-642-13756-3

References:

1. Marc Stickdorn, Jakob Schneider,'This is Service Design Thinking: Basics, Tools, Cases',1st,WILEY,United States,2012,978-1-118-15630-8

Course Outcomes:

1. Innovate new methods in product development
2. 2 Apply Design Thinking in developing the new designs

3. Select ideas from ideation methods in new product development
4. Use Design Thinking in developing software products
5. Apply principles of Design Thinking in service design

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		1	1	2							3	1	1
CO2	3	3		2	1	3	1		2	1	1		2	2	1
CO3	2	3		3	1	2			2	1	2		3	2	1
CO4	2	3		3	1	3							3	2	2
CO5	3	3	3	3	3	3		2		3	3	1	3	2	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS: 29-4-2021 **ACADEMIC COUNCIL: 17-9-2021**

SDG No. & Statement:
SDG 9
The modules and topics mentioned in this course are designed to ensure the engineers build resilient infrastructure which promote inclusive and sustainable industrialization and foster innovation.
SDG Justification:
The course involves design aspects

PHYS1001	PHYSICS	L	T	P	S	J	C
		2	1	2	0	0	4
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**NIL**						

Course Description:

This course is designed with fundamentals of electromagnetism and properties of materials for advanced courses in their respective engineering branches. It introduces electromagnetic theory with relevant mathematical tools, optical fibres and their propagation characteristics, properties of dielectric and magnetic materials. It also introduces principles of semiconductors and some widely used semiconductor devices for various applications.

Course Educational Objectives:

1. To introduce mathematical principles to estimate forces, fields and waves.
2. To familiarize students with electromagnetics in modern communication systems.
3. To impart knowledge concerning the electrical behaviour of dielectric materials.
4. To demonstrate the properties of magnets.
5. To introduce semiconductor physics and devices.

UNIT 1 Basics of Electromagnetics 9 Hours

Electrostatic field: Coulomb's law and Gauss 'law, derivation of Coulombs law from Gauss' law, applications of Gauss' law (line charge, thin sheet of charge and solid charged sphere), Gauss' law of electrostatics in dielectric medium, divergence and curl of electric fields, electric potential, relation between potential and force, Poisson's and Laplace equations. Magnetostatic field: Biot–Savarts' law, divergence and curl of magnetic fields, Faraday's and Ampere's laws in integral and differential form, displacement current, continuity equation, Maxwell's equations.

UNIT 2 Fiber Optics 7 Hours

Introduction, advantages of optical fibers, principle and structure, acceptance angle, numerical aperture, modes of propagation, classification of fibers, fiber optic communication, importance of V-number, fiber optic sensors (Temperature, displacement and force), applications.

UNIT 3 Dielectric, Magnetic and superconducting Materials 10 Hours

Dielectric materials: Introduction, electric polarization, dielectric polarizability, susceptibility and dielectric constant, types of polarizations (qualitative treatment only). Magnetic materials: Introduction, magnetic dipole moment, magnetization, magnetic susceptibility and permeability, origin of permanent magnetic moment, classification of magnetic materials, Weiss theory of ferromagnetism (qualitative), domain theory, hysteresis, soft and hard magnetic materials.

Superconductivity: definition –Meissner effect –type I & II superconductors –BCS theory (qualitative) –high temperature superconductors –Josephson effects applications.

UNIT 4 **Semiconductor Physics** **8 Hours**

Introduction, origin of energy band, intrinsic and extrinsic semiconductors, mechanism of conduction in intrinsic semiconductors, generation and recombination, carrier concentration in intrinsic semiconductors, variation of intrinsic carrier concentration with temperature, n-type and p-type semiconductors, carrier concentration in n-type and p- type semiconductors, Drift and diffusion currents in semiconductors.

UNIT 5 **Semiconductor Devices** **8 Hours**

Zener Diode, Tunnel diode, Hall effect and its applications, magnetoresistance, p-n junction layer formation and V-I characteristics, direct and indirect band gap semiconductors, construction and working of photodiode, LED, solar cell.

PHYSICS LABORATORY

List of Experiments

1. To determine the magnetic field along the axis of a circular coil carrying current.
2. To determine the numerical aperture of a given optical fiber and hence to find its acceptance angle
3. To determine magnetic susceptibility by Quincke's tube method
4. To determine the Hall coefficient using Hall effect experiment
5. To determine the resistivity of semiconductor by Four probe method
6. To determine the energy gap of a semiconductor.
7. To study the characteristics of PN Junction diode.
8. To study magnetic hysteresis loop (B-H curve).
9. To determine the dielectric constant of a substance by resonance method.
10. To determine hysteresis loss by CRO.
11. To study the characteristics of Photodiode
12. To study the characteristics of Solar Cell
13. To study the characteristics of Zener diode
14. To study the resonance of LCR circuit

Text Books:

1. David J.Griffiths, "Introduction to Electrodynamics", 4/e, Pearson Education, 2014.
2. Charles Kittel, "Introduction to Solid State Physics", Wiley Publications, 2011.
3. M. N. Avadhanulu, P.G. Kshirsagar, "A Text book of Engineering Physics", 11/e, S. Chand Publications, 2019.

References:

1. Principles of Physics, 10ed, ISV, Jearl Walker, David Halliday, Robert Resnick, Wiley India.
2. Gerd Keiser, "Optical Fiber Communications", 4/e, Tata Mc Graw Hill, 2008.
3. S.O.Pillai, "Solid StatePhysics", 8/e, New Age International, 2018.

4. S.M. Sze, “Semiconductor Devices-Physics and Technology” , Wiley, 2008.

Journal(s):

1. https://aapt.scitation.org/doi/abs/10.1119/1.3317450
2. https://aapt.scitation.org/doi/full/10.1119/1.5144798
3. https://aapt.scitation.org/doi/abs/10.1119/1.1511591

Course Outcomes:

1. Apply mathematical principles to estimate magnetic and electric forces, fields and waves
2. Use the principles of EM waves and Maxwell equations to understand communication systems
3. Apply basic properties of dielectric, magnetic and superconducting materials in electromagnetics
4. Understand physics of semiconducting materials
5. Use working principles of semiconducting devices in electronic circuits

Text Book:

1. S. Balasubramanian, M.N. Srinivasan “A Text book of Practical Physics”- S Chand Publishers,2017

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1							1			1	1		
CO2	1	1							1			1	1		
CO3	1	1							1			1	1		
CO4	1	1							1			1	1		
CO5	1	1							1			1	1		

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

PHYS1011	MECHANICS AND PROPERTIES OF MATTER	L	T	P	S	J	C
		3	1	0	0	0	4
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**NIL**						

Course Description:

This course is designed for students of Aerospace, Civil and Mechanical Engineering. It introduces fundamentals of elasticity and thermal properties – the essentials for understanding the behaviour of materials. Mechanics of solids is taught to acquaint them with the behaviour of rigid objects. An introduction to sensors will be useful for all the branches as an application of modern technology.

Course Educational Objectives:

1. To acquaint the basic concepts of sound waves and principles in acoustic design.
2. To introduce the concepts of elasticity, strain hardening and failure in materials and impart the relation between stress and strain.
3. To impart the phenomenon of heat transfer so as to understand a wide variety of practical engineering problems.
4. To demonstrate the use of Newton's laws of motion for understanding the mechanics of a particle.
5. To explain the working principle and construction of different types of sensors.

UNIT 1 **Mechanics** **10 Hours**

Basic laws of vectors and scalars; Rotational frames; Conservative and non-conservative forces; F = - grad V; Central forces; Elliptical, parabolic and hyperbolic orbits; Noninertial frames of reference; Centripetal acceleration; Harmonic oscillator; Damped harmonic motion; Forced oscillations and resonance. Degrees of freedom.

UNIT 2 **Elasticity** **8 Hours**

Concepts of elasticity and plasticity, stress and strain, Hooke's law, different moduli of elasticity, Poisson's ratio, strain energy, stress-strain diagram, elastic behavior of a material, factors affecting elasticity, relation between different moduli of elasticity, determination of elastic moduli.

UNIT 3 **Thermal Properties** **10 Hours**

Transfer of heat energy; Thermal expansion of solids and liquids; Expansion joints - bimetallic strips; Thermal conduction, convection and radiation and their fundamental laws; Heat conductions in solids; Thermal conductivity - Forbe's and Lee's disc method: theory and experiment; Applications (qualitative only): heat exchangers, refrigerators, ovens and solar water heaters.

UNIT 4 **Acoustics** **8 Hours**

Characteristics of sound waves; Weber-Fechner Law; Absorption coefficient, determination of absorption coefficient; Reverberation time; Sabine's formula, derivation of Sabine's formula using growth and decay method; Intensity of sound; Acoustics of buildings, Acoustic requirements of a good auditorium.

UNIT 5 **Sensors** **9 Hours**

Sensors (qualitative description only); Different types of sensors and applications; Strain and pressure sensors- Piezoelectric, magnetostrictive sensors; Fibre optic methods of pressure sensing; Temperature sensor - bimetallic strip, pyroelectric detectors; Hall-effect sensor; Smoke and fire detectors.

Text Books:

1. D.Kleppner and Robert Kolenkow"An Introduction to Mechanics- II" Cambridge University Press,2015.
2. M.N. Avadhanulu & T.V.S. Arun Murthy, S Chand A Textbook of Engineering Physics, Volume-I 2018.
3. Ian R Sinclair, Sensor and Transducers 3/e,Elsevier (Newnes), 2001.

References:

1. M K Varma, "Introduction to Mechanics"-Universities Press, 2015
2. Prithwiraj Purkait, Budhaditya Biswas and Chiranjib Koley, Chapter 11 Sensors and Transducers, Electrical and Electronics Measurements and Instrumentation, 1/e., McGraw Hill Education (India) Private Limited, 2013.

Course Outcomes:

After completion of this course, the student will be able to

1. describe the fundamental principles of acoustics with emphasis on physical mechanisms, law and relationships
2. apply the concepts of strain, internal force, stress and equilibrium to deformation of solids
3. explain the fundamental theory for the analysis of heat transfer processess in solids and liquids and to apply basic principles of heat transfer in design of refrigerators and heaters
4. estimate forces and moments in mechanical systems using scalar and vector techniques
5. outline the basic principle and operation of different types of sensors

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1							1			1		1	1	
CO2	1	1						1			1		1	1	
CO3	1	1						1			1		1	1	
CO4	1	1						1			1		1	1	
CO5	1					1		1			1		1	1	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

PHYS1021	PRINCIPLES OF QUANTUM MECHANICS	L	T	P	S	J	C
		3	1	0	0	0	4
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**NIL**						

Course Description:

This course is designed with principles of Quantum mechanics for advanced courses in their respective engineering branches. It introduces Quantum mechanics with relevant mathematical tools and provides a basis for further study of quantum mechanics. It also introduces basics of Qubits for Quantum computing applications.

Course Educational Objectives:

1. To introduce the basic principles of quantum mechanics.
2. To introduce wave equation and significance of wave function.
3. To teach solving the Schrödinger's equation for spinless particles moving in one-dimensional potential.
4. To develop an understanding of concepts of angular momentum.
5. To introduce Dirac bra-ket formalism and the concept of QUBITs.

UNIT 1 Introduction to Quantum Physics 10 Hours

Introduction, Classical Mechanics vs Quantum Mechanics, Planck's quantum theory (qualitative), Photo-electric effect. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them, Wave-particle duality, Heisenberg uncertainty principle: ground state energy of hydrogen atom.

UNIT 2 Properties of Matter Waves 8 Hours

Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities, and normalization.

UNIT 3 Quantum Tunneling 8 Hours

One dimensional infinitely rigid box-energy eigenvalues and eigenfunctions, normalization; Quantum dot as example; Quantum mechanical tunnelling in one dimensional rectangular potential barrier, 1D linear harmonic oscillator (no derivation required, only eigen function, eigen values and zero-point energy).

UNIT 4 Quantum Properties of Electrons 9 Hours

Electron angular momentum, angular momentum operator, Space quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect, Stark Effect, Gyromagnetic Ratio and Bohr

Magneton (qualitative)

UNIT 5 Qubits for Quantum Computing 10 Hours

Introduction to Dirac Bra-Ket notation, Introduction to Pauli spin matrices, Quantum Superposition, Interference, Quantum Measurement, Decoherence, Entanglement, Bloch sphere, Qubits, and multiple qubits, Qubits Vs classical bits, representation of a qubit probability.

Textbooks:

1. Quantum Mechanics, G. Aruldhas, 2ndEdn. 2002, PHI Learning of India.
2. Quantum Mechanics, Satya Prakash, 2016, Pragati Prakashan.
3. Quantum Computing for Everyone, Chris Bernhardt, 2019, The MIT Press,

References:

1. Introduction to Quantum Mechanics, D.J. Griffith, 2ndEd. 2005, Pearson Education.
2. Quantum Computing: An Applied Approach, Jack D. Hidary, 2019,

Journal(s):

1. https://aapt.scitation.org/doi/full/10.1119/1.4897588
2. https://aapt.scitation.org/doi/full/10.1119/1.3639154

Websites

1. https://www.intechopen.com/online-first/73811
2. https://www.quantum-inspire.com/kbase/what-is-a-qubit/

Course Outcomes:

At the end of this course, the students will be able to:

1. Explain the basic principles of quantum mechanics.
2. Interpret wave equation and significance of wave function.
3. Solve the Schrödinger’s equation for spinless particles moving in one-dimensional potential.
4. Understand of concepts of angular momentum and spin.
5. Apply Dirac bra-ket formalism to the concept of QUBITs.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1							1			2	1		
CO2	1	1							1			2	1		
CO3	1	1							1			2	1		
CO4	1	1							1			2	1		
CO5	2	2							2			2	2	1	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">PHYS1241</td><td rowspan="2">PHYSICS OF OPTOELECTRONIC DEVICES</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">NIL</td></tr>
</table>

Course Description:

This course is designed with fundamentals of electromagnetism and properties of materials for advanced courses in their respective engineering branches. It introduces electromagnetic theory with relevant mathematical tools, optical fibres and their propagation characteristics, properties of dielectric and magnetic materials. It also introduces principles of semiconductors, and some widely used semiconductor devices for various applications.

Course Educational Objectives:

1. To introduce nature light and its properties.
2. To familiarize students with different semiconductors and its energy band gaps.
3. To introduce semiconductor physics and devices.
4. To impart knowledge about the semiconducting optical devices.
5. To demonstrate the properties of different semiconducting optical devices.

UNIT 1 Elements of light 8 Hours

Nature of light, Light sources, Black body, Colour temperature, Units of light, Radio metric and photometric units, Light propagation in media and waveguides, Electro-optic effects. Overview of luminescence: Photoluminescence, Cathodoluminescence, Electroluminescence, Injection-luminescence.

UNIT 2 Semiconductor Materials 10 Hours

Free electron theory of metals, Density of states in 1D, 2D, and 3D, Bloch's theorem for particles in a periodic potential, Energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, Direct and indirect bandgaps, Types of electronic materials: metals, semiconductors, and insulators, Occupation probability, Fermi level, Effective mass.

UNIT 3 Principles of Lasers 10 Hours

Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission; Einstein coefficients, Population inversion, Transition rates (Fermi's golden rule), Optical loss and gain; semiconducting diode laser, applications of semiconductor Lasers.

UNIT 4 Solar cells and Photovoltaic devices 9 Hours

Charge carrier generation and recombination, p-n junction model and depletion capacitance, Photovoltaic effect, Physics of Solar Cells, Principle of solar energy conversion,

Conversion efficiency, Type of solar cells in use: Dye Sensitized Solar Cells, Thin film solar cells, Perovskite Solar cell.

UNIT 5 **Semiconductor devices** **8 Hours**

Radiative recombination devices: Light-emitting diodes (LED), Organic Light Emitting Diodes (OLED) and its types, Photoelectric devices: Photodiodes. Photo conducting devices: Photodetectors and photoconductors, Photoresistors, Photo transistors.

Textbooks:

1. Jasprit Singh, Optoelectronics – An Introduction to materials and devices; McGraw Hill,1996.
2. Charles Kittel, Introduction to Solid State Physics, Wiley India Edition 2019
3. Maurice Quillec, Materials for Optoelectronics; Springer Science, 1996.
4. S. C. Gupta, Optoelectronic Devices and Systems; Prentice Hall India, 2005.
5. P. Bhattacharya, Semiconductor optoelectronic devices; Prentice Hall India, 2006.

References:

1. Pyshkin, Ballato, Optoelectronics - Advanced Materials and Devices; InTech, 2013.
2. Manijeh Razeghi, Optoelectronic materials and device concepts; SPIE, 1991
3. Sun and Dalton, Introduction to Organic Electronic and Optoelectronic Materials and Devices; CRC Press, 2008.
4. J. Palais, Introduction to optical electronics; Prentice Hall, 1988.
5. Jasprit Singh, Semiconductor optoelectronics; McGraw-Hill, 1995.

Course Outcomes:

After completion of this unit, the student will be able to

1. Outline the properties of semiconductors
2. explain the occupation probability and Fermi level variation in different electronic materials
3. Know about the interaction of light with materials and its optical properties
4. Explain the conduction mechanism in semiconducting and optical devices.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1							1			1	1		
CO2	2	1							1			2	1		
CO3	1	1							1			2	1		
CO4	2	1					1		1			2	1		1
CO5	2	1					1		1			2	1		1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

PHYS1041	MECHANICS AND MODERN PHYSICS	L	T	P	S	J	C
		3	1	0	0	0	4
Pre-requisite	NIL						
Co- requisite	NIL						
Preferable exposure	NIL						

Course Description:

This course designed for students of Biotechnology to impart principles of Newtonian mechanics will help the students in understanding the oscillatory behavior of materials. It also introduces fundamentals of quantum mechanics – the essentials for understanding the behavior of properties of materials. Fundamentals of optics and electromagnetism in understanding the use in spectroscopy. An introduction to sensors will be useful for all the branches as an application of modern technology.

Course Educational Objectives:

1. To impart knowledge on damped and forced oscillations.
2. To familiarize students with the concepts of quantum mechanics
3. To impart knowledge concerning the wave properties of electromagnetic waves
4. To familiarize the students about the Maxwell's equations and its propagation
5. To outline the principles and working of few common sensing devices

UNIT 1 Fundamentals of Dynamics and Oscillations 10 Hours

Fundamentals of Dynamics: Reference frames. Inertial frames; Galilean transformations.

Galilean invariance. Review of Newton's Laws of Motion.

Oscillations: SHM, Simple Harmonic Oscillations. Differential equation of SHM and its solution. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor

UNIT 2 Modern Physics (Quantum Physics) 8 Hours

Introduction, matter waves and its properties, Davisson-Germer experiment, GP Thomson experiment, Heisenberg's uncertainty principle, Schrodinger's time independent wave equation, physical significance of wave function, particle in a one-dimensional infinite well, rectangular potential barrier (transmission coefficient), band theory of solids (qualitative), distinction between metals, insulators and semiconductors, introduction to Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstien statistics.

UNIT 3 Optics 10 Hours

Interference: Introduction, interference in thin films due to reflected light: interference in parallel-sided film and wedge-shaped film, Newton's rings. Diffraction: Introduction; Fraunhofer diffraction at single slit (qualitative only), diffraction due to N-slits (diffraction

grating) (qualitative only), determination of wavelength of light with a plane transmission grating.
Polarisation: Introduction; Double refraction –double refraction in calcite crystal, negative and positive crystals, Nicol's prism, Retarders (quarter and half¬wave plates).

UNIT 4 Maxwell`s equations and Electromagnetic wave propagation 8 Hours
Maxwell's equations (both differential and integral forms) and its physical significance, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization of EM waves.

UNIT 5 Sensors 9 Hours
Sensors (qualitative description only); Different types of sensors and applications; Strain and pressure sensors -Piezoelectric, magnetostrictive sensors, ultrasonic sensors; Fibre optic methods of pressure sensing; Temperature sensor -bimetallic strip, pyroelectric detectors; Hall-effect sensor; Smoke and fire detectors

Textbooks:

1. Mechanics, D.S. Mathur, S.Chand and Company Limited, 2000.
2. A Text Book of Optics, 25/e, Brij Lal, M N Avadhanulu & N Subrahmanyam, 2012, S. Chand Publishing.
3. Ian R Sinclair, Sensor and Transducers 3rd eds, 2001, Elsevier (Newnes)
4. David J. Griffiths, "Introduction to Electrodynamics"-4/e, Pearson Education,2014
5. M.N. Avadhanulu, P.G. Kshirsagar, A Textbook of Engineering Physics, S.Chand, 2014.

References:

1. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
2. Prithwiraj Purkait, Budhaditya Biswas and Chiranjib Koley, Chapter 11 Sensors and Transducers, Electrical and Electronics Measurements and Instrumentation, 1st eds., 2013 McGraw Hill Education (India) Private Limited.
3. Elements of Properties of Matter, D. S. Mathur, S. Chand Publishing

Journal(s):

1. https://aapt.scitation.org/doi/abs/10.1119/1.3317450
2. https://aapt.scitation.org/doi/full/10.1119/1.3639154

Course Outcomes:

At the end of this course, the students will be able to:

1. Understand the concept of damped and forced oscillations.
2. Understand concepts of quantum mechanics
3. Understand interference, diffraction and polarization of light waves
4. Know about the maxwell's equations and its propagation
5. Use principles and working of few common sensing devices

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						1				1	1				
CO2						1				1	1				
CO3						1				1	1				
CO4						1				1	1				
CO5						1				1	1				

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">PROJ2999</td><td rowspan="2">CAPSTONE PROJECT – INTRODUCTION</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">NIL</td></tr>
</table>

Course Educational Objectives:

1. To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

Course Logistics

Capstone Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.

1. Project can be for one or two semesters based on the completion of required number of credits as per the academic regulations.
2. Can be individual work or a group project, with a maximum of 3 students.
3. In case of group projects, the individual project report of each student should specify the individual's contribution to the group project.
4. Carried out inside or outside the university, in any relevant industry or research institution.
5. Publications in the peer reviewed journals / International Conferences will be an added advantage

Mode of Evaluation: Periodic reviews, Presentation, Final oral viva, Poster submission

Course Outcomes:

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

1. Formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.
2. Perform literature search and / or patent search in the area of interest.
3. Conduct experiments / Design and Analysis / solution iterations and document the results.

4. Perform error analysis / benchmarking / costing
5. Synthesis the results and arrive at scientific conclusions / products / solution
6. Document the results in the form of technical report / presentation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">PROJ3999</td><td rowspan="2">CAPSTONE PROJECT – FINAL</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>6</td><td>6</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">PROJ2999</td></tr>
<tr><td>Co- requisite</td><td colspan="7"></td></tr>
<tr><td>Preferable exposure</td><td colspan="7"></td></tr>
</table>

Course Educational Objectives:

1. To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

Course Logistics:

Capstone Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.

1. Project can be for one or two semesters based on the completion of required number of credits as per the academic regulations.
2. Can be individual work or a group project, with a maximum of 3 students.
3. In case of group projects, the individual project report of each student should specify the individual’s contribution to the group project.
4. Carried out inside or outside the university, in any relevant industry or research institution.
5. Publications in the peer reviewed journals / International Conferences will be an added advantage

Mode of Evaluation: Periodic reviews, Presentation, Final oral viva, Poster submission

Course Outcomes:

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

1. Formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.
2. Perform literature search and / or patent search in the area of interest.
3. Conduct experiments / Design and Analysis / solution iterations and document the results.
4. Perform error analysis / benchmarking / costing
5. Synthesis the results and arrive at scientific conclusions / products / solution

6. Document the results in the form of technical report / presentation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

PROJ2888	PROJECT EXHIBITION 1	L	T	P	S	J	C
		0	0	0	0	1	1
Pre-requisite							
Co- requisite							
Preferable exposure							

Course Educational Objectives:

To provide platform for the student to exhibit their project work to

1. Excite interested students in continuing/initiating in the work of interest
2. Attract startups/industry to commercialize the project work
3. acquire comments on improving the quality of the work from other students/academicians/industry

Mode of Evaluation: Poster submission, Viva-Voce Examination

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

PROJ3888	PROJECT EXHIBITION 2	L	T	P	S	J	C
		0	0	0	0	1	1
Pre-requisite	PROJ2888						
Co- requisite							
Preferable exposure							

Course Educational Objectives:

To provide platform for the student to exhibit their project work to

- Excite interested students in continuing/initiating in the work of interest
- Attract startups/industry to commercialize the project work
- acquire comments on improving the quality of the work from other students/academicians/industry

Mode of Evaluation: Poster submission, Viva-Voce Examination

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

VIVA3555	COMPREHENSIVE EXAMINATION	L	T	P	S	J	C
		1	0	0	0	0	1
Pre-requisite	Completion of minimum of six semesters						
Co- requisite							
Preferable exposure							

Course Educational Objectives:

1. Designed to test the students on the Aerospace Engineering concepts, and tools, and the process of identifying and solving engineering problems.

UNIT 1 Engineering Mechanics

Free-body diagrams and equilibrium; friction and its applications including rolling friction, belt-pulley, brakes, clutches, screw jack, wedge, vehicles, etc.; trusses and frames; virtual work; kinematics and dynamics of rigid bodies in plane motion; impulse and momentum (linear and angular) and energy formulations; Lagrange's equation.

UNIT 2 Mechanics of Materials

Stress and strain, elastic constants, Poisson's ratio; Mohr's circle for plane stress and plane strain; thin cylinders; shear force and bending moment diagrams; bending and shear stresses; concept of shear centre; deflection of beams; torsion of circular shafts; Euler's theory of columns; energy methods; thermal stresses; strain gauges and rosettes; testing of materials with universal testing machine; testing of hardness and impact strength

UNIT 3 Thermodynamics

Thermodynamic systems and processes; properties of pure substances, behaviour of ideal and real gases; zeroth and first laws of thermodynamics, calculation of work and heat in various processes; second law of thermodynamics; thermodynamic property charts and tables, availability and irreversibility; thermodynamic relations

UNIT 4 Fluid Mechanics

Fluid properties; fluid statics, forces on submerged bodies, stability of floating bodies; control volume analysis of mass, momentum, and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; dimensional analysis; viscous flow of incompressible fluids, boundary layer, elementary turbulent flow, flow through pipes, head losses in pipes, bends and fittings; basics of compressible fluid flow.

