Scheme & Syllabus of
III & IV Semesters (2021 Scheme)
(AS PER NEP-2020 GUIDELINES)

BACHELOR OF ENGINEERING (B.E)
IN
AEROSPACE ENGINEERING

(ACADEMIC YEAR 2022-2023)

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ABBREVIATIONS

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

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Bachelor of Engineering in
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				III SEMESTER										
Sl. No.	Course Code	Course Title	Credit Allocation				BoS	Category	CIE Duration (H)	Max Marks CIE		SEE Duration (H)	Max Marks SEE	
			L	T	P	Total				Theory	Lab		Theory	Lab
1	21MA31B	Linear algebra, Integral transforms and Fourier series	3	1	0	**4**	MA	Theory	1.5	**100**	****	3	**100**	****
2	21ME32	Engineering Materials	2	0	0	**2**	ME	Theory	1	**50**	****	2	**50**	****
3	21AS33	Introduction to Aerospace Engineering	2	0	0	**2**	AS	Theory	1	**50**	****	2	**50**	****
4	21AS34	Thermodynamics	3	0	1	**4**	AS	Theory+Lab	1.5	**100**	**50**	3	**100**	**50**
5	21AS35	Mechanics of Fluids	3	0	1	**4**	AS	Theory+Lab	1.5	**100**	**50**	3	**100**	**50**
6	21AS36	Structural Mechanics	3	0	0	**3**	AS	Theory	1.5	**100**	****	3	**100**	****
7	21DMA37***	Bridge Course: Mathematics	2(A)	0	0	**AUDIT**	MA	Theory	1.5	**50**	****	2	**50**	****
8	21AS39	Design Thinking Lab	0	0	2	**2**	AS	Lab	1	****	**50**	2	****	**50**
9	21ASI310	Summer Internship- I	0	0	1	**1**	AS	Internship	1	****	**50**	1	****	**50**
						22								

Summer Internship-1 will be done after the II sem for 03 Weeks (will have CIE & SEE)

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*ENGINEERING MATHEMATICS - III			
Sl.No	COURSE TITLE	COURSE CODE	BRANCHES
1	Linear algebra, Integral transforms and Number theory	21MA31A	CS & IS
2	Linear algebra, Integral transforms and Fourier series	21MA31B	AS, EC, EE, EI & ET
3	Integral transforms and Advanced Numerical Methods	21MA31C	BT, CH, CV, IM & ME
4	Mathematics for AI & ML	21MA31D	AI and ML
**MANDATORY COURSES			
Sl.No	COURSE TITLE	COURSE CODE	BRANCHES
1	Environmental Technology	21BT32A	All circuit Branches
2	Biology for Engineers	21BT32B	BT
3	Engineering Materials	21ME32	ME, CH & AS
*** Bridge Course: Audit course for lateral entry diploma students (Only CIE and no SEE)			
Sl.No	COURSE TITLE	COURSE CODE	BRANCHES
1	Bridge Course Mathematics	21DMA37	AS,BT,CH,CV,EC,EE,EI, IM,ME&TE
2	Bridge Course C Programming	21DCS37	CS,IS & AI

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Sl. No.	Course Code	Course Title	Credit Allocation				BoS	Category	CIE Duration (H)	Max Marks CIE		SEE Duration (H)	Max Marks SEE	
			L	T	P	Total				Theory	Lab		Theory	Lab
								IV SEMESTER						
1	21MA41	Statistics and Probability for Data Science	2	1	0	**3**	MA	Theory	1.5	**100**	********	3	**100**	********
2	21BT42A**	Environmental Technology	2	0	0	**2**	ME	Theory	1	**50**	********	2	**50**	********
3	21AS43	Aerospace Propulsion	3	0	1	**4**	AS	Theory+Lab	1.5	**100**	**50**	3	**100**	**50**
4	21AS44	Aerospace Structures	3	0	1	**4**	AS	Theory+Lab	1.5	**100**	**50**	3	**100**	**50**
5	21AS45	Fundamentals of Avionics	3	0	0	**3**	AS	Theory	1.5	**100**	********	3	**100**	********
6	21AS4AX	Professional Core Elective – Group A	2	0	0	**2**	AS	MOOC	1.5	**50**	********	2	**50**	********
7	21HS46A / 21HS46V	Kannada Course: AADALITHA KANNADA VYAVAHARIKA KANNADA	1	0	0	**1**	HSS	Theory	1	**50**	********	2	**50**	********
	21HSAE46 A/B/C/D/E ***	Ability Enhancement course	0	0	1	**1**	HSS	Lab	1	********	**50**	2	********	**50**
8	21DCS47***	Bridge Course: C Programming	2 (A)	0	0	**AUDIT**	CS	Theory	1.5	**50**	********	2	**50**	********
9	21HSU48	Universal Human Values and Professional Ethics	2	0	0	**2**	HSS	Theory	1	**50**	********	2	**50**	********
						22								

* Summer Internship-II will be done after the IV sem for 04 Weeks

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*ENGINEERING MATHEMATICS - IV			
Sl.No	**COURSE TITLE**	**COURSE CODE**	**BRANCHES**
1	Statistics and Probability for Data Science	21MA41	Common to all branches
** MANDATORY COURSES			
Sl.No	**COURSE TITLE**	**COURSE CODE**	**BRANCHES**
1	Engineering Materials	21ME42	EC,EE,EI,TE
2	Environmental Technology	21BT42A	AS, CH, IM, ME
3	Civil Engineering Materials	21CV42	CV
4	Bio inspired Engineering	21BT42B	AI, BT, CS, IS
*** Bridge Course: Audit course for lateral entry diploma students			
Sl.No	**COURSE TITLE**	**COURSE CODE**	**BRANCHES**
1	Bridge Course Mathematics	21DCS47	CS,IS & AI
2	Bridge Course C Programming	21DCS48	AS,BT,CH,CV,EC,EE, EI,IM,ME & TE

GROUP A: PROFESSIONAL ELECTIVES (MOOC COURSES)			
Sl. No.	**Course Code**	**Course Title**	**Duration**
1.	21AS4A1	Fundamentals of combustion for propulsion	8 Weeks
2.	21AS4A2	Computational science in engineering	8 Weeks
3.	21AS4A3	Data science for engineers	8 Weeks
4.	21AS4A4	Introduction to uncertainty analysis and experimentation	8 Weeks
5.	21CS4A5	Design practice	8 Weeks

Ability enhancement courses ***			
Sl. No.	**Course code**	**Course Title**	**Branches**
1	21HSAE46A	National Service Scheme (NSS)	**Common for all branches Minimum one course under any vertical is mandatory, more than one also permitted.**
2	21HSAE46B	National Cadet Corps (NCC)	
3	21HSAE46C	Physical Education	
4	21HSAE46D	Music/Dance/Theatre	
5	21HSAE46E	Art work/ Painting/ Photography & Film making	

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Semester: III					
LINEAR ALGEBRA, INTEGRAL TRANSFORMS AND FOURIER SERIES **(Theory)** **(Common to AS, EC, EE, EI, ET)**					
Course Code	**:**	21MA31B		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	3:1:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45L+15T		**SEE Duration**	**:**	3.00 Hours

Unit - I	**09 Hrs**

Linear Algebra - I:
Vector spaces, subspaces, linear dependence and independence, basis and dimension, four fundamental subspaces. Rank and nullity theorem (without proof). Linear transformations - matrix representation, kernel and image of a linear transformation, dilation, reflection, projection and rotation matrices.

Unit - II	**09 Hrs**

Linear Algebra - II:
Inner Products, orthogonal matrices, orthogonal and orthonormal bases, Gram-Schmidt process, QR-factorization. Eigen values and Eigen vectors, diagonalization of a matrix (symmetric matrices) and singular value decomposition.

Unit - III	**09 Hrs**

Laplace Transform:
Existence and uniqueness of Laplace transform (LT), transform of elementary functions, region of convergence. Properties - linearity, scaling, s - domain shift, differentiation in the s - domain, division by t, differentiation and integration in the time domain. LT of special functions - Periodic functions (square wave, saw-tooth wave, triangular wave, full & half wave rectifier), Heaviside unit step function, unit impulse function.

Unit - IV	**09 Hrs**

Inverse Laplace Transform:
Definition, properties, evaluation using different methods. Convolution theorem (without proof) - problems. Application to solve ordinary linear differential equations.

Unit - V	**09 Hrs**

Fourier series and Fourier Transforms:
Periodic function, even and odd functions. Dirichlet's conditions, Euler's formulae for Fourier series, problems on time periodic signals (square wave, half wave rectifier, saw-tooth wave and triangular wave), Fourier sine series, Fourier cosine series.

Fourier integral theorem, complex Fourier and inverse Fourier transform, Fourier sine transform, Fourier cosine transform, properties - linearity, scaling, time-shift and modulation - problems.

Course Outcomes: After completing the course, the students will be able to	
CO1:	Illustrate the fundamental concepts of linear algebra, Laplace and inverse Laplace transforms, Fourier series and Fourier transforms.
CO2:	Apply the acquired knowledge of linear algebra, Laplace and inverse Laplace transforms, Fourier series and Fourier transforms to solve the problems of engineering applications.
CO3:	Analyze the solution of the problems using appropriate techniques of linear algebra, integral transforms and Fourier series to the real world problems arising in many practical situations.
CO4:	Interpret the overall knowledge of linear algebra, integral transforms and Fourier series gained to engage in life-long learning.

Reference Books	
1	Linear Algebra and its Applications, Gilbert Strang, 4th Edition, 2014, Cengage Learning India Edition, ISBN: 9788131501726, 8131501728.
2	A Text Book of Engineering Mathematics, N.P. Bali & Manish Goyal, 7th Edition, 2010, Lakshmi Publications, ISBN: 978-81-7008-992-6.
3	Higher Engineering Mathematics, B.S. Grewal, 44th Edition, 2015, Khanna Publishers, ISBN: 978- 81-933284-9-1.
4	Linear Algebra and its Applications, David C. Lay, 4th Edition, 2012, Pearson Education India, ISBN-13: 970321385178, ISBN-10: 0321385171.

ASSESSMENT AND EVALUATION PATTERN		
	CIE	SEE
WEIGHTAGE	50%	50%
QUIZZES		
Quiz-I	Each quiz is evaluated for 10 marks adding up to **20 MARKS**	
Quiz-II		
THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test – I	Each test will be conducted for 50 Marks adding upto 100 marks. Final test marks will be reduced to **40 MARKS**	
Test – II		
EXPERIENTIAL LEARNING	**40**	
MATLAB	**20**	
Model presentation/ case study/ video preparation	**20**	
MAXIMUM MARKS FOR THE THEORY	**100 MARKS**	**100 MARKS**

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Semester: III					
Engineering Materials (Theory)					
Common to AS, ME and CH					
Course Code	:	21ME32		**CIE**	:	50 Marks
Credits: L:T:P	:	2:0:0		**SEE**	:	50 Marks
Total Hours	:	30		**SEE Duration**	:	90 Minutes

Unit - I	**08 Hrs**
Mechanical Properties of Materials: Review of mechanical properties – strength, hardness, toughness, impact strength, brittleness, malleability, ductility, Plastic deformation by twinning and slip, Movement of dislocations, Critical shear stress, Strengthening mechanism, Fatigue and Creep.	

Unit - II	**11 Hrs**
Phase Diagram and Fe-C equilibrium diagram: Phase, Gibbs phase rule, Solid solutions, Hume Rothery Rules, Isomorphous alloy system, Iron-Iron carbide phase diagram- Invariant reactions, Development of microstructure in iron carbon alloys (Slow cooling of steels). Steel & Cast Iron- composition, properties, and applications. **Phase transformation in steel:** TTT diagram of plain carbon steel, annealing, normalizing, hardening and tempering of plain carbon steel. Nucleation: Homogeneous and Heterogeneous Nucleation, Dendritic growth and Cast metal structure.	

Unit - III	**11 Hrs**
Industrial Materials: Stainless Steels: Ferritic, austenitic, and martensitic stainless steels. Magnesium alloys Titanium alloys and Nickel alloys, Intermetallics, shape memory alloys and Amorphous metals, sensors and actuators, piezoelectric and functional materials. **Environmental Degradation of Materials**: Different forms of environmental degradation, forms of corrosion - Galvanic, Intergranular, pitting, stress related corrosion. Corrosion control - Materials selection, protective coating.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the mechanical properties of materials
CO2:	Analyse the different phases and phase transformation and study the relationship between microstructure and properties
CO3:	Classify advanced materials, their properties and applications
CO4:	Visualize the degradation of materials and its prevention

Reference Books	
1	William D Callister, "Material Science and Engineering", John Wiley and Sons, 1997 10th edition, ISBN ISBN-13: 9781119321590
2	Sydney H Avner, "Introduction to Physical Metallurgy" Mc Graw Hill Book Company, 1994, ISBN 0-07-Y85018-6
3	William F Smith, "Material Science and Engineering", Mc Graw Hill Book Company, 2008, 4th edition, ISBN0-07-066717-9

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ASSESSMENT AND EVALUATION PATTERN		
	CIE	SEE
WEIGHTAGE	**50%**	**50%**
QUIZZES		
Quiz-I	Each quiz is evaluated for 10 marks adding up to **20 MARKS.** Reduced to **10**	*****
Quiz-II		
THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test – I	Each test will be conducted for 25 Marks adding up to 50 marks. Final test marks will be reduced to **20 MARKS**	*****
Test – II		
(Maximum of 20 Marks)		*****
Determination of as-cast and heat treated material properties	**15**	
Assignment	**05**	
MAXIMUM MARKS FOR THE THEORY	**50 MARKS**	**50 MARKS**
TOTAL MARKS FOR THE COURSE	**50**	**50**

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Semester: III					
INTRODUCTION TO AEROSPACE ENGINEERING (Theory)					
Course Code	:	21AS33		**CIE**	:	**50 Marks**
Credits: L:T:P	:	2:0:0		**SEE**	:	**50 Marks**
Total Hours	:	29L		**SEE Duration**	:	**2.00 Hours**

Unit-I	10 Hrs
Preliminary Concepts in Aviation: International Standard atmosphere, Temperature, pressure and altitude relationships, Numericals, Anatomy of an aircraft and their functions. **Basic Aerodynamics:** Airfoil nomenclature, NACA Airfoil Series, Wing Planform Geometry, Bernoulli's principle for lift generation, Centre of pressure and its significance, Aerodynamic forces and moments on an Airfoil with Derivation, Lift and drag, Aerodynamic centre, Aerodynamic Coefficients, Aerodynamic characteristics of airfoils, Simple Numericals on lift and drag.	

Unit – II	10 Hrs
Fundamentals of Aerospace propulsion: Brayton Cycle: Illustration of working of gas turbine engine, Working of Turbojet, Turboprop, Turbofan, Ramjet, Scramjet and Pulsejet Engines, Basic Jet Engine Performance parameters, Simple Numericals. **Rocket Propulsion and Space Flight:** Types of rocket propulsion systems: Solid Rockets, Liquid Propellant Rockets, Hybrid Rockets, Nuclear Rockets, Solar Rockets, Orbit equation, Space vehicle trajectories, Kepler's Laws of planetary motion.	

