RV COLLEGE OF ENGINEERING®

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

Bachelor of Engineering (B.E.)
Scheme and Syllabus of III & IV Semesters

2018 SCHEME

MECHANICAL ENGINEERING

VISION

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

MISSION

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

QUALITY POLICY

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

CORE VALUES

Professionalism, Commitment, Integrity, Team Work, Innovation

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2018 SCHEME

DEPARTMENT OF
MECHANICAL ENGINEERING

DEPARTMENT VISION

Quality Education in Design, Materials, Thermal and Manufacturing with emphasis on Research, Sustainable technologies and Entrepreneurship for Societal Symbiosis

DEPARTMENT MISSION

- Imparting knowledge in basic and applied areas of Mechanical Engineering
- Providing state-of-art laboratories and infrastructure for academics and research
- Facilitating faculty development through continuous improvement programs
- Promoting research, education and training in frontier areas of nanotechnology, advanced composites, surface technologies, MEMS and sustainable technology
- Strengthening collaboration with industries, research organizations and institutes for internship, joint research and consultancy
- Imbibing social and ethical values in students, staff and faculty through personality development programs

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1. Successful professional careers with sound fundamental knowledge in Mathematics, Physical Sciences and Mechanical Engineering leading to leadership, entrepreneurship or pursuing higher education.

PEO2. Expertise in specialized areas of Mechanical Engineering such as Materials, Design, Manufacturing and Thermal Engineering with a focus on research and innovation.

PEO3. Ability of problem solving by adopting analytical, numerical and experimental skills with awareness of societal impact.

PEO4. Sound communication skills, team working ability, professional ethics and zeal for life-long learning.

PROGRAM SPECIFIC OUTCOMES (PSOS)

PSO	Description
PSO1	Demonstrate basic knowledge in Mathematics, basic science, Materials Science and Engineering to formulate and solve mechanical engineering problems
PSO2	Design mechanical and thermal systems by adopting numerical, analytical and experimental techniques and analyse the results.
PSO3	Function in multidisciplinary teams with sound communication skills.
PSO4	Self-learn to acquire and apply allied knowledge and update the same by engaging in life-long learning, practice profession with ethics and promote entrepreneurship .

Lead Society: American Society of Mechanical Engineers – ASME

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.	CE	Professional Core Elective
6.	GE	Global Elective
7.	HSS	Humanities and Social Sciences
8.	CV	Civil Engineering
9.	ME	Mechanical Engineering
10.	EE	Electrical & Electronics Engineering
11.	EC	Electronics & Communication Engineering
12.	IM	Industrial Engineering & Management
13.	EI	Electronics & Instrumentation Engineering
14.	CH	Chemical Engineering
15.	CS	Computer Science & Engineering
16.	TE	Telecommunication Engineering
17.	IS	Information Science & Engineering
18.	BT	Biotechnology
19.	AS	Aerospace Engineering
20.	PY	Physics
21.	CY	Chemistry
22.	MA	Mathematics

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MECHANICAL ENGINEERING

THIRD SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			**Total Credits**
				L	**T**	**P**	
1	18MA31C*	Engineering Mathematics-III	MA	4	1	0	**5**
2	18ME32**	Engineering Materials	ME	2	0	0	**2**
3	18ME33	Mechanics of Materials	ME	3	1	1	**5**
4	18ME34	Concept of Metrology& Machine Drawing	ME	3	0	1	**4**
5	18ME35	Thermal Engineering-I	ME	3	0	0	**3**
6	18ME36	Kinematics of Machines	ME	3	1	0	**4**
7	18DMA37***	Bridge Course Mathematics	MA	0	0	0	**0**
8	18HS38 #	Kannada course	HSS	0	0	0	**0**
Total No. of Credits				**18**	**3**	**2**	**23**
Total number of Hours/Week				**18+4***	**6**	**4**	

*Engineering Mathematics - III

Sl. No	COURSE TITLE	COURSE CODE	PROGRAMMES
1.	Linear Algebra, Laplace Transform and Combinatorics	18MA31A	CS & IS
2.	Discrete and Integral Transforms	18MA31B	EC, EE, EI & TE
3.	Engineering Mathematics -III	18MA31C	AS, BT, CH, CV, IM & ME