UNIT 5 **Machining and Machine Tool Operations**

Mechanics of machining; basic machine tools; single and multi-point cutting tools, tool geometry and materials, tool life and wear; economics of machining; principles of non-traditional machining processes; principles of work holding, jigs and fixtures; abrasive machining processes; NC/CNC machines and CNC programming

Mode of Evaluation: 12 Quizzes with Multiple Choice Questions. Best 10 quizzes are considered for computing 100M. Student shall score atleast 80% in atleast 8 quizzes to be considered for grading

Course Outcomes:

The students will be able to

1. Apply knowledge of mathematics, science, and engineering
2. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health care and safety, manufacturability, and sustainability

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

BTEN1001	INTRODUCTION TO BIOTECHNOLOGY-I	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	Nil						
Co- requisite	Nil						
Preferable exposure	Nil						

Course Description:

This course introduces the student to the basics of biology such as classification, cell structure, biomolecular structure, metabolism, function

Course Educational Objectives:

- Introduce the cellular basis of life.
- Provide the basis for classification of living organisms.
- Describe the important biomolecules
- Describe the applications of biomaterials
- Describe the different metabolic pathways

UNIT 1 **6 hours**

Introduction to Biology, Cellular basis of life, differences between prokaryotes and eukaryotes. Classification based on carbon and energy sources, Tools of molecular taxonomy

UNIT 2 **8 hours**

Biomolecules, structure and functions of proteins, nucleic acids, lipids and sugars. Structure and function of hemoglobin, antibodies and enzymes. Industrial applications of enzymes

UNIT 3 **10 hours**

Bioenergetics, Respiration: Glycolysis and TCA cycle, Electron transport chain and oxidative phosphorylation. Anaerobic respiration and Fermentation and its industrial applications Mechanism of photosynthesis, Light and dark reactions

UNIT 4 **12 hours**

Genetics: Mendel’s laws of inheritance. Gene interactions- Epistasis, Incomplete & Codominance, Multiple alleles, Additive, complementation, Pleiotropism. Linkage, Crossing over. Gene mapping. Cell cycle and regulation. Mitosis and Meiosis

UNIT 5 **14 hours**

Human physiology – Membrane transport- Active and passive. Cell signaling and communication. Neurons – structure, function and types. Synapse-types, neurotransmitters, transmission of nerve impulse. Neuromuscular junctions. Muscle- structure, function and types.

Textbooks:

1. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, “Biology: A global approach”, Pearson Education Ltd, 2018.
2. Arthur T Johnson, Biology for Engineers, CRC press, 2011

References

1. Alberts et. al. The molecular biology of the cell, 6/e, Garland Science, 2014
2. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, “Outlines of Biochemistry”, John Wiley and Sons, 2009.
3. John Enderle and Joseph Bronzino Introduction to Biomedical Engineering, 3/e, 2012.

Course Outcomes:

After the completion of the course the student should be able to

1. Explain classification of living organisms.
2. Explain cell as the basis of life
3. Explain the importance of various biomolecules
4. Summarize application of enzymes and fermentation in industry.
5. Analyze metabolic pathways

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1										2			3			
CO2											2		3			
CO3		2	2							1			2			
CO4	3									3				3		
CO5		3				1				3	1	1			3	

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">BTEN1021</td><td rowspan="2">INTRODUCTION TO BIOTECHNOLOGY-II</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Nil</td></tr>
<tr><td>Co- requisite</td><td colspan="7">Nil</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Nil</td></tr>
</table>

Course Description:

This course introduces the student to the Applications of Biotechnology in plant , animal and industrial development

Course Educational Objectives:

1. Describe the concept of Central Dogma of Molecular Biology
2. Describe the transfer of genetic information.
3. Introduce recombinant DNA technology
4. Introduce the techniques used for modification of living organisms

UNIT 1 10 hours

Biotechnology: Concept, scope and importance. Origin of life-theories. Structure of bacterial, plant and animal cells-functions of cell organelles. Significance of biomolecules in biological systems

UNIT 2 12 hours

The central dogma of molecular biology. Concepts of genetic engineering, Restriction endonucleases, cloning vectors, methods of gene transfer. Polymerase Chain Reaction. Introduction to bioinformatics and biological databases

UNIT 3 12 hours

Biotechnology for Plant improvement: Strategies for engineering stress tolerance, transgenic plants. Micropropagation of novel varieties. Production of secondary metabolites and their importance. Molecular pharming.

UNIT 4 12 hours

Biotechnology for improvement of animals: Applications in animal husbandry, medicine and animal husbandry. Transgenic animals. Gene therapy and genetic counselling. Bioethics.

UNIT 5 14 hours

Industrial and Microbial Biotechnology: Overview of industrial fermentation process and products. Fermentation technology for production of Penicillin. Introduction to patents. Biotech industry in India and abroad.

Textbooks:

1. J.M. Walker and R. Rapley, Molecular Biology and Biotechnology, 5/e, Royal society of chemistry, 2009.
2. W. Godbey, An Introduction to Biotechnology, The Science, Technology nd Medical Applications, 1/e, Woodhead Publishing, 2014.

References

1. P.K. Gupta, Elements of Biotechnology, 2/e, Rastogi Publications, 2014.
2. B. Albert’s, A. Johnson, J. Lewis, D. Morgan, M. Raff, K. Roberts and P.Walter, Molecular Biology of the Cell, 6/e, Garland Publishers, 2014.
3. H. Lodish, A. Berk, C. A. Kaiser, M. Krieger, A. Bretscher, H. Ploegh, Amon and M. P. Scott, Molecular Cell biology, 7/e, W.H Freeman and Company, 2014.

Course Outcomes:

After the completion of the course the student should be able to

1. Explain the scope and importance of biotechnology
2. Understand the application of biotechnology in transgenic plant development.
3. Understand the role of biotechnogy in animal husbandry and livestock improvement
4. Explain the potential of biotechnology in industry in strain improvement

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1									2			3			
CO2		2									2		3			
CO3			3							1			2			
CO4	3									3				3		
CO5		3				1				3	1	1			3	

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

FINA1031	PRINCIPLES AND PRACTICE OF BANKING	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	Nil						
Co- requisite	Nil						
Preferable exposure	Nil						

SDG No. & Statement:

SDG Justification:

Course Description:

The significance of the banking sector in India has been continuously upward for several decades. The sector is playing a role of a catalyst in the development of the economy. The Banks started playing a critical role in the social development process and became a partner in Government's welfare schemes and policies. Principles of and Practices of Banking course explores the fundamental principles and practices of banking and credit in India. It helps students to understand basics of banking and regulation to recent developments in Banking technology

Course Educational Objectives:

1. To understand the Indian financial system, role of commercial Banks, RBI in India and the regulations of Indian Banks.
2. To comprehend the banking Principles
3. To give the student adequate exposure to banking practice.
4. To acquaint and apply innovations in the banking sector.
5. To give an overall exposure to banking Principles and Practice.

UNIT 1 Banking System and Structure 9 Hours

Banking system and structure in India: Evolution of Indian Banks-Types of banks; Commercial Banks, Cooperative Banks, Role of RBI; Banking Regulation, Constitution, Objectives, Functions of RBI, Tools of Monetary control; Regulatory Restrictions on Lending. Types of Banking- Retail, Wholesale and International Banking.

UNIT 2 Risk management and Basel Accords 9 Hours

Introduction to Risk Management and Basel I, II &III Accords. Role and functions of CIBIL. Fair practices code for debt collection. Principles of Lending: Cardinal Principles, Non-fund-based limits, Credit appraisal Techniques. Cash management services and its importance.

UNIT 3 Functional Banks 9 Hours

Banker Customer Relationship: Types, Different Deposit Products & Services, Services to customers and Investors; PMLA Act; KYC Norms; Banker as lender: Types of loans, Overdraft facilities, Discounting of bills, Financing book Debts and supply bills- Charging of Security bills- pledge, mortgage

UNIT 4 Customer Protection 9 Hours

COPRA Act and its operational aspects; Banking Ombudsman Scheme; Role and duties Paying and collecting Banks; Banker Protection under Negotiable Instrument Act-Endorsement, Forged Instruments- Bouncing of Cheques and their implications; Operational aspects of opening and maintaining accounts of various types of account holders. Ancillary Services: Remittances & Safe Deposit lockers, Govt Business, EBT

UNIT 5 Banking Technology 9 Hours

Computer Systems: LAN,WAN, UPS, Core banking, Data warehousing, Data Mining. Digital Banking: ATMs, Electronic Kiosks-CDK, BNA, PBP; Cards – Types, Networks, Wallets; PPI. Electronic Banking – Internet & Mobile Banking. Trends In Communication Networks for Banking: EFT System, SWIFT, RTGS, NEFT, Automated Clearing System. Digital Payment Systems – NPCI

Textbooks:

1. Principles and Practices of Banking, IIFB, 5thEditionn 2021
2. Principles And Practices Of Banking (Paperback, N S TOOR & ARUNDEEP TOOR) 14th Edition

References:

1. Shekhar&Shekhar (2010),Banking Theory and Practice, New Delhi: Vikas Publishing House.
2. P.K. Srivastav(2011),Banking Theory and Practice, NewDelhi:Vikas Publishing House.
3. Sundaram& P.N. Varshney (2010), Banking Theory, Law and Practice, New Delhi:S.Chand& Co.
4. Padmalatha Suresh and Justin Paul (2013),Management of Banking and Financial Services, New Delhi: Pearson Education.

Journal(s):

1. GITAM Journal of Management, Visakhapatnam.
2. The Journal of Banking Studies, Mumbai.

Website(s):

1. https://www.icai.org/

Course Outcomes:

1. Student acquires knowledge about theoretical aspects of banking and
2. Student acquires knowledge about relationship between banker and customer
3. Student learns about the practicalities of banking and the latest trends in banking.
4. Students develops skills about legal aspects and negotiable instruments.
5. Student enhance knowledge about latest banking trends and technology.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	0	0	0	0	0							3	1	0
CO2	1	2	0	1	0	0							2	1	1
CO3	2	2	3	2	1	0							0	1	1
CO4	1	2	3	2	1	2							2	0	1
CO5	0	0	0	0	1	1									

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

HRMG1021	HUMAN RESOURCE MANAGEMENT	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	Nil						
Co- requisite	Nil						
Preferable exposure	Nil						

Course Description:

Success in today's competitive business environment is increasingly a function of effective management of its resources, particularly human resources, which are the most valuable assets of an organization. The efficiency and quality of service of an organization depend on its employee's enthusiasm and satisfaction with their jobs, which are directly related to their sense of being treated fairly. To become a successful manager, it is imperative to understand human sensitivities and factors that motivate individuals. Human Resource Management course provides the basic tools required as an HR professional in an organization

Course Educational Objectives:

1. To Understand the fundamentals, evolution, function & challenges of HRM
2. To Explore the role of HRM in procurement, development of human resources
3. To Analyze the basic factors in designing the compensation and collective bargaining
4. To Evaluate safety and health and establish effective separation practices.

UNIT 1 **Introduction** **10 Hours**

Introduction: Nature, scope and significance of HRM - Evolution of HRM – Recent trends in HRM – Functions of HRM – Challenges of HR managers.)

UNIT 2 **Procurement** **10 Hours**

Procurement: Human Resource Planning – HR Forecasting methods - Job analysis and Job design – Recruitment - Selection – Induction.

UNIT 3 **Development** **10 Hours**

Development: Identification of training needs - designing the training program – Methods of training – Difference between Training & Development.

UNIT 4 **Compensation and Integration** **10 Hours**

Compensation and Integration: Introduction - Basic factors in determining pay rates – Basic, Supplementary and Executive Remuneration – types of employee benefits and services - Quality of work-life – Collective Bargaining.

UNIT 5 **Separation and maintaining** **10 Hours**

Separation and Maintaining: Communication and Counseling - Safety and Health – Internal mobility - Retirement and Retirement benefits..

Textbooks:

1. Gary Dessler & Biju Varkkey, "Human Resource Management," Pearson, New Delhi, 16th edition.
2. George W Bohlander, Scott A Snell, "Principles of Human Resource Management," Cengage Learning, 2017.16th edition.
3. Aswathappa, K., Human Resource and Personnel Management: Text & Cases, TMGH
4. Subba Rao, P., Personnel and Human Resource Management (Text & Cases), Himalaya

References:

1. Edwin B Flippo, "Personnel Management," Tata McGraw Hill Publishing, New Delhi, 1984
2. John H. Bernardin, "Human Resource Management - An Experiential Approach," Tata McGraw Hill, New Delhi, 2013
3. Mirza, Saiyadain, "Human Resource Management," Tata McGraw Hill, New Delhi, 2013
4. Gary Dessler & Biju Varkkey, "Human Resource Management," Pearson, New Delhi, 2015 14th edition.

Journal(s):

- Harvard Business Review, Harvard Business School Publication USA
- People Matters Online Magazine
- Human Capital Magazine
- Vikalpa, Indian Institute of Management, Ahmedabad

Course Outcomes:

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

- Understanding the concept of HRM and its importance.
- Describe the process of workflow analysis and identify why it is essential to HRM.
- Understand the concepts of Training and Development
- List various factors determining pay rates.
- Analyze the role of the supervisor in employee safety and minimize accidents at the workplace.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	2	1	0	2						3	1	0
CO2	1	2	1	3	1	1	1						2	1	1
CO3	2	1	2	2	1	0	1						0	1	1
CO4	2	1	2	1	1	1	3						2	0	1
CO5	0	0	2	3	0										

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 8 Decent Work and Economic Growth

SDG Justification: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

MKTG3011	SALES AND DISTRIBUTION MANAGEMENT	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	Nil						
Co- requisite	Nil						
Preferable exposure	Nil						

Course Description:

Sales Management focuses on the sales techniques and the management of the sales force. The success of any sales and marketing department lies in the effectiveness of the Sales Force. The goal of the Sales Management course is to examine the elements of an effective sales force as a key component of the organization's total marketing effort. A successful Sales Manager needs to understand the fundamentals of the sales process, the relationship between sales and marketing, sales force structure and issues in recruiting, selecting, training, motivating, compensating and retaining sales people.

Course Educational Objectives:

1. To understand the planning and staffing needs in professional sales
2. To learn how to manage and motivate a professional sales team as a Sales manager
3. To analyse the key success factors for sales executive performance.

UNIT 1

Introduction to Sales Management - Evolution of Sales Management, importance of Sales Management, types of Selling, difference between Selling and Marketing, Modern Day Sales Activities, Selling Skills, Selling Strategies, Selling Process.

UNIT 2

Sales Planning and Budgeting: Sales planning process, sales forecasting methods, sales budgeting process, methods used for deciding sales budget, types of quotas and quota setting procedure, reasons for establishing or revising sales territories, routing and scheduling sales persons, market cost analysis.

UNIT 3

Sales Force Management: Recruitment and selection of the sales force, training the sales force, sales force motivation, sales force compensation, sales force control and evaluation.

UNIT 4

Introduction to Distribution Management -Definition, need for Distribution Channels, designing the Marketing Channels, Motivating and Evaluating Channel Members, Capturing the Customer requirements

UNIT 5

Managing Distribution Channels - Managing Channel Information Systems, reasons for Channel Conflicts, Managing Conflict, Managing, Ethical issues in Sales and Distribution Management

Textbooks:

1. Krishna K Havaldar, Vasnt M Cavale, Sales and Distribution Management, 2nd edition, Tata Mcgraw Hill, 2011.

References:

1. Tapan K. Panda &Sunil Sahadev (2011), Sales and Distribution Management 2nd edition Oxford Press.
2. S.L. Gupta, M.K.Rampal (2009) Cases in Sales and Distribution Management, Himalaya Publication house.
3. K.Sridhara Bhat (2011) Sales and Distribution Management, 1st, Himalaya Publication house.
4. S.A.Chunawalla (2012) Sales and Distribution Management, 3rd edition, Himalaya Publication house.
5. Dinesh kumar (2012) Marketing Channels ,Oxford Press.
6. Richard R Still, Edward W Cundiff, Norman &A P Govoni(2011) Sales and Distribution Management, 5th edition, Pearson Publications.
7. Spiro Stanton & Rich (2010) Management of Sales Force, 13th edition, Tata McGraw Hill.
8. Prof. M.V. Kulkarni (2010) Sales and Distribution Management, Everest Publishing House.
9. Anne T Coughlan etal (2011), Marketing Channels, 7th edition, Pearson education.
10. Mark W Johnston, Greg W Marshall (2009), Sales Force Management, 9th edition, Tata McGraw Hill.
11. Dr.S.L.Guptha (2010), Sales and Distribution Management, 2nd edition, Excel books.
12. PingaliVenugopal (2012) Sales and Distribution Management, Sage Publications

Journal(s):

- Indian Journal of Marketing & Journal of Advertising Research

- GITAM Journal of Management, GITAM Institute of Management, GITAM Deemed to be university, Visakahapatnam
- Harvard Business Review, Harvard Business School Publication Co. USA
- Vikalpa, Indian Institute of Management, Ahmedabad

Course Outcomes:

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

1. Students would be able to understand the planning and staffing needs in professional sales.
2. Students would learn how to manage and motivate a professional sales team, as a sales manager.
3. Students would be able to analyze the key success factors for sales executive performance.
4. Students would learn how to manage and motivate distribution channel members.
5. Students can manage distribution channels and manage conflicts

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	2	1	0	2	0	0	0	0	1	3	1	0
CO2	1	2	1	3	1	1	1	0	0	0	0	1	2	1	1
CO3	2	1	2	2	1	0	1	0	0	0	0	1	0	1	1
CO4	2	1	2	1	1	1	3	0	0	0	0	1	2	0	1
CO5	0	0	2	3	0	1	1	0	0	0	0	1	1	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

MKTG1001	MARKETING MANAGEMENT	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite							
Co-requisite							
Preferable exposure							

Course Description:

Marketing as a subject primarily caters to the consumerist instincts of an individual. The markets are driven by consumer behaviour, which has evolved and is much more demanding these days. Consumer satisfaction takes precedence for a business to be successful. This calls for managers to adopt creative and unique marketing strategies to gain a competitive advantage. Marketing Management equips managers with the required theoretical knowledge and practical skills to gain insights into the dynamic nature of the markets and then devise ways and means to manage them effectively.

Course Educational Objectives:

- To explain the conceptual framework of marketing and its applications in "the real world."
- To apply concepts of marketing to address problems and opportunities in the new marketing environment
- To illustrate the functionality and application of elements of Marketing Mix
- To create a suitable marketing plan for a product
- To assess the range of common strategies used with each of the various promotional mix tools.

UNIT 1 **9 hours**

Definition, Nature, Scope, and Importance of Marketing – Core Concepts -Need, Want, Desire, Demand, Value, Exchange; philosophies of Marketing- Product – Production - Sales – Marketing – Societal – Relational marketing Concept of Marketing Myopia. Product Vs. service – Recent Trends in Marketing: Social Media Marketing and Digital Marketing.

UNIT 2 **9 hours**

Factors influencing buyer behavior –five-step buyers decision process - Segmenting, Targeting and Positioning - Concept of Market Segmentation, Bases for Segmenting Consumer Markets, Targeting (T), Positioning (P) Value Proposition and USP

UNIT 3 **9 hours**

Elements of the marketing Mix – four P's, extended three Ps of services. Product Decisions:

Product Concept -Classification of Products – Product Life Cycle Stages, New Product Development

UNIT 4 **Pricing and Channels of Distribution** **9 hours**

Pricing Objectives – Factors Influencing the Pricing Policy – Pricing Methods, Channels of Distribution: Definition – Nature – Types-Functions and levels of distribution channels

UNIT 5 **9 hours**

Importance of Promotion – Managing Advertising – Sales Promotion –Personal Selling and Direct Marketing– Publicity and Public Relations. Integrated Marketing Communication (IMC), Social Marketing

TextBooks:

1. Philip Kotler, Gary Armstrong, and Prafulla Agnihotri, Principles of Marketing, Pearson India, 17th Edition. New Delhi: 2018.
2. Rajan Saxena, Marketing Management, Tata-McGraw Hill, Fifth Edition New Delhi:2015

References:

1. Ramaswamy and Namakumari -Marketing Management- Indian Context -Global Perspective, Sage Publications India Pvt Ltd; Sixth Edition 2018
2. C. B. Gupta and Dr. N. Rajan Nair, Marketing Management: Text and Cases 15th Edition, S. Chand, and Sons 2012
3. N Rajan Nair and Sanjith R Nair, Marketing – Revised Edition, Sultan Chand & Sons – Tb, 2017

Course Outcomes:

1. Discuss the core concepts of marketing
2. Explain the factors influencing buyer behaviour
3. Understand the concept of the marketing mix and service Mix
4. Explain the pricing methods in a business setting
   Understand the purpose of promotion for the business

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PS01	PSO2	PSO3	PSO4
CO1	**2**	**3**	**2**	0	**3**			**3**	**3**	**3**	**2**
CO2	**0**	**3**	**3**	3	**0**			**0**	**0**	**0**	**0**
CO3	**3**	**3**	**3**	2	**2**			**3**	**3**	**3**	**3**
CO4	**3**	**3**	**2**	2	**2**			**3**	**3**	**3**	**3**
CO5	**3**	**3**	**2**	2	**2**			**3**	**3**	**3**	**3**

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :28TH APRIL, 2021 **ACADEMIC COUNCIL: 1ST APRIL, 2022**

SDG No. & Statement:

Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

SDG Justification:

OPTS2001	Production and Operations Management	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**None**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

The concept of production is the process through which goods and services are created. We can include both manufacturing and service organizations within the purview of production management. Thus, the essential futures of the production function are to bring together people, machines and materials to provide goods or services thereby satisfying the wants of the people. The scope of the production enables us to look at the problem of production management in a much wider perspective. This paper indicates the general applications of the techniques of management, machines and materials

Course Educational Objectives:

- To enable to the students to understand the basic principles of Production Management
- To help them apply techniques of Production Management

UNIT 1 **7 hours**

Production and Operations Management - Production and Operation Functions - Manufacturing Systems –Differences Between Manufacturing and Service Operations - Functions of Production and Operations Manager.

UNIT 2 **Production Planning and Control** **10 hours**

Steps in PPC - Techniques of Production Planning and Control

UNIT 3 **Plant Location and Layout Planning** **8 hours**

Location of Service Facilities -Location Decision -Types of Layout – Factors Affecting Plant Location.

UNIT 4 **Productivity** **10 hours**

Factors Affecting Productivity -Job Design -Process Flow Charts -Methods Study -Work Measurement.

UNIT 5 **Materials Management** **10 hours**

Costs Associated with Inventory - Economic Order Quantity - ABC Analysis – Just in-timeProduction. Quality Management: Acceptance Sampling -Control Charts – Quality Circle.

Text Books:

1. Aswathapppa & Bhat (2013), *Production and Operations Management*,New Delhi: HimalayaPublishing House.

References:

1. Everett E. Adam, Jr. and Ronals J. E. Ebert (2012),*Production and OperationsManagement: Concepts, Models and Behavior*,New Delhi: Prentice Hall of India.
2. S.N. Chary (2011), *Production and Operations Management*, New Delhi:Tata Mc-Graw Hill Publishing Co. Ltd.

Course Outcomes:

After completing the course. The students able to

1. Understand Basics of Production and Operations Management
2. Understand the phases and techniques of production Planning and Control
3. Enhance their skills in applying appropriate location and layout designs.
4. Enhance their skills in improving the productivity
5. Understands and applies inventory and quality procedures.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	1	1	0	0	1	1	1	1	0	0	1
CO2	1	1	1	1	2	2	1	1	2	2	1
CO3	1	2	2	1	2	1	1	1	2	3	1
CO4	1	2	1	1	2	1	1	2	2	2	1
CO5	2	1	2	0	2	1	1	1	2	2	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-05-2022<< date >> **ACADEMIC COUNCIL: 1st April, 2022**

SDG No. & Statement:SDG

Justification:

HRMG2001	ORGANIZATIONAL BEHAVIOR	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

Practicing managers have long understood the importance of interpersonal skills to managerial effectiveness. Till about three decades ago, most business schools focused on the functional aspects of management – specifically finance, accounting and quantitative techniques. Though Organizational Behavior was a core course right from the inception of the BBA program, the focus was essentially on gaining a psychologically understanding of human behavior, and not on acquiring usable skills. In the last two decades, academia has come to realize the importance that an understanding of human behavior to managerial effectiveness. The course focuses majorly on conceptual knowledge, with emphasis on analytical and presentational skills

Course Educational Objectives:

- The objective of the course is to give to the students a foundation in understanding human behaviour at work.
- This is done in a three stage process. Stage one deals with individual behavior, stage two with group behaviour and stage three gives an overview of the organizational and performance related factors

UNIT 1 **7 hours**

Introduction Nature and Importance of Organizational Behavior - Management Functions, Roles and Skills – People Skills.

UNIT 2 **10 hours**

Foundations of Individual Behavior - The Perception process – Factors, Person Perception - Learning – Theories of Learning, Principles of Learning - Motivation – Primary and General Motives, Theories of Motivation – Maslow, Herzberg, Equity Theory, GoalSetting Theory – Expectancy Theory

UNIT 3 **10 hours**

Foundations of Group Behavior - Nature of Groups – Structure, Types, Stages of Group Development - Group Decision-Making – Groups vs. Individual, Groupthink, Group shift, Group Decision-Making Techniques.

UNIT 4 **10 hours**

Managing Group Behavior - Leadership – Nature and Importance, Theories-Trait theories, Behavioral Theories, Contingency Theories - Understanding Work Teams – Nature of Teams, Types of Teams, Effectiveness of Teams, Team Building - Conflict – Intrapersonal and Interpersonal Conflict

UNIT 5 **8 hours**

Foundations of Organizational Behavior - Organizational Structure – Work Specialization, Departmentalization - Span of Management, - Organizational Culture: Nature – Creating and Maintaining a Culture.

Textbooks:

1. Robbins S., JudgeT.A.Vohra N (2013), *Organizational Behavior*, New Delhi: Pearson Education.

References:

1. Moorehead and Griffin (2013),*Organizational Behavior*, New Delhi: AITBS.
2. Archana Tyagi (2011), *Organizational Behaviour*, New Delhi: Excel Books.
3. Gangadhara Rao, V.S.P. Rao &Narayana (2001), *Organizational Behaviour,* New Delhi: Konark Publishers. (Latest edition)
4. Newstrom & Keith Davis (2012), *Organizational Behaviour*, New Delhi: Tata Mc-Graw Hill Publishing Co.Ltd.

Course Outcomes:

1. To acquaint the students with the characteristics of human behavior in corporations and other organizations.

2. To explain various leadership, group dynamics, and employee incentive philosophies.

3. To describe organizational strategy, analyze organizational design and structure, and assess organizational culture.

4. To demonstrate changing and learning about teamwork and collaboration.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	2	1	0	2	3	1	0	0
CO2	1	2	1	3	1	1	1	2	1	1	0
CO3	2	1	2	2	1	0	1	0	1	1	0
CO4	2	1	2	1	1	1	3	2	0	1	0

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-05-2022<< date >> **ACADEMIC COUNCIL: 1st April, 2022**

SDG No. & Statement: 8 Decent Work and Economic Growth

SDG Justification: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

HRMG1001	PRINCIPLES AND PRACTICE OF MANAGEMENT	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

One of the most important human activities is managing. Management can be traced back to ancient times whenever there was large-scale endeavor like great pyramids in Egypt, the Great Wall of China, Taj Mahal in India. All these required many people working in groups in a better-coordinated way to achieve a well-defined target over some time. In the present context, of globalization, because of the increasing role of large and complex organizations in the development of the economy, the concept of Management has become very significant for managing the business efficiently.