Unit –III	09 Hrs
Aircraft Structures: General types of construction, Monocoque, Semi-Monocoque and Geodesic structures, Typical wing and fuselage structure. **Aircraft Instruments:** Basic Air data systems & Probes, Mach meter, Air speed indicator, Vertical speed indicator, Altimeter, Gyro based instruments.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Appreciate and apply the basic principles of aviation in the development of aerospace vehicles
CO2:	Survey the important fundamental factors that significantly influence the performance of aerospace vehicles
CO3:	Evaluate the various factors affecting the performance of flight vehicles
CO4:	Criticize the design strategy involved in the development of aerospace vehicles

Reference Books	
1	Introduction to Flight, John D. Anderson, 7th Edition, 2011, McGraw-Hill Education, ISBN 9780071086059.
2	Fundamentals of Aerodynamics, Anderson J. D, 5th Edition, 2011, McGraw-Hill International Edition, New York, ISBN:9780073398105.
3	Gas Turbines, V Ganesan, 3rd Edition, 2017, McGraw Hill Education, ISBN-10:0070681929
4	Rocket Propulsion Elements, Sutton G.P., 8th Edition. 2011, John Wiley, New York, ISBH: 1118174208, 9781118174203.

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ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50%**	**50%**
QUIZZES		
Quiz-I	Each quiz is evaluated for 10 marks adding up to **20 MARKS.**	*****
Quiz-II		
THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test – I	Each test will be conducted for 50 Marks adding upto 100 marks. Final test marks will be reduced to **40 MARKS**	*****
Test – II		
EXPERIENTIAL LEARNING	**40**	*****
Self-study on various aircrafts with emphasis on aerodynamics, structures, avionics and propulsion systems	**10**	*****
Numerical Simulation of airfoil characteristics for various flow conditions	**20**	
Video presentation/assignments/elementary design problems on aerospace vehicles	**10**	
MAXIMUM MARKS FOR THE THEORY	**50 MARKS**	**50 MARKS**
PRACTICALS	*****	*****
TOTAL MARKS FOR THE COURSE	**50**	**50**

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Semester: III					
THERMODYNAMICS **(Theory & Practice)**					
Course Code	:	21AS34	**CIE**	:	**100+50 Marks**
Credits: L:T:P	:	3:0:1	**SEE**	:	**100+50 Marks**
Total Hours	:	40L+28P	**SEE Duration**	:	**3.00 +3.00 Hours**

Unit-I	**08 Hrs**
Introductory concepts: Zeroth Law of thermodynamics and temperature Measurement, Thermodynamic definition of Heat and work. Heat and work transfer **First Law of thermodynamics for Closed System:** work Transfer in various processes through P-V diagrams , Concept of Internal Energy, Enthalpy	
Unit – II	**09 Hrs**
First Law of Thermodynamics for a open system: Steady flow process, steady flow energy equation and applications, PMMK1, Application to Unsteady process: Tank filling and emptying Process **Second law of Thermodynamics:** Limitations of First Law of thermodynamics, Heat engine, Heat pump, Carnot's principle, Carnot cycle and its specialties, Clausius and Kelvin Planck statement, PMMK2.	
Unit –III	**09 Hrs**
Entropy: Increase of entropy principle, Isentropic process, T-ds relations, Entropy change of liquids and solids, Entropy change of ideal gases, Isentropic efficiencies of steady flow devices, Entropy balance. **Thermodynamic property relations**: Maxwell relations, Clapeyron equations, Joule-Thomson coefficient. **Properties of Pure Substances:** Property diagrams for phase-change processes, Property tables, Ideal-gas equation of state, Compressibility factor, use of compressibility charts, Other equation of state- Vander Waal's Equation of State.	
Unit –IV	**8 Hrs**
Gas Cycles: Efficiency of air-Standard cycles-Carnot cycle, Otto, Diesel, Dual and Brayton cycle, Mean effective pressure, Representation of cycles on P-V and T-s diagrams.	
Unit –V	**6 Hrs**
Psychrometry: Properties of atmospheric air, Construction and use of psychrometric chart, Analysis of various processes, heating, cooling, dehumidifying and humidifying, Adiabatic mixing of moist air, Analysis of various Air conditioning processes.	

LABORATORY EXPERIMENTS
1.   Determination of flash point and fire point of the given fuels/lubricating oils using Abel Pensky and Pensky Martin's apparatus
2.   Determination of Calorific Value of Solid & Liquid Fuels using Bomb calorimeter
3.   Determination of Calorific Value of gaseous fuel using Junker gas calorimeter
4.   Determination of viscosity of various lubricating oils using Redwood, Saybolts Viscometers
5.   Determination of viscosity of various lubricating oils using Brookfield Viscometer
6.   Study of characteristics and performance of a 4 stroke Diesel Piston engine under various conditions
7.   Study of characteristics and performance of a 4 stroke Petrol Piston engine under various conditions
8.   Determination of Friction power using Morse test
9.   Determination of effectiveness of a parallel and counter flow heat exchangers
10.   Determination of constituents of a gas mixture using Orsat apparatus
11.   Study the performance of vapor compression air conditioning system
12.   Study the performance of vapor compression refrigeration system

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Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the concepts and basic laws of thermodynamics
CO2:	Determine the thermodynamic properties
CO3:	Apply the principle of energy, heat and work and their transfer phenomenon
CO4:	Conduct the thermodynamic analysis of a various heat engines operating with different air standard cycles

Reference Books	
1	Thermodynamics: An Engineering Approach, Yunus A.Cengal and Michael A.Boles, 8th Edition, 2016, Tata McGraw Hill publications, ISBN: 9780070495036.
2	Engineering Thermodynamics, J.B.Jones and G.A.Hawkins, 2nd Edition, 1986, John Wiley and Sons, ISBN: 978-0471812029.
3	Fundamentals of Classical Thermodynamics, G.J.Van Wylen and R.E.Sonntag, 3rd Edition, 1986, Wiley Eastern, ISBN-13: 978-0-471-61075-5.
4	Basic and Applied Thermodynamics P.K.Nag, 2nd Edition., 2002, Tata McGraw Hill Pub, ISBN-13: 978-0070151314.

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50%**	**50%**
QUIZZES		
Quiz-I	Each quiz is evaluated for 10 marks adding up to **20 MARKS.**	*****
Quiz-II		
THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test – I	Each test will be conducted for 50 Marks adding upto 100 marks. Final test marks will be reduced to **40 MARKS**	*****
Test – II		
EXPERIENTIAL LEARNING	**40**	*****
Solving Additional Numerical pertaining to all 5 units using Engineering equation software/Matlab software.	**10**	*****
Thermocouple calibration	**10**	
Working demonstration model for First law and Second Law Principles	**20**	
MAXIMUM MARKS FOR THE THRORY	**100 MARKS**	**100 MARKS**
PRACTICALS	**50**	**50**
TOTAL MARKS FOR THE COURSE	**150**	**150**

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Semester: III					
MECHANICS OF FLUIDS (Theory & Practise)					
Course Code	**:**	21AS35		**CIE**	**:**	**100+50 Marks**
Credits: L:T:P	**:**	3:0:1		**SEE**	**:**	**100 +50 Marks**
Hours	**:**	40L+28P		**SEE Duration**	**:**	**3.00+3.00 Hours**

Unit-I	**10 Hrs**
Basic Concepts: Introduction, definition of fluid, concept of continuum, classification of Fluids **Fluid Properties:** Density, Relative Density, Specific Volume, Specific Weight, Pressure, Shear stress, Newton's law of viscosity, Absolute & Kinematic viscosity, Vapour pressure & cavitation, Bulk Modulus & Compressibility, Surface tension & Capillarity.	

Unit – II	**12 Hrs**
Fluid Statics: Pascal's law, Pressure variation with depth, manometers, hydrostatic thrust on submerged plane and curved surfaces, centre of pressure, Buoyancy, Stability of submerged and floating bodies, Metacenter and Meta centric height. **Fluid Kinematics:** Introduction, Lagrangian & Eulerian Description of Fluids, Types of Fluid Flows, Stream line, streak line and path line, circulation and vorticity, stream function and velocity potential function continuity equation in Integral form and 3D Cartesian coordinates.	

Unit -III	**10 Hrs**
Fluid Dynamics: Basic governing equations of fluid flows**,** Reynold's Transport theorem, Mass conservation, Momentum Conservation and Energy conservation equations, and Introduction to Navier –stokes Equations. **Incompressible Inviscid Flow:** Euler's equation of fluid motion (from first principles), Bernoulli's equation, Bernoulli's equation for real fluid flows. **Application of Bernoulli's equation:** Flow measurement: orifice plate, Venturimeter, Notches: rectangular and V-notch, Pitot tube.	

Unit -IV	**10 Hrs**
Incompressible Viscous flow: Boundary layer concept, Boundary layer thickness, displacement thickness and momentum thickness; flow separation, couette flow, poiseuille flow, kinetic Energy correction factor. **Turbulent Flows:** Mechanism of Transition from Laminar to Turbulent Flows, magnitude, Intensity and scale of Turbulence, Measurement of Turbulence using Hot Wire Anemometer, Velocity distribution in a Turbulent Flow, Head Loss in Pipe due to Friction (Darcy's Equation).	

Unit -V	**10 Hrs**
Dimensional Analysis & Model Studies: Units and Dimensions, Dimensional Homogeneity, Dimensional Analysis-Rayleigh's Method, Buckingham's π-Theorem, Dimensionless numbers. Model Analysis, Types of Similarities and Similitude, Similarity Laws. **Introduction to Compressible Flows:** Stagnation Properties, One-Dimensional Isentropic Flow, Mach number, Mach Cone.	

LABORATORY EXPERIMENTS
1.   Determination of major losses in fluids flowing through pipes.
2.   Determination of minor losses in fluids flowing through pipes
3.   Determination of Co-efficient of discharge over a V-notch
4.   Determination of force generated by the impact of water jet on the vanes
5.   Determination of Co-efficient of discharge through venturimeter
6.   Determination of Co-efficient of discharge through orifice meter
7.   Determination of type of flow for different Reynolds Number using Reynolds apparatus

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8.	Study of performance characteristics of a single stage centrifugal pump
9.	Study of performance characteristics of a multi-stage centrifugal pump
10.	Study of performance characteristics of a Francis turbine
11.	Study of performance characteristics of a Pelton wheel
12.	Determination of metacentric height of floating bodies
13.	Flow Visualization studies using water tunnel

Course Outcomes:

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

CO 1:	Identify the properties of fluid which influence flow characteristics
CO 2:	Distinguish fluid flows and evaluate the properties associated with the flow
CO 3:	Apply Dimensional analysis and similarity laws for conducting model tests
CO 4:	Evaluate and comment on the flow using flow measuring devices
CO 5:	Discriminate and comment on boundary layer flows
CO 6:	Interpret the effect of compressibility on fluid flows

Reference Books

1	Fluid Mechanics, Frank M White, 7th Edition, 2012, McGraw Hill, ISBN 9780073529349
2	Fluid Mechanics and Applications, Yunus A. Cengel & John M Cimbala, 12th Edition, 2009, Tata McGraw-Hill Publishers,. ISBN: 9780070700345
3	Fluid Mechanics, Streeter. V. L., and Wylie, E.B., 9th Edition, 2017, McGraw Hill, 1983 ISBN: 0071156003
4	Mechanics of Fluids, B S Massey, 7th Edition, 1998, ELBS Edition. ISBN-10: 0748740430
5	Fluid Mechanics, Hydraulics and Fluid Machines, Ramamritham. S, 9th Edition, 2014, Dhanpat Rai& Sons, Delhi, 1988.ISBN: 978-93-84378-27-1

ASSESSMENT AND EVALUATION PATTERN			
WEIGHTAGE		**50%**	**50%**
QUIZZES			
Quiz-I	Each quiz is evaluated for 10 marks adding up to **20 MARKS.**		*****
Quiz-I II			
THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)			
Test – I	Each test will be conducted for 50 Marks adding upto 100 marks. Final test marks will be reduced to **40 MARKS**		*****
Test – II			
EXPERIENTIAL LEARNING		40	*****
Writing code either using EES/Python/Matlab and reading the solution, report preparation		10	*****
Study of various flow measuring devices used in fluid mechanics		20	
Application of Fluid Mechanics in Design of an RC plane		10	
MAXIMUM MARKS FOR THE THRORY		**100 MARKS**	**100 MARKS**
PRACTICALS		50	50
TOTAL MARKS FOR THE COURSE		150	150

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Semester: III					
STRUCTURAL MECHANICS					
(Theory)					
Course Code	**:**	21AS36		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	40 hours		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**10 Hrs**
Basic equations of linear elasticity: Stress and Strain, True stress and Engineering Stress, Hooke's Law, Generalized Hooks law, Relationship between Elastic Constants, Thermal Stresses, Compound bars, Principle of Superposition. **Principal Stresses and Strain:** State of Stress, Stress and Strain at a point, Plane Stress and Plane Strain approximations.	
Unit – II	**08 Hrs**
Bending Moment and Shear Force Diagram: Sign Convention, Procedure for drawing BMD and SFD, Different types of Loading and their S.F & B.M Diagram, Point of Contra flexure, General expression.	
Unit –III	**08 Hrs**
Euler-Bernoulli beam theory: The Euler-Bernoulli assumptions, Implications of the Euler-Bernoulli assumptions. **Deflection of Beams:** Equation of Elastic curve, Deflection of Beams.	
Unit –IV	**06 Hrs**
Torsion: Torsion of circular shafts, polar moment of inertia and polar section modulus, Comparison of solid and hollow shaft, Torsion combined with axial force and bending moments, Power transmission.	
Unit –V	**08 Hrs**
Shells: Thin cylindrical shell of circular cross section, Thin spherical shell, Cylindrical shell with hemispherical ends.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the nature of different types of loads
CO2:	Describe the behaviour of structures under various loads
CO3:	Apply various principles to ascertain the character of materials under different loads
CO4:	Evaluate the stability of various structures under different loading environments

Reference Books	
1	Timoshenko and Young "Elements of Strength of Mateials', East-West Press, 1976. ISBN: 978-93-84378-27-1
2	Beer.F.P. and Johnston.R, 'Mechanics of Materials', McGraw Hill Publishers, 2006. ISBN: 978-0073398235
3	Structural Mechanics, Bao Shihua, Gong Yaoqing, Wuhan University of Technology Press, 2005.
4	Aircraft structural Analysis, T.H.G Megson, Butterworth-Heinemann Publications, 2007. ISBN: 978-1-85617-932-4
5	S.Ramamrutham, R Narayanan, "Strength of Materials', Dhanapath Rai Publishing Company, New Delhi, 2012. ISBN: 978-93-84378-26-4

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ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50%**	**50%**
QUIZZES		
Quiz-I	Each quiz is evaluated for 10 marks adding up to **20 MARKS.**	*****
Quiz-II		
THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test – I	Each test will be conducted for 50 Marks adding up to 100 marks. Final test marks will be reduced to **40 MARKS**	*****
Test – II		
EXPERIENTIAL LEARNING	**40**	*****
Development of solutions in PYTHON for numerical problems in Aerospace Structures.	**40**	*****
MAXIMUM MARKS FOR THE THRORY	**100 MARKS**	**100 MARKS**
PRACTICALS	**50**	**50**
TOTAL MARKS FOR THE COURSE	**150**	**150**

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Semester: III
Bridge Course: MATHEMATICS
(Common to all branches)

Course Code	:	21DMA37		CIE	:	50 Marks
Credits: L:T:P	:	2:0:0		**SEE**	:	**NA**
Audit Course				**SEE Duration**	:	**NA**

Unit-I	**05 Hrs**

Differential Calculus:
Partial derivatives – Introduction, simple problems. Total derivative, composite functions. Jacobians – simple problems.

Unit – II	**05 Hrs**

Vector Differentiation:
Introduction, simple problems in terms of velocity and acceleration. Concepts of gradient, divergence – solenoidal vector function, curl – irrotational vector function and Laplacian, simple problems.