**

Sl. No	COURSE TITLE	COURSE CODE	PROGRAMMES
1.	Environmental Technology	18BT32A	EE, EC, EI, CS, TE & IS
2.	Biology for Engineers	18BT32B	BT & AS
3.	Engineering Materials	18ME32	ME, CH & IM

*** Bridge Course: Audit course for lateral entry diploma students

Sl. No	COURSE TITLE	COURSE CODE	PROGRAMS
1	Bridge Course Mathematics	18DMA37	AS, BT,CH, CV, EC, EE, EI, IM, ME &TE
2	Bridge Course C Programming	18DCS37	CS & IS

Mandatory audit course for all students

There are two text books prescribed by VTU for the kannada Course:

1. Samskruthika Kannada **(AADALITHA KANNADA);**
2. Balake Kannada **(VYAVAHARIKA KANNADA);**

The first text book is prescribed for the students who know kannada to speak, read and write (**KARNATAKA STUDENTS**). The second text book is prescribed for the students who do not understand the kannada language(**NON KARNATAKA Students**)

RV COLLEGE OF ENGINEERING®

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MECHANICAL ENGINEERING

FOURTH SEMESTERCREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**CreditAllocation**			**Total Credits**
				L	**T**	**P**	
1	18MA41C*	Engineering Mathematics-IV	MA	4	1	0	**5**
2	18BT42A**	Environmental Technology	BT	2	0	0	**2**
3	18ME43	Manufacturing Process	ME	3	0	1	**4**
4	18ME44	Thermal Engineering-II	ME	3	0	1	**4**
5	18ME45	Dynamics of Machines	ME	**3**	1	0	**4**
6	18ME46	Fluid Mechanics	ME	**2**	1	1	**4**
7	18ME47	Design thinking lab	ME	0	0	2	**2**
8	18DCS48***	Bridge Course C Programming	CS	0	0	0	**0**
9	18HS49	Professional Practice-I Communication Skills	HSS	0	0	1	**1**
Total No. of Credits				17	3	6	**26**
Total number of Hours/Week				**17+2***	**6**	**12+2***	

* ENGINEERING MATHEMATICS – IV

Sl. No	COURSE TITLE	COURSE CODE	PROGRAMMES
1.	Graph Theory, Statistics and Probability Theory	18MA41A	CS & IS
2.	Linear Algebra, Statistics and Probability Theory	18MA41B	EC, EE, EI & TE
3.	Engineering Mathematics -IV	18MA41C	AS, CH, CV & ME

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Sl. No	COURSE TITLE	COURSE CODE	PROGRAMMES
1.	Engineering Materials	18EC42	EC, EE, EI & TE
2.	Biology for Engineers	18BT42B	CS & IS
3.	Environmental Technology	18BT42A	CV, ME, IM, CH, BT & AS

*** Bridge Course: Audit course for lateral entry diploma students

Sl. No	COURSE TITLE	COURSE CODE	PROGRAMMES
1	Bridge Course Mathematics	18DMA48	CS & IS
2	Bridge Course C Programming	18DCS48	AS, BT, CH,CV,EC, EE,EI,IM,ME & TE

Note: Internship to be taken up during the vacation period after the 4th semester
Bridge Course C programming will have 1 hour theory in lab.

Semester: III						
ENGINEERING MATHEMATICS – III (Theory) (Common to AS, BT, CH, CV, IM & ME)						
Course Code	**:**	18MA31C		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	4:1:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	52L+13T		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Understand variation and extremal of functionals.
2	Analyze the concept of periodic phenomena and develop Fourier series.
3	Solve initial value problems using Laplace transform.
4	Determine the approximate solutions of algebraic/transcendental and partial differential equations using numerical methods.
5	Use mathematical IT tools to analyze and visualize the above concepts.