Course Educational Objectives:

- To understand theoretical aspects, processes and principles, the scope of Management and its application to modern management practice.
- To analyze how the field of Management has evolved and its significant contributions
- To learn various organizational structures and types for the optimum utilization of the available resources.
- To apply leadership theories and demonstrate leadership styles to getting things done through people.
- To validate various controlling techniques to enhance managerial practices to accomplish the predetermined goals of the organization.

UNIT 1 **Management Nature and Concept** **10 hours**

Nature, Concept, Scope and Significance; Functions; Management: Art or Science or Profession;

Organization vs Administration vs Management, Schools of Management: Contributions of F.W. Taylor, Henry Fayol, Elton Mayo; Roles of Managers; Social Responsibility and Business Ethics.

UNIT 2 **Planning** **9 hours**

Concept, Objectives, Types, Steps and Techniques; Making Planning Effective; Decision Making: Steps in Decision Making and Types; Management by Objectives (MBO).

UNIT 3 **Organizing** **10 hours**

Structure, Nature, Types of Organizations, Principles of Organizing; Departmentalization; Delegation; Decentralization of Authority; Span of Control - Line and Staff Functions; Staffing: Concept, Significance and Functions.

UNIT 4 **Leading** **9 hours**

Introduction, Characteristics of a Leader, Functions of a Leader; Leadership and Management; Principles of Leadership, Styles of Leaders.

UNIT 5 **Controlling** **9 hours**

Introduction, Concept of Controlling, Purpose of Controlling; Types of Control; Steps in Controlling; Techniques in Controlling.

TextBooks:

1. Harold Koontz & Heinz Weirich (2012), Management, a Global and Entrepreneurial Perspective, New Delhi: Tata McGraw Hill Publishing company.

References:

1. Dipak Kumar Bhattacharyya (2012), Principles of Management: Text and Cases, New Delhi: Pearson Publications.
2. Balasubramanian. N. (2012), Management Perspectives, New Delhi: MacMillan India Ltd.
3. Charles Hill, Steven Mc Shane (2012), Principles of Management, New Delhi: Tata Mac Graw Hill
4. Ricky W. Griffin (2012), Management, New Delhi: Cengage Learning.
5. Terry and Franklin (2011), Principles of Management. New Delhi: AITBS Publishers.
6. Robert Kreitner (2012), Principles of Management. New Delhi: Cengage, South-Western12 E

Course Outcomes:

1. can apply different managerial roles in Business organization
2. explain the importance of MBO in organization
3. aware the concept and principles of Organizing
4. analyze and apply different leadership styles
5. understand the concept and purpose of Controlling in Organizations

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PS01	PSO2	PSO3	PSO4
CO1	0	2	0	1	1	1	0	3	1	1	0
CO2	0	1	2	0	1	0	1	2	2	0	0
CO3	2	1	2	0	1	0	1	2	2	2	1
CO4	1	2	1	1	2	1	1	2	2	3	2
CO5	2	1	1	1	1	0	0	2	1	2	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :28TH APRIL, 2021 **ACADEMIC COUNCIL: 1ST APRIL, 2022**

SDG No. & Statement:

SDG Justification:

The modules and topics mentioned in this course are designed to ensure quality management education which helps lifelong learning in understanding and managing the challenges of changes in the dynamic business environment.

Programme Core

<table>
<tr><td rowspan="2">AERO1011</td><td rowspan="2">AEROMODELLING WORKSHOP</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course is intended to make students learn about the design of an RC plane and students will have hands-on experience to build and fly a RC plane.

Course Educational Objectives:

- Facilitate to design, build and fly model airplanes.
- Train to have hands-on experience necessary for developing a practical aptitude.
- Demonstrate the flying characteristics like speed or duration of flight.

List of Exercises:

1. Making of symmetric airfoil
2. Making of Cambered airfoil
3. Modelling skeleton structure of wing
4. Skin moulding of aircraft wing
5. Making of winglet
6. Sheet forming of empennage
7. Design, fabrication and flying of engine powered RC plane
8. Design, fabrication and flying of battery powered RC model airplanes.
9. Design, fabrication and flying of quadcopters.
10. Design, fabrication and flying of gliders.
11. Design, fabrication and flying of solar powered RC planes.
12. Design, fabrication and flying of a blended wing body.
13. Design, fabrication and flying of parachutes.

Note:

1. Exercises No. 1 to 6 are mandatory.
2. Any 4 models can be performed out of above 7 to 13 exercises.

Course Outcomes:

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

1. demonstrate logical, analytical, strategic and critical thinking skills for developing new designs of different aircraft models. (L4)
2. hands on creation of electronic circuit, biomechanical model using kits. (L4)

3. analyze the aerodynamics, stability and structural criteria of the model. (L4)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	0	1	1	1	1	0	0	0	0	1	1	3	3	1
CO2	2	2	3	1	2	1	0	1	1	0	1	0	1	3	1
CO3	2	2	3	2	1	0	1	0	0	1	1	1	2	3	1
CO4	2	2	3	1	1	1	1	1	1	0	2	1	2	3	1
CO5	3	2	3	1	1	0	0	1	0	0	1	1	2	3	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01/04/2022**

SDG No. & Statement:

SDG Justification:

AERO1001	INTRODUCTION TO AEROSPACE ENGINEERING	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	**None**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

This course is designed specifically for the branch of Aerospace engineering. This course will give a brief introduction of aircrafts and different streams in aerospace engineering which will help to understand the requirements for the design of an aircraft.

Course Educational Objectives:

- Familiarize the basic concepts of airplanes and space vehicles.
- Provide 360-degree view in Aerodynamics, Propulsion, Structures, and Systems etc.

UNIT 1 Introduction 6 hours

Evolution of airplanes, classification of aircrafts and space vehicles, functions of major components of an airplane. Role of DGCA in air safety as regulatory authority.

UNIT 2 Basic Aerodynamics and Flight Control Surfaces 7 hours

Basic Aerodynamics:
Introduction to Atmosphere - characteristics, pressure, temperature and density variations; airfoil nomenclature, types of airfoils; forces acting on airfoil.
Flight Control Surfaces:
Aircraft principle axes, Primary and Secondary control surfaces.

UNIT 3 Structures 5 hours

Types of structures - Truss, monocoque, semi-monocoque, and geodesic construction. Structural layout of wing, fuselage and tail plane. Types of wings and tail planes.

UNIT 4 Propulsion and Helicopters 6 hours

Propulsion: Introduction to Thrust production - Types of aircraft engines (Piston, Turbojet, Turbofan, Turboprop, Turboshaft, Ramjet, Pulsejet and Scramjet). Rockets – Evolution of rockets, principle of operation, types and applications.
Helicopters: Rotorcraft, types of rotorcraft, autogyro, gyrodyne.

UNIT 5 **Satellite Systems** **6 hours**

Satellite Systems: Elements, operations, structures, power systems, satellite missions, communication and telemetry - Indian satellites and launch vehicles.

Text Books:

1. J. D. Anderson, Introduction to Flight, 6/e, McGraw Hill, 2010.
2. R. S. Shevell, Fundamentals of Flight, 2/e, Pearson, 2004.

References:

1. A. C. Kermode, Flight Without Formulae, 5/e, Pearson, 1989.
2. L. Gupta, Helicopter Engineering, Himalayan Books, 1996.
3. D. Newman, Interactive Aerospace Engineering and Design, McGraw Hill, 2002.
4. R. H. Barnard and D. R. Philpot, Aircraft Flight, 3/e, Pearson, 2004

Course Outcomes:

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

1. demonstrate knowledge on evolution of plates, functioning of different components, role of regulatory and authorities and safety aspects of flight.
2. gain knowledge on aerodynamic behavior of rigid curved surfaces and their significance in controlling flight
3. exercise good command on structured anatomy and strength aspects of different components of aircraft.
4. identify different types of engines that suit the needs of different aerospace vehicles
5. exhibit the science of flying an aerospace vehicle and controlling of crucial subsystems that make a full-fledged flight

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	0	2	0	2	0	0	1	0	2	2	1	1
CO2	3	2	1	0	2	0	1	1	0	0	0	2	1	2	1
CO3	3	1	1	2	0	0	1	0	1	1	0	1	1	1	2
CO4	2	1	0	1	2	1	2	1	1	0	0	2	2	1	1
CO5	2	1	1	1	1	0	1	0	0	0	0	1	1	1	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01/04/2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">MECH2001</td><td rowspan="2">ENGINEERING MECHANICS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course is an introduction to learning and applying the principles required to solve engineering mechanics problems. Concepts will be applied in this course from previous courses of basic mathematics and physics This course addresses the modeling and analysis of static equilibrium problems with an emphasis on real world engineering applications and problem solving. This course forms the backbone of mechanical engineering design and acts as a prerequisite to mechanics of solids, design of machines and dynamics of machinery.

Course Educational Objectives:

- Explain the effect of force and moment and equilibrium in engineering applications.
- Compute geometric properties such as centroid and moment of inertia of various plane sections.
- Explain kinematics of particles and rigid bodies.
- Analyze the rigid bodies under dynamic conditions.
- Expose the concepts of work-energy, conservation of energy and momentum to rigid bodies.

UNIT 1 **Introduction to Engineering Mechanics** **8 hours**

Units, Significance of Engineering Mechanics, Composition and resolution of forces, parallelogram law, principle of transmissibility, types of force systems - concurrent and non-concurrent, coplanar forces, resultant of coplanar force systems, couple, moment of a force, Varignon's theorem, concept of free body diagrams, concept of equilibrium of coplanar force systems.

UNIT 2 **Friction and Analysis of Structures** **8 hours**

Friction and Analysis of Structures Friction: Laws of friction, types of friction, equilibrium of force systems involving frictional forces, wedge friction. Free body diagrams involving frictional forces.

Analysis of Structures: Introduction to plane trusses, analysis of plane trusses by method of joints and method of sections.

UNIT 3 Properties of Surfaces and Moment of Inertia 8 hours

Properties of Surfaces: Centroid and center of gravity, derivation of centroids from first moment of area, centroids of composite areas, Theorems of Pappus
Moment of Inertia: Area moment of inertia of plane and composite shapes, parallel axis theorem, perpendicular axis theorem, polar moment of inertia, radius of gyration.

UNIT 4 Kinematics 8 hours

Kinematics: Kinematics of particles – Rectilinear motion of particles, curvilinear motion of particles, use of rectangular coordinates, tangential and normal coordinates, radius of curvature, projectile motion, Kinematics of rigid bodies in translation, rotation of a rigid body about a fixed axis.

UNIT 5 Kinetics & Ideal systems 8 hours

Kinetics and Ideal systems: Kinetics: Principles of dynamics - Newton's Laws of motion, D'Alembert's principle in rectilinear translation, principle of work and energy.
Ideal Systems: Principle of conservation of energy, concept of power, conservation of linear momentum, principle of momentum and impulse, impact - types of impact.

Text Books:

1. N.H. Dubey, Engineering Mechanics: Statics and Dynamics, Tata McGraw Hill,2014.
2. S. Timoshenko, D.H. Young, J.V. Rao, Sukumar Pati, Engineering Mechanics (in SI units), 5/e, McGraw Hill, 2013.

References:

1. Basudeb Bhattacharya, Engineering Mechanics, 2/e, Oxford University Press (India),2015.
2. Irving Shames, G.K.M. Rao, Engineering Mechanics: Statics and Dynamics, 4/e, Pearson,2009.
3. K.L. Kumar, Venu Kumar, Engineering Mechanics, 4/e, Tata McGraw Hill,2010.
4. S.S. Bhavikatti, Engineering Mechanics, 4/e, New Age International,2008.

Course Outcomes:

Upon successful completion of the course, the students will be able to Obtain a basic understanding of the laws of solid mechanics.

1. Comprehend the significance of the concepts of solid mechanics in engineering systems.
2. Calculate the physical properties of rigid bodies required for the analysis of engineering systems.
3. Apply the principles of statics and dynamics to solve engineering problems.
4. Analyze various static and dynamic engineering systems and understand the underlying mechanics and drawbacks/problems.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	1	1	2	1	1	2	1	3	2	1
CO2	3	2	2	1	1	1	1	1	1	1	2	1	3	2	1
CO3	3	3	2	1	1	1	1	2	1	1	2	1	3	2	1
CO4	2	2	2	1	1	1	1	2	1	1	2	1	2	2	1
CO5	3	3	2	1	1	1	1	1	1	1	1	1	1	1	0

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">AERO2021</td><td rowspan="2">ENGINEERING FLUID MECHANICS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Engineering Mechanics (MECH2001)</td></tr>
</table>

Course Description:

This course is designed for Aerospace Engineering undergraduate students. This course aims to introduce and explain the basic concepts in fluid mechanics. Understanding these concepts will help in analyzing both internal and external flows. It is designed for the students for the experimental understanding of fluid flows

Course Educational Objectives:

- Explain different properties of Newtonian fluids.
- Familiarize governing equations of a fluid at rest and in motion.
- Demonstrate how the governing equations can be used to analyze different flow problems.
- Familiarize fundamental concepts in boundary layer flows.
- Introduce the concepts of modelling and similitude.

UNIT 1 Fluid Properties and Statics and Measurement of Pressure 8 hours

Fluid Properties and Statics: Density, viscosity, vapor pressure, compressibility, surface tension and capillarity. Pressure definition, Pascal's law and hydrostatic law.
Measurement of Pressure: Types of manometers. Total pressure and center of pressure of horizontal, vertical and inclined plane surfaces, venturi meter and orifice meter; nozzles

UNIT 2 Fluid Kinematics and Fluid Dynamics 10 hours

Fluid Kinematics: Types of fluid flows, velocity and acceleration, stream function, potential function, types of motion, vorticity and circulation, free vortex flow and forced vortex flow.
Fluid Dynamics: Continuity equation in cartesian and cylindrical coordinates; Euler's and Bernoulli's equation of motion, applications of Bernoulli's equation.

UNIT 3 Closed Conduit Flow 8 hours

Characteristics of real fluids, Reynolds experiment, Darcy's equation; Major and minor energy losses in pipes, pipes in series, pipes in parallel, flow through circular pipes: Hagen-Poiseuille law and flow between two parallel plates

UNIT 4 **Boundary Layer Flow** **10 hours**

Boundary layer thickness, boundary layer over a thin flat plate, skin friction coefficient for laminar, and turbulent boundary layer, momentum integral equation of the boundary layer, boundary layer separation and its control.

UNIT 5 **Dimensional Analysis** **9 hours**

Dimensional homogeneity, methods of dimensional analysis: Rayleigh method and Buckingham pi theorem, Types of similarity, force ratios, dimensionless numbers, Illustrative examples.

Laboratory

List of Experiments: Any 7 experiments need to conduct

1. Calibration of venturimeter,
2. Calibration of orifice meter
3. Calibration of flow nozzle.
4. Calibration of Pitot tube.
5. Flow through V-notch
6. Determination of friction factor of a given pipe.
7. Study of impact of jet on a stationary flat plate
8. Study of impact of jet on an inclined plate
9. Study of impact of jet on a curved vane.Verification of Bernoulli's principle.

Text Books:

1. F. M. White, Fluid Mechanics, 8/e, McGraw Hill, 2017.
2. P. N. Modi and S. M. Seth**,** Hydraulics and Fluid Mechanics including Hydraulics Machines, 20/e, Standard Publishers, 2015.

References:

1. R. K. Bansal**,** A Textbook of Fluid Mechanics and Hydraulic Machines**,** 9/e**,** Laxmi Publications, 2011.
2. K. L. Kumar, Engineering Fluid Mechanics, 8/e, Eurasia Publishing House, 2010.
3. V. Gupta, S. K. Gupta, Fluid Mechanics and its Applications, 2/e, New Age International, 2011.
4. R. W. Fox, P. J. Pritchard, A. T. McDonald, Introduction to Fluid Mechanics, 7/e, Wiley India, 2011.
5. K. W. Bedford, V. Streeter, E. B. Wylie., Fluid Mechanics, 9/e, McGraw Hill, 2010.

Course Outcomes:

1. compute fluid properties and pressure in a fluid at rest given appropriate information.
2. apply bernoulli's equation in combination with the continuity equation to solve simple flow problems.
3. apply appropriate equations and principles to analyze a variety of pipe flow situations and flow between two parallel plates.

4. explain the characteristics of different types of boundary layers and the reason for flow separation.
5. develop a set of dimensionless variables for a given flow situation using different dimensional analysis methods

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	2	1	1	1	1	1	1	3	1	1
CO2	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1
CO3	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1
CO4	2	2	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

AERO2001	SOLID MECHANICS	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	**Engineering Mechanics (MECH2001)**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

This course projects concepts connected to understanding the strength of different elements that forms the basis for a typical structural system. It focuses mainly on the initial design aspect of elements subjected to mechanical loads and their implications. Course finds appealing and enhances interest in aerospace structures.

Course Educational Objectives:

- To make learn the fundamentals connected to mechanics of different structural members.
- To impart knowledge of complex stresses and strains.
- To teach concepts of shear force and bending moment section loads.
- To train basic design principles of flexural members
- To give exposure to analyzing strength of thin cylinders.

UNIT 1 Simple Stresses and Strains 7 hours

Classification of stress, strain, loads and elongation produced in a bar due to its self-weight, tie bar of uniform strength, stress in a bar due to rotation, elongation in case of a taper rod, Poisson’s ratio, relation between the elastic units, stresses induced in compound bars, thermal stress and strain.

UNIT 2 Principal Stresses, Principal Strains and Theories of Failure 12 hours

Principal Stresses: Introduction, stresses on an oblique plane under-uniaxial loading, stresses on an oblique plane under biaxial loading, biaxial stresses combined with shear stresses, principal stresses and principal planes, Mohr’s circle for complex stresses.
Principal Strains: Introduction, strains on an oblique plane under biaxial strains combined with shear strains, principal strains, and Mohr’s circle for complex strains
Theories of Failure: Maximum normal stress theory, maximum shear stress theory, maximum strain energy theory and maximum distortion energy theory.

UNIT 3 **Thin Cylinders and Spherical Shells and Shear Force and Bending Moment** **10 hours**

Thin Cylinders and Spherical Shells: Stresses and strains (principal stress, principal strain, shear stress, shear strain and volumetric strain) in thin cylinders, thin spherical shells.
Shear Force and Bending Moment: Basic definitions, classification of beams, types of loads, types of supports, shear force and bending moment diagrams for cantilever, simply supported and overhanging beams for different types of loadings, the point of contraflexure, general relation between the load, the shearing force and the bending moment.

UNIT 4 **Bending and Shear Stresses in Beams** **8 hours**

Theory of simple bending (bending equation / flexural formula), position of neutral axis, section modulus, practical application of bending equation, shear stresses in beams, variation of shear stress distribution for rectangular, circular and I-sections.

UNIT 5 **Deflection of Beams** **8 hours**

Beam deflection, relation between slope, deflection and radius of curvature, slope and deflection at a section, double integration method, Macaulay's method and moment area method for cantilever, simply supported and fixed beams.

Solid Mechanics Laboratory:

List of Experiments:

1. Stress-strain characteristics of tension and compression members using UTM.
2. Determination of hardness of metals using Brinnel's and Rockwell's hardness test.
3. Impact test by using Izod's method and Charpy's method.
4. Bending test on simply supported and cantilever beams to find load deflection relation.
5. Modulus of rigidity by compression and tension test on springs.
6. Shear and Torsion test on circular shafts.

Text Books:

1. R.K Bansal, Strength of Materials, S Chand, 6/e.
2. F. P. Beer, E. R. Johnston Jr. and J. T. Dewolf, Mechanics of Materials, 6/e, Tata McGraw Hill, 2013

References:

1. Timoshenko, Strength of Materials, Part - I and II, 3/e, CBS Publishers,2011.
2. E. P. Popov, Mechanics of Solids, 2/e, Pearson Education, 2003.
3. I. H. Shames and J. M. Pitarres, Introduction to Solid Mechanics, 3/e, Prentice Hall India,2009

Course Outcomes:

At the end of course student will be able to Assess the response of axially and transversely loaded structural members

1. Deduces the complexities associated with bi axial loaded members
2. Appreciates the modulation of applied loads to design flexural loads
3. Exhibit strong design knowledge of various beams carrying transverse loads
4. Estimate the deflection of beams

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	1	1	2	1	1	2	1	3	2	1
CO2	3	2	2	1	1	1	1	1	1	1	2	1	3	2	1
CO3	3	3	2	1	1	1	1	2	1	1	2	1	3	2	1
CO4	2	2	2	1	1	1	1	2	1	1	2	1	2	2	1
CO5	3	3	2	1	1	1	1	1	1	1	1	1	1	1	0

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

AERO2011	ENGINEERING THERMODYNAMICS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**None**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

This course is designed for Aerospace Engineering undergraduate students. This course aims to introduce and explain the fundamental concepts of aerodynamics. Understanding these concepts will help in estimating aerodynamic forces and moments.

Course Educational Objectives:

- Introduce governing equations of the fluid flow.
- Provide insight on flow characteristics over an airfoil and wing.
- Familiarize different theoretical and numerical methods used in the analysis of potential flow over an airfoil and wing.
- Introduce different sources of drag.

UNIT 1 Governing Equations of Fluid Flow 10 hours

Flow regimes, definition of incompressible and compressible flows, governing equations of inviscid incompressible and compressible flow in integral and differential forms, substantial derivative, isentropic relations, stagnation state, stagnation properties and its use.

UNIT 2 Basic Aerodynamics 8 hours

Wing and airfoil geometry, aerodynamic force and moments, estimation of lift, drag and pitching moment from the pressure distribution, aerodynamic center, center of pressure, types of drag, characteristics of symmetric and cambered airfoils.

UNIT 3 Potential Flows 10 hours

Laplace's equations, boundary conditions, basic elementary flows: uniform flow, source flow, doublet flow and vortex flow, superimposition of elementary flows, non-lifting and lifting flow over a circular cylinder. Kutta - Joukowski theorem and the generation of lift, numerical source panel method, real flow over a circular cylinder, D'Alembert's paradox.

UNIT 4 **Thin Airfoil Theory** **9 hours**

Vortex sheet, Kutta condition and Kelvin's circulation theorem. Classical thin airfoil theory: symmetric and cambered airfoil, vortex panel numerical method, experimental characteristics of airfoils and comparison with theoretical results.

UNIT 5 **Finite Wing Theory** **9 hours**

Downwash, induced drag, Biot-Savart's law and Helmholtz's theorem. Prandtl's classical lifting line theory, Elliptic and general lift distribution over finite unswept wings, effect of aspect ratio, correlation of CL distribution over other aspect ratios, flow past swept and delta wings, lifting surface theory.

Text Books:

1. J. D. Anderson, Fundamentals of Aerodynamics, 5/e, McGraw Hill, 2010.
2. E. L. Houghton, P. W. Carpenter, S. H. Collicott, D. T. Valentine, Aerodynamics for Engineering Students, 6/e , Elsevier Science, 2012

References:

1. L. J. Clancy, Aerodynamics, 1/e, Shroff Publications, 2006
2. J. J. Bertin and R. Cummings, Aerodynamics for Engineers, 6/e, Pearson, 2013.
3. B. W. McCormick, Aerodynamics, Aeronautics and Flight Mechanics, 2/e, John Wiley and Sons, 1995.
4. C. Y. Chow and A. M. Kuethe , Foundations of Aerodynamics, 5/e, Wiley India, 2009

Course Outcomes:

After the completion of this course the student will be able to

- Apply the governing equations in both integral and differential form for different flows.
- Compute center of pressure, aerodynamic center, lift, drag and moment coefficients given appropriate information.
- Compute potential flow around two-dimensional bodies.
- Apply appropriate theoretical and numerical methods to estimate aerodynamic characteristics of an airfoil.
- Applyin appropriate theoretical and numerical methods to estimate aerodynamic characteristics of a wing.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1		1	1	1	1	1	3	1	1
CO2	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1
CO3	3	2	1	1	1	1		1	1	1	1	1	3	1	1
CO4	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1
CO5	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

AERO2041	AERODYNAMICS – I	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	**Engineering Fluid Mechanics (AERO2021)**						
Co-requisite	**Flight Mechanics (AERO2051)**						
Preferable exposure							

Course Description:

This course is designed for Aerospace Engineering undergraduate students. This course aims to introduce and explain the fundamental concepts of aerodynamics. Understanding these concepts will help in estimating aerodynamic forces and moments.

Course Educational Objectives:

- Introduce governing equations of the fluid flow.
- Provide insight on flow characteristics over an airfoil and wing.
- Familiarize different theoretical and numerical methods used in the analysis of potential flow over an airfoil and wing.
- Introduce different sources of drag.

UNIT 1 — Governing Equations of Fluid Flow — 10 hours

Flow regimes, definition of incompressible and compressible flows, governing equations of inviscid incompressible and compressible flow in integral and differential forms, substantial derivative, isentropic relations, stagnation state, stagnation properties and its use.

UNIT 2 — Basic Aerodynamics: — 8 hours

Wing and airfoil geometry, aerodynamic force and moments, estimation of lift, drag and pitching moment from the pressure distribution, aerodynamic center, center of pressure, types of drag, characteristics of symmetric and cambered airfoils.

UNIT 3 — Potential Flows — 10 hours

Laplace’s equations, boundary conditions, basic elementary flows: uniform flow, source flow, doublet flow and vortex flow, superimposition of elementary flows, non-lifting and lifting flow over a circular cylinder. Kutta - Joukowski theorem and the generation of lift, numerical source panel method, real flow over a circular cylinder, D’Alembert’s paradox.

UNIT 4 **Thin Airfoil Theory** **9 hours**

Vortex sheet, Kutta condition and Kelvin's circulation theorem. Classical thin airfoil theory: symmetric and cambered airfoil, vortex panel numerical method, experimental characteristics of airfoils and comparison with theoretical results.

UNIT 5 **Finite Wing Theory** **9 hours**

Downwash, induced drag, Biot-Savart's law and Helmholtz's theorem. Prandtl's classical lifting line theory, Elliptic and general lift distribution over finite unswept wings, effect of aspect ratio, correlation of CL distribution over other aspect ratios, flow past swept and delta wings, lifting surface theory.

Aerodynamics Laboratory

List of Experiments:

Any 7 experiments need to be performed

1. Study of the pressure distribution over smooth and rough cylinder.
2. Study of the pressure distribution over symmetric and cambered airfoils.
3. Performance of an airfoil with flap, influence of flap angle on lift, drag and stall.
4. Aerodynamic characterization of different wing configurations
5. Flow visualization studies in low-speed flow over airfoil with different angle of incidence
6. Measurement of the velocity profile in the boundary layer at on rough and smooth plates
7. Measurement of the velocity profile in the boundary layer at various distances from the leading edge of the plate
8. Pressure distribution around a two- dimensional model in supersonic flow conditions, at different angles of attack.
9. Lift and drag coefficient for aerodynamic models in supersonic flow.
10. Shock waves and expansion patterns around a two - dimensional model in supersonic flow conditions. (Flow visualization with Schlieren apparatus).