Unit –III	**06 Hrs**

Differential Equations:
Higher order linear differential equations with constant coefficients, solution of homogeneous equations - Complementary functions. Non homogeneous equations –Inverse differential operator method of finding particular integral based on input function (force function).

Unit –IV	**05 Hrs**

Numerical Methods:
Solution of algebraic and transcendental equations – Intermediate value property, Newton-Raphson method. Solution of first order ordinary differential equations – Taylor series and 4th order Runge-Kutta methods. Numerical integration – Simpson's $1/3^{rd}$, $3/8^{th}$ and Weddle's rules. (All methods without proof)**.**

Unit –V	**05 Hrs**

Multiple Integrals:
Evaluation of double integrals, change of order of integration. Evaluation of triple integrals. Applications – Area, volume and mass – simple problems.

Course Outcomes: After completing the course, the students will be able to	
CO1:	Illustrate the fundamental concepts of partial differentiation, double integrals, vector differentiation, solutions of higher order linear differential equations and numerical methods.
CO2:	Derive the solution by applying the acquired knowledge of total derivatives of implicit functions, Jacobians, homogeneous linear differential equations, velocity and acceleration vectors to the problems of engineering applications.
CO3:	Evaluate the solution of the problems using appropriate techniques of differential and integral calculus, vector differentiation, differential equations and numerical methods to the real world problems arising in many practical situations.
CO4:	Compile the overall knowledge of differential and integral calculus, vector differentiation, differential equations and numerical methods gained to engage in life – long learning.

Reference Books	
1	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2015, ISBN: 978-81-933284-9-1.
2	Higher Engineering Mathematics, B.V. Ramana, 11th Edition, 2010, Tata McGraw-Hill, ISBN: 978-0-07-063419-0.

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3	N.P. Bali & Manish Goyal, A Text Book of Engineering Mathematics, Lakshmi Publications, 7th Edition, 2010, ISBN: 978-81-31808320.
4	Advanced Engineering Mathematics, E. Kreyszig, 10th Edition (Reprint), 2016. John Wiley & Sons, ISBN: 978-0470458365.

Continuous Internal Evaluation (CIE); Theory (50 Marks)

CIE is executed by way of quizzes (Q) and tests (T). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. The two tests are conducted for 30 marks each and the sum of the marks scored from two tests is reduced to 30. **Total CIE is 20(Q) +30(T)=50 Marks.**

Semester End Evaluation (SEE); Theory (50 Marks)

SEE for 50 marks is executed by means of an examination. The Question paper for the course consists of five main questions, one from each unit for 10 marks adding up to 50 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

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Semester: III					
DESIGN THINKING LAB					
Course Code	:	21AS39		CIE Marks	: 50
Credits: L:T:P	:	0:0:2		SEE Marks	: 50
Hours	:	26P		SEE Duration	: 02 Hours
Course Learning Objectives: To enable the students to:					
1	*Knowledge Application:* Acquire the ability to make links across different areas of knowledge and to generate, develop and evaluate ideas and information to apply these skills to provide solutions of societal concern				
2	*Communication:* Acquire the skills to communicate effectively and to present ideasclearly and coherently to a specific audience in both the written and oral forms.				
3	*Collaboration:* Acquire collaborative skills through working in a team to achievecommon goals.				
4	*Independent Learning:* Learn on their own, reflect on their learning and takeappropriate action to improve it.				

Guidelines for Design Thinking Lab:
1. The Design Thinking Lab (DTL) is to be carried out by a team of two-three students.

2. Each student in a team must contribute equally in the tasks mentioned below.

3. Each group has to select a theme that will provide solutions to the challenges of societal concern.Normally three to four themes would be identified by the by the department

4. Each group should follow the stages of Empathy, Design, Ideate, prototype and Test for completion of DTL.

5. After every stage of DTL, the committee constituted by the department along with the coordinators would evaluate for CIE. The committee shall consist of respective coordinator & two senior faculty members as examiners. The evaluation will be done for each student separately.

6. The team should prepare a Digital Poster and a report should be submitted after incorporation ofany modifications suggested by the evaluation committee.

The Design Thinking lab tasks would involve:
1. Carry out the detailed questionnaire to arrive at the problem of the selected theme.The empathyreport shall be prepared based on the response of the stake holders.

2. For the problem identified, the team needs to give solution through thinking out of the box innovatively to complete the ideation stage of DTL

3. Once the idea of the solution is ready, detailed design must be formulated in theDesign stageconsidering the practical feasibility.

4. If the Design of the problem is approved, the team should implement the design andcome out withprototype of the system.

5. Conduct thorough testing of all the modules in the prototype developed and carryoutintegrated testing.

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6. Demonstrate the functioning of the prototype along with presentations of the same.

7. Prepare a Digital poster indicating all the stages of DTL separately. A Detailed project report alsoshould be submitted covering the difficulties and challenges faced in each stage of DTL.

8. Methods of testing and validation should be clearly defined both in the Digital poster as well asthe report.

The students are required to submit the Poster and the report in the prescribed format provided by the department.

Course Outcomes: After completing the course, the students will be able to	
CO 1:	Interpreting and implementing the empathy, ideate and design should be implemented by applying the concepts learnt.
CO 2:	The course will facilitate effective participation by the student in team work and development of communication and presentation skills essential for being part of any ofthe domains in his / her future career.
CO 3:	Applying project life cycle effectively to develop an efficient prototype.
CO 4:	Produce students who would be equipped to pursue higher studies in a specialized area or carry out research work in an industrial environment.

Scheme of Evaluation for CIE Marks: Evaluation will be carried out in three phases:

Phase	Activity	Weightage
I	Empathy, Ideate evaluation	10M
II	Design evaluation	15M
III	Prototype evaluation, Digital Poster presentation and report submission	25M
	Total	**50M**

Scheme of Evaluation for SEE Marks:

Sl. No.	Evaluation Component	Marks
1.	Written presentation of synopsis: Write up	5M
2.	Presentation/Demonstration of the project	15M
3.	Demonstration of the project	20M
4.	Viva	05M
5.	Report	05M
	Total	**50M**

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Semester III					
SUMMER INTERNSHIP-I (Practice)					
Course Code	:	21ASI310		CIE Marks :	50
Credits: L:T:P	:	0:0:2		SEE Marks :	50
Total Hours	:	3 Weeks		SEE Duration :	1 Hours

Guidelines	3 Weeks

1. A minimum of 1 credit of internship after I year may be counted towards B.E. degree program.
2. During II semester to III semester transition, three weeks of internship is mandatory**.**
3. Internship report and certificate need to be submitted at the end of the internship to the concerned department for the evaluation.
4. Internship evaluation will be done during III semester for 1 credit in two phases.
5. Students can opt the internship with the below options:

1. **Within the respective department at RVCE (Inhouse) Departments** may offer internship opportunities to the students through the available tools so that the students come out with the solutions to the relevant societal problems that could be completed within THREE WEEKS.
2. At RVCE Centre of Excellence/Competence
RVCE hosts around 16 CENTER OF EXCELLENCE in various domains and around 05 CENTER OP COMPETENCE. The details of these could be obtained by visiting the website https:/ /rvce.edu.in / rvce-center-excellence. Each center would be providing the students relevant training/internship that could be completed in three weeks.
C. At Intern Shala
Intern Shala is India's no.1 internship and training platform with 40000+ paid internships in Engineering. Students can opt any internship for the duration of three weeks by enrolling on to the platform through https: / /internsha1a.com

D. At Engineering Colleges nearby their hometown
Students who are residing out of Bangalore, should take permission from the nearing Engineering College of their hometown to do the internship. The nearby college should agree to give the certificate and the letter/email stating the name of the student along with the title of the internship held with the duration of the internship in their official letter head.
E. At Industry or Research Organizations
Students can opt for interning at the industry or research organizations like BEL, DRDO, ISRO, BHEL, etc.. through personal contacts. However, the institute/industry should provide the letter of acceptance through hard copy/email with clear mention of the title of the work assigned along with the duration and the name of the student.

Procedures for the Internship:

1. Request letter/Email from the office of respective departments should go to Places where internships are intended to be carried out with a clear mention of the duration of Three Weeks. Colleges/Industry/ CoEs/CoCs will confirm the training slots and the number of seats allotted
for the internship via confirmation letter/ Email.
2. Students should submit a synopsis of the proposed work to be done during internship program. Internship synopsis should be assessed or evaluated by the concerned Colleges/Industry/CoEs/CoC. Students on joining

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internship at the concerned Colleges/Industry/ CoEs/CoCs submit the Daily log of student's dairy from the joining date.

3. Students will submit the digital poster of the training module/project after completion of internship.
4. Training certificate to be obtained from industry.

Course Outcomes: After completing the course, the students will be able to	
CO1:	Develop communication, interpersonal, critical skills, work habits and attitudes necessaryfor employment.
CO2:	Assess interests, abilities in their field of study, integrate theory and practice and explorecareer opportunities prior to graduation.
CO3:	Explore and use state of art modern engineering tools to solve societal problems with affinity towards the environment and involve in professional ethical practice.
CO4:	Compile, document and communicate effectively on the internship activities with theengineering community.

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
Phase – I	20	
Phase- II	30	50
TOTAL MARKS FOR THE COURSE	50	

Semester: IV					
STATISTICS AND PROBABILITY FOR DATA SCIENCE **(Theory)** **(Common to ALL Programs)**					
Course Code	**:**	21MA41	**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	2:1:0	**SEE**	**:**	**100 Marks**
Total Hours	**:**	30L+15T	**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**06 Hrs**
Statistics: Central moments, mean, variance, coefficients of skewness and kurtosis in terms of moments. Correlation analysis, rank correlation, linear and multivariate regression analysis – problems.	
Unit – II	**06 Hrs**
Random Variables: Random variables-discrete and continuous, probability mass function, probability density function, cumulative density function, mean and variance. Two or more random variables - Joint probability mass function, joint probability density function, conditional distribution and independence, Covariance and Correlation.	
Unit –III	**06 Hrs**
Probability Distributions: Discrete distributions - Binomial, Poisson. Continuous distributions – Exponential, Normal and Weibul.	
Unit –IV	**06 Hrs**
Sampling and Estimation: Population and sample, Simple random sampling (with replacement and without replacement). Sampling distributions of means (σ known), Sampling distributions of mean (σ unknown): t - distribution, Sampling distributions of variance (σ unknown): Chi - squared distribution. Estimation - Maximum Likelihood Estimation (MLE).	
Unit –V	**06 Hrs**
Inferential Statistics: Principles of Statistical Inference, Test of hypothesis - Null and alternative hypothesis, Procedure for statistical testing, Type I and Type II errors, level of significance, Tests involving the normal distribution, one – tailed and two – tailed tests, P – value, Special tests of significance for large and small samples (F, Chi – square, Z, t – test).	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Illustrate the fundamental concepts of statistics, random variables, distributions, sampling, estimation and statistical hypothesis.
CO2:	Apply the acquired knowledge of statistics, random variables, distributions, sampling, estimation and statistical hypothesis to solve the problems of engineering applications.
CO3:	Analyze the solution of the problems using appropriate statistical and probability techniques to the real world problems arising in many practical situations.
CO4:	Interpret the overall knowledge of statistics, probability distributions and sampling theory gained to engage in life-long learning.

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	Reference Books
1	Theory and Problems of Probability, Seymour Lipschutz & Marc Lars Lipson, 2nd Edition, Schaum's Outline Series, McGraw – Hill,2000, ISBN: 9780071386517.
2	Applied Statistics and Probability for Engineers, Douglas C. Montgomery and George C. Runger, 7th Edition, John Wiley & Sons, 2019, ISBN: 9781119570615.
3	Probability & Statistics for Engineers & Scientists, Ronald E. Walpole & Raymond H. Myers, 9th edition, 2016, Pearson Education, ISBN-13: 9780134115856.
4	The Elements of Statistical Learning - Data Mining, Inference, and Prediction, Trevor Hastie Robert Tibshirani Jerome Friedman, 2nd Edition, 2009 (Reprint 2017), Springer, ISBN-10: 0387848576, ISBN-13: 9780387848570.

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
WEIGHTAGE	**50%**	**50%**
QUIZZES		
Quiz-I	Each quiz is evaluated for 10 marks adding up to **20 MARKS**	
Quiz-II		
THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analysing, Evaluating, and Creating)		
Test – I	Each test will be conducted for 50 Marks adding up to 100 marks. Final test marks will be reduced to **40 MARKS**	
Test – II		
EXPERIENTIAL LEARNING	**40**	
MATLAB	**20**	
Model presentation/ case study/ video preparation	**20**	
MAXIMUM MARKS FOR THE THEORY	**100 MARKS**	**100 MARKS**

Semester: IV					
ENVIRONMENTAL TECHNOLOGY **(Theory)** **(Common to all branches)**					
Course Code	:	21BT42A		**CIE**	:	50 Marks
Credits: L:T:P	:	2:0:0		**SEE**	:	50 Marks
Total Hours	:	26 L		**SEE Duration**	:	90 min

Unit I	**08 hrs**
Introduction: Climate action – Paris convention, Sustainable Developmental Goals in relation to environment, Components of environment, Ecosystem. Environmental education, Environmental acts & regulations, role of non-governmental organizations (NGOs), EMS: ISO 14000, Environmental Impact Assessment. Environmental auditing.	

Unit II	**09 hrs**
Pollution and its remedies: Air pollution – point and non-point sources of air pollution and their controlling measures (particulate and gaseous contaminants). Noise pollution, Land pollution (sources, impacts and remedial measures), **Water management:** Advanced water treatment techniques, water conservation methods. **Waste management:** Solid waste, e-waste & biomedical waste – sources, characteristics & disposal methods. Concepts of Reduce, Reuse and Recycling of the wastes. **Waste to Energy:** Different types of Energy, Conventional sources & Non-conventional sources of energy: Solar, Hydro Electric, Wind, Nuclear, Biomass & Biogas Fossil Fuels and Hydrogen.	

Unit III	**09 hrs**
Environmental design: Green buildings, green materials, Leadership in Energy and Environmental Design (LEED), Hydroponics, Organic Farming, Biofuels, IC engine to E mobility transition and its impacts, Carbon Credits, Carbon Foot Prints, Opportunities for Green Technology Markets, Carbon Sequestration. **Resource recovery system:** Processing techniques, Materials recovery systems, Biological conversion (composting and anaerobic digestion). Thermal conversion products (Combustion, Incineration, Gasification, Pyrolysis, use of Refuse Derived Fuels). Case studies.	

Reference Books	
1	Shashi Chawla, A Textbook of Environmental Studies, McGraw Hill Education, 2017, ISBN: 1259006387,
2	Richard A Schneider and Jerry A Nathanson, Basic Environmental Technology, Pearson, 6th Edition, 2022. ISBN: 9789332575134,
3	G. Tyler Miller (Author), Scott Spoolman (Author), (2020) Environmental Science – 15th edition, Publisher: Brooks Cole, ISBN-13: 978-1305090446 ISBN-10: 130509044
4	Howard S. Peavy, Donald R. Rowe and George Tchobanoglous. 2000. Environmental Engineering, McGraw Hill Education, First edition (1 July 2017). ISBN-10**:** 9351340260, ISBN-13**:** 978-9351340263

Course Outcomes: After completing the course, the students will be able to	
CO1:	Identify the components of environment and exemplify the detrimental impact of anthropogenic activities on the environment.

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CO2:	Differentiate the various types of wastes and suggest appropriate safe technological methods to manage the waste.
CO3:	Apply different renewable energy resources for sustainable development of clean energy.
CO4:	Adopt the appropriate recovering methods to recover the essential resources from the wastes for reuse or recycling.