Unit-I	**10 Hrs**
Calculus of Variations: Introduction to variation of functionals, extremal of a functional, Euler's equation –special cases, problems. Geodesics, Hanging cable and Brachistochrone problems. Exploring geodesics graphically using MATLAB.	
Unit – II	**11 Hrs**
Fourier Series: Introduction, periodic function, even and odd functions. Dirichlet's conditions, Euler's formula for Fourier series, complex Fourier series, problems on time periodic signals (square wave, half wave rectifier, saw-tooth wave and triangular wave), Fourier sine series, Fourier cosine series. Exploring Fourier series using MATLAB.	
Unit –III	**11 Hrs**
Laplace and Inverse 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. Transform of periodic functions (square wave, saw-tooth wave, triangular wave, full and half wave rectifier). Inverse Laplace transform – properties, evaluation using different methods. Convolution theorem (without proof), problems. Solution of ordinary differential equations. Exploring Laplace and inverse Laplace transform using MATLAB commands.	
Unit –IV	**10 Hrs**
Numerical Methods – I: Roots of algebraic and transcendental equations. Fixed point iteration method, Newton- Raphson method for multiple roots. Solution to system of linear equations – LU decomposition method, partition method. Sparse linear systems – Thomas algorithm for tridiagonal matrices. Computing numerical solutions using MATLAB.	
Unit –V	**10 Hrs**
Numerical Methods – II: Numerical solutions to partial differential equations – Finite difference approximation to derivatives, solution of Laplace equation in two dimension, heat and wave equations in one dimension (explicit methods). Exploring solution of PDE using MATLAB.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the fundamental concepts of variation of functionals, periodic phenomena, Laplace and inverse Laplace transforms and numerical techniques.
CO2:	Solve the problems on extremal of functional, Fourier series, Laplace and inverse Laplace transforms and basics of numerical methods.
CO3:	Apply the acquired knowledge to solve variational problems, half range series, differential equations using Laplace transform, system of linear equations and PDEs using finite difference technique.
CO4:	Analyze and interpret applications of functionals, complex Fourier series, IVP and BVP using LT, sparse linear systems and PDEs occurring in Engineering problems.

Reference Books	
1	Higher Engineering Mathematics, B.S. Grewal, 44th Edition, 2015, Khanna Publishers, ISBN: 81-7409-195-5.
2	Higher Engineering Mathematics, B.V. Ramana, 11th Edition, 2010, Tata McGraw-Hill, ISBN: 13-978-07-063419-0; ISBN: 10-0-07-063419-X.
3	Advanced Engineering Mathematics, Erwin Kreyszig, 9th Edition, 2007, John Wiley & Sons, ISBN: 978-81-265-3135-6.
4	Numerical methods for scientific and engineering computation, M.K. Jain, S.R.K. Iyenger and R.K. Jain, 6th Edition, 2012, New Age International Publishers, ISBN: 9788122433234, 8122433235.

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

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

Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

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

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

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

High-3 : Medium-2 : Low-1

Semester: III						
ENGINEERING MATERIALS (Theory) (Common to ME, CH & IM)						
Course Code	**:**	18ME32		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	2:0:0		**SEE**	**:**	**50 Marks**
Total Hours	**:**	26L		**SEE Duration**	**:**	**2.00 Hours**

Course Learning Objectives: The students will be able to

1	Understand the behavior of materials for different loading conditions
2	Analyze different phase diagrams, related composition and microstructure
3	Understand heat treatment methods of steel and their properties
4	Understand solidification process in casting and material degradation
5	Discuss Non Destructive methods of testing materials

Unit-I	**04 Hrs**
Mechanical behavior of Materials: Plastic deformation of metals, Mechanism of plastic deformation, role of dislocation in plastic deformation and Work Hardening. Fracture- mechanism of Ductile and brittle fracture, Ductile to brittle transition, Fatigue- Types of loading, S-N curve	
Unit – II	**07 Hrs**
Phase Diagram and Fe-C equilibrium diagram: Phase, Gibbs phase rule, Solid solutions, Hume Rothery Rules, Isomorphous alloy system, (Problems to find chemical composition and relative amount of phases present), Binary eutectic and Eutectoid 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.	
Unit -III	**07 Hrs**
Phase transformation in steel: Heat treatment of steel, Annealing-Full annealing, spheroidizing, process annealing, Normalizing, Hardening, TTT diagram of eutectoid steel and its phase transformation. Tempering, austempering, martempering, Hardenability, Jominy End quench test. Surface Heat treatment methods- Carburizing, Nitriding and Flame hardening.	
Unit –IV	**05 Hrs**
Foundry Metallurgy: Casting and Solidification process, Nuclei, Dendrite and grain, Nucleation: Homogeneous and Heterogeneous Nucleation, Dendritic growth and Cast structure. Shrinkage of liquids and metals. **Environmental Degradation of Materials**: Different forms of environmental degradation, forms of corrosion- Galvanic, Intergranular, pitting, stress related corrosion. Corrosion control- Materials selection, protective coating.	
Unit –V	**03 Hrs**
NON DESTRUCTIVE TESTING: Non Destructive Testing basic principles, Advantages and testing methods like Liquid penetrant inspections, Magnetic particle inspection, Ultrasonic testing, and Eddy current.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand behavior of various materials such as metals, composites and special materials
CO2:	Analyze materials, composition and their phase transformation
CO3:	Investigate solidification process during casting and materials degradation
CO4:	Recognize different types of Nondestructive testing methods to find subsurface defects in the materials.