Textbooks:

1. J. D. Anderson, Fundamentals of Aerodynamics, 5/e, McGraw Hill, 2010.
2. E. L. Houghton, P. W. Carpenter, S. H. Collicott, D. T. Valentine, Aerodynamics for Engineering Students, 6/e , Elsevier Science, 2012

References:

1. L. J. Clancy, Aerodynamics, 1/e, Shroff Publications, 2006
2. J. J. Bertin and R. Cummings, Aerodynamics for Engineers, 6/e, Pearson, 2013.
3. B. W. McCormick, Aerodynamics, Aeronautics and Flight Mechanics, 2/e, John Wiley and Sons, 1995.
4. C. Y. Chow and A. M. Kuethe , Foundations of Aerodynamics, 5/e, Wiley India, 2009

Course Outcomes:

After the completion of this course the student will be able to

1. Apply the governing equations in both integral and differential form for different flows.
2. Compute center of pressure, aerodynamic center, lift, drag and moment coefficients given appropriate information.
3. Compute potential flow around two-dimensional bodies.
4. Apply appropriate theoretical and numerical methods to estimate aerodynamic characteristics of an airfoil.
5. Applying appropriate theoretical and numerical methods to estimate aerodynamic characteristics of a wing.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1		1	1	1	1	1	3	1	1
CO2	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1
CO3	3	2	1	1	1	1		1	1	1	1	1	3	1	1
CO4	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1
CO5	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

AERO2051	**FLIGHT MECHANICS**	**L**	**T**	**P**	**S**	**J**	**C**
		3	**0**	**0**	**0**	**0**	**3**
Pre-requisite	**Engineering fluid mechanics (AERO2021)**						
Co-requisite	**None**						
Preferable exposure	**Engineering Mechanics (MECH2001)**						

Course Description:

This course is designed for aerospace engineering students. It introduces the fundamentals of mechanics of flight. This course is designed to acquaint the learners with governing equations of motion of flight, flow physics during mission profile and stability of the aircraft.

Course Educational Objectives:

- To introduce the science of predicting and controlling the motion of flight that results from Aerodynamic forces and moments.
- To familiarize the students about the complete picture of atmosphere and its physical properties.
- To analyze the flow physics of high lift devices.
- To introduce basic concepts of stability and control.
- To describe the main principles of aircraft motion and the governing equation.

UNIT 1 Principles of Flight 9 hours

Physical properties and structure of the atmosphere, international standard atmosphere, temperature, pressure and density variations with altitude, measurement of speed: true, indicated and equivalent air speed; Streamlined and bluff bodies, various types of drag, drag polar, methods of drag reduction, infinite vs finite wings, critical Mach number, drag divergence Mach number.

UNIT 2 Aircraft Performance in Level, Climbing and Gliding Flight 10 hours

Straight and level flight, thrust required and available, power required and available, effect of altitude on thrust and power, conditions for minimum drag and minimum power required, gliding and climbing flight, maximum rate of climb, numerical, Breguet range and endurance equation for jet and propeller engine aircraft, effect of tail and head wind on range and endurance.

UNIT 3 High Lift Devices 7 hours

Introduction, trailing edge flap, plain flap, split flap, slotted flap, fowler flap, comparison of different types of flap, general comments on trailing edge flaps, leading edge slot, leading edge flap, boundary layer control, boundary layer blowing, boundary layer suction and jet flap.

UNIT 4 Accelerating Flight 9 hours

Take off and landing performance, turning performance, horizontal and vertical turn, pull up and pull down, control in a turn, maximum turn rate, numericals, V-n diagram.

UNIT 5 Introduction to Stability and Control 10 hours

Introduction, static stability, dynamic stability, aircraft controls, axes of reference and notation, longitudinal stability, wing alone, wing and horizontal tail, factors affecting tail contribution, neutral point and static margin.

Text Books:

1. J. D. Anderson, Introduction to Flight, 7/e, McGraw Hill, 2011.
2. E. L. Houghton, P. W. Carpenter, S. H. Collicott and D. T. Valentine Aerodynamics for Engineering Students, 6/e , Elsevier, 2012.

References:

1. L. J. Clancy, Aerodynamics, Shroff Publications, 2006.
2. J. J. Bertin and R. Cummings, Aerodynamics for Engineers, 6/e, Pearson, 2013.
3. A.W. Babister, Aircraft Stability and Response, Pergamon Press, 1980.
4. R. C. Nelson, Flight Stability and Automatic Control, 2/e, McGraw Hill, 1998.
5. M. V. Cook, Flight Dynamics Principles, 2/e, Elsevier Publications, 2012

Course Outcomes:

After completion of the course the student will be able to

1. Predict the influence of atmosphere and airplane configuration on aircraft performance.
2. Understand the factors that influence aircraft design and limit aircraft performance.
3. Apply knowledge of basic aerodynamics necessary for understanding mechanics of flight.
4. Apply control system and maneuvering methodologies to solve flight control problems
5. Identify limitations of the aircraft stability principles and equations as applied to aircraft.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	1	1	1	1	1	1	1	3	2	1
CO2	2	2	2	1	1	1	1	1	1	1	1	1	2	2	2
CO3	2	2	1	1	1	1	1	1	0	1	1	1	2	2	2

CO4	2	2	2	1	1	1	1	1	1	1	0	1	2	2	2
CO5	3	2	1	1	1	1	1	1	0	1	1	1	2	1	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">AERO1031</td><td rowspan="2">COMPUTER AIDED AIRCRAFT DRAWING</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course is designed for aerospace engineering students. It introduces the learning of CATIA software. This course is designed to acquaint the learners with basic modeling of 3D models used in aerospace and mechanical industry

Course Educational Objectives:

- To introduce 2D and 3D Models of different types of Screw Threads used in aeronautical industries by using CATIA Software.
- To familiarize 2D and 3D Models of different types of Fasteners like Nuts, Bolts, Washers, Rivets etc. used in aeronautical industries by using CATIA Software.
- To introduce 2D and 3D Models of different types of Keys and Cotter Joints like Taper key, Sunk Key, Round Key, Feather key, Socket and Spigot Joint and Knuckle joints etc. used in aeronautical industries by using CATIA Software.
- To enable students to draw 2D and 3D Models of different types of Symmetrical and cambered Airfoils, NACA 4- and 5-Digits Airfoil used in flying vehicles by using CATIA Software

Sectional Views: Principles involved in constraints, convention representation of sectional plane, hatching, sectional views of machining components.

Fasteners: Bolted joints, screw joints, stud joints, riveted joints, welded joints and their conventional representation.

Airfoil and Wing Drawings: NACA 4-digit airfoil (symmetrical, cambered), NACA 5-digit airfoil. Rectangular wing swept wing and delta wing configurations.

Aircraft Assembly Drawings: Different types of trusses used in wings, spars, ribs, stringers, skin, brackets, bulkhead, and rings (frame) longerons. Different types of fuselage, landing gear, hydraulic cylinder, connecting rod and piston engine

Text Books:

1. S. Tickoo, G. Verma, Catia V5-6R2012 for Engineers and Designers, Dreamtech Press, 2013.

Course Outcomes:

On successful completion of this module a student should be able to:

1. Apply drawing and modeling concept by using CATIA Modeling Software.
2. Acquire skills for applying the drawing methodology to different Joining parts of aircrafts.
3. Analyze the drawback and limits of software while making drawing and modeling any objects.
4. Use Computer Aided Design software to create simple 3D models using solid, assembly and surface modelling techniques.
5. Apply their knowledge and skills to design aircraft components as part of the Group.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3		1	2	1	1	1	1	1	1	2	1	1
CO2	2	2	1	2	2	2	1	1	1	1	1	1	3	1	2
CO3	3	2	3	2	1	1	1	1	1	1	1	1	2	2	1
CO4	2	2	3		1	2	1	1	1	1	1	1	2	1	1
CO5	2	2	2	1	2	1	1	1	1	1	1	1	2	1	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">AERO2031</td><td rowspan="2">MECHANICS OF AEROSPACE STRUCTURES</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Solid Mechanics (AERO2001) Engineering Mechanics (MECH2001)</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course is designed for Aerospace Engineering undergraduate students. It is designed for the students to understand the basics principles of Mechanics of different components of Aerospace Structures. Understanding these principles will help them in the Design and Analysis of Aerospace Structures

Course Educational Objectives:

- To study and analyze structures using various energy methods.
- To familiarize different methods for statically indeterminate structures.
- To impart knowledge on the principles of the theory of elasticity.
- To educate the behavior of bending of thin plates under different load conditions.
- To identify the behavior of columns and struts with different end conditions.
- To study the principles of thin plates and tension field beams.
- To learn the fundamental principles of mechanical vibrations

UNIT 1 Energy Methods and Statically Indeterminate Structures 10 hours

Energy Methods: Unit load method for calculating displacement, strain energy method for uniaxial stress, pure bending and shearing stresses, Castigliano's theorem.
Statically Indeterminate Structures: Introduction, methods for indeterminate beams, superposition method, double integration method and moment distribution method, matrix methods for indeterminate trusses and frames

UNIT 2 Theory of Elasticity 8hours

Stress - Strain relations, equilibrium and compatibility conditions for elastic solids, 2D elasticity equations for plane stress, plane strain and generalized plane strain cases, stress functions; Airy's stress function, bending of end-loaded cantilever beams

UNIT 3 **Bending of Thin Plates** **9 hours**

Pure bending of thin plates, plates subjected to bending, twisting and distributed transverse loads, combined bending and in-plane loading of a thin rectangular plate, bending of thin plates having a small initial curvature, energy methods for bending of thin plates.

UNIT 4 **Columns and Struts and Thin Plates** **10 hours**

Columns and Struts: Elastic instability, Euler's buckling of columns - columns with one end free and the other fixed, both ends fixed, one end fixed and other hinged, inelastic buckling, column with initial curvature, column carrying eccentric load, laterally loaded columns, empirical formulae.
Thin Plates: Buckling of thin plates - elastic buckling of isotropic flat plates in compression, elastic buckling of plates due to shear and bending stresses. Instability of stiffened panels, crippling stresses by Needham's and Gerard method.

UNIT 5 **Torsion of Circular Shafts** **8hours**

Shafts, torsion of shafts, torsion equation, hollow circular shafts, torsional rigidity, power transmitted by the shaft, importance of angle of twist and shear stresses in shafts, shafts in series, shafts in parallel, comparison of solid and hollow shafts, combined bending and torsion

Aerospace Structures Laboratory

List of Experiments:

1. Maxwell's reciprocal theorem verification for beams with different end conditions.
2. Column instability test for different end conditions.
3. Shear tests on riveted joints.
4. Study the behavior of pressurized thin cylinder.
5. Shear centre in open sections beams.
6. Shear centre in closed sections beams.
7. Wagner tension field beam
8. Combined bending and torsion of a circular tube

Text Books:

1. T. H. G. Megson, Aircraft Structures for Engineering Students, 5/e, Elsevier Publications, 2013.

References:

1. Timoshenko, Strength of Materials Part - I and II, 3/e, CBS Publishers, 2011.
2. E. P. Popov, Mechanics of Solids, 2/e, Pearson Education, 2003.
3. I. H. Shames and J. M. Pitarres, Introduction to Solid Mechanics, 3/e, Prentice Hall of India, 2009.
4. F. P. Beer, E. R. Johnston, Jr. and J. T. Dewolf, Mechanics of Materials, 6/e, Tata

McGraw Hill, 2013.
5. S. S. Rattan, Strength of Materials, 2/e, Tata McGraw Hill, 2011.

Course Outcomes:

After the completion of this course student will be able to

1. Solve problems on statically determinate and indeterminate beams
2. Make use of principles of theory of elasticity to solve 2-D elastic solid problems
3. Explain the behavior of columns under different load conditions and end conditions
4. Analyse buckling of thin plates under different types of loads
5. Solve simple problems on mechanical vibrations

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1	1	1	1	1	1	1	3	2	1
CO2	3	2	1	1	1	1	1	1	1	1	1	1	3	2	1
CO3	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1
CO4	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1
CO5	3	2	1	1	1	1	1	1	1	1	1	1	3	2	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

AERO3001	AERODYNAMICS - II	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**Engineering Thermodynamics (AERO2011) & Aerodynamics – I (AERO2041)**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

This course highlights syllabus related to high speed flows. It includes flow theories of normal, oblique and expansion shocks and flow linearization methods. Course find appealing and enhances interest in the area of high speed flows and gas dynamics

Course Educational Objectives:

- Explain behavior of airflow both internal and external in a compressible flow regime with particular emphasis on supersonic flows.
- Train principles behind the formation of shocks and expansion fans in supersonic flows.
- Impart the knowledge of flow physics of nozzles and supersonic inlets.
- Familiarize approximation theory and linearization of potential flows.
- Encourage take up design of nozzles and supersonic airfoils

UNIT 1 Isentropic Flows and Normal Shock Theory 11 hours

Isentropic Flows: Steady one-dimensional isentropic flow: differential equations for 1D flow, isentropic flow with area variation, area-velocity relation and its application.
Normal Shock Theory: Normal shock concept, normal shock relations, stationary normal shocks.

UNIT 2 Oblique Shocks and Shock Reflections and Expansion Theory 10hours

Oblique Shocks and Shock Reflections: Oblique shocks, concept and theory, oblique shock relations, property variations, detached shocks, shock reflections, numerical examples and shock-shock interactions.
Expansion Theory: Expansions: 1D expansion wave, expansion fan, Prandtl-Meyer function, smooth expansions/compressions and numerical examples. Shock expansion theory: examples and its applications.

UNIT 3 **Nozzle Flows and Supersonic Inlets** **10 hours**

Nozzle Flows: Area-Mach number relations, geometric choking, convergent nozzles, divergent nozzles, convergent-divergent nozzles, multiple choking points, and effect of different pressure ratio across nozzle, under and over expanded nozzles.
Supersonic Inlets: Introduction, starting problem, convergent-divergent diffuser, divergent inlet, shock boundary layer problem, external deceleration and performance.

UNIT 4 **Linearized Potential flow Theory** **7hours**

Potential equation for 2-dimensional compressible flow, linearization of potential equation, perturbation potential, linearised pressure coefficient, linearised subsonic flow, Prandtl-Glauert rule and Introduction to method of characteristics.

UNIT 5 **Linearized Supersonic Flows** **7hours**

Linearized supersonic flow, Critical Mach number, drag divergence Mach number, shock stall, supercritical airfoil sections, transonic area rule, swept wing, lift, drag, pitching moment and centre of pressure for supersonic profiles

Text Books:

1. E. Rathakrishnan, Gas Dynamics, 5/e, Prentice Hall of India, 2013.
2. J. D. Anderson, Modern Compressible flow, 3/e, McGraw Hill, 2012.

References:

1. C. R Peterson and P. G. Hill, Mechanics and Thermodynamics of Propulsion, 2/e, Pearson, 2009.
2. H. W. Liepmann and A. Roshko, Elements of Gas Dynamics, Dover publications, 2007.
3. A. H. Shapiro, The Dynamics and Thermodynamics of Compressible Fluid Flow, volume I and II, 1/e, John Wiley, 1953.
4. P. H. Oosthuizen and W .E. Carscallen, Compressible Fluid Flow, 1/e, McGraw Hill, 1997.

Course Outcomes:

At the end of course student will be able to

1. Realize the significance of nature of high speeding flows and their relevance to mach number
2. Exhibit knowledge of quantification of supersonic flow shock field concepts
3. Ascertain, and design typical supersonic nozzle and inlet
4. Understands the importance of linearization of potential flow and its quantification
5. Exhibit knowledge of supersonic flow field complexities and quantification methods

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	1	1	2	1	1	2	1	3	2	1
CO2	3	2	2	1	1	1	1	2	1	1	2	1	3	2	1
CO3	3	2	1	1	1	1	1	2	1	1	2	1	3	2	1
CO4	2	2	1	1	1	1	1	2	1	1	2	1	2	1	1
CO5	3	2	1	1	1	1	1	2	1	1	2	1	3	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

AERO2061	AIRCRAFT PROPULSION	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	**Engineering Thermodynamics (AERO2011)**						
Co-requisite	**Aerodynamics – I (AERO2041)**						
Preferable exposure	**None**						

Course Description:

These course projects concepts connected to power plants that are used in aircrafts. It focuses mainly on performance estimation, characterization and analysis of different subsystems used in aircraft engines. Course find appealing and enhances interest on gas turbine-based power plant engineering.

Course Educational Objectives:

- To make learn the principles of the several types of power plants.
- To impart knowledge on performance of Turbojet, Turbo fan, Turbo prop and turbo shaft engines.
- To teach concepts of Ramjet and Scramjet engines.
- To train basic design of Compressors, Combustors, Turbine and Nozzle.
- To propel for Analyze and identify the cause of off design performance

UNIT 1 **Thermodynamics of Gas Turbine Engines and Aerothermodynamics of Engines:** **10 hours**

Thermodynamics of Gas Turbine Engines:

Introduction: Nomenclature, types of air breathing engines, principle of gas turbine engine, thrust equation and related factors.

Aerothermodynamics of Engines: Turboprop engine, turbojet engine, turbo fan engine, turbo shaft engine, ramjet engine, and their performance characteristics, thermodynamic cycles, thrust, efficiencies, specific fuel consumption(thrust), specific thrust.

UNIT 2 **Axial Flow Compressors and Energy transfer:** **10hours**

Axial Flow Compressors:

Introduction: Geometry structure of stage and related terminology, Flow and airfoil angles, standard airfoil profiles

Energy transfer: components of energy transfer, stage reaction, Rothalpy and total enthalpy, incidence and deviation angles, radial equilibrium, specific speed and its design role, Compressor performance charts, polytropic efficiency, total and static efficiencies. Concepts of rotating stall and surge, Primary and secondary losses.

UNIT 3 Axial Flow Turbines 10hours

Introduction, geometry, comparison with axial flow compressor, velocity polygons, stage energy analysis- pressure ratio, degree of reaction – impulse, reaction turbines and related flow angles, Study of performance charts, typical blade profiles, Blade cooling, blade and vane materials.

UNIT 4 Combustion System 10hours

Introduction, geometries, primary combustor, afterburner, Flame stability, ignition and engine starting, adiabatic flame temperature thermodynamics, combustion process, pressure losses- Rayleigh, Fanno line flows, combined heat addition and friction. Performance maps.

UNIT 5 Subsonic 1-D Flow 10 hours

Inlets: Introduction, geometry structure, subsonic inlets: capture area, low subsonic and high subsonic diffusers, internal flow, external flow study and their implications, area ratio and design criteria.

Propulsion Laboratory

List of Experiments:

1. Performance study of axial flow compressors
2. Performance study of centrifugal Compressors
3. Nozzles aerodynamics (pressure distribution, under and over expanded)
4. Nozzles performance (jet reaction, efficiency and choking)
5. Study of reaction turbine performance
6. Study of impulse turbine performance
7. Performance of gas turbine engine
8. Wall jet and wake study
9. Combustion process
10. Flame propagation and stability
11. Study of heat transfer by convection
12. Thermal conductivity of fuels.

Text Books:

1. R. D. Flack, Fundamentals of Jet Propulsion with Applications, 2/e, Cambridge University Press, 2010.
2. Erian A Baskharone, Principles of Turbomachinery in air breathing engines.
3. J. D. Mattingly, Elements of Gas Turbine Propulsion, 3/e, McGraw Hill,2011.

4. G. C. Oates, Aerothermodynamics of Aircraft Engine Components, AIAA,2007.

References:

1. C. R Peterson and P. G. Hill, Mechanics and Thermodynamics of Propulsion, 2/e, Pearson,2009.
2. Cumpsty, Jet Propulsion, 2/e, Cambridge University Press,2008.
3. A. F. El-Sayed, Aircraft Propulsion and Gas Turbine Engines, 1/e, CRC Press,2008.
4. J. L. Kerrebrock, Aircraft Engines and Gas Turbines, 2/e, MIT Press,1992.

Course Outcomes:

At the end of course student will be able to

1. Gain understanding on various gas turbine engines performance.
2. Exhibit knowledge on axial flow compressor and turbines working.
3. Appreciates combustion mechanism and its sensitivity.
4. Exhibit knowledge on working and performance determination of axial flow turbines.
5. Demonstrate knowledge of subsonic inlet of gas turbine engine.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	2	1	1	1	1	1	1	3	1	1
CO2	3	2	2	1	1	1	1	2	1	1	2	1	3	2	1
CO3	2	1	1	1	1	2	1	1	1	1	1	1	2	1	1
CO4	2	2	2	1	1	1	1	1	1	1	2	1	2	1	1
CO5	2	2	1	1	1	1	1	1	1	1	2	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">AERO2071</td><td rowspan="2">AEROSPACE MATERIALS ENGINEERING</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course is designed for Aerospace Engineering undergraduate students. It is designed for the students for the basic understanding of aerospace materials and processing technologies used

Course Educational Objectives:

- Facilitate the knowledge on recent developments in materials science and engineering within the framework of aerospace engineering.
- Demonstrate the introduction to metals, alloys and composites used for aerospace applications.
- Impart knowledge on manufacturing processes of aircraft parts.
- Train to understand the characterization of various types of composite materials.

UNIT 1 Introduction to Aerospace Materials and Constitution of Alloys 9 hours

Introduction to Aerospace Materials: Historical development, classification of materials, Properties of flight vehicle materials, importance of strength/weight ratio of materials for aerospace vehicles structures (importance of temperature variations, factors affecting the selection of material for different parts of airplanes); crystal structure of metals and alloys (metallography); Mechanical Properties of aerospace materials.
Constitution of Alloys: Needs of alloying, types of solid solutions, intermediate alloy phases.

UNIT 2 Introduction to Binary Phase Diagrams 9 hours

Introduction to Binary Phase Diagrams: Interpretation of phase diagrams of Iron, Aluminium, Titanium and Nickel based alloys.
Classification of steels alloys, effect of alloying elements, properties and applications in aerospace industry; Introduction to Heat treatment processes and its important, initial stresses and stress alleviation procedures; corrosion prevention and protective treatments

UNIT 3 Light Metal Alloys and Introduction to Super Alloys

Light Metal Alloys: Aluminum and its alloys, Titanium and its alloys, magnesium alloys and their properties: applications, machining, forming, welding and heat treatment.
Introduction to Super Alloys: High strength, high corrosion alloys and Heat Resistant Alloys: Classification of heat resistant materials, iron, nickel and cobalt based superalloys, properties of inconel, monal, nimonic and super alloys; Introduction to refractory materials & ceramics;

UNIT 4 Composite Materials

Classification, characteristics of composite materials, volume fraction, particulate composites, fibrous composites and laminated composites. Types of reinforcements, their shape and size, production and properties of fiber reinforced plastics.

UNIT 5 Aircraft Manufacturing Processes

Profiling, hydro forming, spar milling, spark erosion and powdered metal parts, integral machining, contour etching, high energy rate forming and manufacturing of composites including honeycomb structures and general methods of construction of aircraft engine parts.

Materials and Machine Tools Lab

List of Exercises:

1. Lathe: Step turning, taper turning, knurling, thread cutting, chamfering,
2. Shaping: Round to square cutting, v-groove cutting, and semi hexagonal cutting.
3. Slotting: Internal key-way cutting.
4. Milling: Round to hexagonal nut cutting using direct indexing method.
5. Milling: Form cutting of spur gear using simple indexing method.
6. Grinding: Single-point tool grinding as per given signature.
7. Study of micro structures of ferrous and alloys.
8. Nondestructive testing of aircraft materials using dye penetrant and ultrasonic flow detection methods.

Text Books:

1. G. F. Titterton, Aircraft Materials and Processes, 5/e, Sterling Book House,1998.
2. F. C. Campbell, Manufacturing Technology for Aerospace Structural Materials, 1/e, Elsevier Publications,2006.

References:

1. R. H. Avner, Introduction to Physical Metallurgy, 2/e, Tata McGraw Hill,1997.
2. W. D. Callister, D. G. Rethwisch, An Introduction on Material Science and Engineering, John Wiley,2010.
3. G. E. Dieter, Mechanical Metallurgy, 1/e, McGraw Hill, 1976.
4. L. Gupta, Advanced Composite Materials, 2/e, Himalayan Books,2006

Course Outcomes:

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

1. Demonstrate a general understanding of aerospace materials and the appropriate manufacturing techniques for the major critical components.
2. Select appropriate manufacturing processes for composites.
3. Describe likely performance of classes of aerospace materials in the context of specific applications
4. Describe methods of processing aerospace materials particularly joining issues and propose suitable routes for selected applications
5. Apply the knowledge on the criteria for the selection of material.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1		1	2	1	1	1	1	1	1	3	1	1
CO2	2	1		1	1	2		1	1	1	1	1	2	1	1
CO3	2	2	1	1	2	2	1	1	1	1	1	1	3	1	1
CO4	2	1	1		1	1		1	1	1	1	1	2	1	1
CO5	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

AERO3011	ANALYSIS OF AEROSPACE STRUCTURES	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	Solid Mechanics (AERO2001), Engineering Mechanics (MECH2001)						
Co-requisite	None						
Preferable exposure	Mechanics of Aerospace Structures (AERO2031)						

Course Description:

This course is intended to give a insight knowledge on thin walled beams used in aerospace vehicles. Student will gain knowledge on the design of thin-walled beams and will be able to understand the behaviour of beams which undergo different loading conditions in aircrafts.

Course Educational Objectives:

- Provide concepts on bending stresses and deflections for beams.
- Train to compute shear stresses and twist angles in torsion for solid sections, closed thin- walled sections and open thin-walled sections.
- Focus on the application of structural idealization for different aircraft structures.
- Impart skills to design structural joints used in aerospace domain.

UNIT 1 **Bending of Open and Closed Thin-Walled Beams** **10 hours**

Symmetrical and unsymmetrical bending, resolution of bending moments, direct stress distribution, position of neutral axis, deflections due to bending and approximations for thin walled sections.

UNIT 2 **Shear of Open and Closed Thin-Walled Beams** **10 hours**

General stress, strain and displacement relationships for open and single-cell closed section thin-walled beams, shear of open section beams, shear center, shear of closed section beams.

UNIT 3 **Torsion of Beams** **8 hours**

Torsion of closed section, displacements associated with Bredt-Batho shear flow, torsion of open section beams, warping of cross section, conditions for zero warping.

UNIT 4 **Structural Idealization** **7 hours**

Idealization of panel, effect of idealization on the analysis of open and closed section be Deflection of open and closed section beams.

UNIT 5 **Joints and Fittings** **10 hours**

Introduction to bolted and riveted joints, standard parts, splices, eccentrically loaded connections, gusset joints, welded joints, bonded joints, lug analysis (bolt in shear), tension fittings (bolt in tension) and tension clips.

Text Books:

1. T. H. G., Megson, Aircraft Structures for Engineering Students, 5/e, Elsevier, 2013.
2. M. C. Niu, Airframe Stress Analysis and Sizing, 3/e, 2011.

References:

1. D. J. Peery, Aircraft Structures, 2/e, Dover publications, 2012.
2. B. K. Donaldson, Analysis of Aircraft Structures: An Introduction, 2/e, Cambridge University Press, 2012.
3. D. William, E. Arnold, An Introduction to the Theory of Aircraft Structures, Elsevier, 2013.
4. J. Cutler, Understanding Aircraft Structures, 3/e, Aditya Books, 2002.