Experiential learning topics		
Assessment of the environment of certain big campuses/areas/industries etc, a case study		
1	Development of data sheet	
2	Survey and its record	
3	Identifying the problems associated	
4	Provide a solution for the identified problem	

Experiments to be performed	
1	Data development
2	Working model (in silico or demo model)
3	Preparing a report
4	Brainstorming of the work carried out.

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
WEIGHTAGE	**50%**	**50%**
QUIZZES		
Quiz-I	Each quiz is evaluated for 5 marks adding up to 1**0 MARKS.**	*****
Quiz-II		
THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		*****
Test – I	Each test will be conducted for 25 Marks adding upto 50 marks. Final test marks will be reduced to 2**0 MARKS**	*****
Test – II		
EXPERIENTIAL LEARNING (Maximum of 20 Marks)		*****
Case Study-based Teaching-Learning	**10**	*****
Experiments performed	**10**	
MAXIMUM MARKS FOR THE THEORY	**50 MARKS**	**50 MARKS**
TOTAL MARKS FOR THE COURSE	**50**	**100**

Experiential learning evaluation will be evaluated based on the experiments and the preparation, presentation of the topics, equal weightage is given for experiments and theory.

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Semester: IV					
AEROSPACE PROPULSION (Theory & Practice)					
Course Code	:	21AS43		**CIE**	:	100 +50 Marks
Credits: L:T:P	:	3:0:1		**SEE**	:	100 +50 Marks
Total Hours	:	40L+28P		**SEE Duration**	:	3.00 +3.00 Hours

Unit-I	**08 Hrs**
Jet Engine Performance: Thrust of a Jet Engine (derivation), Factors affecting thrust, Afterburner and Water Injection Technique for thrust augmentation, Airbreathing Engine Performance Parameters: Specific Thrust, Thrust Power, Specific Impulse, TSFC, Propulsive Efficiency, Thermal Efficiency and Numericals on jet engine cycle analysis.	
Unit – II	**12 Hrs**
Aircraft Propulsion Systems: Aircraft Inlets-Subsonic & Supersonic Inlets, Compressors: Centrifugal & Axial Types, Velocity diagrams, Combustion Chambers: Principle of operation, Classification of Combustion Chambers, Turbines: Types of turbines-Operating Principle, Velocity triangles**,** Degree of reaction (Without Numericals).	
Unit –III	**06 Hrs**
Solid Rocket Propulsion: Solid propellants: Types of Solid Propellants, Propellant Characteristics, Propellant Ingredients, Liners, Insulators & Inhibitors, Thrust profiles, Propellant Burning Rate, Ignition of Solid propellants, Thrust Termination.	
Unit –IV	**06 Hrs**
Liquid Rocket Propulsion: Liquid propellants: Types of Liquid Oxidizers and Fuels, Properties, Propellant feed systems: Pump and Gas Pressure Feed systems, Liquid Engines for Maneuvering, Orbit Adjustments and Attitude Control.	
Unit –V	**08 Hrs**
Electric and Ion Propulsion Systems: Electrothermal Thrusters, Arc-jet Thrusters, Ion Propulsion, Plasma Thrusters: Hall Effect Thrusters, Electric Power Generation: Solar Cells, Solar Generators, Radioactive Thermal Generators, Nuclear Fission Power Generators. **Rocket Performance:** Rocket equation, Performance Parameters: Thrust, Total Impulse, Specific Impulse, Specific propellant consumption, Effective Exhaust Velocity, Characteristic Velocity, Mass Ratio, Propellant Mass Fraction, Impulse to weight ratio, Thrust to weight ratio, Energy and Efficiencies, Numerical examples.	

LABORATORY EXPERIMENTS
1. Performance analysis of a micro gas turbine/jet propulsion system
2. Determination of Performance characteristics of a fixed pitch aircraft propeller
3. Determination of Performance characteristics of a variable pitch aircraft propeller-Open Experiment
4. Measurement of burning velocity of a pre-mixed flame in a gas turbine combustion chamber
5. Determine the pressure and velocity variation of an exhaust gas flowing out of a convergent nozzle
6. Determination of pressure and velocity variation of a supersonic exhaust jet flowing out of a convergent-divergent nozzle
7. Study of pressure distribution across a turbine cascade
8. Study of flow through an axial cascade turbine blade row
9. Preparation of Solid Propellant Rocket Fuel- Open Experiment

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10.	Evaluation of Burning Characteristics of Solid Propellant Fuel- Open Experiment

Course Outcomes: After completing the course, the students will be able to	
CO1:	Demonstrate skills to comprehend the design complexities associated with air and non-air breathing propulsion systems
CO2:	Categorize the various design and performance parameters affecting the operation of each propulsion system
CO3:	Analytically determine the performance of the subsystems through the applications of fundamental principles of engineering
CO4:	Design and create an efficient Propulsion system for a particular aerospace vehicle

Reference Books	
1	Gas Turbines, V Ganesan, 3rd Edition, 2017, McGraw Hill Education, ISBN-10: 0070681929
2	Gas Turbine Propulsion, D P Mishra, 2nd Edition, M V Learning, 2015, ISBN: 978-81-309-27527
3	Elements of Propulsion: Gas Turbines and Rockets, Jack D Mattingly, 5th Edition, 2006, American Institute of Aeronautics and Astronautics (AIAA), ISBN: 1563477793.
4	Rocket Propulsion Elements, Sutton G P, 8th Edition, 2010, John Wiley, New York, ISBN:9781118174203
5	Understanding Aerospace Chemical Propulsion, H S Mukunda, 1st Edition, 2017, I K International Publishing House, ISBN: 978-93-85909-42-9
6	Rocket and Spacecraft Propulsion: Principles, Practices and Developments, Martin J L Turner, 3rd Edition, 2009, Praxis Publishing Ltd, Chichester, UK, ISBN 978-3-540-69202-7

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	50%	50%
QUIZZES		
Quiz-I	Each quiz is evaluated for 10 marks adding up to **20 MARKS.**	*****
Quiz-II		
THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test – I	Each test will be conducted for 50 Marks adding upto 100 marks. Final test marks will be reduced to **40 MARKS**	*****
Test – II		
EXPERIENTIAL LEARNING	**40 Marks**	*****
Video presentation/assignments/elementary design problems on aerospace vehicles	20	*****
Study of various jet engines with various tools for simulating jet engine performance	10	
Self-Study on various components of jet/rocket engines	10	
MAXIMUM MARKS FOR THE THRORY	**100 MARKS**	**100 MARKS**
PRACTICALS	**50**	**50**
TOTAL MARKS FOR THE COURSE	**150**	**150**
Semester: IV		

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			Aerospace Structures (Theory & Practice)		
Course Code	:	21AS44	**CIE**	:	**100 +50 Marks**
Credits: L:T:P	:	3:0:1	**SEE**	:	**100 +50 Marks**
Total Hours	:	40L+28P	**SEE Duration**	:	**3.00 +3.00 Hours**

Unit-I	**08 Hrs**
Loads on Aircraft: Structural nomenclature, Load Factors, Wing Design Loads, Empennage Loads, and Fuselage loads, Propulsion Loads, landing gear loads, Miscellaneous loads, Velocity diagram V-n diagram for the loads acting on the aircraft, salient features of the V-n diagram. Flight envelope for different flying conditions.	
Unit – II	**10 Hrs**
Shear Flow in Open & Closed Sections: Open Sections: Concept of shear flow, Shear Flow in Thin walled beams, the shear centre and Elastic axis. **Closed Sections**: Bredt - Batho theory, shear centre of closed sections	
Unit –III	**08 Hrs**
Buckling of Columns : Introduction, Critical Load, Euler's Critical Load for various end conditions, Slenderness ratio, Rankine's Crippling Load	
Unit –IV	**06 Hrs**
Design of Aircraft Structures: Design criteria, Safety Factor, Life Assessment procedures, Damage tolerance and Fail safe Design.	
Unit –V	**08 Hrs**
Bolted Riveted and Welded Connections: Failure of single bolt fitting, Lug strength analysis under Axial, Transverse and Oblique Loading, Riveted Connections, Welded Connections.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand and comprehend the loading behaviour on aircraft.
CO2:	Develop solutions to analyse the structures response to load.
CO3:	Assess the influence of shear flow in open and closed sections
CO4:	Quantitatively analyse the loads acting on the fuselage and the wings

LABORATORY EXPERIMENTS
1. Tensile Characterization of Aerospace Alloys
2. Fatigue Behaviour of Aerospace Alloys
3. Crack Propagation behaviour of Aerospace Alloys
4. Energy absorbed under an impact velocity (Izod and Charpy Test)
5. Geometry cleanup for FE modelling
6. 2D Meshing of Aerospace Component
7. Solid and 3D meshing of Aerospace Component
8. Failure of a circular plate subjected to the impact of an infinite rigid sphere
9. Introduction on how to simulate a bird strike on the windshield
10. Study of the stress wave propagation and the strain rate effect on the Hopkinson bar.
11. Topology Optimization of Aerospace Components
12. Shape Optimization of Aerospace Component

Reference Books	
1	Megson, T.M.G 'Aircraft Structures for Engineering Students', Edward Arnold, 1995. ISBN: 978-0-75066-7395
2	Donaldson, B.K., "Analysis of Aircraft Structures – An Introduction", McGraw-Hill, 1993. ISBN:978-0521865838
3	Peery, D.J., and Azar, J.J., "Aircraft Structures", 2nd edition, McGraw, Hill, N.Y., 1993. ISBN-10:0486485803
4	C. T. Sun, "Mechanics of Aircraft Structures" Wiley-Interscience, March 1998, ISBN-13: 9780471178774

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50%**	**50%**
QUIZZES		
Quiz-I	Each quiz is evaluated for 10 marks adding up to **20 MARKS.**	*****
Quiz-II		
THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test – I	Each test will be conducted for 50 Marks adding up to 100 marks. Final test marks will be reduced to **40 MARKS**	*****
Test – II		
EXPERIENTIAL LEARNING	40	*****
Development of solutions in PYTHON for numerical problems in Mechanics of Materials.	40	*****
MAXIMUM MARKS FOR THE THEORY	100 MARKS	100 MARKS
PRACTICALS	50	50
TOTAL MARKS FOR THE COURSE	150	150

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Semester: IV					
FUNDAMENTALS OF AVIONICS					
(Theory)					
Course Code	:	21AS45		CIE	:	100 Marks
Credits: L:T:P	:	3:0:0		SEE	:	100 Marks
Hours	:	40 L		SEE Duration	:	3 Hours

Unit-I	07 Hrs
Electronic Circuits: Different Types of Transistor amplifiers, Oscillators; Analysis/design of Amplifiers, Oscillators, Mixers & Modulators / Demodulators - single/multi-stage; Feedback & uses; Timers, Multipliers, Wave shaping, A/D - D/A converters.	

Unit – II	08 Hrs
Transmission Lines: Introduction, transmission lines equations and solutions, termination of line by infinite line, by characteristic impedance, short circuit line, open circuit line, VSWR, problems Microstrip lines. **Waveguides:** Rectangular and circular type, TE and TM waves in wave guides, their transmission properties and attenuation., E-plane & H Plane Waveguides, Magic Tee, Circulator, Duplexer and their S matrices, Wave guide resonator, loaded and unloaded.	

Unit –III	09 Hrs
Propagation of EM Waves: Electromagnetic Spectrum; Basics of E M Wave, Polarization, Types of Polarization, Modes of Radio wave Propagation, Surface wave, Troposphere duct Propagation, Tropo-scatter Propagation, Ionosphere Propagation, Magneto-ionic theory, Secant law, MUF, Critical frequency, Skip distance. Fading & Remedial measures. **Antenna Basics & Microwave Antenna**: Oscillating dipole: Electromagnetic radiation, retarding potential, Antenna parameters: directivity, beam width, gain, radiation, effective aperture, Friss transmission formula **Antenna array:** Horn, Parabolic Reflector and its feed, Cassegrain antenna, Slot array, lens antenna. Beam Forming, Phased Arrays.	

Unit –IV	07 Hrs
Elements of Communication Systems: Definition of Signal & System, Types of Signals, Classification of Signals, Classification of Systems; Signals – Amplitude, Frequency & Phase. Gain, Attenuation & Decibels; Tuned Circuits & Filters, Noise & SNR comparison; Modulator / Demodulator, Frequency Synthesizer, Phase lock loop demodulator, Transmitter / Receiver.	

Unit –V	09 Hrs
Analog and Digital Communication Systems: Analog Communication Techniques**:** Amplitude Modulation, Frequency Modulation & Phase Modulation, Pulse Modulation. **Digital Communication Basics**: Sampling, quantizing, coding, PCM, DPCM, multiplexing-audio/video; Digital modulation: ASK, FSK, PSK; Multiple access: TDMA, FDMA, CDMA.	

Course Outcomes:	At the end of this course the student will be able to :
CO 1:	Develop the understanding of electronic devices, associated circuits and their applications in communication systems.
CO 2:	Explain the process of E M Wave propagation, antenna behaviour and their application in Radar & Communication systems.
CO 3:	Understand the functioning of Transmission lines & Waveguides and their applications in Radar & Communication.
CO 4:	Develop understanding of different types of Digital communication techniques.

Reference Books	
1	Integrated Electronics : Millman & Halkias, 2nd Edition, 1 July 2017, McGraw Hill Education, ISBN-13: 978-0070151420
2	Microelectronics, Millman & Grabel, 2nd Edition, 2017, McGraw Hill Education,ISBN-13: 978-0074637364
3	Principles of Electronics Communication Systems: Louis E Fresnel Jr, 4th/5th edition, Mc Graw Hill, ISBN 978-0-07-337385-0.
4	Electronic Communication Systems: George Kenndy & Bernard Davis, Tata McGraw Hill, 37th reprint 2009, ISBN-13: 978-0-07-463682-4, .ISBN-10: 0-07-463682-0
5	Principle of Digital Communication System:Robert G Gallager, 2008 Edition, Cambridge University Press. ISBN-10-0521879078, ISBN-13 978-0521879071.