Reference Books	
1	Material Science and Engineering, William D Callister, 6th Edition, 1997, John Wiley and Sons, ISBN 9812-53-052-5
2	Introduction to Physical Metallurgy, Sydney H Avner, 1994, Mc. Graw Hill Book Company, ISBN 0-07-Y85018-6
3	Material Science and Engineering, William F Smith, 4th Edition, 2008, Mc. Graw Hill Book Company, , ISBN0-07-066717-9

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

CIE is executed by way of quizzes (Q), tests (T) and Experiential Learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks which will be reduced to 15marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 25 marks each and the sum of the marks scored from three tests is reduced to 30. The marks component for assignment is 05.

The total marks of CIE is 15(Q) + 30(T) + 05(EL) = 50 marks.

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

SEE for 50 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 10 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 08 marks adding up to 40 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

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

High-3 : Medium-2 : Low-1

Semester: III						
MECHANICS OF MATERIALS (Theory and Practice)						
Course Code	**:**	18ME33		**CIE**	**:**	**100+50 Marks**
Credits: L:T:P	**:**	4:0:1		**SEE**	**:**	**100+50 Marks**
Total Hours	**:**	52 L+26P		**SEE Duration**	**:**	**03+03 Hours**

Course Learning Objectives: The students will be able to

1	Understand mechanics ofdeformablebodies and applythem in analysis anddesign problems
2	Analyzebodies subjectedto two dimensional stress systems.
3	Understand behaviourof structuralmembers in flexure.
4	Evaluate slope and deflection in beams subjectedto loading.
5	Understand stabilityofcolumns and struts.
6	Predict thestress distribution in beams, pressurevesselsand shafts

Unit-I	**09 Hrs**
Review of stress, strain & Elastic Constants: Stress, Strain, relationship among elastic constants, Volumetric strain. (No questions to beset on these topics) **Thermal stresses and strains** (compound bars not included). Numericals	
Unit – II	**14 Hrs**
Two-Dimensional Stress System: Introduction, Stress components on inclined planes, Principal Stresses, Principal planes, Mohr's circle of stress, Numericals **Bending moment and shear force in beams:** Introduction,Types of beams, Loads and Reactions, Shear forces and bending moments, Rate of loading, Sign conventions, Relationship between shear force and bending moments, Shear force and bending moment diagrams subjected to concentrated loads, uniform distributed load (UDL) for different types of beams. (UVL not included)	
Unit -III	**14 Hrs**
Bending stresses in beams: Introduction, Assumptions in simple bending theory, Derivation of Bernoulli'sequation, Modulus of rupture, Section modulus, Flexural rigidity, Bending stress distribution in beams of various sections, Beam of uniform strength (No numerical on beam of uniform strength). **Shear stresses in beams**: Expression for horizontal shear stress in beam, Shear stress diagram for simple rectangular and I section and T sections only. Numericals. **Deflection of determinate Beams:** Introduction, Definitions of slope, Deflection, Elastic curve, Derivation of differential equation of flexure, Sign convention, Double integration method, Slope and deflection using Macaulay's method for prismatic beams and over-hanging beams subjected to point loads, UDL and couples. Numerical problems.	
Unit –IV	**09 Hrs**
Thick and thin cylinders: Stresses in thin cylinders, Changes in dimensions of cylinder (diameter, length and volume), Thick cylinders subjected to internal and external pressures (Lame's equation), (Compound cylinders not included).	
Unit –V	**10 Hrs**
Analysis of columns and struts: Introduction, Euler'stheory on columns, Effective length, Slenderness ratio, Short and long columns, Radius of gyration, Buckling load, Assumptions, Derivation of Euler's Buckling load for different end conditions, Limitations of Euler'stheory, Rankine's formula. Numerical problems.	