Course Outcomes:

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

1. understand fundamental principles relating to the bending analysis ofthin-walled structures.
2. Computer stresses, deflections and shear centers in asymmetric beams in bending.
3. analyze the circular and non circular sections subjected to torsion
4. develop ability to size practical aerospace structures given representative loads
5. analyze different types of joints

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1	0	1	2	2	1	2	3	2	1
CO2	3	2	1	1	1	1	0	1	2	2	1	2	3	2	1
CO3	3	2	1	1	1	1	0	1	2	2	1	2	3	2	1
CO4	2	2	1	1	1	1	0	1	2	2	1	2	3	2	1
CO5	3	2	1	1	1	1	0	1	2	2	1	2	3	2	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

AERO3021	AEROSPACE PROPULSION	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**Aircraft Propulsion (AERO2061)**						
Co-requisite	**None**						
Preferable exposure	**Aerodynamics – I (AERO2041)**						

Course Description:

This course intends to train students on aspects connected to power plants that are used in rockets and missiles. It focuses mainly on the design of the rocket and thrust chamber. It as well projects different aspects connected with fuels, fuel systems and nozzle aerodynamics. Course find appealing and enhances interest on rocket power plant engineering

Course Educational Objectives:

- Explain principles of the several types of rocket power plants.
- Impart knowledge on performance evaluation of different types of rocket engines.
- Familiarize concepts of turbo pump, feed systems, nozzle and thrust chamber.
- Facilitate basic design of different typical rocket engines.
- Provide exposure to a variety of fuels used across different rocket engines.

UNIT 1 **Elements of Rocket Propulsion** **8 hours**

Introduction to rocketry, classification and applications of rocket propulsion, Newton laws, rocket equation for gravity and drag free condition, vehicle velocity, mass ratio, mass fraction. Multi-staging of rocket and strap on boosters. Exhaust velocity, thrust at sea level and vacuum, energy and efficiencies, total impulse, specific impulse, effect of propulsion system on vehicle performance.

UNIT 2 **Rocket Nozzle dynamics** **9 hours**

Aerothermodynamics of nozzle, review of thermodynamic relations, mass flow rate, Isentropic flow through nozzle and different types of expansions, design parameters. Performance measures of chemical rocket nozzle - thrust coefficient, specific impulse, engine parameters, thrust chamber pressure, temperature, characteristic and jet exhaust velocity. Nozzle configuration: Cone and bell-shaped nozzles. Nozzle alignment

UNIT 3 **Solid Propellant Rocket Motor, Grain, Propellants and Other Propellants** **9 hours**

Solid Propellant Rocket Motor: Rocket motor and components, applications, classification of motors, propellant burning rate-effect of temperature, pressure and burn rate modifiers, erosive burning, basic performance relations.

Grain - propellant grain and grain configurations, grain stress and strain.

Propellants: Solid propellants - classification, characteristics, ingredients and hazards.

Other propellants - gas generator, smoke, smokeless and igniter propellants

UNIT 4 Liquid Rocket Engines, Propellants and Thrust Chamber 10 hours

Liquid Rocket Engines: Liquid rocket engines, propellants, **propellant feed systems** – gas and pressure feed, propellant tanks, tank pressurization, flow and pressure balance, **Liquid engines** – RCS & OMS.

Propellants: Propellant properties, liquid oxidizers, liquid fuels, monopropellants, gaseous propellants,

Thrust Chamber: Injector, combustion chamber, and Combustion of liquid propellants.

UNIT 5 Combustion Instabilities and Electric Propulsion Systems 9 hours

Combustion Instabilities: Introduction to instabilities, Modes of instabilities: constant, increasing, and decaying amplitude.

Electric Propulsion Systems: Electro-thermal: resisto jet and arc jet, magneto plasma dynamic (MPD) electric thruster, Electro-static types of Ion, hall thrusters.

Text Books:

1. G. P. Sutton and D. M. Ross, Rocket Propulsion Elements, 8/e, John Wiley, 2010.
2. M. J. L. Turner, Rocket and Spacecraft Propulsion, 3/e, Springer Praxis, 2008

References:

1. H. S. Mukunda, Understanding Aerospace Chemical Propulsion, 1/e, Interline Publishing, 2004.
2. K. Ramamurthi, Rocket Propulsion, 2/e, Mach Millan, 2012.
3. H. G. Ang, P. Sreekumar, High Energetic Polymers, 1/e, Wiley, 2011.
4. Champak Jyoti Bora, Fundamentals of Rocket and Spacecraft Propulsion, 1/e, Lulu Publications, 2014.
5. Kubota, Propellants and Explosives: Thermo Chemical Aspects of combustion, 2/e, Wiley, 2008

Course Outcomes:

At the end of course student will be able to

1. Develops knowledge on working of rockets, missiles and space crafts (L6)
2. Exhibit desire to design and develop solid motor rockets systems(L4)
3. Exercises better choice across different engines and propellants(L3)

4. Understand, interpret and assess the performance of different rocket systems combustion instabilities(L2)
5. Appreciate the availability and usage of alternate advanced propulsion concepts(L5)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	2	2	1	1	1	2	1	2	2	1
CO2	2	1	3	2	1	2	2	1	2	1	1	1	2	2	1
CO3	2	2	2	1	1	2	1	1	1	1	2	1	2	1	1
CO4	2	2	1	1	1	1	2	1	2	1	2	1	2	1	1
CO5	2	1	1	1	1	2	2	1	1	1	1	1	1	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">AERO1021</td><td rowspan="2">COMPUTATIONAL METHODS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course is designed for Aerospace Engineering undergraduate students. It is designed for the students for the basic understanding of techniques for numerical solution of algebraic equations, differentiation, integration used to solve aerospace engineering application problems.

Course Educational Objectives:

- Develop the mathematical skills in the areas of numerical methods.
- Focus on the theory and applications of numerical methods in many engineering subjects which require solutions of linear systems, finding eigenvalues, eigenvectors, interpolation, and applications, solving ODEs, PDEs.
- Help in the foundation of computational mathematics for postgraduate courses, specialized studies, and research.
- Train in developing the codes for implementing the numerical methods using any programming languages.
- Formulate a mathematical model for a given engineering problem

UNIT 1 Mathematical Modeling of Engineering Problems 11 hours

Approximations: Accuracy and precision, round-off and truncation errors, error problem with example problems.

Roots of Equations: Formulations of linear and non-linear algebraic equations, solution with bisection, Newton-Raphson and Secant methods. Application to practical problems.

Algebraic Equations: Formulation of linear algebraic equations from engineering problems, solution of these problems by Gauss elimination method, pitfalls of elimination and techniques for improving the solutions, Gauss Seidel iteration for solving sparse equations by avoiding storage of zero coefficients in matrix, convergence of iteration methods. LU decomposition methods for symmetric (Chelosy) matrices.

UNIT 2 Eigenvalues and Eigenvectors Problems, Interpolation Methods and Regression or Curve Fitting 9 hours

Eigenvalues and Eigenvectors Problems: Formulation of equations to column, truss, spring-

mass and friction problems. Solutions for the largest and smallest eigenvalues and corresponding eigenvectors.
Interpolation Methods: Polynomial interpolation, Lagrange interpolation polynomials with equi- spaced data.
Regression or Curve Fitting: Linear regression by least squares method

UNIT 3 Initial Value Problems and Boundary Value Problems 9hours

Initial Value Problems: Ordinary differential equations, Euler, Heun's and Ralston methods. Runge- Kutta method of 2nd and 4th order, application to vibration and heat transfer problems.
Boundary Value Problems: Linear and nonlinear ordinary differential equations, boundary value problems over semi-infinite domain, solution of nonlinear equations by finite difference method.

UNIT 4 Laplace Equations and Parabolic Transient Diffusion Equations 9hours

Laplace Equations: Finite difference discretization of computational domain, different types of boundary conditions, solution to elliptic equations.
Parabolic Transient Diffusion Equations: Explicit and implicit formulation, Crank Nicolson Method.

UNIT 5 Numerical Integration 11hours

Trapezoidal, Simpson's 1/3 and 3/8 rule and Gauss quadrature method.

List of exercises for code development:

1. Raphson until the approximate error falls below 0.5
2. Solve the system of simultaneous linear equations by
   i. Determine the real root for a given polynomial equation by (i) Bisection, (ii) Newton- Naïve -Gauss elimination
   ii. Gaussian elimination with partial pivoting
   iii. Gauss -Seidal method.
   iv. **LU decomposition**
3. Implement power method to find Eigenvalues and Eigenvectors for Spring mass system
4. Solve the parabolic partial differential equations by using explicit, implicit and semi-implicit methods
5. Solve the elliptic partial differential equations by finite difference techniques.

6. Finding the integral for a second-order polynomial using Gauss quadrature formula.
7. Solve numerical differentiation problems using Runge-Kutta 2nd and 4th order methods. Find the integral by numerical methods such as Trapezoidal and Simpson's rule

Textbooks:

1. S.P. Venkateshan, P. Swaminathan, Computational Methods in Engineering, 1/e, Ane Publisher, 2014.
2. S.C. Chapra, R.P. Canale, Numerical Methods for Engineers, 6/e, Tata McGraw-Hill, 2012.

References:

1. S.K. Gupta, Numerical Methods for Engineers, 1/e, New Age International, 2005.

Course Outcomes:

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

1. Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.
2. Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
3. Analyse and evaluate the accuracy of common numerical methods.
4. Implement numerical methods using any programming language (matlab, scilab, python…)
5. Write efficient, well-documented code and present numerical results in an informative way.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	1	1	1	1	1	1	3	2	1
CO2	3	3	2	2	2	1	1	1	1	1	1	1	3	2	1
CO3	3	3	2	3	2	1	1	1	1	1	1	1	3	2	1
CO4	3	3	2	3	3	1	1	1	1	1	2	2	3	2	1
CO5	3	3	2	3	3	1	1	1	1	1	2	2	3	2	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">AERO2081</td><td rowspan="2">DESIGN PRACTICE FOR AEROSPACE ENGINEERING</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Flight Mechanics (AERO2051) & Aerodynamics -I (AERO2041)</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Aerodynamics – I (AERO2041)</td></tr>
</table>

Course Description:

This course is designed for aerospace engineering students. It introduces the basic principles of aircraft design practice

Course Educational Objectives:

- Familiarize students with the important issues and methodologies of aircraft design.
- Instruct the process of aircraft synthesis as an outcome of the integration of the disciplines of aerodynamics, performance, stability and control, propulsion, structures
- Provide the ability to function as a member of a team in a design setting; including the ability to conduct a peer review of the other team members.
- Impart the students with Federal Aviation Regulations as a means for ensuring passenger safety.
- Explain, enhance and develop technical design skills.

UNIT 1 Design Preliminaries 7 hours

Aircraft design requirements, specifications, and role of users, aerodynamic and structural consideration, and importance of weight. Classification of airplanes, special features of modern airplanes.

UNIT 2 Airplane Weight Estimation 6 hours

Weight estimation based on types of airplanes, trends in wing loading, weight-estimation based on mission requirements, iterative approach. Basics of wing design: selection of airfoil selection, influencing factors.

UNIT 3 Fuselage and Empennage design 6 hours

Volume considerations, aerodynamic considerations, drag estimation, spreadsheet for fuselage design. Horizontal and vertical tail design: tail arrangement, horizontal and vertical tail sizing, tail planform shape, airfoil section type, tail placement, spreadsheet for tail design.

UNIT 4 Landing Gears 6 hours

Different kinds of landing gears and associate arrangement for civil and military airplanes. Preliminary calculations for locating main and nose landing gears, landing gear arrangements, tire sizing, shock absorbers, castoring, wheel geometry, gear-retraction geometry, seaplanes and subsystems. Landing gear design and integration.

UNIT 5 **Engine selection** **5 hours**

Propulsion selection, number of engines, Engine ratings, turbojet engine sizing, propulsion system.

List of Experiments:

Any 8 experiments need to be performed by the student

1. Comparative configuration study of different types of airplanes
2. Comparative study on specification and performance details of aircraft
3. Preliminary weight estimations, selection of main parameters,
4. Power plant selection, aerofoil selection, wing tail and control surfaces
5. Preparation of layouts of balance diagram and three view drawings
6. Aircraft conceptual sketch and its gross weight estimation algorithm
7. V- n diagram for the design study
8. Gust and maneuverability envelopes
9. Preliminary weight estimation (rubber sizing)
10. Load or induced drag estimation
11. Airfoil and geometry selection, determination of thrust to weight ratio, wing loading.
12. Balancing and maneuvering loads on tail plane, aileron and rudder loads.

Text Books:

1. D. P. Raymer, Aircraft Design: A conceptual approach, 5/e, AIAA 2013.
2. T. D. Stinton, The Design of Airplane, 2/e, AIAA, 2001.
3. J. D. Anderson,, Airplane Performance and Design, International Edition, Tata McGraw Hill, 1999.

References:

1. L. M. Nicolai, G. E. Carichner, Fundamentals of Aircraft and Airship Design, AIAA Education Series, 2010.
2. J. Bertin, Aerodynamics for Engineers, 4/e, Pearson Education, 2002.
3. E. E. Scheler and L.G. Dunn, Airplane Structural Analysis and Design, John Wiley and Sons, 1963.

Course Outcomes:

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

1. Explain the design requirements for an aircraft based on fundamental principles and statistical data.
2. Evaluate the design specifications and discuss an aircraft design to meet the necessary

requirements
3. Apply engineering knowledge and applied skills to a design problem
4. Analyze design issues considering aerodynamics, propulsion, structure, weights, stability, cost, and performance
5. Design to a specified mission and generate a layout.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	1	1	1	1	1	1	1	1	1	3	1	1
CO2	2	2	2	2	1	1	1	1	1	1	1	1	2	1	1
CO3	3	1	2	2	1	1	1	1	1	1	1	1	3	1	1
CO4	2	2	2	2	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	2	1	1	1	1	1	2	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

Programme Electives

AERO1041	ASTRONOMY	L	T	P	S	J	C
		3	0	0	0	0	3
Prerequisite	None						
Co-requisite	None						
Preferable Exposure	None						

Course Description:

This course aims to cover the basics of astronomy, including the history of astronomy, observational techniques, Space science and technology and an overview of the universe.

Course Objectives:

- Explain Earth's motions in space: rotation and revolution.
- Classify objects in the solar system as stars, gas giants, terrestrial or other.
- Describe the importance of the electromagnetic spectrum to astronomers.
- Identify the parts of a star's lifecycle.
- Identify galaxy types and explain redshift and blueshift of light to explain expansion of the universe.

UNIT-1 Introduction

Introduction-Astronomy Exploring-Time and Space, Science and Historical Evidence, remote and inaccessible regions of space and time. Astronomy oldest science-The Night Sky, insignificant status ancient universe.

UNIT-2 Tools of Astronomy and Solar System

Revolution in telescope design, construction, astronomers an unprecedented set of tools, Exploring universe ,Matter and radiation-electromagnetic spectrum, spectra to measure the composition of distant objects and diagnose extreme physical conditions.

Solar system- Space probes, orbiters and rovers , Space exploration and beyond.

Unit-3 **Life in Universe and Cosmology**

Expoplanet-extrasolar planets , Stars are the crucibles of heavy element creation, the chaotic regions of their birth , Gravity is the ultimate victor, white dwarfs, neutron stars, and black holes.

Earth ringside physical element, chemical, geological, and biological evolution of a dynamic terrestrial planet.

Unit-4 **Space Science and Technology**

Knowledge of the Universe, Revolutions in Astronomy, Astronomy and its benefits, The Sun , Working principle of telescope, Stardust,Space Atmosphere,.

Unit-5 **Spectroscopy and Dark Energy**

Light and it's component parts,Fundamentals of astrophysics,Elements of mysterious dark energy, Computers and Killer rocks- meteors, meteoroids, asteroids and their detecting phenomenon,Detectors and First galaxies.

References:

- An Introduction to Modern Astrophysics" by Bradley W. Carroll and Dale A. Ostlie.
- The Essential Cosmic Perspective" by Jeffrey O. Bennett and Megan O. Donahue.
- A Book on 'Cosmos' by Carl Sagan.

Course Outcomes:

Upon completion of the course, students will be able to:

- Be inspired to continue and share their interest in astronomical advances and discoveries throughout their lives.
- Have a solid grounding in many areas of modern astronomy and their basic underlying physical principles.
- Know about and understand the observed properties of physical systems that comprise the known universe, on various scales.
- Demonstrate the ability to design, make, analyze, and interpret quantitative observations of celestial objects.
- Demonstrate their ability to communicate information clearly, logically, and critically, both orally and in writing, and to make presentations.

AERO3031	COMPUTATIONAL AERODYNAMICS	L	T	P	S	J	C
		2	0	2	0	0	3
Pre-requisite	Engineering Fluid Mechanics (AERO2021)						
Co-requisite	Computational Methods (AERO1021)						
Preferable exposure	None						

Course Description:

This course gives introduction to computational fluid dynamics and applications of CFD in various branches of engineering along with emphasis on finite difference approach in solving Navier-Stokes equations in solving different flow field problems.

Course Educational Objectives:

To make the student to:

- understand the forms of governing equations of fluid flow particularly best suited for CFD.
- classify the given system of partial differential equations and find the characteristics.
- understand basic aspects of finite difference and finite volume discretization.
- understand the various types of grid generation methods.
- understand various numerical schemes used in solving incompressible as well as compressible flow problems

UNIT 1 Introduction and Governing Equations and Physical Boundary Conditions 5 hours

Introduction: Applications of CFD in various branches of Engineering, models of fluid flow: finite control volume and infinitesimal fluid element.

Governing Equations and Physical Boundary Conditions: Continuity, momentum and energy equations, physical boundary conditions, significance of conservation and non-conservation forms and their implication on CFD applications - strong and weak conservation forms - shock capturing and shock fitting approaches.

UNIT 2 Mathematical Behavior of Partial Differential Equations and Their Impact on Computational Fluid Dynamics 5 hours

Classification of quasi-linear partial differential equations by Cramer’s rule and Eigenvalue method; General behavior of different classes of partial differential equations and their importance in understanding physical and CFD aspects of aerodynamic problems at different Mach numbers involving hyperbolic, parabolic and elliptic equations; Domain of dependence and range of influence for hyperbolic equations - well posed problems.

UNIT 3 **Basic Aspects of Discretization** **7 hours**

Introduction to finite differences, finite difference approximation for first order, second order and mixed derivatives. Difference equations: explicit and implicit approaches, truncation and round-off errors, consistency, stability, accuracy, convergence, efficiency of numerical solutions; Von-Neumann stability analysis and physical significance of CFL stability condition.

UNIT 4 **CFD Techniques** **7 hours**

Lax-Fredrich's technique, Lax-Wendroff technique, Mac Cormack's technique, Relaxation technique, aspects of numerical dissipation and dispersion. Pressure correction technique: application to incompressible viscous flow; Need for staggered grid. Numerical procedures: SIMPLE, SIMPLER algorithms, boundary conditions for pressure correction method.

UNIT 5 **Finite Volume Methods and Grid Types and Characteristics** **6 hours**

Finite Volume Methods: Basis of finite volume method, conditions on the finite volume selections, cell-centered and cell-vertex approaches, definition of finite volume discretization, general formulation of a numerical scheme, two-dimensional finite volume methods with example.
Grid Types and Characteristics: Need for grid generation, types of structured grids and unstructured grids.

CFD Laboratory

List of Experiments:

1. Introduction to anyone one of the suitable software employed in modeling and simulation of aerodynamic and structural problems
2. Numerical Solution for the following equations using finite difference and finite volume method (Code development).
    a) 1-D and 2-D Linear Convection equations using Lax – Fredrich and Lax Wendroff Techniques
    b) 1-D and 2-D Burger's Equations using Lax-Fredrich and Lax Wendroff Techniques
    c) One dimensional heat conduction equation using explicit and implicit method.
3. Numerical Simulation of the following flow problems using commercial packages:
    a) Simulation of flow through a Converging - Diverging nozzle
    b) Simulation of Supersonic flow over a flat plate and a wedge
    c) Simulation of Boundary Layer over a Flat plate
    d) Grid Generation of Aerofoil NACA 0012
    e) Simulation of laminar flow through pipe

Textbooks:

1. J. D. Anderson, Computational Fluid Dynamics: The Basics with Applications, 1/e, McGraw Hill, 2012.
2. 2. R. H. Pletcher , J. C. Tannehill , D. A. Anderson, Computational Fluid Mechanics and Heat Transfer, 3/e, Taylor and Francis, 2011.

References:

1. S. V. Patankar, Numerical Heat Transfer and Fluid Flow, 1/e, ANE Books, 1980.
2. C. Hirsch, Numerical Computation of Internal and External Flows: Fundamentals of Computational Fluid Dynamics, 2/e, Elsevier, 2007.
3. H. K. Versteeg, and W. Malalasekra, An Introduction to Computational Fluid Dynamics: The Finite Volume Method, 2/e, Pearson Education, 2010.
4. K. Muralidhar, and T. Sundararajan, Computational Fluid Flow and Heat Transfer, Narosa Publishing House, 1995.
5. T. K. Bose, Computational Fluid Dynamics, Wiley Eastern Limited, 1988.

Course Outcomes:

Students will be able to

1. identify the type of any partial differential equation whether it is parabolic, elliptic and hyperbolic.
2. write the canonical form of solution using the characteristics.
3. write the difference equations of the given partial differential equation.
4. formulate the finite difference and finite volume discretization for a given problem.
5. find the stability restrictions and convergence of a given numerical scheme.
6. identify the type of grid to be selected for a particular flow problem.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	1	1	1	1	1	1	3	3	2
CO2	3	3	2	2	2	1	1	1	1	1	1	1	3	2	1
CO3	3	3	3	3	3	1	1	1	1	1	2	2	3	3	2
CO4	3	3	2	1	1	1	1	1	1	1	2	2	3	2	1
CO5	3	3	3	1	1	1	1	1	1	1	2	2	3	2	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

AERO2091	WIND TUNNEL TECHNIQUES	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	Aerodynamics -I (AERO2041), Aerodynamics -II (AERO3001)						

Course Description:

This course is designed for Aerospace Engineering undergraduate students. This course aims to introduce fundamental aspects of wind tunnel testing.

Course Educational Objectives:

- Introduce different types of wind tunnels.
- Acquaint different pressure, velocity and force measurement techniques.
- Familiarize different aspects of wind tunnel calibration.
- Acquaint different flow visualization techniques.
- Familiarize different aspects in testing of aircraft and its various components.

UNIT 1 Wind Tunnel Testing 9 hours

Review of dimensional analysis, similitude, classification of wind tunnels and testing, different flow regime testing - subsonic, transonic, supersonic and hypersonic speed regions, layouts: sizing and design parameters.

UNIT 2 Wind Tunnel Measurements 9 hours

Pressure and velocity measurements, force measurements, three component and six component balances, internal balances.

UNIT 3 Calibration of Wind Tunnels 9 hours

Test section speed, horizontal buoyancy, flow angularities, turbulence measurements, associated instrumentation, and calibration of supersonic tunnels.

UNIT 4 Flow Visualization and Non-Intrusive Flow Diagnostics 9 hours

Flow Visualization: Smoke and tuft grid techniques, dye injection special techniques, optical methods of flow visualization.

Non-Intrusive Flow Diagnostics: Laser-doppler anemometry, particle image velocimetry, laser induced fluorescence.

UNIT 5 **Aircraft and Component Testing** **9 hours**

General test procedures, components, complete configuration, power effects, propeller aircraft, jet aircraft and V/STOL vehicles.

Text Books:

1. A. Pope and L Goin, High Speed Wind Tunnel Testing, John Wiley, 1985.
2. J. B. Barlow, W. H. Rae, A. Pope, Low Speed wind Tunnel Testing, 3/e, John Wiley, 2010.

References:

1. E. Rathakrishnan, Instrumentation, Measurements, and Experiments in Fluids, CRC Press, 2007.
2. Bradsaw "Experimental Fluid Mechanics", Pergamon Press, 2nd Revised edition,1970, ISBN-13: 978-0080069814
3. Short term course on Flow visualization techniques, NAL, 2009
4. Lecture course on Advanced Flow diagnostic techniques 17-19 September 2008 NAL, Bangalore

Course Outcomes:

After the completion of this course the student will be able to

1. Classify and explain different types of wind tunnels and its components.
2. Explain the principle behind the different techniques used for measuring pressure, velocity and force in a wind tunnel.
3. Explain the various parameters that need to be considered during the calibration of the wind tunnel.
4. Explain the principle behind the different intrusive and non-intrusive flow visualization techniques used in wind tunnels.
5. Explain the general test procedure of an aircraft and its various components.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	3	2	1	1	2	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1			1	1	1	1	1	2	1	1
CO4	3	2	1	1	2	1	1	1	1	1	1	1	2	1	1
CO5	3	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">AERO3041</td><td rowspan="2">BOUNDARY LAYER THEORY</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Engineering Fluid Mechanics (AERO2021)</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course is designed for Aerospace Engineering undergraduate students. This course aims to introduce and explain the fundamental concepts of laminar and turbulent boundary layers.

Course Educational Objectives:

- Provide an insight into development of boundary layer in various flow situations.
- Introduce Navier-Stokes equations and some of its exact solutions.
- Familiarize governing equations of laminar and turbulent flows.
- Familiarize exact and approximate methods to solve laminar boundary layer equations.
- Acquaint the basic concepts of compressible boundary layer.

UNIT 1 Introduction 8 hours

Description of flow along a solid surface, development of boundary layer along a flat plate, different measures of boundary layer thickness, boundary layer with pressure gradient, flow separation, boundary layer at inlet of pipe, flow through diffuser, flow over symmetrical and bluff bodies, form drag and skin friction drag, dependence of drag coefficient on Reynolds number

UNIT 2 Navier-Stokes Equation and Exact Solution of Navier-Stokes Equation 10 hours

Navier-Stokes Equation: Relation between stress and strain system in a solid body (Hooke's law), relation between stress and strain rate system in liquids and gases (Stokes law), Navier-Stokes equations - general properties of Navier-Stokes equation.

Exact Solution of Navier-Stokes Equation: Two-dimensional flowthrough a straight channel, Hagen-Poiseuille flow, suddenly accelerated plane wall, flow near a rotating disk, and parallel flow past a sphere.

UNIT 3 Laminar Boundary Layer 11hours

Simplified form of boundary layer equations, Blasius solution for flat plate, thermal boundary layer over an isothermal plate, Falkner-Skan wedge flow, momentum and energy integral equations for the boundary layers, one parameter integral methods: Pohlhausen method and Thwaites method. Application of integral methods to flow past a flat plate and a circular cylinder.

UNIT 4 Turbulent Boundary Layer 10hours

Two-dimensional turbulent boundary layer equations, eddy viscosity, integral relations, turbulent boundary layer on a flat plate, velocity profiles: law of the wall, logarithmic law and law of the wake, turbulent flow in pipes and channels.