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50%**	**50%**
QUIZZES		
Quiz-I	Each quiz is evaluated for 10 marks adding up to **20 MARKS.**	*****
Quiz-II		
THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test – I	Each test will be conducted for 50 Marks adding upto 100 marks. Final test marks will be reduced to **40 MARKS**	*****
Test – II		
EXPERIENTIAL LEARNING	**40**	*****
Case Study-based Teaching-Learning	**10**	*****
Sector wise study & consolidation (viz., Engg. Semiconductor Design, Healthcare & Pharmaceutical, FMCG, Automobile, Aerospace and IT/ITeS)	**20**	
Video based seminar (4-5 minutes per student)	**10**	
MAXIMUM MARKS FOR THE THRORY	**100 MARKS**	**100 MARKS**
TOTAL MARKS FOR THE COURSE	**100**	**100**

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Semester: IV					
FUNDAMENTALS OF COMBUSTION FOR PROPULSION **(Theory)**					
Course Code	:	21AS4A1		**CIE**	:	**50 Marks**
Credits: L:T:P	:	2:0:0		**SEE**	:	**50 Marks**
Hours	:	28 L		**SEE Duration**	:	**1.5 Hours**

Unit-I	09 Hrs
Equilibrium: physical, thermodynamic and chemical, Equilibrium controlled and rate controlled processes in gaseous, liquid and solid fuels, Calculation of equilibrium states, Laminar premixed and diffusion flames: principal features and differences, Quenching, flammability and other limit phenomena	
Unit – II	**11 Hrs**
Basics of composite solid propellant deflagration, Statistical representation of composite propellants in HeQu1D – geometry and thermochemistry, Overview of the HeQu1D software and demonstration, Effect of aluminum	
Unit –III	**08 Hrs**
Instability in solid rockets – 1, Principal ideas of combustion in liquid propellant rockets, Combustion in boundary layers and hybrid rockets – essential ideas and emerging trends, Strategies for evolving instability free designs – global and local considerations	

Course Outcomes: At the end of this course the student will be able to :	
CO 1:	To understand the fundamentals of combustion
CO 2:	Comprehend the parameters controlling combustion phenomenon
CO 3:	Quantify the effect of various combustion parameters affecting the design of propulsion systems

Reference Books	
1	Beckstead, Merrill W., R. L. Derr, and C. F. Price. "A model of composite solid-propellant combustion based on multiple flames." AiAA Journal 8.12 (1970): 2200-2207.
2	Varunkumar, S., M. Zaved, and H. S. Mukunda. "A novel approach to composite propellant combustion modeling with a new Heterogeneous Quasi One-dimensional (HeQu1-D) framework." Combustion and Flame 173 (2016): 411-424.
3	Varunkumar, S., and H. S. Mukunda. "Aluminized composite propellant combustion modeling with Heterogeneous Quasi-One dimensional (HeQu1-D) approach." Combustion and Flame 192 (2018): 59-70

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50%**	**50%**
QUIZZES		
Quiz-I	Each quiz is evaluated for 10 marks adding up to **20 MARKS.**	*****
Quiz-II		
THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test – I	Each test will be conducted for 50 Marks adding upto 100 marks. Final test marks will be reduced to **40 MARKS**	*****
Test – II		

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EXPERIENTIAL LEARNING	40 MARKS	*****
MAXIMUM MARKS FOR THE THRORY	**100 MARKS**	**100 MARKS**
TOTAL MARKS FOR THE COURSE	100	100

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Semester: IV					
COMPUTATIONAL SCIENCE IN ENGINEERING					
(Theory)					
Course Code	:	21AS4A2		CIE	:	50 Marks
Credits: L:T:P	:	2:0:0		SEE	:	50 Marks
Hours	:	30 L		SEE Duration	:	1.5 Hours

Unit-I	12 Hrs
Linear Algebra: Introduction to Vectors, Vector spaces and subspaces, Solving Linear systems, Linear Algebra: Orthogonality, Determinants, Eigenvalues & Eigen vectors, SVD, Ordinary Differential Equations: ODE, homogeneous and non-homogeneous ODEs, second order linear ODE, higher order ODEs	
Unit – II	**10 Hrs**
Solution of Higher Order ODEs, Fourier Analysis, Fourier Integrals, Laplace Transforms, Partial Differential Equations: Classification, 1D & 2D equations, BC, 2nd order PDEs, Basis of numerical analysis, errors, stability, Interpolation and extrapolation, System of linear algebraic equations and eigenvalue problems: Direct methods, Iterative methods, convergence analysis, Eigenvalues and Eigenvectors, bounds on eigenvalues, Methods for symmetric matrices and arbitrary matrices	
Unit –III	**08 Hrs**
Solution of ODEs: Difference equation, Numerical methods, convergence, stability, Single step and multistep methods, Predictor-corrector methods, stability analysis of multistep methods, IVP (shooting methods), BVP (methods and solutions)	

Course Outcomes: At the end of this course the student will be able to :	
CO 1:	Assess and Evaluate the behaviour of Partial differential terms in the governing equations
CO 2:	Formulate and Estimate the solution of fluid physics using discretization methods using FDM and FVM
CO 3:	Demonstrate the application of numerical solution techniques

Reference Books	
1	Atkinson, K. E., An Introduction to Numerical Analysis, John Wiley & Sons, 1978.
2	Ferzziger, J.H., and Peric, M., Computational Methods for Fluid Dynamics, Springer, 2002.
3	Numerical recipes: the art of scientific computing - William H. Press, Saul A. Teukolsky, William T.

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	50%	50%
QUIZZES		
Quiz-I	Each quiz is evaluated for 10 marks adding up to **20 MARKS.**	*****
Quiz-II		
THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test – I	Each test will be conducted for 50 Marks adding upto 100 marks. Final test marks will be reduced to **40 MARKS**	*****
Test – II		

EXPERIENTIAL LEARNING	40 MARKS	*****
MAXIMUM MARKS FOR THE THRORY	100 MARKS	100 MARKS
TOTAL MARKS FOR THE COURSE	100	100

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Semester: IV						
DATA SCIENCE FOR ENGINEERS						
(Theory)						
Course Code	**:**	21AS4A3		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	2:0:0		**SEE**	**:**	**50 Marks**
Hours	**:**	30 L		**SEE Duration**	**:**	**1.5 Hours**

Unit-I	**10 Hrs**
Course philosophy and introduction to R, Linear algebra for data science, Algebraic view - vectors, matrices, product of matrix & vector, rank, null space, solution of over-determined set of equations and pseudo-inverse), Geometric view - vectors, distance, projections, eigenvalue decomposition	
Unit – II	**10 Hrs**
Statistics (descriptive statistics, notion of probability, distributions, mean, variance, covariance, covariance matrix, understanding univariate and multivariate normal distributions, introduction to hypothesis testing, confidence interval for estimates), Optimization	
Unit –III	**10 Hrs**
Simple linear regression and verifying assumptions used in linear regression, Multivariate linear regression, model assessment, assessing importance of different variables, subset selection, Classification using kNN and k-means clustering	

Course Outcomes: At the end of this course the student will be able to :	
CO 1:	Describe a flow process for data science problems (Remembering)
CO 2:	Classify data science problems into standard typology (Comprehension)
CO 3:	Develop R codes for data science solutions (Application)

Reference Books	
1	Introduction to linear algebra - by gilbert strang
2	Applied statistics and probability for engineers – by douglas montgomery

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50%**	**50%**
QUIZZES		
Quiz-I	Each quiz is evaluated for 10 marks adding up to **20 MARKS.**	*****
Quiz-II		
THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test – I	Each test will be conducted for 50 Marks adding upto 100 marks. Final test marks will be reduced to **40 MARKS**	*****
Test – II		
EXPERIENTIAL LEARNING	**40 MARKS**	*****
MAXIMUM MARKS FOR THE THRORY	**100 MARKS**	**100 MARKS**
TOTAL MARKS FOR THE COURSE	**100**	**100**

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Semester: IV					
INTRODUCTION TO UNCERTAINTY ANALYSIS AND EXPERIMENTATION (Theory)					
Course Code	:	21AS4A4		CIE	:	50 Marks
Credits: L:T:P	:	2:0:0		SEE	:	50 Marks
Hours	:	30 L		SEE Duration	:	1.5 Hours

Unit-I	10 Hrs
INTRODUCTION-Outline of the course; Course objectives; Learning outcomes; Course plan, Expressing a result as a mean (nominal) value and its uncertainty at a specified confidence level, Importance of uncertainty analysis in research, industry, legal metrology, education, Developments in uncertainty analysis, ASME PTC 19.1 and ISO JCGM-100 GUM, The approach to uncertainty analysis	
Unit – II	10 Hrs
The result relation, measured parameters, Error distribution, statistical basis, standard uncertainty, definition of uncertainty and its variants, Classification of errors as per ASME PTC 19.1 and ISO GUM; Correlated/Uncorrelated errors, Processes from need for data (for decision making) to obtaining the data, Options for conducting an experiment, Stages / Phases of experimentation, test execution, pre-test and post-test activities, Relevance of uncertainty analysis in the experimentation processes	
Unit –III	10 Hrs
UNCERTIANTY IN A MEASURMENT – I (FUNDAMENTALS), Measured parameters (measurands) and raw data. Calculated parameters (result), Sources of errors in a measurement – elemental sources of error; classification as random/systematic or Type A/Type B, Calculating/estimating elemental sources of errors in a measurement, Calculating combined standard uncertainty and expanded uncertainty in a measurement	
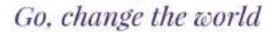
Course Outcomes: At the end of this course the student will be able to :	
CO 1:	Assess the solution approach
CO 2:	Correlate results to the solution approach followed (A
CO 3:	Construct use cases to validate approach and identify modifications required

Reference Books	
1	Hugh W. Coleman, W. Glenn Steele Jr., Experimentation, Validation, and Uncertainty Analysis for Engineers, 3rd Ed., 2009, John Wiley.
2	ME Performance Test Code (PTC) 19.1-2018 "Test Uncertainty", ASME PTC 19-1. ASME New York, 2019 ISO JCGM 100:2008. Evaluation of measurement data — Guide to the expression of uncertainty in measurement (GUM). ISO 2008
3	Jack P. Holman, Experimental Methods for Engineers, 2001. 7th Ed., McGraw-Hill. Various IS/ISO/ASME/ASTM standards.

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	50%	50%
QUIZZES		
Quiz-I	Each quiz is evaluated for 10 marks adding up to **20 MARKS.**	*****
Quiz-II		
THEORY COURSE		

(Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test – I	Each test will be conducted for 50 Marks adding upto 100 marks. Final test marks will be reduced to **40 MARKS**	*****
Test – II		
EXPERIENTIAL LEARNING	**40 MARKS**	*****
MAXIMUM MARKS FOR THE THRORY	**100 MARKS**	**100 MARKS**
TOTAL MARKS FOR THE COURSE	**100**	**100**

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Semester: IV					
DESIGN PRACTICE **(Theory)**					
Course Code	**:**	21AS4A5	**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	2:0:0	**SEE**	**:**	**50 Marks**
Hours	**:**	30 L	**SEE Duration**	**:**	**1.5 Hours**

Unit-I	**07 Hrs**
Introduction to Design/Product design, Stanford model of Design thinking/ Stages of engineering design of products/Introduction to Concurrent engineering, Concurrent engineering Approaches: Benefits, influencing factors	
Unit – II	**08 Hrs**
Product embodiment design(robustness of design/Average Quality loss), Material selection process in design	
Unit –III	**09 Hrs**
House of quality, Specifications (Fits and Tolerances), Axiomatic Design, Introduction to Group Technology, Creating forms and shapes, Introduction to electronics	

Course Outcomes: At the end of this course the student will be able to :	
CO 1:	Understand the critical importance of Designing in Engineering
CO 2:	Distinguish the critical design parameters involved in basic design of Engineering products
CO 3:	Quantify the effect of each critical parameter

Reference Books	
1	Nanua Singh, "Systems approach to computer integrated design and manufacturing", Wiley India Pvt. Ltd., 4435-36/7, Ansari Road, Daryaganj, New Delhi-110002.
2	Karl T. Ulrich, Steven. D. Eppinger, "Product design and development", McGraw hill publications.

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50%**	**50%**
QUIZZES		
Quiz-I	Each quiz is evaluated for 10 marks adding up to **20 MARKS.**	*****
Quiz-II		
THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test – I	Each test will be conducted for 50 Marks adding upto 100 marks. Final test marks will be reduced to **40 MARKS**	*****
Test – II		
EXPERIENTIAL LEARNING	**40 MARKS**	*****
MAXIMUM MARKS FOR THE THRORY	**100 MARKS**	**100 MARKS**
TOTAL MARKS FOR THE COURSE	**100**	**100**

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ

ವಿಷಯ ಸಂಕೇತ (Course Code)	21KSK39/49	ನಿರಂತರ ಆಂತರಿಕ ಮೌಲ್ಯಮಾಪನದ ಅಂಕಗಳು	50
ಒಂದು ವಾರಕ್ಕೆ ಬೋಧನಾ ಅವಧಿ (Teaching Hours / Week (L:T:P: S)	0:2:0:1	ಸೆಮಿಸ್ಟರ್ ಅಂತ್ಯದ ಪರೀಕ್ಷೆಯ ಅಂಕಗಳು	50
ಒಟ್ಟು ಬೋಧನಾ ಅವಧಿ Total Hours of Pedagogy	25 ಗಂಟೆಗಳು	ಒಟ್ಟು ಅಂಕಗಳು	100
ಕ್ರೆಡಿಟ್ಸ್ (Credits)	01	ಪರೀಕ್ಷೆಯ ಅವಧಿ	01 ಗಂಟೆ

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು:

1. ವೃತ್ತಿಪರ ಪದವಿ ವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದ ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡದ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.

2. ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಪ್ರಧಾನ ಭಾಗವಾದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳನ್ನು ಸಾಂಕೇತಿಕವಾಗಿ ಪರಿಚಯಿಸಿ ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಸಾಹಿತ್ಯ ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಅರಿವು ಹಾಗೂ ಆಸಕ್ತಿಯನ್ನು ಮೂಡಿಸುವುದು.

3. ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯದನ್ನು ಹಾಗೂ ಅವರುಗಳ ಸಾಧಿಸಿದ ವಿಷಯಗಳನ್ನು ಪರಿಚಯಿಸುವುದು.

4. ಕನ್ನಡ ಶಬ್ದಸಂಪತ್ತಿನ ಪರಿಚಯ ಮತ್ತು ಕನ್ನಡ ಭಾಷೆಯ ಬಳಕೆ ಹಾಗೂ ಕನ್ನಡದಲ್ಲಿ ಪತ್ರ ವ್ಯವಹಾರವನ್ನು ತಿಳಿಸಿಕೊಡುವುದು.

ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವ್ಯವಸ್ಥೆ (Teaching–Learning Process – General Instructions) :

These are sample Strategies, which teacher can use to accelerate the attainment of the course outcomes.

1. ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡವನ್ನು ಬೋಧಿಸಲು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಪ್ರಸ್ತುತ ಪುಸ್ತಕ ಆಧಾರಿಸಿ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನವನ್ನು ಅನುಸರಿಸುವುದು. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಪ್ರೇರೇಪಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅವುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿಕೊಡುವುದು.

2. ಇತ್ತೀಚಿನ ತಂತ್ರಜ್ಞಾನದ ಅನುಕೂಲಗಳನ್ನು ಬಳಸಿಕೊಳ್ಳುವುದು - ಅಂದರೆ ಕವಿ-ಕಾವ್ಯ ಪರಿಚಯದಲ್ಲಿ ಕವಿಗಳ ಚಿತ್ರಣ ಮತ್ತು ಲೇಖನಗಳು ಮತ್ತು ಕಥೆ ಕಾವ್ಯಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂಧಪಟ್ಟ ಧ್ವನಿ ಚಿತ್ರಗಳು, ಸಂಭಾಷಣೆಗಳು, ಈಗಾಗಲೇ ಇತರ ವಿಮರ್ಶಕರು ಬರೆದಿರುವ ವಿಮರ್ಶಾತ್ಮಕ ವಿಷಯಗಳನ್ನು ಟಿಪಿಟಿ, ಡಿಜಿಟಲ್ ಮಾಧ್ಯಮಗಳ ಮುಖಾಂತರ ವಿಶ್ಲೇಸುವುದು.

3. ನವೀನ ಮಾದರಿಯ ಸಾಹಿತ್ಯ ಬೋಧನೆಗೆ ಸಂಬಂಧಪಟ್ಟ ವಿಧಾನಗಳನ್ನು ಶಿಕ್ಷಕರು ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಅನುಕೂಲವಾಗುವ ರೀತಿಯಲ್ಲಿ ಅಳವಡಿಸಿಕೊಳ್ಳಬಹುದು.

ಘಟಕ -1 ಲೇಖನಗಳು	
1. ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿ – ಹಂಪ ನಾಗರಾಜಯ್ಯ 2. ಕರ್ನಾಟಕದ ಏಕೀಕರಣ : ಒಂದು ಅಪೂರ್ವ ಚರಿತ್ರೆ – ಜಿ. ವೆಂಕಟಸುಬ್ಬಯ್ಯ 3. ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ – ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ ಮತ್ತು ಪ್ರೊ. ವಿ. ಕೇಶವಮೂರ್ತಿ	
ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಖಾಂತರ ಚರ್ಚಿಸುವುದು.