Practice	
MECHANICS OF MATERIALS LABORATORY	
Section I	**18 Hrs**
1. Hardness Tests (Brinell, Rockwell,Vicker)	
2. Tension test on Mild steel and HYSD(High YieldStrength Deformed) bars	
3. Compression test ofMild Steel, HYSD, Cast iron.	
4. Torsion test on Mild Steel circularsections.	
5.BendingTest on Wood Undertwo point loading.	
6.ShearTest on Mild steel.	
7.Impact test on Mild Steel (Charpy&Izod)	
8.WearTest usingPin on discTribometer	
Section– II (Non-destructive testing)	**08 Hrs**
1. MagneticParticleTest	
2. UltrasonicTest	
3.Dye Penetrant Test	
4. Eddycurrent inspection for metals	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Identify the different engineering materials, describe their properties and predict their Behaviour under different types ofloading
CO2:	Compute the stresses, strains, moments,deflections,etc.and derive the expressions used from the fundamentals.
CO3:	Select materials,sizes and sections for various applications such as beams, shafts, Pressure vessels, columns, etc. and justify the selection
CO4:	Determine mechanical properties by destructive and non-destructive methods

Reference Books	
1	Strength of Materials, S.S.Bhavikatti, 2012,Vikas Publications House Pvt. L td. New Delhi, ISBN 9788125927914
2	Elements of Strength of Materials,TimoshenkoandYoung ,1976 , Affiliated East-West Press, ISBN-10: 0442085478,ISBN-13: 978-0442085476.
3	Mechanics of Materials, F.P. Beer and R. Johnston,2006 ,McGraw-Hill Publishers, ISBN 9780073529387
4	Strength of Materials, S.Ramamrutham, R.Narayanan, 2012, Dhanapath Rai Publishing Company, New Delhi, ISBN: 818743354X

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

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

Total CIE is 30 (Q) + 50 (T) + 20 (EL) = 100 Marks.

Scheme of Continuous Internal Evaluation (CIE);

Practical Test for 50 Marks

The Laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average marks (AM) over number of weeks is considered for 30 marks. At the end of the semester a test (T) is conducted for 10 marks. The students are encouraged to

implement additional innovative experiments (IE) in the lab and are rewarded for 10 marks. Total marks for the laboratory is 50.
Total CIE is 40 (AM) + 10 (T) = 50 Marks.
Total CIE is 30 (AM) +10 (T) + 10 (IE) = 50 Marks.

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

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

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

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

High-3 : Medium-2 : Low-1

Semester: III						
CONCEPT OF METROLOGY AND MACHINE DRAWING (Theory and Practice)						
Course Code	**:**	18ME34		**CIE**	**:**	**100+50 Marks**
Credits: L:T:P	**:**	3:0:1		**SEE**	**:**	**100+50 Marks**
Total Hours	**:**	42L +26P		**SEE Duration**	**:**	**03+03 Hours**

Course Learning Objectives: The students will be able to

1	Understand the working of linear, angular and optical measuring instruments.
2	Familiarize with the working of various advanced measuring devices and machine tool metrology.
3	Understand and fundamentals of limits, fits and GD&T
4	Apply the principle of measurement of force, torque, strain and stress and temperature for various devices
5	Model the machine component in CAD software by applying the basic knowledge of machine drawing.