UNIT 5 Compressible Boundary Layer 6 hours

Compressible boundary layer equation, recovery factor, similarity solutions, laminar supersonic cone rule and shock-boundary layer interaction.

Text Books:

1. H. Schlichting, Boundary Layer Theory, 7/e., McGraw-Hill, 1979.
2. F. M. White, Viscous Fluid Flow, 2/e, McGraw Hill, New York, 1991.

References:

1. A. J. Reynolds, Turbulent Flows in Engineering, John Wiley, 1980.
2. R. L. Panton., Incompressible Flow, John Wiley, 1984.
3. L. Rosenhead., Laminar boundary layers, Dover Publications, 1963.

Course Outcomes:

After the completion of this course the student will be able to

1. Illustrate And Explain The Development Of Boundary Layer In Various Flow Situations.
2. Apply Navier-Stokes Equation To Analyse Various Internal And External Flow Problems.
3. Develop Similarity Solutions For Velocity And Thermal Boundary Layer Over A Flat Plate And Also Apply Integral Methods.
4. Explain The Differences Between The Governing Equations Of Laminar And Turbulent Boundary Layers And Also Compare The Velocity Profiles In Pipes, Channel And Flat Plate In These Flows.
5. Explain The Differences Between The Governing Equation Of Compressible And Incompressible Boundary Layer And The Interaction Of A Shock Wave With The Boundary Layer.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1
CO2	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1
CO3	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1
CO4	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1
CO5	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">AERO2101</td><td rowspan="2">INDUSTRIAL AERODYNAMICS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Engineering Fluid Mechanics (AERO2021), Aerodynamics -I (AERO2041)</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course is intended for graduate students in the area of fluid dynamics, wind engineering, and Aerodynamics

Course Educational Objectives:

- Familiarize the learner with non-aeronautical uses of aerodynamics such as road vehicle, building aerodynamics and problems of flow induced vibrations
- Impart this course offers an introduction to industrial aerodynamics and wind engineering with the main characteristics of natural winds.
- Support the characteristics of velocity profiles and atmospheric turbulence are described along with the effects of upstream exposure.
- Develop wind speed and turbulence models for inhomogeneous upstream exposures are presented in comparison with atmospheric measurements and wind-tunnel simulations.
- Explain basic elements of wind-building interaction in the time-averaged mode for uniform and boundary layer flows are described, external and internal pressures and forces on buildings with emphasis on design significance are discussed.

UNIT 1 Atmospheric Boundary Layer 9 hours

Atmospheric circulation, local winds, terrain types, mean velocity profiles, power law and logarithm law. Wind speeds, turbulence profiles, roughness parameters and simulation techniques in wind tunnels.

UNIT 2 Wind Energy Collectors 9 hours

Horizontal and vertical axis machines, energy density of different rotors, power coefficient, Betz coefficient by momentum theory.

UNIT 3 Bluff Body Aerodynamics 9hours

Boundary layers and separation, two dimensional wake and vortex formation. Strouhal and

Reynolds number, separation and reattachments, power requirements and drag coefficients of automobiles, effects of cut back angle, aerodynamics of trains.

UNIT 4 **Building Aerodynamics** **9hours**

Pressure distribution on low rise buildings, wind forces on buildings, environmental winds in city blocks and special problems of tall buildings. Basic information about the wind flow around isolated buildings and generic building groups.

UNIT 5 **Flow Induced Vibrations** **9 hours**

Effect of Reynolds number on wake formation of bluff shapes, vortex induced vibrations, vortex shedding, galloping - wind galloping of circular cables, oscillation of tall structure and launch vehicles under wind loads and stall flutter.

Text Books:

1. M. Sovran, Aerodynamics and Drag Mechanisms of Bluff Bodies and Road Vehicles, Plenum press, 1978.
2. P. Sachs, Winds Forces in Engineering, Pergamon Press, 1978
3. R. D. Blevins, Flow Induced Vibrations, Van Nostrand, 1990.

References:

1. R. S. Scorer, Environmental Aerodynamics, Ellis Harwood, 1978.
2. R. McAllen, F. Browand, J. Rose, The Aerodynamics of Heavy Vehicles: Trucks, Buses and Trains, Springer Berlin, 2004.
3. R. D. Blevins, Flow Induced Vibrations, Van Nostrand, 1990.
4. N. G. Calvert, Wind Power Principle, Charles Griffin and Co, 1997

Course Outcomes:

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

1. To understand the concepts of industrial aerodynamics and wind engineering with the main characteristics of natural winds.(L2)
2. To impart knowledge of external and internal pressures and forces on buildings and vehicles with emphasis on design significance (L3)
3. use of aerodynamics for non- aerodynamics such as vehicle building.(L2)
4. Solve the problems and be able to analyze vibrations during flow.(L3)
5. Apply the problems on effect of Reynolds number on wake formations (L3)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1	1	1	1	1	2	1	2	1	2
CO2	2	3	1	1	1	1	1	1	1	1	1	1	3	1	1
CO3	3	2	1	1	1	1	1	1	1	1	2	1	2	1	2
CO4	2	3	1	1	1	1	1	1	1	1	2	1	2	1	1
CO5	3	2	1	1	1	1	1	1	1	1	1	1	1	1	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

AERO2111	FLAPPING WING AERODYNAMICS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**Aerodynamics -I (AERO2041)**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

This course is designed for aerospace engineering students. It introduces the fundamentals of flapping wing aerodynamics. This course is designed to acquaint the learners with aerodynamics of birds, insects and low Reynolds number flyers which is useful for understanding the mechanism of Bio- inspired MAVs and UAVs.

Course Educational Objectives:

- To impart the various aspects of aerodynamics of natural flyers such as birds, bats, and micro aerial vehicles.
- To familiarize the role of structural flexibility of low Reynolds number wing aerodynamics.
- To acquaint the flight stability for flapping wings and also the passive control.
- To exhibit the insight into low Reynolds number flight science while providing guidelines for vehicle development

UNIT 1 **Introduction** **9 hours**

Flapping flight in nature, scaling, geometrical similarity, wing span, wing area, wing loading, aspect ratio, wing - beat frequency. Mechanics of gliding, forward and hovering flight - gliding and soaring, powered flight flapping - power implication of flapping wings.

UNIT 2 **Rigid Fixed-Wing Aerodynamics** **9 hours**

Laminar separation and transition to turbulence - Navier-Stokes equation and the transition model, factors affecting low Reynolds number aerodynamics, 3D wing aerodynamics.

UNIT 3 **Rigid Flapping Wing Aerodynamics** **9hours**

Flapping wing and body kinematics, governing equations and non-dimensional parameters - Reynolds number, Strouhal number and reduced frequency. Unsteady aerodynamics mechanism in flapping wings - leading edge vortices, wake capture, tip vortices, clap and fling mechanism.

UNIT 4 **Flow Physics at Low Reynolds Numbers** **9hours**

Flow physics in ‘O’ regime, effects of kinematics on hovering airfoil performance, effects of wind gust on hovering aerodynamics. Flow around a flat plate in shallow and deep stall, airfoil shape effects; force prediction for pitching and plunging.

UNIT 5 **Flexible Wing Aerodynamics** **9 hours**

Introduction, governing equations for wing structures, linear membrane model, hyperplastic membrane model, flat plate and shell models, flapping flexible wings, non-dimensional wing tip deformation parameters, scaling and lift generation of hovering flexible wing of insect size, power input efficiency.

Text Books:

1. W. Shyy, H. Aono, C. K. Kang, H. Liu, An Introduction to Flapping Wing Aerodynamics, Cambridge University Press, 2015.

References:

1. Muller and Thomas, Fixed and Flapping Wing Aerodynamics for Micro Air Vehicle Applications, AIAA, 2002.
2. J. E. Toomey, Proquest, Numerical and Experimental Studies of flexibility in Flapping Wing Aerodynamics, Umi Dissertation Publishing, 2011.
3. Wei Shyy, YongshengLian,Jian Tang, Dragos vileru,HaoLiu,Aerosynamics of low reynold number flyers, Cambridge Aerospace Series, 2008

Course Outcomes:

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

1. Apply the knowledge of low Reynolds number for natural flyers and manmade flyers.
2. Demonstrate the aerodynamics of fixed, rigid and flapping wings
3. Analyze the implications of laminar-turbulent transition, multiple time scale,
4. Exhibit aerofoil shapes and Time-dependent structural and fluid dynamics of flapping wing body.
5. Differentiate the aerodynamic flow behavior of rigid, flexible and hovering wings

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1	1	1	1	1	2	1	3	1	2
CO2	3	2	1	1	1	1	1	1	1	1	2	1	2	1	2
CO3	2	2	1	1	1	1		1	1	1	1	1	3	1	1
CO4	2	2	1	1	1	1	1	1	1	1	2	1	2	1	2
CO5	2	2	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">AERO2121</td><td rowspan="2">EXPERIMENTAL TECHNIQUES</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">PHYS1001: Physics</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course is designed for Aerospace Engineering undergraduate students. It is designed for the students to understand the basics principles of Measurements, Instrumentation and Experimental Methods of Stress Analysis. Understanding these principles will help them in the Design, Analysis and Testing of Aerospace Structures.

Course Educational Objectives:

- To explain different principles of measurement.
- To familiarize various instruments required for measurement
- To focus on electrical resistance strain gauges
- To impart knowledge on optical methods for stress analysis
- To help the students to understand Non-destructive testing techniques.

UNIT 1 Measurements and Extensometers 9 hours

Principles of measurements, accuracy, sensitivity and range of measurements, extensometers – types and uses of acoustic, mechanical, electrical, electronic, optical and laser, basic electrical components, resistance thermometers, thermocouples, dynamic response of temperature sensors, flow velocity, flow rates in closed systems by pressure variation measurements.

UNIT 2 Instru mentation for Engineering Measurements 8 hours

Applications of electronic instrument systems, engineering analysis, experimental error, general characteristics of recording instruments, voltmeters for slowly and rapidly varying signals, eddy-current sensors, signal conditioning circuits, data acquisition system.

UNIT 3 Strain Measurement Methods and Strain Gauges 10 hours

Introduction to strain measurements and strain gauges, electrical resistance strain gages, strain gage circuits and instrumentation, strain sensitivity of a strain gage, bridge sensitivity, Rosettes, strain gauge alloys, carriers and adhesives, performance of strain gauge system, temperature compensation, two-wire and three-wire circuits, strain gauge selection, bonding of a strain gauge, soldering, accounting for transverse sensitivity effects.

UNIT 4 Optical methods of Stress analysis 9 hours

Introduction to optics, photoelasticity, applied photoelasticity, two dimensional and three-dimensional photoelasticity, interferometry and holography, Moiré method, Moiré interferometry, polariscope - circular and plane, speckle methods -subjective, objective, digital image correlation, optical methods for determining fracture parameters.

UNIT 5 Non-Destructive Testing 9 hours

Fundamentals of non-destructive testing, radiography, ultrasonics, holography, laser holography magnetic particle inspection, fluorescent penetrant technique, eddy current testing, acoustic emission technique, X-ray applications, ultrasonic C-scan, thermograph, fiber- optic sensors.

Textbooks:

1. J. W. Dally, W. F. Riley, K. G. McConnell, Instrumentation For Engineering measurements, 2/e, John Wiley and Sons, 1984.
2. P. Fordham, Non-Destructive Testing Techniques, Business PublicationsLimited, 1988.

References:

1. J. W. Dally and M. F. Riley, Experimental Stress Analysis, 3/e, McGraw Hill,1988.
2. L. S. Srinath, M. R. Raghavan, K. Lingaiah, G. Gargesa, B. Pant, And K.Ramachandra, Experimental Stress Analysis, Tata McGraw Hill, 1984.
3. M. Hetenyi, Handbook of Experimental Stress Analysis, John Wiley and Sons,1980.
4. G. S. Holister, Experimental Stress Analysis, Principles and Methods,Cambridge University Press, 1987.

Course Outcomes:

After the completion of this course student will be able to

1. summarize the function of basic electrical components involved in measurement
2. select proper electronic and recording instruments for a given application
3. build strain gauge circuits and use them for strain measurements
4. apply the optical methods for determining fracture parameters
5. choose and make use of proper Non-destructive testing technique based on the requirement

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	0	1	0	0	1	1	1	0	2	1	2	1
CO2	2	1	1	1	2	1	0	1	1	1	0	2	2	2	1
CO3	2	2	2	1	2	1	0	1	1	1	1	2	2	1	1
CO4	2	2	2	2	2	1	1	1	1	1	1	2	2	3	1
CO5	2	2	2	2	2	1	1	1	1	1	1	2	2	3	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">AERO3051</td><td rowspan="2">HYPERSONIC AERODYNAMICS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Aerodynamics -II (AERO3001)</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course is designed for aerospace engineering students. It introduces the fundamentals on hypersonic flows and their characteristics. This course is designed to acquaint the learners with methods used for hypersonic flows and different experimental facilities available to understand the hypersonic flow behavior

Course Educational Objectives:

- Explain the flow behavior at hypersonic flows.
- Impart knowledge on the physics of shock-interactions under different conditions.
- Explain the theory used for predicting the flow characteristics at hypersonic speeds.
- Familiarize about the experimental test facilities available for hypersonic flows.
- Explain the concept of boundary layers in hypersonic flows.

UNIT 1 **Basics of Hypersonic Aerodynamics** **8hours**

Introduction to hypersonic aerodynamics, thin shock layers, entropy layers, low density and high-density flows, hypersonic flight paths, hypersonic flight similarity parameters, shock wave and expansion wave relations of inviscid hypersonic flows.

UNIT 2 **Surface Inclination Methods for Hypersonic Inviscid Flows** **8 hours**

Local surface inclination methods and modified Newtonian law. Newtonian theory, tangent wedge/ tangent cone and shock expansion methods, calculation of surface flow properties.

UNIT 3 **Approximate Methods for Inviscid Hypersonic Flows** **10 hours**

Approximate methods hypersonic small disturbance equation and theory. Thin shock layer theory, blast wave theory, entropy effects, rotational method of characteristics, hypersonic shock wave shapes and correlations.

UNIT 4 Viscous Hypersonic Flow Theory 9hours

Navier-Stokes equations, boundary layer equations for hypersonic flow, hypersonic boundary layer theory and non-similar hypersonic boundary layers, hypersonic aerodynamic heating and entropy layers effects on aerodynamic heating.

UNIT 5 Viscous Interactions in Hypersonic Flows and Shock Tube Based Experimental Facilities 9 hours

Viscous Interactions in Hypersonic Flows: Strong and weak viscous interactions, hypersonic shockwaves and boundary layer interactions, role of similarity parameter for laminar viscous interactions in hypersonic viscous flow.
Shock Tube Based Experimental Facilities: Impulse facilities, hypersonic wind tunnels, shock tunnels, gun tunnels, and heat transfer measurements.

Text Books:

1. J. D. Anderson, Hypersonic and High Temperature Gas Dynamics, 2/e, McGraw Hill, 2002.
2. P. Curtis, The Shock tube, Kindle edition, Dream Engine Interactive limited, 2014.

References:

1. J. J. Bertin, Hypersonic Aerothermodynamics, AIAA Education series, 1994.
2. Y. Burtschell, R. Brun, and D. Zeitoun, Shock Waves, 1/e, Springer Verlag, 1992.

Course Outcomes:

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

1. apply the knowledge of hypersonic flow conditions for various configurations.
2. apply the knowledge of shock-boundary layer interactions in the design of supersonic combustion engines.
3. apply the knowledge of shock-shock interactions in the design of missile body or re-entry vehicle design.
4 design and test any model in shock tunnels in order to understand the high temperature effects in hypersonic flows.
5 obtain knowledge about the application of heat transfer measurements in high speed experimental test facilities.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**2**	**1**	**1**	**2**	**1**	**2**	**2**	**0**	**1**	**1**	**2**	**2**	**1**	**2**
CO2	**3**	**2**	**1**	**0**	**1**	**2**	**1**	**1**	**1**	**2**	**0**	**2**	**1**	**2**	**1**
CO3	**3**	**1**	**1**	**2**	**0**	**0**	**1**	**0**	**1**	**1**	**2**	**1**	**3**	**1**	**2**
CO4	**3**	**1**	**0**	**1**	**3**	**1**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**3**
CO5	**2**	**1**	**1**	**1**	**1**	**0**	**1**	**1**	**0**	**1**	**0**	**1**	**3**	**1**	**2**

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">AERO3061</td><td rowspan="2">INTRODUCTION TO FINITE ELEMENT ANALYSIS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Computational Methods (AERO1021)</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">FEA lab</td></tr>
</table>

Course Description:

This course is designed for aerospace engineering students. It introduces the basic principles of finite element procedure. This course is designed to acquaint the learners with finite element solutions to structural and thermal problems and deals with the realistic engineering problems.

Course Educational Objectives:

- To learn basic principles of finite element analysis procedure.
- To develop the ability to generate the governing FE equations for systems governed by partial differential equations.
- To learn and apply finite element solutions to structural, thermal, dynamic problem to develop the knowledge and skills needed to effectively evaluate finite element analyses performed by others.
- To develop proficiency in the application of the finite element method (modeling, analysis, and interpretation of results) to realistic engineering problems

UNIT 1 Introduction and Interpolation models 6 hours

General description of the finite element method, Engineering applications of finite element method. Review of various approximate methods and application to structural mechanics problems , strain - displacementrelations, stress-strain relationship ,temperature effects, Potential energy method, Rayleigh-Ritz method, Galerkin's method.
Interpolation models: Simplex , complex and multiplex elements

UNIT 2 Discrete Elements, Plane trusses and Beam Element 7 hours

Discrete Elements: One-Dimensional Bar elements- shape functions , uniform section, mechanical and thermal loading, assembly of the global stiffness matrix and load vector, treatment of boundary conditions, quadratic shape functions, temperature effects.
Plane Trusses- local and global co-ordinate system**.**
Beam Element – problems for various loadings and boundary conditions – 2D and 3D Frame elements.

UNIT 3 Continuum Elements and Axisymmetric Elements 6 hours

Continuum Elements: Constant strain triangle- Element matrices for constant and linear strain triangular elements , problem modelling and boundary conditions, isoperimetric representation, element stiffness, force terms, stress calculations. Plane stress, plane strain relations. **Axisymmetric Elements-** Axisymmetric formulation, strain displacement relations, stiffness matrix, body force terms.

UNIT 4 Two-dimensional Isoperimetric Elements and Numerical Integration 9hours

Four-node quadrilateral element, shape functions, element stiffness matrix, element force vector. Numerical integration, Gauss quadrature, one dimension and two-dimension integrals, stiffness integration, stresses calculations.

UNIT 5 Scalar Field Problems and Dynamic Considerations 5 hours

Scalar Field Problems: Steady state heat transfer, one dimensional heat conduction and heat transfer in thin fins.

Dynamic Considerations: Formulation, solid body with distributed mass, element mass matrices, evaluation of eigen values and eigenvectors

FEA Laboratory

List of Experiments:

1. Analysis using 1-D element
   a. Stepped bar under axial load.
   b. Truss with transverse loads and thermal loads.
2. Analysis using plane stress: Stress concentration in rectangular plate with a hole
   a. With full geometry
   b. Half geometry
   c. Symmetric boundary condition with 16, 64, 256 elements and study of convergence
3. Axi-symmetric element
   a. Thick cylinder subjected to internal pressure.
4. Beams:
   a. Cantilever with concentrated loads, UDL with 16, 64,256 elements
      i. Cantilever with roller support at free end, uniformly distributed load.
      ii. Propped cantilever with uniformly distributed load
   b. Simply supported beam
      i. Concentrated load, uniformly distributed load with 16, 64,256 elements

ii. Simply supported beam with inverted L (Γ) bracket at the centre concentrated

Text Books:

1. Tirupathi R. Chandrupatla, Ashok D. Belegundu, Introduction to Finite Elements in Engineering, 3/e, Pearson Education, 2009.
2. Reddy. J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw-Hill, 2005

References:

1. S.S.Rao, Finite Element Method in Engineering, Elsevier Butterworth-Heinmenn Publications, 2013.
2. J.N. Reddy, An Introduction to the Finite Element Method, 3/e, McGraw-Hill Publications, 2006.
3. Robert D. Cook, David S. Malkus, Michael E. Plesha, Rober J. Witt, Concepts and Applications of Finite Element Analysis, 4/e, Wiley India 2001.
4. Logan, D.L., "A first course in Finite Element Method", Thomson Asia Pvt. Ltd., 2002

Course Outcomes:

1. Understand the numerical methods involved in Finite Element Theory
2. Apply the role and significance of shape functions in finite element formulations and use linear, quadratic, and cubic shape functions for interpolation
3. Understand global, local, and natural coordinates and formulation of one-dimensional elements (truss and beam)
4. Formulate two-dimensional elements ,three dimensional and axisymmetric element.
5. identify how the finite element method expands beyond the structural domain, for problems involving dynamics, heat transfer, and fluid flow.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**3**	**2**	**2**
CO2	**2**	**2**	**2**	**1**	**1**	**0**	**1**	**1**	**1**	**1**	**2**	**1**	**2**	**1**	**2**
CO3	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**0**	**1**	**2**	**1**	**2**	**1**	**2**
CO4	**2**	**2**	**1**	**1**	**1**	**0**	**1**	**1**	**1**	**1**	**2**	**0**	**2**	**3**	**2**
CO5	**3**	**2**	**1**	**1**	**1**	**2**	**1**	**1**	**0**	**1**	**2**	**1**	**2**	**2**	**2**

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

AERO3071	ADVANCED AEROSPACE STRUCTURES	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**Solid Mechanics (AERO2001), Engineering Mechanics (MECH2001), Analysis of Aerospace Structures (AER03011)**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

This course is designed for Aerospace Engineering undergraduate students. It is designed to understand the advanced principles of mechanics of different components of aircraft structures. Understanding these principles will help them in the Design and Analysis of Aerospace Structures.

Course Educational Objectives:

- Provide basic concepts to size practical aerospace structures given representative loads and other parameters.
- Learn to compute stresses for different aerospace structural components.
- Develop skills to design simple aerospace structures to support mechanical loads.
- Develop a mind set to understand the advanced aircraft structures.

UNIT 1 **10hours**

Stress Analysis of Wing Spars and Box Beams: Tapered beams of single web, open and closed section beams and beams having variable stinger areas.
Stress Analysis of Fuselages: Bending, shear and torsion of fuselage, cutouts in fuselages.

UNIT 2 **10 hours**

Stress Analysis of Wings: Bending, shear and torsion of wings, shear centre, tapered wings, deflections and cut-outs in wings.
Stress Analysis of Fuselage Frames and Wing Ribs: Principles of stiffener/ web construction, fuselage frames, wing ribs

UNIT 3 **11hours**

Structural and Loading Discontinuities in Thin Walled Beams: Closed section beams: shear stress distribution of a closed section beam built in at one end under bending, shear and torsion loads, semi monocoque. Open section beams: I section beam subjected to torsion, torsion of beam of arbitrary section, torsion bending constant and shear lag.

UNIT 4 **7hours**

Fatigue: Safe life and fail-safe structures, designing against fatigue, fatigue strength of components, prediction of aircraft fatigue life, crack propagation.

UNIT 5 **7 hours**

Fracture Mechanics: Strength of cracked bodies, potential energy and surface energy; Griffith's theory, Irwin-Orwin extension of Griffith's theory to ductile materials, stress analysis of cracked bodies, effect of thickness on fracture toughness, stress intensity factors for typical geometries

Text Books:

1. T. H. G. Megson, Aircraft Structures for Engineering Students, 5/e, Elsevier, 2013.
2. J. F. Knott, Fundamentals of Fracture Mechanics, Butterworth and Co., 1983.

References:

1. E. F. Bruhn, R. J. H. Bollard, Analysis and Design of Flight Vehicles Structures, Jacob Publishing, 1973.
2. B. K. Donaldson, Analysis of Aircraft Structures an Introduction, 2/e, Cambridge University Press, 2012.
3. D. William, E. Arnold, An Introduction to the Theory of Aircraft Structures, Elsevier, 2013.
4. E. H. Dowell, A Modern course in Aeroelasticity, 5/e, Springer International Publishing, 2014.

Course Outcomes:

After the completion of this course student will be able to

1. Perform the stress analysis of wing spars, box beams and fuselages subjected to mechanical loads. (L3)
2. Analyse aircraft wings, wing ribs and fuselage frames under loading (L2)
3. Analyse the effect of structural and loading discontinuities on thin walled beams (L2)
4. solve problems of fatigue damage and calculate fatigue-crack growth under aircraft spectrum loading.(L3)
5. Apply the principles of fracture mechanics to analyse aircraft structures (L3)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	3	2	1	1	1	1	1	1	1	1	1	1	2	2	1
CO3	3	2	1	1	1	1	1	1	1	1	1	1	2	2	1
CO4	3	2	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	3	2	1	1	1	1	1	1	1	1	1	1	2	2	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

AERO3081	VIBRATIONS AND ACOUSTICS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**Engineering Mechanics (MECH2001)**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

This course is designed for aerospace engineering students. It introduces the fundamentals of vibration and acoustics. This course is designed to acquaint the learners with vibration theory involved in the mechanical system, dynamic behavior of the system and sound and wave propagation.

Course Educational Objectives:

- To impart the fundamental concepts of vibration theory and dynamic modeling methods
- To acquaint to mathematically model real-world mechanical vibration problems
- To assess fluctuations and acoustic processes in nature in different forms.
- To understand the role of damping, stiffness and inertia in mechanical systems.
- Develops methods and understanding of analyzing vibrations in mechanical systems, which are closely related to acoustics engineering problems.

UNIT 1 — Free Vibration of Single Degree of Freedom Systems — 8 hours

Free Vibration of Single Degree of Freedom Systems: Introduction, free vibration of an undamped translational system, free vibration of an undamped torsional system, stability conditions, Rayleigh's energy method, free vibration with viscous damping, Coulomb damping and hysteretic damping.

UNIT 2 — Harmonically Excited Vibrations and Two Degree of Freedom System — 10 hours

Harmonically Excited Vibrations: Introduction, equations of motion, response of undamped and damped systems under harmonic excitation, harmonic motion of the base and rotating unbalance.

Two Degree of Freedom System: Equations of motion for forced vibration, free vibration analysis of an undamped system, torsional system

UNIT 3 **Multi Degrees of Freedom Systems and Determination of Natural Frequencies and Mode Shapes:** **10hours**

Multi Degrees of Freedom Systems: Introduction, modeling of continuous systems as multi degree of freedom systems, Newton's second law to derive equations of motion, influence coefficients, generalized coordinates and generalized forces, Lagrange's equation to derive the equation of motion, Eigenvalue problem and solution.
Determination of Natural Frequencies and Mode Shapes: Introduction, Dunkerley's formula, Rayleigh's method.

UNIT 4 **Introduction to Acoustics** **9hours**

Introduction, wave equation, traveling wave solutions, acoustic energy corollary, impedance and admittance, standing wave solutions.

UNIT 5 **Propagation and Noise Reduction** **9 hours**

Effect of area and temperature variation on wave propagation, wave equation in cylindrical coordinates and its applications, Rayleigh's criteria, noise reduction techniques.