ಘಟಕ -2 ಆಧುನಿಕ ಪೂರ್ವದ ಕಾವ್ಯ ಭಾಗ	
1. ವಚನಗಳು : ಬಸವಣ್ಣ, ಅಕ್ಕಮಹಾದೇವಿ, ಅಲ್ಲಮಪ್ರಭು, ಆಯ್ದಕ್ಕಿ ಮಾರಯ್ಯ, ಜೇಡರದಾಸಿಮಯ್ಯ, ಆಯ್ದಕ್ಕಿ ಲಕ್ಕಮ್ಮ.	
2. ಕೀರ್ತನೆಗಳು : ಅದರಿಂದೇನು ಫಲ ಇದರಿಂದೇನು ಫಲ – ಪುರಂದರದಾಸರು	
ತಲ್ಲಣಿಸದಿರು ಕಂಡ್ಯ ತಾಳು ಮನವೇ – ಕನಕದಾಸರು	
3. ತತ್ವಪದಗಳು : ಸಾವಿರ ಕೊಡಗಳ ಸುಟ್ಟು – ಶಿಶುನಾಳ ಶರೀಫ	
ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಖಾಂತರ ಚರ್ಚಿಸುವುದು.

ಘಟಕ -3 ಆಧುನಿಕ ಕಾವ್ಯಭಾಗ	
1. ಡಿವಿಜಿ ರವರ ಮಂಕುತಿಮ್ಮನ ಕಗ್ಗದಿಂದ ಅಯ್ದು ಕೆಲವು ಭಾಗಗಳು	
2. ಕುರುಡು ಕಾಂಚಾಣ : ದಾ.ರಾ. ಬೇಂದ್ರೆ	
3. ಹೊಸಬಾಳಿನ ಗೀತೆ : ಕುವೆಂಪು	
ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಖಾಂತರ ಚರ್ಚಿಸುವುದು.

ಘಟಕ -4 ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯ	
1. ಡಾ. ಸರ್. ಎಂ. ವಿಶ್ವೇಶ್ವರಯ್ಯ : ವ್ಯಕ್ತಿ ಮತ್ತು ಇತಿಹ್ಯ - ಎ ಎನ್ ಮೂರ್ತಿರಾವ್	
2. ಕರಕುಶಲ ಕಲೆಗಳು ಮತ್ತು ಪರಂಪರೆಯ ವಿಜ್ಞಾನ : ಕರೀಗೌಡ ಬೀಚನಹಳ್ಳಿ	
ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಖಾಂತರ ಚರ್ಚಿಸುವುದು.

ಘಟಕ -5 ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ	
1. ಯುಗಾದಿ : ವಸುಧೇಂದ್ರ	
2. ಮೆಗಾನೆ ಎಂಬ ಗಿರಿಜನ ಪರ್ವತ : ಹಿ.ಚಿ. ಬೋರಲಿಂಗಯ್ಯ	
ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಖಾಂತರ ಚರ್ಚಿಸುವುದು.

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ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಪರಿಣಾಮಗಳು (course Outcomes):

1. ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡದ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯವಾಗುತ್ತದೆ.

2. ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳು ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಆಸಕ್ತಿಯ ಮೂಡುತ್ತದೆ.

3. ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.

4. ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ, ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.

ಮೌಲ್ಯಮಾಪನದ ವಿಧಾನ (Assessment Details- both CIE and SEE) :

(methods of CIE – MCQ, Quizzes, Open book test, Seminar or micro project)
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain a minimum of 40% marks individually both in CIE and 35% marks in SEE to pass. Theory Semester End Exam (SEE) is conducted for 50 marks (01 hour duration). Based on this grading will be awarded.

Continuous Internal Evaluation:
Three Tests each of **20 Marks (duration 01 hour)**
    a. First test at the end of 5th week of the semester
    b. Second test at the end of the 10th week of the semester
    c. Third test at the end of the 15th week of the semester
Two assignments each of **10 Marks** : **1.** First assignment at the end of 4th week of the semester
    2. Second assignment at the end of 9th week of the semester
Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**
    3. At the end of the 13th week of the semester
The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**
CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.
ಸೆಮಿಸ್ಟರ್ ಅಂತ್ಯದ ಪರೀಕ್ಷೆಯ ಈ ಕೆಳಗಿಸಂತಿರುತ್ತದೆ - **Semester End Exam (SEE):**

SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject.
    1. The question paper will have 50 questions, Each question is set for 01 mark,

SEE Pattern will be in MCQ Model for 50 marks. Duration of the exam is 01 Hour.

ಪಠ್ಯಪುಸ್ತಕ :

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ

ಡಾ. ಹಿ.ಚಿ.ಬೋರಲಿಂಗಯ್ಯ ಮತ್ತು ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ,
ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

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BE – III / IV Semester – Common to All

ಬಳಕೆ ಕನ್ನಡ - baLake Kannada (Kannada for Usage)

ಕನ್ನಡ ಕಲಿಕೆಗಾಗಿ ನಿಗದಿಪಡಿಸಿದ ಪಠ್ಯಪುಸ್ತಕ - (Prescribed Textbook to Learn Kannada)

ವಿಷಯ ಸಂಕೇತ (Course Code)	21KBK39/49	ನಿರಂತರ ಆಂತರಿಕ ಮೌಲ್ಯಮಾಪನದ ಅಂಕಗಳು (Continuous Internal Evaluation Marks)	50
ಒಂದು ವಾರಕ್ಕೆ ಬೋಧನಾ ಅವಧಿ (Teaching Hours / Week (L:T:P: S)	0:2:0:1	ಸೆಮಿಸ್ಟರ್ ಅಂತ್ಯದ ಪರೀಕ್ಷೆಯ ಅಂಕಗಳು (Semester End Examination Marks)	50
ಒಟ್ಟು ಬೋಧನಾ ಅವಧಿ Total Hours of Pedagogy	25 ಗಂಟೆಗಳು	ಒಟ್ಟು ಅಂಕಗಳು (Total Marks)	100
ಕ್ರೆಡಿಟ್ಸ್ (Credits)	01	ಪರೀಕ್ಷೆಯ ಅವಧಿ (Exam Hours)	01 ಗಂಟೆ

ಬಳಕೆ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು (Course Learning Objectives):

- To Create the awareness regarding the necessity of learning local language for comfortable and healthy life.
- To enable learners to Listen and understand the Kannada language properly.
- To speak, read and write Kannada language as per requirement.
- To train the learners for correct and polite conservation.

ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವ್ಯವಸ್ಥೆ (Teaching–Learning Process – General Instructions) :

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. ಬಳಕೆ ಕನ್ನಡವನ್ನು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಬೋಧಿಸಲು ವಿಟಿಯು ಸೂಚಿಸಿರುವ ಪಠ್ಯಪುಸ್ತಕವನ್ನು ಉಪಯೋಗಿಸಬೇಕು.

2. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಉತ್ತೇಜಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅವುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿಕೊಡುವುದು.

3. ಪ್ರತಿ ವಿದ್ಯಾರ್ಥಿ ಪುಸ್ತಕವನ್ನು ತರಗತಿಯಲ್ಲಿ ಬಳಸುವಂತೆ ನೋಡಿಕೊಳ್ಳುವುದು ಮತ್ತು ಪ್ರತಿ ಪಾಠ ಮತ್ತು ಪ್ರವಚನಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂಧಪಟ್ಟಂತೆ ಪೂರಕ ಚಟುವಟಿಕೆಗಳಿಗೆ ತೊಡಗಿಸತಕ್ಕದ್ದು.

1. ಡಿಜಿಟಲ್ ತಂತ್ರಜ್ಞಾನದ ಮುಖಾಂತರ ಇತ್ತೀಚಿಗೆ ಡಿಜಿಟಲೀಕರಣ ಗೊಂಡಿರುವ ಭಾಷೆ ಕಲಿಕೆಯ ವಿಧಾನಗಳನ್ನು ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ಮುಖಾಂತರ ಚರ್ಚಿಸಲು ಕ್ರಮಕ್ಕೆಗೊಳ್ಳುವುದು. ಇದರಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ತರಗತಿಯಲ್ಲಿ ಹೆಚ್ಚು ಏಕಾಗ್ರತೆಯಿಂದ ಪಾಠ ಕೇಳಲು ಮತ್ತು ಅಧ್ಯಯನದಲ್ಲಿ ತೊಡಗಲು ಅನುಕೂಲವಾಗುತ್ತದೆ.

2. ಭಾಷಾಕಲಿಕೆಯ ಪ್ರಯೋಗಾಲಯದ ಮುಖಾಂತರ ಬಹುಬೇಗ ಕನ್ನಡ ಭಾಷೆಯನ್ನು ಕಲಿಯಲು ಅನುಕೂಲವಾಗುವಂತೆ ಕಾರ್ಯಚಟುವಟಿಕೆಗಳನ್ನು ಮತ್ತು ಕ್ರಿಯಾ ಯೋಜನೆಗಳನ್ನು ರೂಪಿಸುವುದು.

Module-1

1. Introduction, Necessity of learning a local language. Methods to learn the Kannada language.
2. Easy learning of a Kannada Language: A few tips. Hints for correct and polite conservation, Listening and Speaking Activities
3. Key to Transcription.
4. ವ್ಯೆಯಕ್ತಿಕ, ಸ್ವಾಮ್ಯಸೂಚಕ/ಸಂಬಂಧಿತ ಸಾರ್ವನಾಮಗಳು ಮತ್ತು ಪ್ರಶ್ನಾರ್ಥಕ ಪದಗಳು - **Personal Pronouns, Possessive Forms, Interrogative words**

ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಖಾಂತರ ಚರ್ಚೆಸುವುದು.

Module-2

1. ನಾಮಪದಗಳ ಸಂಬಂಧಾರ್ಥಕ ರೂಪಗಳು, ಸಂದೇಹಾಸ್ಪದ ಪ್ರಶ್ನೆಗಳು ಮತ್ತು ಸಂಬಂಧವಾಚಕ ನಾಮಪದಗಳು - **Possessive forms of nouns, dubitive question and Relative nouns**

2. ಗುಣ, ಪರಿಮಾಣ ಮತ್ತು ವರ್ಣಬಣ್ಣ ವಿಶೇಷಣಗಳು, ಸಂಖ್ಯಾವಾಚಕಗಳು **Qualitative, Quantitative and Colour Adjectives, Numerals**

3. ಕಾರಕ ರೂಪಗಳು ಮತ್ತು ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು – ಸಪ್ತಮಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯ – (ಅ, ಅದು, ಆವು, ಅಲ್ಲಿ) **Predictive Forms, Locative Case**

ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಖಾಂತರ ಚರ್ಚೆಸುವುದು.

Module-3

1. ಚತುರ್ಥಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯದ ಬಳಕೆ ಮತ್ತು ಸಂಖ್ಯಾವಾಚಕಗಳು – **Dative Cases, and Numerals**

4. ಸಂಖ್ಯಾಗುಣವಾಚಕಗಳು ಮತ್ತು ಬಹುವಚನ ನಾಮರೂಪಗಳು – **Ordinal numerals and Plural markers**

5. ನ್ಯೂನ / ನಿಷೇಧಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು ಮತ್ತು ವರ್ಣ ಗುಣವಾಚಕಗಳು **Defective / Negative Verbs and Colour Adjectives**

ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಖಾಂತರ ಚರ್ಚೆಸುವುದು.

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Module-4

1	ಅಪ್ಪಣೆ / ಒಪ್ಪಿಗೆ, ನಿರ್ದೇಶನ, ಪ್ರೋತ್ಸಾಹ ಮತ್ತು ಒತ್ತಾಯ ಅರ್ಥರೂಪ ಪದಗಳು ಮತ್ತು ವಾಕ್ಯಗಳು	
	Permission, Commands, encouraging and Urging words (Imperative words and sentences)	
2.	ಸಾಮಾನ್ಯ ಸಂಭಾಷಣೆಗಳಲ್ಲಿ ದ್ವಿತೀಯ ವಿಭಕ್ತಿ ಪ್ರತ್ಯೆಯಗಳು ಮತ್ತು ಸಂಭವನೀಯ ಪ್ರಕಾರಗಳು	
	Accusative Cases and Potential Forms used in General Communication	
3.	"ಇರು ಮತ್ತು ಇರಲ್ಲ" ಸಹಾಯಕ ಕ್ರಿಯಾಪದಗಳು, ಸಂಭಾವ್ಯಸೂಚಕ ಮತ್ತು ನಿಷೇಧಾರ್ಥಕ ಕ್ರಿಯಾ ಪದಗಳು - Helping Verbs "iru and iralla", Corresponding Future and Negation Verbs	
6.	ಹೋಲಿಕೆ (ತರತಮ) , ಸಂಬಂಧ ಸೂಚಕ ಮತ್ತು ವಸ್ತು ಸೂಚಕ ಪ್ರತ್ಯೆಯಗಳು ಮತ್ತು ನಿಷೇಧಾರ್ಥಕ ಪದಗಳ ಬಳಕೆ- Comparitive, Relationship, Identification and Negation Words	
ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಖಾಂತರ ಚರ್ಚಿಸುವುದು.	

Module-5

1. ಕಾಲ ಮತ್ತು ಸಮಯದ ಹಾಗೂ ಕ್ರಿಯಾಪದಗಳ ವಿವಿಧ ಪ್ರಕಾರಗಳು - ifferent types of forms of Tense, Time and Verbs	
2. ದ್, -ತ್, - ತು, - ಇತು, - ಆಗಿ, - ಅಲ್ಲ, -ಗ್, -ಕ್, ಇದೆ, ಕ್ರಿಯಾ ಪ್ರತ್ಯೆಯಗಳೊಂದಿಗೆ ಭೂತ, ಭವಿಷ್ಯತ್ ಮತ್ತು ವರ್ತಮಾನ ಕಾಲ ವಾಕ್ಯ ರಚನೆ - Formation of Past, Future and Present Tense Sentences with Verb Forms	
3. Kannada Vocabulary List : ಸಂಭಾಷಣೆಯಲ್ಲಿ ದಿನೋಪಯೋಗಿ ಕನ್ನಡ ಪದಗಳು -Kannada Words in Conversation	
ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಖಾಂತರ ಚರ್ಚಿಸುವುದು.

ಬಳಕೆ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಅನುಕೂಲಗಳು ಮತ್ತು ಫಲಿತಾಂಶಗಳು: course Outcomes (Course Skill Set): At the end of the Course, The Students will be able

1. To understand the necessity of learning of local language for comfortable life.
2. To Listen and understand the Kannada language properly.
3. To speak, read and write Kannada language as per requirement.
4. To communicate (converse) in Kannada language in their daily life with kannada speakers.
5. To speak in polite conservation.

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Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester–end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Tests each of **20 Marks (duration 01 hour)**
   a. First test at the end of 5th week of the semester
   b. Second test at the end of the 10th week of the semester
   c. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks : 1.** First assignment at the end of 4th week of the semester
   7. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**
   8. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

ಸೆಮಿಸ್ಟರ್ ಅಂತ್ಯದ ಪರೀಕ್ಷೆಯು ಈ ಕೆಳಗಿನಂತಿರುತ್ತದೆ - **Semester End Exam (SEE):**

SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject.
   2. The question paper will have 50 questions. Each question is set for 01 mark.
   3. SEE Pattern will be in MCQ Model for 50 marks. Duration of the exam is 01 Hour.