Unit-I	**07 Hrs**
Concept of measurements General concept – Generalised measurement system-Units and standards-measuring instruments-sensitivity, readability, range of accuracy, precision-static and dynamic response-repeatability-systematic and random errors-correction, calibration. **Transducers:** Characteristics transfer efficiency, primary and secondary transducers, Electrical, mechanical transducers. Signal transmission and processing: Devices and systems**.** Signal Display & Recording Devices	
Unit – II	**11 Hrs**
Comparators: Mechanical, pneumatic and electrical types, applications. Angular measurements:- Sine bar, optical bevel protractor. Slip gauges and classification, interferometry, optical flats. **Limits, fits and tolerances**: Definition of tolerance, Principle of interchangeability and selective assembly, Indian standards, concept of limits of size and tolerances, definition of fits, types of fits, hole basis system, shaft basis system, classification of gauges, brief concept of design of gauges (Taylor's principles), Wear allowance on gauges. **Geometric Dimensioning and Tolerance:** Introduction to GD &T, symbols, form tolerance-flatness, cylindricity, straightness, circularity, orientation tolerances-perpendicularity, parallelism and angularity. Elements of surface texture, factors affecting surface finish, reasons for controlling surface texture, methods of measuring surface finish, indication of surface roughness symbols used.	
Unit -III	**11 Hrs**
Advances in Metrology Precision instruments based on laser-Principles- laser interferometer-application in linear, angular measurements and machine tool metrology. Coordinate measuring machine (CMM)- Constructional features – types, applications. **Measurement of Torque, Force & Temperature related properties** Force, torque: -mechanical, pneumatic, hydraulic and electrical type. Temperature: bimetallic strip, pressure thermometers, thermocouples, electrical resistance thermistor.	
Unit –IV	**07 Hrs**
Machine Drawing Fundamentals-I Need of Graphical Language, Importance Machine Drawing, Tools (from Instruments to Current Software's). Projections: Designation, Relative position of views. Principles of Drawings: Scales as per ISO standards, Importance of Title Block and Part list, Lines convention. Conventional Representations, Materials and Interrupted views, Surface finishing & Machining symbols. Classification of nuts, terminology used in the drawing of nuts and bolts. Drawing of orthographic projections of a bolt, empirical relations of dimensions of nut and bolt with respect to bolt head diameter.	

Unit –V	06 Hrs
Machine Drawing Fundamentals-II Screw Thread Form: Screw thread terminology, Basic profiles, Standard forms of V-threads (Whitworth thread, seller thread, ISO thread), Standard Square threads, Modified forms of square threads, Numericals. Types of Welded Joints, Representation of Welds, Symbols and its conventions. Rivet and Riveting, applications, terminology. Classifications (Lap and Butt joints).	

Practice		
CONCEPT OF METROLOGY AND MACHINE DRAWING		
		26 Hrs
1	**Orthographic views:** Conversion of pictorial views into orthographic views of simple machine parts with and without section (full, half, off, aligned and partial or local sections) Hidden line conventions, Precedence of lines. – 8 Hrs	
2	**Joints:** Cotter joint (socket and spigot), Knuckle joint (pin joint)- 8 Hrs	
3	**Couplings:** Flange Coupling, Sleeve coupling, Pin (bush) type flexible coupling, Split muff coupling and Universal coupling. – 10 Hrs	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the principle of linear and angular measuring instruments and apply the acquired knowledge for the accurate and precise measurement of a given quantity.
CO2	Apply the principle of limits, fits and GD&T to assemblies in machine drawing.
CO3	Illustrate the principle of CMM and various devices for measuring torque, force, temperature.
CO4	Create 3D model of machine components and indicate the drawing conventions.

Reference Books	
1.	Engineering Metrology and Measurements, NV Raghavendra, L Krishna murthy, Oxford publishers. ISBN-13: 978-0198085492
2.	Mechanical Measurements, Beckwith, Marangoni, Lienhard, Pearson Education. ISBN-13: 978-9332518520
3.	Mechanical Measurements and Instrumentation, R K Rajput, S.K. Kataria & Sons publication, ISBN-13: 978-9350142851
4.	Engineering Metrology by R K Jain, Khanna Publication, ISBN-13: 978-8174091536
5.	Fundamentals of Machine Drawing by Sadhu singh, Prentice Hall India Learning publications. ISBN-13: 978-8120346796

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

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

Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Scheme of Continuous Internal Evaluation (CIE); Practical Test for 50 Marks

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

Total CIE is 30(AM) +10 (T) +10 (IE) =50 Marks.

Total CIE is 40(AM) +10 (T) =50 Marks.

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

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

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

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

High-3: Medium-2: Low-1

Semester: III						
THERMAL ENGINEERING I (Theory)						
Course Code	**:**	18ME35		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	39 L		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Familiarizewith variousdefinitions involved in thermodynamics including work and heat
2	Applyfirst and second law ofthermodynamics to variousprocesses.
3	Demonstratetheskills to explain corollaries ofsecondLaw ofthermodynamics.
4	Explain the concept ofEntropy, available and un-available energy
5	Understand thebehaviorofpuresubstanceswith thehelp ofpropertydiagrams
6	Differentiate between real and idealgases