Text Books:

1. S. S. Rao, Mechanical Vibrations, 4/e, Pearson Education Inc., 2009.
2. F. Fahy and P. Gardonio, Sound and Structural Vibration: Radiation, Transmission and Response, 2/e, 2007.

References:

1. L. Meirovich, Elements of Vibration Analysis, 2/e, Tata McGraw Hill 2007.
2. L. E. Kinsler, A. R. Frey, A. B. Coppens and J. V. Sanders, Fundamentals of Acoustics, 4/e, Wiley, 2000.
3. L. Cremer, M. Heckl and B. A. T. Peterson, Structure Borne Sound, 3/e, Springer-Verlag, 2005
4. G. K. Grover, Mechanical Vibrations, 8/e, NemChand and Brothers, 2009

Course Outcomes:

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

1. understand complex system behavior including interactions between components and with other systems.
2. develop schematic models for physical systems and formulate governing equations of motion
3. analyze rotating and reciprocating systems and compute critical speeds
4. develop models using appropriate tools such as computer software, laboratory equipment and other devices.
5. evaluate different acoustic system designs and formulate the design of acoustic targets.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	2	1	1	1	1	1	1	3	1	1
CO2	3	2	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	2	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	2	1	1	1	1	1	1	1	1	1	1	2	1	0
CO5	2	2	1	1	1	1	1	1	1	1	1	1	2	1	0

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

AERO3091	THEORY OF ELASTICITY	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**Solid Mechanics (AERO2001)**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

This course is designed for Aerospace Engineering undergraduate students. It is designed to understand the basics principles of Theory of Elasticity. Understanding these principles will help them in the Design and Analysis of Aerospace Structures.

Course Educational Objectives:

- To familiarize notations and sign conventions for stress and strain
- To impart knowledge on basic equations of elasticity
- To help to understand plane stress and plane strain conditions
- To explain the elasticity problems using polar coordinates
- To focus on torsion of prismatic bars

UNIT 1 **8hours**

Introduction: Definitions, sign conventions for stress and strain, equations of equilibrium, principal stresses and principal strains, Mohr's circle, Saint-Venant's principle.

UNIT 2 **10 hours**

Basic Equations of Elasticity: Strain-displacement relations, stress-strain relations, Lame's constant cubical dilation, compressibility of material, bulk modulus, shear modulus, Compatibility equations for stresses and strains.

UNIT 3 **9hours**

Plane Stress and Plane Strain Problems: Airy's stress function, biharmonic equations, polynomial solutions, simple two-dimensional problems in Cartesian coordinates like bending of cantilever and simply supported beams, etc.

UNIT 4 **10hours**

Polar Coordinates: Equations of equilibrium, strain-displacement relations, stress-strain relations, axi-symmetric problems, Kirsch, Michell's and Boussinesq problems.

UNIT 5 **9 hours**

Torsion of Prismatic Bars: Navier's theory, St. Venant's theory, Prandtl's theory on torsion, the semi- inverse method and applications to shafts of circular, elliptical, equilateral triangular and rectangular sections.

Text Books:

1. S. Timoshenko and T. N. Goodier, Theory of Elasticity, 3/e, Tata McGrawHill, 2010.

References:

1. E. Volterra and J. H. Caines, Advanced Strength of Materials, Prentice Hall, 1991.
2. C. T. Wang, Applied Elasticity, McGraw Hill, 1993.
3. R. B. Hetnaarski and J. Ignaczak, Mathematical Theory of Elasticity, CRCPress, 2011.
4. J. R. Barber, Elasticity, Springer, 2010.

Course Outcomes:

After the completion of this course student will be able to

1. Apply proper sign conventions in the given problems
2. Develop basic equations of elasticity
3. Solve two dimensional problems in Cartesian and polar coordinates
4. Apply equations of elasticity in polar coordinates to solve axi-symmetric problems
5. Analyse prismatic bars under torsion

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1	1	1	1	1	1	1	3	2	1
CO2	3	2	1	1	1	1	1	1	1	1	1	1	3	2	1
CO3	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1
CO4	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1
CO5	3	3	1	1	1	1	2	1	1	2	1	1	3	2	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">AERO3101</td><td rowspan="2">INTRODUCTION TO MECHANICS OF COMPOSITE MATERIALS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Solid Mechanics (AERO2001)</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Aerospace Materials Engineering (AERO2071)</td></tr>
</table>

Course Description:

This course is designed for Aerospace Engineering undergraduate students. It is designed for the students to understand the basics principles of Mechanics of Composite Materials. Understanding these principles will help them in the Design of Aerospace Structures.

Course Educational Objectives:

- To familiarize the terminology and materials used for composite materials
- To impart knowledge on macro mechanical behavior of lamina
- To focus on micro mechanics of lamina
- To support them to understand the stress strain behavior of different types of laminates
- To instruct the strength criteria of orthotropic lamina
- To explain the design of composite structures

UNIT 1 — Composite Materials , Classification and Behavior of unidirectional composites — 8hours

Composite Materials: Composite materials terminology.

Classifications: Polymer matrix, metal matrix, ceramic matrix, carbon-carbon matrix composites. **Fabrication of Fibers:** Glass fibers, carbon/graphite fibers, aramid fibers, boron fibers, banana and bamboo fibers.

Behavior of unidirectional composites: Longitudinal behavior, transverse stiffness and strength in prediction of shear modulus and Poisson's ratio.

UNIT 2 — Macro Mechanical Behavior of Lamina — 9hours

Hooke's Law, stiffness and compliance matrix for generally anisotropic materials, orthotropic materials, transversely isotropic materials and isotropic materials. Relations between engineering constants and elements of stiffness and compliance matrix.

Stress-strain relations for plane stress in a unidirectional orthotropic material and arbitrary oriented orthotropic material.

UNIT 3 Micro Mechanical Behavior of Lamina 9hours

Introduction, Mechanics of materials approach to stiffness to determine Young's modulus, Poisson's ratio and rigidity modulus. Elasticity approach to stiffness by bounding techniques of elasticity.

UNIT 4 Macro Mechanical Behavior of Laminate 10hours

Classical Lamination Theory: Lamina stress-strain behavior, stress and strain variation in a laminate, resultant laminate forces and moments.
Special Cases of Laminate Stiffness: Single-layered, symmetrical laminates, anti-symmetrical laminates, unsymmetrical laminates.

UNIT 5 Performance of Composite Materials 9 hours

Strength Criteria of Orthotropic Lamina: Maximum stress failure criterion, maximum strain failure criterion, Tsai-Hill failure criterion, Hoffman failure criterion and Tsai-Wu failure criterion.
Design of Composite Structures: Elements of design, structural design process, design objectives and design drivers, design analysis stages. Material selection factors, fiber selection factors, matrix selection factors.

Text Books:

1. R M Jones, Mechanics of Composite Materials, 2/e, Taylor and Francis, 1999.

References:

1. Nicholas J. Pagano, Reddy J.N, Mechanics of Composite Materials, Kluwer Academic Publishers, 1994.
2. Agarwal. B. D, Boatman. L. J, Chandrasekhar K, Analysis and Performance of Fiber Composites, 3/e, John Wiley and Sons, 2006.
3. Malik P.K, Fiber Reinforced Composites, 3/e, CRC Press, 2013.
4. Autar K Kaw, Mechanics of Composite Materials, 2/e, Taylor and Francis, 2013.

Course Outcomes:

After the completion of this course student will be able to

1. summarize on the terminology and classification of composite materials and outline The procedure for fabrication of fibers
2. develop relations for orthotropic materials under plane stress
3. apply various approaches to determine elastic constants of composite materials
4. analyze the macro mechanical behavior of laminates make use of various strength criteria in the design of composite structures

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	0	0	2	2	1	1	2	0	2	0	0	1
CO2	3	2	2	1	1	1	0	1	2	2	1	2	2	2	1
CO3	3	2	2	1	1	1	0	1	2	2	1	2	2	2	1
CO4	3	2	2	1	1	1	0	1	2	2	1	2	2	2	1
CO5	3	2	3	2	1	1	0	1	2	2	1	2	2	3	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

AERO3111	AEROELASTICITY	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**Analysis of Aerospace Structures (AERO3011)**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

This course is designed for aerospace engineering students. It introduces about the fundamentals of aeroelastic effect during flight. This course is designed to Emphasize on the analysis of aeroelastic deformation, divergence, flutter and control surface efficiency, based on finite element analysis and potential flow methods.

Course Educational Objectives:

- Model aeroelastic aero-structure interactions that create phenomena such as divergence, lift effectiveness and control effectiveness.
- Predict structural instabilities such as flutter and divergence.
- Calculate unsteady aerodynamic forces for elementary wings.
- Model and analyze discrete, vibrating mechanical systems

UNIT 1 **8 hours**

Introduction: Aeroelastic problems, Collar's triangle, static and dynamic aeroelasticity, deformation of structures and influence coefficients, energy method, classification and solution of aeroelastic problems.

UNIT 2 **10 hours**

Static Aeroelasticity: Divergence of 2-D airfoil and finite wing, aileron reversal, control effectiveness for 2D and finite wing, wing loading and deformations, swept wing divergence.

UNIT 3 **8 hours**

Dynamic Aero elasticity: Dynamic flutter model of 2-D airfoil, aero elasticity problems in rotary wing vehicles, coupling, prevention of flutter, experimental determination of flutter speed, control surface flutter.

UNIT 4 **9 hours**

Unsteady Aerodynamics: Introduction, 2-D and 3-D supersonic flow, subsonic flow - Kernel function approach, Theodore theory, finite state model.

UNIT 5 **10 hours**

Flutter Analysis: Flutter calculation, p-k method, exact treatment of bending, torsion flutter of uniform wing, and flutter analysis by assumed mode method, panel flutter.

Text Books:

1. R. L. Bisplinghoff, H. Ashley and R. L Halfmann, Aeroelasticity, Addison Wesley, 2/e, 1987.
2. D. H. Hodges and G. A. Pierce, Introduction to Structural Dynamics and Aeroelasticity, 2/e, Cambridge Aerospace Series, 2011.

References:

1. T. H. G. Megson, Aircraft Structures for Engineering Students, 5/e, Elsevier, 2013.
2. Y. C. Fung, An Introduction to the Theory of Aeroelasticity, John Wiley, 1985.
3. E. G. Broadbent, Elementary Theory of Aeroelasticity, Bun Hill Publications, 1986

Course Outcomes:

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

1. Explain how the aero elastic phenomena flutter, divergence and aileron reversal arise and how they affect aircraft performance
2. Formulate aero elastic equations of motion and use there to derive fundamental relations for aero elastic analysis
3. Perform a preliminary aero elastic analysis of a slender wing structure in low-speed airflow
4. Explain under what circumstances an aero elastic analysis can be expected to produce useful results
5. Demonstrate the flutter analysis phenomenon of wing and elevator

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1		1		1	1	1	3	1	1
CO2	2	2	1	1	1	1	1	1	1	1	1	1	2	1	
CO3	2	2	1	1	1	1		1		1	1	1	2	1	1
CO4	2	2	1	1	1	1		1		1	1	1	2	1	
CO5	2	2	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

AERO3121	AERODYNAMICS OF TURBOMACHINERY	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	Aerodynamics – I (AERO2041)						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course projects contents that include different types of turbomachinery aerodynamics. It focuses mainly on working of turbo machines and performance characterization and design philosophies. Course find appealing and enhances interest in the area of compressor and turbines

Course Educational Objectives:

- Impart knowledge on principles of turbomachinery and various subsystems within.
- Train students on performance characterization of different turbo machines.
- Impart design knowledge of axial and centrifugal compressors and turbines.
- Familiarize to analyze various types of losses rotating machines could undergo.
- Explain fundamentals of matching different turbo machine components.

UNIT 1 Axial Flow Compressors 8hours

Geometry structure of stage and related terminology, velocity triangles, flow behavior, thermodynamic process, single and multistage, degree of reaction, stage pressure ratio and other performance characteristics, compressor pressure curve. Losses - causes, primary and secondary losses, stall, surge. Efficiencies - polytropic, stage and adiabatic. Cascade aerodynamics - nomenclature, analysis of cascade forces, and study of performance charts.

UNIT 2 Centrifugal Compressors 9hours

Introduction, elements of centrifugal compressor, inlet and impeller slip factor, concept of rothalpy. Incidence and lag angles, forward lean, backward lean, velocity triangles, diffuser - vane and vaneless, volute casing centrifugal compressor characteristics, stage losses.

UNIT 3 **Axial Flow Turbines** **9hours**

Velocity diagrams for rotors and stators, performance computations, degree of reaction, impulse and reaction turbines, flow losses and causes, efficiencies - total to total and total to static, blade spacing. Typical blade profiles, study of performance charts. Limitations: Materials used for blades and disks, cooling - internal, external cooling.

UNIT 4 **Radial Flow Turbines** **9 hours**

Elements of radial turbines stage, stage velocity triangles, enthalpy - entropy diagrams, stage losses and efficiency, performance characteristics.

UNIT 5 **Dimensional Analysis and Matching** **9 hours**

Geometric similarity, dynamic similarity, Buckingham's PI theorem for turbo machines, compressor and turbine maps, choking of compressor and turbines, specific speed and its design role, turbine and compressor matching.

Text Books:

1. Baskharone, Principles of Turbomachinery in Air Breathing Engines, 2/e, Cambridge University Press, 2006.
2. R. D. Flack, Fundamentals of Jet Propulsion with Applications, 2/e, Cambridge University Press, 2010.

References:

1. E. Logan Jr., Turbomachinery: Basic Theory and Applications, 2/e, Taylor and Francis limited, 1993.
2. S. A. Korpela, Principles of Turbomachinery, 2/e, John Wiley, 2012.

Course Outcomes:

At the end of course student will be able to

1. Appreciate working of axial flow compressor for fluid pressurization
2. Understands and distinguishes the working and performance of centrifugal and axial compression systems
3 Comprehend thermodynamic working of axial flow turbines
4 Ascertain and design typical radial inflow turbine
5 Determine best matching combinations across compressors and turbine

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	2	1	2	1	1	2	1	3	2	1
CO2	3	2	2	2	1	2	1	2	2	1	2	1	3	2	1
CO3	3	2	1	1	1	2	1	2	1	1	2	1	3	1	1
CO4	3	2	1	1	1	2	1	1	2	1	2	1	3	1	1
CO5	3	2	2	1	1	2	1	1	1	1	1	1	3	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

AERO2131	THEORY OF CRYOGENICS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	Engineering Thermodynamics (AERO2011)						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course highlights syllabus related to cryogen zing of propellants. It includes different theories of liquefaction, refrigeration, separation and purification. Course find appealing and enhances interest in the area of very low temperature liquid production

Course Educational Objectives:

- Explain the importance of cryogenics and very low temperature processes.
- Train different principles behind gas liquefaction and refrigeration systems
- Impart the knowledge of gas separation and purification process.
- Familiarize different properties of materials at very low temperatures.
- Provide exposure on challenges, design of cryogenic fluid process, materials and storage

UNIT 1 Introduction 9 hours

Properties of engineering materials at cryogenic temperatures, mechanical properties thermal properties, electric and magnetic properties, superconducting materials, thermoelectric materials, properties of cryogenic fluids, super fluidity of He3 and He4.

UNIT 2 Low Temperature Processes 9hours

Importance and applications, thermodynamic minimum work, cooling duty and COP, isobaric cooling minimum work, production of low temperatures, Joule-Thomson expansion, adiabatic reversible turbine expansion, discontinuous sudden expansion, Philips refrigerator, Gifford McMahan refrigerator, pulse tube refrigerator

UNIT 3 Gas Liquefaction and Refrigeration Systems 9hours

Thermodynamically ideal system for liquefaction, liquefaction for nitrogen, oxygen, and argon by Linde-Hampson process and simple Claude process. Neon, hydrogen, helium liquefaction by precooled Linde-Hampson, Collins helium liquefaction process, natural gas by pure component refrigeration.

UNIT 4 **Gas Separation and Purification** **9 hours**

Gas separation and purification, principles, cryogenic and non- cryogenic for air, hydrogen and helium separation systems.

UNIT 5 **9 hours**

Cryogenics in Aerospace Applications: Challenges for cryogenic propellants, design concept for cryogenic propellant, boil off rate, storage and transportation of cryogenic fluids, storage vessel, thermal shields and insulation, effect of size shape on heat in-leak transfer and draining of liquid, transportation issues - nitrogen, helium and hydrogen.

Text Books:

1. R. F. Barron, Cryogenic Systems, 2/e, McGraw Hill, 2008.
2. M. Mamata, Fundamentals of Cryogenic engineering, 1/e, PHI, 2010.

References:

1. T. M. Flynn, Cryogenic Engineering, 2/e , CRC press, 2005.
2. T. Flynn, Cryogenic Process Engineering, 1/e, Plenum press, 1989.
3. G. Haseldom, Cryogenic Fundamentals, 1/e, Academic Press, 1971.

Course Outcomes:

At the end of course student will be able to

- Understands properties of various materials that take part in cogeneration process
- Realize the significance of low temperature processes
- Exhibit knowledge on gas liquefaction and refrigeration systems
- Apply principles of gas separation and purification for air, hydrogen and helium
- Appreciates challenges and design issues with regard to materials and processes

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**3**	**1**	**1**
CO2	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**3**	**1**	**1**
CO3	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**2**	**1**	**1**
CO4	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**3**	**1**	**1**
CO5	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**2**	**1**	**1**

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

AERO2141	ROCKETS AND MISSILES	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**Aerodynamics – I (AERO2041)**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

This course projects contents that involve the fundamentals of rocket and missile systems. It focuses mainly on rocket aerodynamic, typical engines used, trajectory design and rocket optimization. Course find appealing and enhances interest on rocketry

Course Educational Objectives:

- Impart knowledge on aerodynamics of rocketry.
- Train students on rocket propulsion systems solid and liquid engines.
- Impart design knowledge of different types of trajectories.
- Explain fundamentals of multi-staging and optimization of rocket design.
- Familiarize different types of materials used for rockets and missile applications.

UNIT 1 Aerodynamics of Rockets and Missiles 9 hours

Airframe components of rockets and missiles, forces acting on a missile while passing through the atmosphere, classification of missiles, methods of describing aerodynamic forces and moments, lateral aerodynamic moment, lateral damping moment and longitudinal moment of a rocket, lift and drag forces.

UNIT 2 Solid Rocket Systems, Liquid Rocket Systems 9hours

Solid Rocket Systems: Basic concepts and design, solid propellants, casing, nozzle and its performance.

Liquid Rocket Systems: Liquid rocket engines, propellants, **propellant feed systems** – gas and pressure feed, propellant tanks, tank pressurization, flow and pressure balance, **Liquid engines** – RCS & OMS. **Propellants:** Propellant properties, liquid oxidizers, liquid fuels, monopropellants,

UNIT 3 **Rocket Motion in Free Space and Gravitational Field** **9hours**

One dimensional and two-dimensional rocket motions in free space and under gravity, description of vertical, inclined and gravity turn trajectories, determination of range and altitude, simple approximations to burn out velocity, estimation of culmination time and altitude.

UNIT 4 **Multi-Stage Rocket and Attitude Control** **9 hours**

Nomenclature of the multi-stage rocket, ideal velocity of the multi-stage rocket, vertical ascent in a gravitational field and in vacuum (burnout velocity, culmination altitude, vertical ascent of a two-stage rocket). Rocket thrust vector control, methods of thrust vector control, thrust magnitude control, and thrust termination.

UNIT 5 **Separation Systems for Rockets and Missiles and Materials for Rockets and Missiles:** **9 hours**

Separation Systems for Rockets and Missiles: Stage separation dynamics, separation techniques.
Materials for Rockets and Missiles: Criteria for selection of materials for rockets and missiles, choice of materials at cryogenic temperatures, extremely high temperatures, requirement of materials for thermal protection and pressure vessels.

Text Books:

1. J. W. Cornelisse, H. F. R. Schoy, K. F. Wakker, Rocket propulsion and Space Dynamics, Pitman Publishing, 1979.
2. G. P. Sutton, Rocket Propulsion Elements, John Wiley, 2000.

References:

1. Barrere et al, Rocket Propulsion, Elsevier, 1960.
2. M. J. L. Turner, Rocket and Spacecraft propulsion: Principles, Practice and New Developments, Springer Praxis, 2004.
3. N. Nielsen, Missile Aerodynamics, Mountain View, 1998.
4. S. S. Chin, Missile configuration Design, McGraw Hill, 1961.
5. E. R. Parker, Material for Missiles and Spacecraft, McGraw Hill, 1982.

Course Outcomes:

At the end of Course student will be able to

1. Appreciates working of aerodynamic forces and moments in sustaining the flight
2. Realize suitability and capacity of matching propulsive engines
3. Calculate kinematic and kinetic parameters that specify the trajectory

4. Gain knowledge of multi staging of rocket and its design
5. Select suitable high temperature materials

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**2**	**1**	**2**	**1**	**1**	**1**	**2**	**1**	**1**	**2**	**1**	**3**	**2**	**1**
CO2	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**2**	**1**	**2**	**1**	**1**
CO3	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**2**	**2**	**1**
CO4	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**2**	**1**	**3**	**1**	**1**
CO5	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**3**	**1**	**1**

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">AERO3131</td><td rowspan="2">FLIGHT DYNAMICS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Flight mechanics (AERO2051)</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course is designed for aerospace engineering students. It introduces the fundamentals of flight dynamics. This course is designed to acquaint the learners with different types of operating conditions and various controls and maneuvering dynamics.

Course Educational Objectives:

- To acquaint the students about the performance of airplanes under various operating conditions
- To familiarize them about the performance of control surfaces and their characteristics.
- To impart knowledge about the purpose of elevators and ailerons in various operating conditions.
- To learn the various maneuvering criteria and their stability.
- To familiarize the students with the concepts of dynamic stability in aircraft.

UNIT 1 Stick Fixed Static Longitudinal Stability 9hours

Introduction to stability of airplane, wing alone configuration, wing and tail configuration, effect of tail on static stability, stick fixed longitudinal stability, neutral point, centre of gravity limits. In-flight measurement of stick fixed neutral point.

UNIT 2 Control Surfaces and Aerodynamic Balancing 9hours

Control surface hinge moments, floating and restoring tendencies, different types of tabs used on airplanes, mass balancing, frise aileron, the sealed nose balance, spoiler controls, aeroelastic effects.

UNIT 3 Stick Free Static Longitudinal Stability 9hours

Effect of free elevator on airplane stability, elevator control force, stick force gradients, neutral point and controls, free center of gravity limit. In-flight measurement of stick free neutral point.

UNIT 4 Maneuvering Flight, Directional and Lateral Control 9 hours

Maneuver margins. Asymmetric flight, weather cock stability, contribution of different parts of the airplane, rudder fixed and rudder free static directional stability, dihedral effect. Contribution of different parts of airplane controls in roll, cross coupling of lateral and directional effects.

UNIT 5 **Dynamic Stabilit** **9 hours**

Introduction to dynamics, spring-mass system. Equations of motion without derivation, phugoid modes, Routh's criteria (b) lateral and directional dynamic stability and control - approximate analysis of roll subsidence spiral mode and Dutch roll.

Text Books:

1. B. N. Pamadi, Performance, Stability, Dynamics, and Control of Airplane; 2/e, AIAA, 2004.
2. T. R. Yechout, S. L. Morris, D. E. Bossert and W. F. Hallgren, Introduction to Aircraft Flight Mechanics, AIAA, 2009.

References:

1. J. D. Anderson, Aircraft Performance and Design, 1/e, McGraw Hill, 2011.
2. J. J. Bertin and R. Cummings, Aerodynamics for Engineers, 6/e, Pearson, 2013.
3. A.W. Babister, Aircraft Stability and Response, Pergamon Press, 1980.
4. R. C. Nelson, Flight Stability and Automatic Control, 2/e, McGraw Hill, 199

Course Outcomes:

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

1. Apply the knowledge of performance characteristics under various operating.
2. Implement the role of primary and secondary control surface in stability of aircraft.
3. Apply the knowledge of elevator lock and unlock conditions.
4. Implement the concept of various maneuvering conditions and their stability.
5. Characterize and explain relevant flight and handling qualities and the disturbances acting on an aircraft.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**2**	**1**
CO2	**2**	**2**	**2**	**1**	**1**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**
CO3	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**0**	**1**	**1**	**1**	**2**	**1**	**1**
CO4	**2**	**2**	**1**	**1**	**1**	**0**	**1**	**1**	**1**	**1**	**0**	**0**	**2**	**3**	**0**
CO5	**3**	**2**	**1**	**1**	**1**	**2**	**1**	**1**	**0**	**1**	**1**	**1**	**2**	**2**	**0**

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

AERO3141	SPACE TECHNOLOGY	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**Aerospace propulsion (AERO3021)**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

This course is designed for aerospace engineering students. It introduces the basic introduction of Space Technology

Course Educational Objectives:

- Explain basic knowledge on fundamentals of Rocketry and space technology applications.
- Impart the awareness of the universality of use and multiplicity of space applications.
- Explain basic knowledge on space missions and national programs.
- Demonstrate and explain basic principles of rocket propulsion
- Focus and apply physical and mathematical methods used in analyzing engineering applications involving rocket

UNIT 1 Fundamentals of Rocketry 9 hours

Space mission, space environment, launch vehicle selection, types of orbits. Two-dimensional trajectories of rockets and missiles, vehicle sizing, two stage, multi-stage rockets; Trade-off ratios, single stage to orbit, sounding rocket, gravity turn trajectories.

UNIT 2 Atmospheric Re-entry 9hours

Introduction, steep ballistic re-entry, ballistic orbital re-entry, skip re-entry, double dip reentry, aero braking, lifting body re-entry.

UNIT 3 Fundamentals of Orbit Mechanics 9hours

Orbit maneuvers, two body motion- circular, elliptic, hyperbolic, and parabolic orbits; basic orbital elements, ground trace in-plane orbit changes, Hofmann transfer, bi-elliptical transfer, plane changes, combined maneuvers, propulsion for maneuvers.

UNIT 4 Satellite Attitude Dynamics 9 hours

Torque free axi-symmetric rigid body, attitude control for spinning spacecraft, attitude control for non-spinning spacecraft, Yo-Yo mechanism, gravity - gradient satellite, dual spin spacecraft and attitude determination.

UNIT 5 Space Mission Operations 9 hours

Supporting ground systems, architecture and team interfaces, mission phases and core operations, team responsibilities, mission diversity, standard operations practices, impact point calculation, injection conditions, flight dispersions.

Text Books:

1. W. E. Wiesel, Spaceflight Dynamics, 2/e, McGraw Hill, 2014.
2. F. J. Hale, Introduction to Space Flight, 1/e, Prentice Hall, 1993.