Textbook :

ಬಳಕೆ ಕನ್ನಡ

ಲೇಖಕರು : ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ

ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

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Semester: IV					
NATIONAL SERVICE SCHEME (NSS)					
(Practical)					
Course Code	:	21HSAE46A		CIE	:	50 Marks
Credits: L:T:P		0:0:1		SEE	:	50 Marks
Total Hours	:	L+ T +13P		SEE Duration	:	2 Hours

Pre requisites:
1. Students should have service oriented mindset and social concern.
2. Students should have dedication to work at any remote place, any time with available resources and proper time management for the other works.
3. Students should be ready to sacrifice some of the timely will and wishes to achieve service oriented targets on time.

Content	13 Hours

Students has to take up any one activities on below mentioned topics and has to prepare contents for awareness and technical contents for implementation of the projects and has to present strategies for implementation of the same. Compulsorily has to attend one camp.
CIE will be evaluated based on their presentation, approach and implementation strategies. (Any one of the below mentioned activity)

1. Helping local schools to achieve good result and enhance their enrolment in Higher/technical/ vocational education.
2. Preparing an actionable business proposal for enhancing the village/ farmer income and approach for implementation.
3. Developing Sustainable Water management system for rural/ urban areas and implementation approaches.
4. Setting of the information imparting club for women leading to contribution in social and economic issues.
5. Spreading public awareness/ government schemes under rural outreach program. (minimum 5 programs)
6. Contribution to any national level initiative of Government of India. For eg. Digital India, Skill India, Swachh Bharat,
    Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc
7. Social connect and responsibilities
8. Plantation and adoption of plants. Know your plants
9. Organic farming , Indian Agriculture (Past, Present and Future) Connectivity for marketing
10. Waste management – Public, Private and Govt organization, 5 R's
11. Water conservation techniques – Role of different stakeholders - Implementation
12. Govt . School Rejuvenation and assistance to achieve good infrastructure.
13. Organize National integration and social harmony events/ workshops/ seminars. (minimum 2 programs)

AND

ONE NSS - CAMP

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the importance of his/her responsibilities towards society.
CO2:	Analyze the environmental and societal problems/ issues and will be able to design solutions for the same.
CO3:	Evaluate the existing system and to propose practical solutions for the same for sustainable development.

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Go, change the world

CO4:	Implement government or self-driven projects effectively in the field.

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50%**	**50%**
	CIE	SEE
Presentation 1- Selection of topic- (phase 1) Justification for Importance, need of the hour with surveyed data.	**10**	*****
EXPERIENTIAL LEARNING Presentation 2 (phase 2) Content development, strategies for implementation methodologies.	**10**	*****
Case Study-based Teaching-Learning	**10**	Implementation strategies of the project with report
Sector wise study & consolidation	**10**	
Video based seminar (4-5 minutes per student)	**10**	
TOTAL MARKS FOR THE COURSE	**50 MARKS**	**50 MARKS**

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Semester: IV					
NATIONAL CADET CORPS (NCC) (Practical)					
Course Code	:	21HSAE46B		**CIE**	:	**50 Marks**
Credits: L: T:P	:	0:0:1		**SEE**	:	**50 Marks**
Total Hours	:	15 P		**SEE Duration**	:	**2 hrs**

Unit 1	07 hrs
Drill (Contact Hrs. 12). Foot Drill- Drill ki Aam Hidayaten, Word ki Command, Savdhan, Vishram, Aram Se, Murdna, Kadvar Sizing, Teen Line Banana, Khuli Line, Nikat Line, Khade Khade Salute Karna	

Unit 2	03 hrs
Weapon Training (WT): Introduction & Characteristics of 7.62 Self Loading rifle, Identification of rifle parts	

Unit 3	03 hrs
Adventure activities: Trekking and obstacle course	

Unit 4	02 hrs
Social Service and Community Development (SSCD): Students will participate in various activities throughout the semester e.g., Blood donation Camp, Swachhata Abhiyan, Constitution Day, All National Festival	

Course Outcomes: Cadets will be able to: -	
CO1	Understand that drill as the foundation for discipline and to command a group for common goal.
CO2	Understand the importance of a weapon its detailed safety precautions necessary for prevention of accidents and identifying the parts of weapon
CO3	Understand that trekking will connect human with nature and also cross the obstacles to experience army way of life.
CO4	Understand the various social issues and their impact on social life Develop the sense of self-less social service for better social & community life.

	ASSESSMENT AND EVALUATION PATTERN	
WEIGHTAGE	**50%**	**50%**
	CIE	SEE
Drill Skill Test	**20**	*****
Weapon Training	**10**	*****
Adventure activities	**10**	Report on adventure and social service activities
Social service activities	**10**	
TOTAL MARKS FOR THE COURSE	**50 MARKS**	**50 MARKS**

Reference Books	
1	NCC Cadet Hand Book by R K Gupta, Ramesh Publishing House, New Delhi, Book code:R-1991, ISBN: 978-93-87918-57-3, HSN Code: 49011010

Semester: IV					
PHYSICAL EDUCATION (SPORTS & ATHLETICS)					
(Practical)					
Course Code	**:**	21HSAE46C		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	0:0:1		**SEE**	**:**	**50 Marks**
Total Hours	**:**	30 P		**SEE Duration**	**:**	**2.30 Hours**

Introduction of Physical Education and Sports			
General & Specific warm up exercises			
Conditioning exercises			
Any 2 Major Games			
Intramural Competitions			
Choose any one according to serial no			
1. Kho-Kho	Giving Kho, Single chain, Pole dive, Pole turning, 3-6 Up	**6. Kabaddi**	Hand touch, Chain hold, Ankle hold, Thigh hold, Getting bonus
2. Throwball	Service, Receive, Spin pass, Simple pass, Jump throw	**7. Volleyball**	Attack, Block, Service, Upper hand pass, Lower hand pass
3. Netball	Step with ball, Shooting, Passing, Blocking	**8. Handball**	Step with ball, Shooting, Passing, Blocking, Dribbling
4. Softball	Catching, Pitching, Slugging, Base Running, Stealing	**9. Football**	Dribbling, Chest Drop, Ball Control, Thigh Drop, Shooting
5. Ball badminton	Service, Fore hand receive, Back hand receive, Spin smash, Rally	**10. Table Tennis**	Service, Fore hand receive, Back hand receive, Smash, Rally

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the basic principles and practices of Physical Education and Sports.
CO2	Instruct the Physical Activities and Sports practices for Healthy Living
CO3	To develop professionalism among students to conduct, organize & Officiate Physical Education and Sports events at schools and community level

Topics for Viva:
1. On rules and regulations pertaining to the games / sports
2. On dimensions of the court, size / weight of the ball and standards pertaining to that sports / game
3. Popular players and legends at state level / National level/ International level
4. Recent events happened and winner / runners in that particular sport / game
5. General awareness about sport / game, sports happenings in the college campus

Reference Books	
1	Muller, J. P. (2000). Health, Exercise and Fitness. Delhi: Sports.
2	Vanaik.A (2005) Play Field Manual, Friends Publication New Delhi
3	• IAAF Manual

4	M.J Vishwanath, (2002) Track and Field Marking and Athletics Officiating Manual, Silver Star Publication, Shimoga
5	Steve Oldenburg (2015) Complete Conditioning for Volleyball, Human Kinestics.

Note: Skills of Sports and Games (Game Specific books) may be referred

ASSESSMENT AND EVALUATION PATTERN CIE-50 MARKS		
Activity book- **10** marks		
QUIZZES		
Quiz-I	Each quiz is evaluated for 10 marks adding up to **20 MARKS.**	
Quiz-II		
Test – I	Demonstration of skills is evaluated for 10 marks adding up to **20 MARKS.**	
Test – II		
ASSESSMENT AND EVALUATION PATTERN SEE-50 MARKS		
Practicals	**30 marks**	
Viva voce	**20 marks**	
Total	**50 marks**	

Rubric for CIE (2022 Scheme)		
Sl.No.	**Content**	**Marks**
1	Attendance	10
2	Performing Skills (Any Two)	20
3	Court measurement (Markings)	20
	Total :	**50**

Rubric for SEE (2022 Scheme)		
Sl.No.	**Content**	**Marks**
1	Performing Skills (Any Two)	30
2	Viva	20
	Total :	**50**

Semester: IV					
MUSIC (Practical)					
Course Code	**:**	21HSAE46D1	**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	0:0:1	**SEE**	**:**	**50 Marks**
Total Hours	**:**	13 P	**SEE Duration**	**:**	**2.30 Hours**

Prerequisites
1.   Students should know basics of music.
2.   Students should have dedication to learn and improve on their musical skills.
3.   Students should have participated in musical events and have basic knowledge on how to present their music.

Content	13 Hours
1. Introduction to different genres of music	
2. Evolution of genres in India: Inspiration from the world	
3. Ragas, time and their moods in Indian Classical Music	
4. Identification of ragas and application into contemporary songs	
5. Adding your touch to a composition	
6. Maths and Music: A demonstration	
7. Harmonies in music	
8. Chords: Basics and application into any song	
9. Music Production-I	
10. Music Production-II	
Students have to form groups of 2-4 and present a musical performance/ a musical task which shall be given by the experts. The experts shall judge the groups and award marks for the same. **CIE will be evaluated based on their presentation, approach and implementation strategies. Students need to submit their certificates of any event they participated or bagged prizes in. This shall also be considered for CIE evaluation.**	
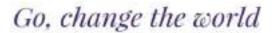
Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand basics of Music and improve their skills
CO2:	Appreciate the impacts on health and well being
CO3:	Perform and present music in a presentable manner
CO4:	Develop skills like team building and collaboration

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50%**	**50%**
	CIE	SEE
Presentation 1- Selection of topic- (phase 1)	**10**	*****

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Experiential Learning Presentation 2 (phase 2)	10	*****
Case Study-based Teaching-Learning	10	Implementationstrategies of theproject with report
Sector wise study & consolidation	10	
Video based seminar (4-5 minutes per student)	10	
TOTAL MARKS FOR THE COURSE	**50 MARKS**	**50 MARKS**

Reference Books	
1.	Music Cognition: The Basics by Henkjan Honing
2.	Basic Rudiments Answer Book - Ultimate Music Theory: Basic Music Theory Answer Book by Glory St Germain
3.	Elements Of Hindustani Classical Music by Shruti Jauhari
4.	Music in North India: Experiencing Music, Expressing Culture (Global Music Series) by George E. Ruckert

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Semester: IV						
DANCE **(Practical)**						
Course Code	**:**	21HSAE46D2		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	0:0:1		**SEE**	**:**	**50 Marks**
Total Hours	**:**	13 P		**SEE Duration**	**:**	**2.00 Hours**

Prerequisites: 1. Students should have the will and interest to learn dancing. 2. Students should have a positive mindset. 3. Students should be willing to interact and cooperate in group activities	
Content	**13 Hours**
1. Introduction to Dance 2. Preparing the body for dancing by learning different ways to warm up. 3. Basics of different dance forms i.e. classical, eastern, and western. 4. Assessing the interest of students and dividing them into different styles based on interaction. 5. Advancing more into the styles of interest. 6. Understanding of music i.e. beats, rhythm, and other components. 7. Expert sessions in the respective dance forms. 8. Activities such as cypher, showcase to gauge learning. 9. Components of performance through demonstration. 10. Introduction to choreographies and routines. 11. Learning to choreograph. 12. Choreograph and perform either solo or in groups.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the fundamentals of dancing.
CO2:	Adapt to impromptu dancing.
CO3:	Ability to pick choreography and understand musicality.
CO4:	To be able to do choreographies and perform in front of a live audience.

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50%**	**50%**
	CIE	SEE
Presentation 1- Selection of topic- (phase 1)	**10**	*****

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Experiential Learning Presentation 2 (phase 2)	**10**	*****
Case Study-based Teaching-Learning	**10**	Implementationstrategies of theproject with report
Sector wise study & consolidation	**10**	
Video based seminar (4-5 minutes per student)	**10**	
TOTAL MARKS FOR THE COURSE	**50 MARKS**	**50 MARKS**

Reference Books	
1	Dance Composition: A practical guide to creative success in dance making by Jacqueline M. Smith-Autard

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Semester: IV					
LIGHTS CAMERA DRAMA					
(Practical)					
Course Code	:	21HSAE46D3	**CIE**	:	**50 Marks**
Credits: L:T:P	:	0:0:1	**SEE**	:	**50 Marks**
Total Hours	:	13 P	**SEE Duration**	:	**2.00 Hours**

Prerequisites
1. Students should have creative oriented mindset and social concern.
2. Students should have dedication to work with their classmates for long hours until a collective goal is reached.
3. Students should be ready to sacrifice some of the timely will and wishes to achieve targets on time.

Content	**13 Hours**
1. **Break the ICE** 2. **Introduction to freedom** Talk to each and every single person for a period of 5 complete minutes**.** This is aimed at to make everyone in the room comfortable with each other. This helps everyone get over social anxiety, Shyness and Nervousness. 3. **Ura** 4. **Rhythm Voice Projection, Voice Modulation, Weeping & Coughing** Voice projection is the strength of speaking or <u>singing</u> whereby the <u>voice</u> is used powerfully and <u>clearly</u>. It is a technique employed to command respect and attention, as when a <u>teacher</u> talks to a class, or simply to be heard clearly, as used by an actor in a <u>theatre</u>. 5. **It's Leviosa, Not Leviosaaa!** 6. **Speech work: Diction, Intonation, Emphasis, Pauses, Pitch and Volume Tempo Dialogues delivery.** The art of dialogue delivery plays a vital role in in ensuring the efficacy of communication especially from the dramatic aspect of it, This unit discusses some tips to help the young actors improve their dialogue delivery skills. 7. **Elementary, My dear Watson.** 8. **Responsibilities of an actor tools of an actor character analysis** Observations aspects, Stage presence, concentration, conviction, confidence, energy and directionality. 9. **Show time.** 10. **Pick a genre: COMEDY, THRILLER, HORROR, and TRAGEDY: Showcase a performance.** Stylized acting with reference to historical and mythological plays. **Mime**: conventional, occupational and pantomime **Mono acting:** different types of characters	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Develop a range of Theatrical Skills and apply them to create a performance.
CO2:	Work collaboratively to generate, develop and communicate ideas.
CO3:	Develop as creative, effective, independent and reflective students who are able to make informed choices in process and performance.
CO4:	Develop an awareness and understanding of the roles and processes undertaken in contemporary

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professional theatre practice.

CIE's will be evaluated through mono-acting or dialogue. The students need to use whatever they've learnt through the course of the drama class. Judges/Teachers can award the marks accordingly. Certificates won outside of college, can be submitted for evaluation as well.

For SEE's. Students need to form groups of 4-6. They need to pick a genre and enact a play of atleast 20 mins long. The venue will be IEM auditorium. No mics should be used. They will be given 2 weeks to prepare.

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50%**	**50%**
	CIE	SEE
Presentation 1- Selection of topic- (phase 1)	**10**	*****
Experiential Learning Presentation 2 (phase 2)	**10**	*****
Case Study-based Teaching-Learning	**10**	Implementationstrategies of theproject with report
Sector wise study & consolidation	**10**	
Video based seminar (4-5 minutes per student)	**10**	
TOTAL MARKS FOR THE COURSE	**50 MARKS**	**50 MARKS**

Reference Books	
1	The Empty Space by Peter Brook
2	The Viewpoints Book: A Practical Guide to Viewpoints and Composition by Anne Bogart and Tina Landau

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Semester: IV					
ART (Practical)					
Course Code	:	21HSAE46D4	CIE	:	50 Marks
Credits: L:T:P	:	0:0:1	SEE	:	50 Marks
Total Hours	:	13 P	SEE Duration	:	2.00 Hours

Prerequisites:
Although there are no prerequisite qualifications for this subject, students must have a basic understanding of and interest in the fields of art and design in order to enroll in it.