Unit-I	**05 Hrs**
Fundamental Concepts and Definitions: System, control volume, properties, state, process, exact and inexact differentials–Quasi-static process, Definition of Thermodynamic work and Heat, Thermodynamic equilibrium– adiabatic and diathermic walls **Temperature:** Equality of temperature–Zeroth law of thermodynamics - thermometry-Temperature scales-Numericals	
Unit – II	**09 Hrs**
Heat and Work: work done in a quasi-equilibrium process – *pdv* work in various quasi-static processes - other types of work transfer, Pure substances and two property rule, Numericals **First Law of Thermodynamics:** First law of thermodynamics for a closed system under going thermodynamic cycle and process – Perpetual Motion Machine of kind I–Internal energy – property of the system – Enthalpy – Specific heats, Application of first law of thermodynamics to steady flow processes, Steady flow energy equation applied to open steady system and Numericals	
Unit -III	**09 Hrs**
Second Law of Thermodynamics: Limitations of first law of thermodynamics–Thermal reservoirs–Heat engines, Refrigerator and Heat pump–Statements of second law of thermodynamics–Equivalence of Kelvin Planck and Clausius statements– Perpetual Motion Machine of kindII, Numericals **Carnotcycle**–Corollaries of Second law of thermodynamics, Absolute thermodynamic temperature scale, International temperature scale, Numericals	
Unit –IV	**08 Hrs**
Entropy: Clausius Inequality, Entropy – property of a system, Principle of increase of entropy – The combined first and second law (T-ds equations), Thermodynamic relations, Change of entropy for different processes of Ideal gas. **Available and Unavailable energy:** Introduction, Availability function for a non-flow process, availability function of a flow processes.	
Unit –V	**08 Hrs**
Ideal gases and Real gases: Deviation of Ideal gas, equation of state– Real gases– Vander Waal's equation of state – compressibility factor, Use of compressibility charts, Simple Numericals **Introduction to Air standard cycles:** Air standard assumptions, efficiency, work done and MEP of Otto and diesel cycle, simple Numericals.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Define and Explain basic concepts, properties of substances and Laws of thermodynamics
CO2:	Analyse thermodynamic processes for heat and work transfer
CO3:	Apply the Laws of Thermodynamics for analyzing thermodynamic processes/cycles
CO4:	Adapt knowledge of thermodynamics to suggest solutions for thermodynamic problems

Reference Books	
1	Engineering Thermodynamics, Nag P.K, 4th Edition, 2011 ,Tata McGraw Hill, ISBN-13:978-0-07-026062-7:ISBN-10:0-07-026062-1
2	Thermodynamics, YunusACengelandBolesM.A,7thEdition, 2009 ,TataMcGrawHill, ISBN-13:978-0-07-107254-0;ISBN-10:0-07-107254-3
3	Fundamentals of Thermodynamics,R.E Sonntag,C.BorgnakkeandG.J.VanWylen, 2003, JohnWiley, ISBN:0-471-15232-3
4	EngineeringThermodynamics, RajputR.K, 3rd Edition, 2007, Laxmi Publications Pvt.Ltd, ISBN: 978-0-7637-8272-6

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

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

Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

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

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

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

High-3 : Medium-2 : Low-1

Semester: III						
KINEMATICS OF MACHINES (Theory)						
Course Code	**:**	18ME36		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	39L		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Explain types of relative motion
2	Differentiate between Machine, Mechanism, and Structure..
3	Draw velocity and acceleration diagrams of linkages..
4	Design Cam profile for the desired follower motion.
5	Determine gear parameters and determine train value & fixing torque in gear trains
6	Explain types of relative motion