References:

1. Cornelisse, H. F. R Schoyer and K. F. Wakker, Rocket Propulsion and Spaceflight Dynamics, Pitman, 1984.
2. V. L. Pisacane, Fundamentals of Space Systems, Oxford University Press, 2005.
3. J. Sellers, Understanding Space: An Introduction to Astronautics, McGraw Hill, 2000.
4. C. D. Brown, Spacecraft Mission Design, AIAA Education Series, 1998.
5. M. Rudolph, Elements of Space Technology for Aerospace Engineers, Academic Press, 1999.
6. C. Sivaram, Rocket Dynamics and Space Flight, 1/e, Ane Books Pvt. Limited, 2009.

Course Outcomes:

At the completion of this course, students will be able to:

- The candidate has broad knowledge on satellite orbits and multidisciplinary knowledge in space technology.
- Possess the basic knowledge on rocketry and related combustion
- Analyze and understand the spacecraft launch, space environment
- Exercise strong knowledge on working of spacecraft in different environment conditions.
- Good knowledge on space applications such as earth observation, navigation and communication.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**1**	**1**
CO2	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**
CO3	**2**	**2**	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**
CO4	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**
CO5	**2**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**2**	**1**	**1**

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">AERO3151</td><td rowspan="2">SPACE MECHANICS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Space technology (AERO3141)</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course is designed for aerospace engineering students. It introduces the basic concepts of space mechanics.

Course Educational Objectives:

- Explain the basic concepts of orbital Mechanics with particular emphasis on interplanetary trajectories.
- Focus the general N-Body problems related to satellite orbits in relation with space and time.
- Impart the concepts of Satellite Injection and orbit perturbation.
- Encourage the concepts of interplanetary trajectories of Spacecraft and Launch vehicles.
- Instruct about Ballistic Missiles trajectory and Materials used for launch vehicles.

UNIT 1 **Basic Concepts** **8 hours**

The Solar System – References Frames and Coordinate Systems – The Celestial Sphere – The Ecliptic – Motion of Vernal Equinox – Sidereal Time – Solar Time – Standard Time – The Earth's Atmosphere.

UNIT 2 **The General N-Body Problem** **9hours**

The many body problem – Lagrange – Jacobian identity –The circular restricted three body problem – Libration points- Relative motion in the N-body problem –Two –body problem – Satellite orbits-Relations between position and time – Orbital elements.

UNIT 3 **Satellite Injection and Satellite Orbit Perturbation** **9hours**

General aspects of satellite injections – Satellite orbit transfer –Various cases – Orbit deviations due to injection errors – Special and general perturbations – Cowell's method– Encke's method – Method of vibrations of orbital elements – General perturbations approach.

UNIT 4 Interplanetary Trajectories 9hours

Two-dimensional interplanetary trajectories – Fast interplanetary trajectories – Three-dimensional interplanetary trajectories – Launch of interplanetary spacecraft – Trajectory about the target planet.

UNIT 5 Ballistic Missile Trajectories and Material 9 hours

Phases of ballistic missiles - Optimal flights – Time of flight – Re– entry phase – The position of the impact point – Influence coefficients. Space environment – Peculiarities – Effect of space environment on the selection of spacecraft material.

Text Books:

1. Cornelisse, J.W., "Rocket Propulsion and Space Dynamic", W.H. Freeman & Co., 1984.

References:

1. Sutton, G.P., "Rocket Propulsion Elements", John Wiley, 1993.
2. Van de Kamp, P. "Elements of Astro-mechanics", Pitman, 1979.
3. Parker E.R., "Materials for Missiles and Spacecraft", McGraw-Hill Book Co. Inc., 1982.

Course Outcomes:

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

1. apply the basic concepts of orbital Mechanics with particular emphasis on interplanetary trajectories.
2. apply the general N-Body problems related to satellite orbits in relation with space and time.
3. formulate mathematical model for the Satellite Injection and orbit perturbation.
4. apply mathematical model on interplanetary trajectories of Spacecraft and Launch vehicles.
5. follow methods used for the Ballistic Missiles trajectory and Materials used for launch vehicles.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	2	1	1	1	1	1	1	1	1	2	1	1
CO2	2	2	1	3	1	1	1	1	1	1	1	1	2	1	1
CO3	3	2	3	2	1	1	1	1	1	1	1	0	3	1	1
CO4	2	2	2	2	1	1	1	1	1	1	1	1	2	1	1
CO5	2	2	3	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

AERO3161	SATELLITE ATTITUDE AND CONTROL	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	Flight mechanics (AERO2051) & Avionics- AERO3191						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides an introduction to the basic concepts of satellites and its control systems of space missions.

Course Educational Objectives:

- Focus on developing mathematical models of spacecraft attitude dynamics
- Analyzing the response to external disturbances and control torques
- Demonstrate Multiplexing schemes and multiple access techniques
- Impart rigorously develop the concepts, mathematical procedures, and methods associated with defining, determining, and controlling the attitude of a spacecraft.
- Encourage, the student will develop the theoretical background necessary to purse advanced courses in the field of Spacecraft Attitude Dynamics.

UNIT 1 Elements of Satellite Communication 8hours

Satellite systems, orbital description and orbital mechanics of LEO, MEO and GSO, placement of a satellite in a GSO, satellite, description of different communication subsystems, bandwidth allocation.

UNIT 2 Transmission, Multiplexing, Multiple Access and Coding 9hours

Different modulation and multiplexing schemes, multiple access techniques FDMA, TDMA, CDMA and DAMA, coding schemes, satellite packet communications.

UNIT 3 Attitude and Orbit Control System 9hours

Coordinate system, AOCS requirements, environment effects, attitude stabilization, attitude sensors, actuators, design of control algorithms.

UNIT 4 **Propulsion Systems, Structures and Thermal Control** **12 hours**

Propulsion Systems, Structures: Systems trade-off, mono propellant systems, thermal consideration, system integration design factors, pre-flight test requirements, system reliability configuration design of spacecraft structure, structural elements, material selection. Environmental loads, vibrations, structural fabrication.

Thermal Control: Orbital environments, average temperature in space, transient temperature evaluation, thermal control techniques, temperature calculation for a spacecraft, thermal design and analysis program structure, thermal design verification, active thermal control techniques

UNIT 5 **Telemetry Systems** **7 hours**

Base band telemetry system, modulation, TT and CRF system, telecommand system, ground control systems.

Text Books:

1. K. V. B. Narayana, Satellite Architecture, 2/e, ISRO Satellite Center, 2011.
2. V. V. Beletsky and E. M. Levin, Dynamics of Space Tether Systems, 1/e, Amer Astronautical Society 1993.

References:

1. P. C. Hughes, Spacecraft Attitude Dynamics, 1/e, Dover Publications, 2004.
2. V. A. Chobotov, Spacecraft Attitude Dynamics and Control, 1/e, Orbit Books,1991

Course Outcomes:

After completion of this course students are able to

1. learn the subject of spacecraft attitude dynamics, determination and control.
2. analyze the free and forced rotational dynamics of rigid bodies.
3. apply rigid body dynamic equations and basic control concepts to the modeling of orbiting spacecraft maneuvers

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**2**	**1**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**1**	**2**	**1**	**1**
CO2	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**
CO3	**2**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**2**	**1**
CO4	**2**	**2**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**
CO5	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">AERO3171</td><td rowspan="2">GUIDANCE AND CONTROL</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Satellite Attitude and Control-AERO3161</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:
This course work is designed specifically for the undergraduate students of Aerospace Engineering. It introduces aircraft guidance and control.

Course Educational Objectives:
- Acquaint the concept of navigation systems.
- Understand the operating principle of guidance law.
- Explore various augmentation systems.
- Study the concepts of longitudinal stability and lateral stability.
- Understand the mission requirements and its guidance.

UNIT 1	Introduction	6 hours

Introduction to navigation, guidance and control - definition and historical background.

UNIT 2	Missile and Launch Vehicle Guidance	10 hours

Operating principles and design of guidance laws, homing guidance laws - short range, medium range and beyond visual range missiles, launch vehicle - introduction, mission requirements, implicit guidance schemes, explicit guidance, Q- guidance of missile.

UNIT 3	Augmentation Systems	9hours

Need for automatic flight control systems, stability augmentation systems, control augmentation systems, gain scheduling concepts.

UNIT 4	Longitudinal Autopilot	11 hours

Displacement autopilot - pitch orientation control system, acceleration control system, glide slope coupler and automatic flare control and flight path stabilization, longitudinal control law design using back stepping algorithm.

UNIT 5 Lateral Autopilot 9 hours

Damping of the Dutch roll, methods of obtaining coordination, yaw orientation control system, turn compensation, automatic lateral beam guidance. Introduction to fly-by-wire flight control systems, lateral control law design using back stepping algorithm.

Course Outcomes:

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

1. Apply the principle of stability to various control augmentation systems (l2)
2. Design the guidance laws for short, medium and long range missiles. (l3)
3. Implement the application of back stepping algorithm in longitudinal and lateral control law design.(l2)
4. Apply the algorithm for longitudinal and lateral autopilot.(l2)
5. Learn the significance of fly-by-wire fligt control systems using back step algorithms.(l2)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	3	1	1	1	1	1	1	1	2	1	1	1	1
CO2	2	2	2	2	1	1	1	1	1	1	2	1	2	1	1
CO3	2	2	3	3	1	1	1	1	1	1	2	1	2	1	1
CO4	2	2	2	2	1	1	1	1	1	1	2	1	2	1	1
CO5	1	2	3	2	1	1	1	1	1	1	2	1	1	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">AERO2151</td><td rowspan="2">AIRCRAFT SYSTEMS AND INSTRUMENTATION</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course work is designed specifically for the undergraduate students of Aerospace Engineering as an elective. This course work is mainly aimed for the students, who are very interested in obtaining the knowledge of instrumentation and system components of the Aircraft. In the view of the outline, this course will provide knowledge to the students in the areas of control surfaces, Engine and fuel systems, Hydraulic and Pneumatic systems, Environmental Control Systems and Aircraft Instruments of flying machines.

Course Educational Objectives:

- Introduction to various aircraft systems, integration and overview of the functions of the same.
- To impart knowledge of the hydraulic and pneumatic systems components
- To obtain knowledge of aircraft system and instrumentation’s failures and analysis.

UNIT 1 FLIGHT CONTROL SYSTEMS 8hours

Principles of flight control, flight control surfaces, flight control linkage systems, trim and feel, flight control actuation, fly by wire system, Airbus and Boeing implementations, interrelationship of flight control, guidance and vehicle management systems.

UNIT 2 ENGINE CONTROL AND FUEL SYSTEMS 6 hours

ENGINE CONTROL: Engine control problem, fuel flow control, air flow control, control system parameters, engine starting and ignition systems, lubricating systems for aircraft piston and jet/propeller engines.

Fuel systems: Characteristics of aircraft fuel systems, fuel systems components, fuel transfer pumps, fuel booster pumps, fuel transfer valves, and fuel quantity measurement systems

UNIT 3 HYDRAULIC & PNEUMATIC SYSTEMS 6 hours

Hydraulic systems: Hydraulic circuit design, hydraulic actuation, hydraulic fluid, hydraulic pumps. Types of hydraulic systems, landing gear systems - retraction, steering, braking and anti skid
Pneumatic systems: Basic working principle of pneumatic systems, pneumatic power system - components, use of pneumatic power in aircraft, sources of pneumatic power, the engine bleed air, engine bleed air control,

UNIT 4 ENVIRONMENTAL CONTROL SYSTEMS 7 hours

The need for a controlled environment in aircraft, Refrigeration systems - vapour cycle systems, boost-strap air cycle system, humidity control, aircraft anti-icing and de-icing systems, air distribution systems, cabin pressurization, g-tolerance, rain dispersal, anti-misting and demisting.

UNIT 5 AIRCRAFT INSTRUMENTS 5 hours

Flight instruments and navigation instruments, gyroscope, accelerometers, air speed indicators – TAS and EAS; Machmeters, altimeters, principles and operation, study of various types of engine instruments, tachometers, temperature gauges, pressure gauges – operation and principles.

Aircraft System Laboratory

List of Experiments: Any 8 experiments need to conduct

1. Operation of aircraft fuel system (to find fuel tank quantity by using float type and capacitance type).
2. Aircraft jacking and leveling procedure (to jack the aircraft from its steady position and to level the aircraft for inspection purpose).
3. Aircraft “Symmetry Check” procedure.
4. Airplane rigging check procedure (to find the defection angle of aircraft control surfaces).
5. Assembly and disassembly of aircraft instruments like gyro, altimeter, and Pitot system.
6. Demonstration and operation of aircraft hydraulic system.
7. Demonstration and operation of aircraft pneumatic system.
8. Demonstration and operation of aircraft landing gear system.
9. Demonstration and operation of aircraft oxygen system.
10. Demonstration and operation of aircraft engine starting and ignition systems.

Text Books:

1. A. Seabridge, I. Moir, Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration, 2/e, John Wiley and Sons, 2008.
2. E. H. J. Pallett, Aircraft Instruments and Integrated Systems, 1/e, Pearson Education, 1992.
3. Mekinley, J.L. and R.D. Bent, "Aircraft Power Plants", McGraw Hill 1993

References:

1. Moir, I. and Seabridge, A., Design and development of aircraft systems-an introduction, AIAA education series, AIAA,2004.
2. Aircraft systems by David A Lambro tata Mc Graw Hill. Ed;2009.

Course Outcomes:

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

1. Develop a mind set to implement instrumentation requirements and describe instrumentation elements, mechanism, error sources. (l3)
2. Understand the aircraft classical and state of art control systems, engine control system fuel systems and its components for both civil and military aircrafts.(l2)
3. Learn the significance of hydraulic system; pneumatic systems and emergency power sources used in aircraft. (l3)
4. Increase the understanding of electrical systems (both a.c and d.c) utilizing as an auxiliary power sources in aircrafts. (l2)
5. Develop effective skills for the operation of flight instruments incorporating gyroscopes, basic flight indicators, sensors and its operating principles. (l2)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**3**	**1**	**2**	**1**	**1**
CO2	**2**	**2**	**3**	**1**	**1**	**1**	**1**	**1**		**1**	**2**	**1**	**1**		**1**
CO3	**1**	**1**	**2**	**2**	**2**	**1**			**1**		**1**	**1**	**3**	**2**	**1**
CO4	**2**	**2**	**2**	**1**	**2**		**1**	**1**	**1**	**1**	**2**		**1**	**1**	**1**
CO5	**2**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

AERO2161	AIRPORT PLANNING AND MANAGEMENT	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**None**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

This course is designed for Aerospace Engineering undergraduate students. This course aims in basic understanding of airport operations, planning and management.

Course Educational Objectives:

- Impart knowledge on administration and organization of airport systems.
- Familiarize about the components of the airport such as airfield, airspace and control, terminal, and ground access.
- Understand the concepts of airport security and financial management.
- Focus on the economic role that airports play within local communities.
- Describe the different types of airfield pavements and their potential failures

UNIT 1 Airports and airport systems 9 hours

An introduction, organization and administration, a historical and legislative perspective.

UNIT 2 The components of the airport 10 hours

the airfield, airspace and air traffic control, airport terminals and ground access.

UNIT 3 Airport Operations and Financial Management 10 hours

Airport operations management under FAR 139, airport security, airport financial management

UNIT 4 Airport public administration and planning 9 hours

The economic, political, and social role of airports, airport system and master planning.

UNIT 5 Future of Airport management 7 hours

Airport capacity and delay, the future of airport management

Text Books:

1. Seth Young and Alexander T. Wells, Airport Planning and Management, 7/e, McGraw Hill, 2019.

References:

1. Richard de Neufville and Amedeo Odoni, Airport Systems: Planning, Design and Management, 2/e, McGraw Hill, 2016.
2. P.C.K. Ravindran, Airport Management, 1/e by, Asian Law House, 2013.

Course Outcomes:

After successful completion of this course the students will be able to:

- Gain knowledge on the development of national administrations that have regulated civil aviation throughout its history.
- Identify various components of the airport and be familiar with airfield lighting.
- Be familiar with the process of airport financial accounting
- Appreciate the complex relationships between airport management and the airlines that serve their airports
- Understand the challenges for future airport management

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1		1	1	1	1	1	1	1	1	2	1	1
CO2	2	2	1		1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1		1	1		1	1	1	2	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">AERO2171</td><td rowspan="2">AIR TRANSPORTATION SYSTEMS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course is designed for Aerospace Engineering undergraduate students. This course aims in basic understanding of elements of air transportation systems

Course Educational Objectives:

UNIT 1 **Aviation Industry and its Regulatory Authorities** **8hours**

Introduction, history of aviation, evolution, development, growth and challenges. The breadth of regulation: ICAO, IATA, DGCA, and FAA. Safety regulations, risk assessment, human factors and safety, security regulations and environmental regulations.

UNIT 2 **9hours**

After completion of this unit the student will be able to

- Recall the history of aviation and its evolution. (l1)
- Outline the breadth of regulatory authorities. (l2)
- Understand the safety, security and environmental regulations. (l2)

UNIT 3 **Aircraft** **9hours**

Costs, project cash-flow, aircraft price, compatibility with the operational infrastructure, direct and indirect operating costs, balancing efficiency and effectiveness, payload, range, fuel efficiency, technical contribution to performance, operating speed and altitude, aircraft field length performance, typical operating costs, effectiveness, wake-vortices, cabin dimensions and flight deck

UNIT 4 **Airports** **10hours**

Airport demand, airport siting, runway characteristics, length, declared distances, aerodrome areas, obstacle safeguarding. Runway capacity, evaluating runway capacity, sustainable runway capacity, runway pavement length, maneuvering area, airfield lighting, aprons, passenger terminals, terminal sizing and configuration, airport demand, capacity and delay.

UNIT 5 **Airlines** **9 hours**

Modern airline objectives, route selection and development, airline fleet planning, annual utilization and aircraft size, seating arrangements. Indirect operating costs, aircraft - buy or lease. Revenue generation, computerized reservation systems, yield management, integrating service quality into the revenue-generation process, airline scheduling, evaluating success -financial viability, regulatory compliance, efficient use of resources and effective service.

Text Books:

1. Hirst. M, The Air Transport System, 3/e, Woodhood Publishing Ltd.,Cambridge, 2008.

References:

1. J. G. Wensven, Air Transportation: A Management Perspective, 7/e, Ashgate Publishing 2007.
2. M. Bazargan, Airline Operations and Scheduling, 1/e, Ashgate Publishing, 2004.
3. Dieter Shmitt, and Valker Gollnick, Air Transport System, Springer 2016.
4. A. Wells and S. Young, Airport Planning and Management, 5/e, McGraw Hill, 1986.

Course Outcomes:

After completion of this unit the student will be able to

1. Recall the history of aviation and the breadth of regulatory authorities.
2. Define the airspace and learn the technologies used for navigating within the defined airspaces.
3. Understand the various costs attributing to total aircraft cost.
4. Understand the need for airport demand and interpret the concepts of runway and other areas of aerodrome.
5. Learn the advanced technologies for understanding airline management

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1			1	2	1	2	1	1	1	1	2	1	1
CO2	2	1	1		1	1		1	1	1	1	1	2	1	1
CO3	2	2	1	1	2	2	1	1	1	1	1	1	2	1	1
CO4	2	1	1		1	1		1	1	1	1	1	2	1	1
CO5	3	2	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

AERO3181	HELICOPTER AERODYNAMICS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**Aerodynamics -I (AERO2041)**						
Co-requisite	**None**						
Preferable exposure	**None**						

Course Description:

This course is intended to introduce helicopters to aerospace engineering students. This course will help student to gain knowledge on different types of helicopters and working principle and the design of helicopters considering various aspects.

Course Educational Objectives:

1. Familiarize different configurations of helicopters based on rotors.
2. Explain the basic concepts of helicopter basic aerodynamics.
3. Explain blade element theory of helicopter rotors and help to find aerodynamic force and moments generation using BET.
4. Explain helicopter rotor using vertical and forward motion of helicopter.
5. Explain the concept of auto-rotation, gliding and powered flight of helicopter.

UNIT 1 Elements of Helicopter Aerodynamics 8hours

Introduction, helicopters, configurations: jet rotors and compound helicopters, methods of control, collective and cyclic pitch, lead-lag, flapping hinges and lift dissymmetry, helicopters - tandem and tail rotor configuration and their advantages and disadvantages, auto rotation of helicopter.

UNIT 2 Momentum Theory and Wake Analysis and Blade Element Theory 10 hours

Momentum Theory and Wake Analysis: Momentum theory for hover, non-depersonalization, figure of merit, axial flight, momentum theory of vertical climb.
Blade Element Theory: Basic method - thrust grading, torque grading, non-uniform flow, ideal twist, blade mean lift coefficient, power approximations, tip loss, hover characteristics.

UNIT 3 Rotor Mechanism and Aerodynamics 9hours

The edgewise rotor, flapping motion, rotor control, equivalence of flapping and feathering, blade sailing, lagging motion, Coriolis acceleration, lag frequency, blade flexibility, ground resonance. Descending forward flight, wake analysis, flapping coefficients.

UNIT 4 Configuration and Power Estimates 9 hours

Tilt wing and vectored thrust, performance of VTOL and STOL aircraft in hover, transition and forward motion. Induced, profile and parasite power requirements in hover and forward flight, performance curves with effects of altitude, in-ground and out of ground effects of helicopter.

UNIT 5 Rotor Aerodynamic Design 9 hours

Blade section design, blade tip shapes - rectangular, swept, and advanced planforms, tail rotors - propeller moment, precession, yaw agility, calculation of downwash, yaw acceleration, and parasite drag, rear fuselage upsweep and aerodynamic design process.

Textbooks:

1. J. Seddon and S. Newman, Basic Helicopter Aerodynamics, 3/e, John Wiley, 2011.
2. W. Johnson, Helicopter Theory, Dover Publications, 1994.

References:

1. A. Gessow and G. C. Myers, Aerodynamics of Helicopter, Macmillan and Co., 1987.
2. B.W. McCormick, Aerodynamics of V/STOL Flight, Academics Press, 1987.
3. J. G. Leishman, Principles of Helicopter Aerodynamics, 2/e, Cambridge University Press, 2006.
4. L. Gupta, Helicopter Engineering, Himalayan Books, 1996

Course Outcomes:

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

1. Design helicopter blades using blade element theory for modern helicopters based on the requirement.
2. Approximate the power calculations for hover, vertical and forward flight of a helicopter.
3. Adapt the design of blades in different applications such as windmills for energy generation.
4. Apply the knowledge of helicopter aerodynamics for autorotation and normal flying conditions.
5. Exhibit the aerodynamic design process in rear fuselage of helicopter

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**2**	**1**	**1**	**2**	**1**	**1**	**2**	**1**	**0**	**1**	**1**	**2**	**0**	**2**
CO2	**3**	**2**	**1**	**0**	**1**	**2**	**2**	**1**	**2**	**2**	**0**	**2**	**1**	**2**	**0**
CO3	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**1**	**1**	**3**	**2**	**2**
CO4	**3**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**2**
CO5	**3**	**2**	**2**	**1**	**1**	**0**	**1**	**1**	**1**	**1**	**2**	**1**	**3**	**1**	**2**

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">AERO3191</td><td rowspan="2">AVIONICS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Guidance and Control-AERO3171</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course work is mainly aimed for the students, who are very interested in obtaining the knowledge of Avionics and avionics systems. From the outline of this course, it can be observed that, after completion of this course work, students are able to obtain knowledge in the areas of basics and working with of Avionic systems, overview of flight desks and cockpits, radio navigation systems, Autopilots configurations and, needs and operations of surveillance systems which are also green areas of research works in aircraft research and manufacturing organizations

Course Educational Objectives:

- Introduce the students to functioning and principle of operation of various avionics systems namely, flight sensors installed on a modern passenger and fighter aircraft.
- Introduce the students to guidance, landing, the concepts of autopilots and surveillance systems of UAV’s, and MAV’s,
- To introduce various digital electronic principles and working operations of digital circuit.
- To integrate the digital electronics with cockpit equipment
- To understand the various principles in flight disk and cockpit panels.
- To study the communication and navigation equipment

UNIT 1 **Introduction to Avionics** **8hours**

Importance and role of avionics, basic principles of avionics, typical avionics subsystem in civil/ military aircraft and space vehicles need for avionics in civil and military aircraft and space systems, traffic collision avoidance system - TCAS-I and TCAS-II, ground proximity warning system.

UNIT 2 **Flight Decks and Cockpits** **9hours**

Control and display technologies: CRT, LED, LCD, EL, plasma panel, touch screen, direct voice input (DVI). Civil and military cockpits: MFDS, MFK, HUD, HMD, HOTAS

UNIT 3 **Radio Navigation Systems and Ranging and Landing Systems** **10 hours**

Radio Navigation Systems: Aircraft audio systems, basic audio transmitter and receiver principles, types of frequency bands - HF, VHF, UHF, Tautomeric direction finder (ADF) - transmitter and receiver principles of operation.

Ranging and Landing Systems: Very high frequency Omni direction range(VOR), transmitter receiver principles of operation, distance measuring equipment (DME), transmitter and receiver principles of operation, instrument landing system (ILS), localizer and glideslope.

UNIT 4 **Fly-By-Wire Flight Control and Navigation Systems and Navigation Systems** **9 hours**

Fly-By-Wire Flight Control and Navigation Systems: FBW flight control features, basic concept, advantages of FBW control, fly-by-wire control laws, redundancy, and failure Survival.

Navigation Systems: Types, inertial navigation, GPS basic principles, integration of GPS and INS, differential GPS.

UNIT 5 **Surveillance and Auto Flight Systems and Flight Management Systems** **10 hours**

Surveillance and Auto Flight Systems: Basic principles, height control, heading control, ILS/ML Scoupled control, automatic landing, and speed control and auto-throttle control system.

Flight Management Systems: Introduction, radio navigation tuning, navigation, flight planning, performance prediction and flight path optimization, control of vertical flight path profile.

Text Books:

1. R. P. G Collinson, Introduction to Avionics System, 3/e, Springer, 2011.
2. C. R. Spitzer, Digital Avionics Systems: Principles and Practice, 2/e, TheBlackburn Press, 2001.

References:

1. D. H. Middleton, E. Longman, Avionics systems, Longman Group, 1989.
2. I. Moir, A. Seabridge, M. Jukes, Civil Avionics Systems, 2/e, John Wiley,2013.
3. R. P. G. Collinson, Introduction to Avionics, 3/e, Springer, 2011.
4. Kayton, M., & Fried, W.R, Avionics Navigation Systems, Wiley, 1997,ISBN 0-471-54795-6Z

Course Outcomes:

Upon completion of the course, students will be able to:

- Describe the hardware required for aircraft

- Explain the communication and navigation techniques used in aircrafts
- Discuss about the autopilot and cockpit display related concepts
- Apply the algorithm for an aircraft actuation system, servo-components, inertial sensors, modelling, design and testing of sensors.
- Deploy these skills effectively in the solution of problems in avionics engineering.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**3**	**1**	**2**	**1**	**1**
CO2	**1**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**
CO3	**2**	**2**	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**2**	**1**	**1**
CO4	**2**	**1**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**
CO5	**1**	**2**	**1**	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :20/05/2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

GITAM School of Technology

GITAM (Deemed to be Universtiy)

Visakhapatnam | Hyderabad | Bengaluru