Content	13 Hours

1. Use points, line and curves to create various shapes and forms

2. Use of shapes and forms to create various objects and structures

3. Recognizing distinctions in objects when viewed from various perspectives and grasping basic notions of perspective

4. Students will be introduced to the significance of color in art, as well as the principles of color theory and application.

5. Applied the concepts of unity, harmony, balance, rhythm, emphasis and proportion, abstraction and stylization to create a composition.

6. Learn how to use which materials and for what types of art and textures.

7. Use of the above concepts to create art through the medium of collage, mosaic, painting, mural, batik, tie and dye.

8. Real world application of the above concepts in the form of book cover design and illustration, cartoon, poster, advertisements, magazine, computer graphics and animation

9. Familiarization with the many art forms and techniques of expression found throughout India.

AND

ONE EDUCATIONAL VISIT TO AN ART MUSEUM/INSTITUTE/ GALLERY

Students have to turn in assignments for each of the above said topics on a weekly basis and have to compulsorily take part in the museum visit. CIE will be evaluated based on a still life piece, a composition using any one of the media of composition and a presentation on Indian art styles and creation of a piece pertaining to the presented art style.

Course Outcomes: After completing the course, the students will be able to	
CO1:	To use lines, shapes, and colors to depict the various sentiments and moods of life and nature.
CO2:	To use one's creativity to develop forms and color schemes, as well as the ability to portray them effectively in drawing and painting on paper.

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CO3:	To develop the ability to properly use drawing and painting materials (surfaces, tools and equipment, and so on).
CO4:	To improve their observation abilities by studying everyday items as well as numerous geometrical and non-geometrical (i.e. organic) shapes found in life and nature and to hone their drawing and painting talents in response to these insights.

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50%**	**50%**
	CIE	SEE
Presentation 1- Selection of topic- (phase 1)	**10**	*****
Experiential Learning Presentation 2 (phase 2)	**10**	*****
Case Study-based Teaching-Learning	**10**	Implementationstrategies of theproject with report
Sector wise study & consolidation	**10**	
Video based seminar (4-5 minutes per student)	**10**	
TOTAL MARKS FOR THE COURSE	**50 MARKS**	**50 MARKS**

Reference Books	
1	Catching the Big Fish: Meditation, Consciousness, and Creativity by David Lynch
2	Art & Fear: Observations on the Perils (and Rewards) of Artmaking by David Bayles & Ted Orland

Semester: IV						
PHOTOGRAPHY **(Practical)**						
Course Code	**:**	21HSAE46D5		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	0:0:1		**SEE**	**:**	**50 Marks**
Total Hours	**:**	13 P		**SEE Duration**	**:**	**2.00 Hours**

Prerequisites:
1. Students should know basics of photography and cinematography.
2. Students should have dedication to learn and improve on their photography and film making skills.
3. Students should have participated in photography events.
4. Students should have a DSLR camera.

Content	13 Hours

1. Introduction to photography.

2. Understanding the terminologies of DSLR.

3. Elements of photography.

4. Introduction to script writing, storyboarding.

5. Understanding the visualization and designing a set.

6. Basics of film acting

7. Video editing using software

8. Introduction to cinematography.

9. Understanding about lighting and camera angles.

10. Shooting a short film.

Students have to form groups of 2-4 and present a short film which shall be given by the experts. The experts shall judge the groups and award marks for the same.
CIE will be evaluated based on their presentation, approach and implementation strategies. Students need to submit their certificates of any event they participated or bagged prizes in. This shall also be considered for CIE evaluation.

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand basics of photography and videography and improve their skills
CO2:	Appreciate the skills acquired from photography
CO3:	Perform and present photos and films in a presentable manner
CO4:	Develop skills like team building and collaboration

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50%**	**50%**

	CIE	SEE
Presentation 1- Selection of topic- (phase 1)	**10**	*****
Experiential Learning Presentation 2 (phase 2)	**10**	*****
Case Study-based Teaching-Learning	**10**	Implementationstrategies of theproject with report
Sector wise study & consolidation	**10**	
Video based seminar (4-5 minutes per student)	**10**	
TOTAL MARKS FOR THE COURSE	**50 MARKS**	**50 MARKS**

Reference Books	
1	Read This If You Want to Take Great Photographs – Henry Carroll
2	The Digital Photography Book: Part 1 – Scott Kelby

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Semester: IV					
Bridge Course:C Programming **(Theory)** **(Common to all Branches)**					
Course Code	**:**	**21DCS47**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	2:0:0		**SEE**	**:**	**---**
Total Hours	**:**	30L		**SEE Duration**	**:**	**2 Hours**

Unit-I	**08 Hrs**
Introduction-Perspectives **Business Domains:** Programming. **Applications:** Design games, GUI, DBMS, Embedded Systems, Compilers and Operating Systems. **Introduction to Computer Concepts:** Introduction to Computer Hardware, Software and its Types. **Introduction to C programming:** Programming paradigms, Basic structure of C program, Process of compiling and running a C program, Features of C language, Character set, C tokens, Keywords and Identifiers, Constants, Variables, Data types, Pre-processor directives. **Handling Input and Output operations and operators:** Formatted input/output functions, Unformatted input/output functions with programming examples using all functions.	

Unit – II	**10 Hrs**
Operators: Introduction to operator set, Arithmetic operators, Relational operators, Logical Operators, Assignment operators, Increment and Decrement operators, Conditional operators, Bit-wise operators, Special operators. **Expressions:** Arithmetic expressions, evaluation of expressions, Precedence of arithmetic operators, Type conversion in expressions, Operator precedence and associativity. **Decision Making and Branching:** Decision making with 'if' statement, Simple 'if' statement, the 'if…else' statement, nesting of 'if…else' statements, The 'else if' ladder, The 'switch' statement, The '*?:*' operator, The '*goto*' statement.	

Unit –III	**12 Hrs**
Programming Constructs: Decision making and looping: The 'for','while','do-while' statements with examples, Jumps in loops**. Arrays:** Introduction to Arrays, Types of arrays, Declaration arrays, Initializing dimensional arrays (One Dimensional and Multidimensional Array) with examples. **String Operations:** Introduction, Declaration and Initializing String Variables using arrays, String operations and functions with examples. **Functions:** Need for Functions, Types of functions (User Defined and Built –In), working with functions, Definition, declaration and its scope. **Pointers:** Introduction, Benefits of using pointers, Declaration and Initialization of pointers, Obtaining a value of a variable.	

Course Outcomes: After completing the course, the students will be able to:-	
CO 1	Apply logical skills to solve the engineering problems using C programming constructs.
CO 2	Evaluate the appropriate method/data structure required in C programming to develop solutions by investigating the problem.
CO 3	Design a sustainable solution using C programming with societal and environmental concern by engaging in lifelong learning for emerging technology
CO 4	Demonstrate programming skills to solve inter-disciplinary problems using modern tools effectively by exhibiting team work through oral presentation and written reports.

Reference Books	
1.	Programming in C, P. Dey, M. Ghosh, 2011, 2nd Edition, Oxford University press, ISBN (13): 9780198065289.
2.	Algorithmic Problem Solving, Roland Backhouse, 2011, Wiley, ISBN: 978-0-470-68453-5
3.	The C Programming Language, Kernighan B.W and Dennis M. Ritchie, 2015, 2nd Edition, Prentice Hall, ISBN (13): 9780131103627.
4.	Turbo C: The Complete Reference, H. Schildt, 2000, 4th Edition, Mcgraw Hill Education, ISBN-13: 9780070411838.
5.	Rasberry pi: https://www.raspberrypi.org/documentation/
6.	Nvidia: https://www.nvidia.com/en-us/
7.	Ardunio: https://www.arduino.cc/en/Tutorial/BuiltInExamples
8.	Scratch software: https://scratch.mit.edu/

PRACTICE PROGRAMS

Implement the following programs using cc/gcc compiler

1. Develop a C program to compute the roots of the equation $ax^2 + bx + c = 0$.
2. Develop a C program that reads N integer numbers and arrange them in ascending or descending order using selection sort and bubble sort technique.
3. Develop a C program for Matrix multiplication.
4. Develop a C program to search an element using Binary search and linear search techniques.
5. Using functions develop a C program to perform the following tasks by parameter passing to read a string from the user and print appropriate message for palindrome or not palindrome.
6. Develop a C program to compute average marks of 'n' students (Name, Roll_No, Test Marks) and search a particular record based on 'Roll_No'.
7. Develop a C program using pointers to function to find given two strings are equal or not.
8. Develop a C program using recursion, to determine GCD , LCM of two numbers and to perform binary to decimal conversion.

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
WEIGHTAGE	**100%**	**---**
QUIZZES		
Quiz-I	Each quiz is evaluated for 10 marks adding up to 1**0 MARKS.**	
Quiz-II		

THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test – I	Each test will be conducted for 50 Marks adding upto 100 marks. Final test marks will be reduced to 3**0** **MARKS**	
Test – II		
EXPERIENTIAL LEARNING	**10**	
TOTAL MARKS FOR THE COURSE	**50**	**---**

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Semester: IV				
Universal Human Values 2 **(Theory & Practical)**				
Course Code	:	**21HSS48**	**CIE**	:	**50 Marks**
Credits: L:T:P	:	1:0:1	**SEE**	:	**50 Marks**
Total Hours	:	28L+0T+14P	**SEE Duration**	:	**2.00 Hours**

Unit-I	**05 Hrs**

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education: Purpose and motivation for the course, recapitulation from Universal Human Values-I, Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, 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 – II	**06 Hrs**

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

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

Unit –III	**06 Hrs**

Understanding Harmony in the Family and Society- Harmony in Human Human Relationship: 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, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, 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

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relationships. Discuss with scenarios. Elicit examples from students' lives

Unit –IV	05 Hrs

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence: Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self-regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all pervasive space, Holistic perception of harmony at all levels of existence. 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 –V	06 Hrs

Implications of the above Holistic Understanding of Harmony on Professional Ethics, Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, 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, Case studies of typical holistic technologies, management models and production systems, 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, Sum up.

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

Course Outcomes:
CO1: 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,
CO2: While keeping human relationships and human nature in mind. They would have better critical ability.
CO3: They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
CO4: 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

Reference Books	
1	Jeevan Vidya: Ek Parichaya, 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. |
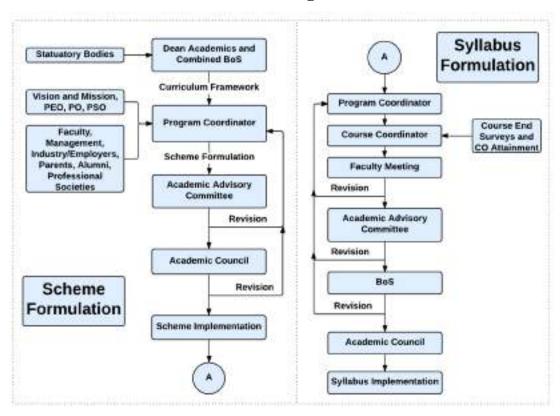
ASSESSMENT AND EVALUATION PATTERN

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

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Curriculum Design Process

Academic Planning And Implementation

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│  Calender of Events │
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┌──────────────────────────────────────────────────────────┐
│ • Align Course Contents (Lesson Plan)                     │
│ • Identify Expected Attainment Level (Threshold)          │
│ • Publish course Materials (PPT's, Notes, Model           │
│   Question Paper)                                          │
│ • Publish Schedule (Time Table, Test, Self Study, Lab)    │
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│   Implement Program Curriculum    │
│        (Course Delivery)          │
└──────────────────────────────────┘
          │
┌──────────────────────────────────────────────────┐
│        Formative Student Assessment               │
│ (Tests, Quizzes, Lab and Through Pedagogical      │
│              Initiatives)                          │
└──────────────────────────────────────────────────┘
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┌──────────────────────────────────────────┐
│  Assess Results and Feedback to Students  │
└──────────────────────────────────────────┘
          │
   ◇ Performace < Expected ◇ ──Yes──> [ Remedial ]
          │ No
         ( A )
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Right side:

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┌──────────────────────┐
│  Cumulative Outcome   │
│     Assessment        │
└──────────────────────┘
  │
┌──────────────────────┐
│    Course End         │
│     Survey            │
└──────────────────────┘
  │
┌──────────────────────┐
│  Assessment Outcome   │
│  Data and Students    │
│   Feedback on TLP     │
└──────────────────────┘
  │
┌──────────────────────┐
│  Academic Advisory    │
│    Committee          │
└──────────────────────┘
  │
┌──────────────────────┐
│   Improve Program     │
│ Curriculum/Assessment │
│ Methods/Redefine CO's │
└──────────────────────┘
```

Process For Course Outcome Attainment

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```
┌─────────────────────────┐
│    Course Curriculum    │
└─────────────────────────┘
            │
            ▼
┌─────────────────────────┐
│      CO-PO Mapping      │
└─────────────────────────┘
            │
            ▼
┌─────────────────────────┐
│  Mapping of COs to CIE QP │
└─────────────────────────┘
            │
            ▼
┌───────────────────────────────────┐
│ Weightage of COs from tests and quizzes │
└───────────────────────────────────┘
            │
            ▼
┌───────────────────────────────────┐
│ Students marks from tests and quizzes │
└───────────────────────────────────┘
            │
            ▼
┌───────────────────────┐        ⊕        ┌───────────────────────┐
│ Lab experiment assessment, │ ────► ◄──── │ Self Study assessment score │
│   Score and weightage     │             │      and weightage        │
└───────────────────────┘                 └───────────────────────┘
            │
            ▼
┌───────────────────────────────────┐
│   Attainment of CO for each student   │
└───────────────────────────────────┘
            │
            ▼
┌───────────────────────────────────┐
│ Number of students getting more than the │
│         target attainment          │
└───────────────────────────────────┘
```

Final CO Attainment Process

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```
                        Course (Syllabus) ─────────────────────────────┐
                              │                                        │
                        Course Achievable Matrix                       │
                              │                                        │
                    Mapping of COs to CIE question paper               │
                              │                                        │
                        QP Achieved                                    │
                   (Student score from Test and Quiz)                  │
                              │                                        │
                 Ratio of QP achieved to course achievable            │
                              │                                        │
 Lab experiments mapped to COs ←──(+)──→ Self-study assessment rubrics mapped to COs
                              │                                        │
      90%            80%      │                                        │
            Direct ←──(+)──  CIE                                       │
              │        ↑                                              │
 CO           │        │                                             │
 Attainment ←(+)       │  20%                    CO attainment from SEE│
              │        └────  SEE ──────────────────────────────────┘
      10%     │
            Indirect
              ↑
         Course end
         survey            At the end of the course
         mapped to  ←─────────────────────────────────────────────────┘
         COs
```

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Program Outcome Attainment Process

```
                  Course (Syllabus)
                         │
                         ▼
                   CO Attainment
                         │
                         ▼
                  CO –PO Mapping
                         │
                         ▼
                   PO Attainment
                      DIRECT
                         │
                        80%
                         │
                         ▼
                        (○)  ──────────►   PO Attainment
                         ▲
                        20%
                         │
   Alumni Survey ──►  PO Attainment  ◄── Employer Survey
                      INDIRECT
                         ▲
                         │
                  Senior Exit Survey
```

PROGRAM OUTCOMES (POs)

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

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

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

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

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

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

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

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

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

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

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

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