Unit-I	**06 Hrs**
Simple Mechanism: Definition of link, pair, kinematic chain, mechanism, machine, inversion, structure – Types of motion : constrained, unconstrained and successfully constrained motions, Grashof's criterion, Inversions of 4 bar chain, single slider crank chain and double slider crank chain – Degrees of freedom – Gruebler's criterion for mobility of mechanisms.	
Unit – II	**10 Hrs**
Mechanisms: Drag link and toggle mechanisms – Straight line mechanisms, Condition for exact straight line motion, Peaucellier and Hart mechanisms – Intermittent motion mechanisms, Ratchet and pawl and Geneva wheel – Pantograph, Condition for perfect steering, Steering gear mechanisms, Davis and Ackermann– Hooke's joint **Velocity and Acceleration:** Determination of velocity and acceleration of a point/link in simple mechanisms by relative velocity method (graphical) – Coriolis component of acceleration. Instantaneous centre – Centrodes – Kennedy's theorem – To determine linear velocity and angular velocity of links of simple mechanisms by instantaneous centre method	
Unit -III	**10 Hrs**
Klein's Construction for velocity and acceleration of slider crank mechanism. **Complex algebra method:** Analysis of velocity and acceleration of single slider crank chain and four bar chain by complex algebra method **Toothed Gearing:** Classification of toothed wheels – Gear terminology –Law of gearing –Velocity of sliding – Length of path of contact, Arc of contact – Contact ratio – Interference in involute gears, Methods of avoiding interference – Minimum number of teeth to avoid interference on pinion meshing with gear and on pinion meshing with rack. Characteristics of involutes action, Comparison of involute and cycloidal teeth profiles. Numerical problems.	
Unit –IV	**06 Hrs**
Gear Trains–Velocity ratio & Train value, Types of gear trains– Simple, Compound, Reverted & Epicyclic gear trains. Algebraic/Tabular method of finding Train value of Epicyclic gear trains, Bevel gear Differential of an automobile	
Unit –V	**07 Hrs**
Cams: Types of cams, Types of followers and types of follower motion – Displacement, velocity and acceleration curves for SHM, Uniform velocity, UARM and cycloidal motion – To draw cam profile for disc cam with reciprocating follower (knife edge, roller and flat faced) and disc cam with oscillating roller follower – To find maximum velocity and acceleration in each case	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Define the basic mechanisms for developing a machine.
CO2:	Construct velocity and acceleration diagram for mechanism.

CO3:	Design and synthesize mechanisms for specific type of relative motion
CO4:	Estimate kinematic parameters for industrial mechanisms

Reference Books	
1	Theory of Machines, Thomas Bevan, 3rd Edition, 1984, CBS Publishers, ISBN: 9788131729666
2	Theory of Machines, Shigley, , 3rd Edition, 2003,Tata McGraw Hill, ISBN:9780071137478
3	Theory of Machines, Sadhu Singh, 2nd Edition, 2007, Pearson Education Publications, ISBN: 9788177581270
4	Theory of Machines, Rattan S.S., 3rd Edition,2008, Tata McGraw Hill Publications, ISBN: 9780070144774

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

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

Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

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

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

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

High-3 : Medium-2 : Low-1

Semester: III/IV						
MATHEMATICS **Bridge Course** **(Common to all branches)**						
Course Code	**:**	18DMA37/48		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	2:0:0		**SEE**	**:**	**50 Marks**
Audit Course				**SEE Duration**	**:**	**2.00 Hours**

Course Learning Objectives: The students will be able to

1	Understand the concept of functions of several variables, types of derivatives involved with these functions and its applications, approximate a function of single variable in terms of infinite series.
2	Acquire concepts of vector functions, scalar fields and differential calculus of vector functions in Cartesian coordinates.
3	Explore the possibility of finding approximate solutions using numerical methods in the absence of analytical solutions of various systems of equations.
4	Recognize linear differential equations, apply analytical techniques to compute solutions.
5	Gain knowledge of multiple integrals and their applications.
6	Use mathematical IT tools to analyze and visualize the above concepts.

Unit-I	**05 Hrs**
Differential Calculus: Taylor and Maclaurin series for function of single variable. 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 4^{th} 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:	Understand the concept of partial differentiation, double integrals, vector differentiation, solutions of higher order linear differential equations and requirement of numerical methods.
CO2:	Solve problems on total derivatives of implicit functions, Jacobians, homogeneous linear differential equations, velocity and acceleration vectors.
CO3:	Apply acquired knowledge to find infinite series expansion of functions, solution of non-homogeneous linear differential equations and numerical solution of equations.

CO4:	Evaluate triple integrals, area, volume and mass, different operations using del operator on scalar and vector point functions, numerical solution of differential equations and numerical integration.

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

Semester: III

VYAVAHARIKA KANNADA
(Common to all branches)

Course Code	**:**	18HS38		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	1:0:0		**SEE**	**:**	**50 Marks**
Total Hours	**:**	16Hrs		**CIE Duration**	**:**	**90 Minutes**

Course Learning Objectives of Vyavaharika Kannada: The students will be able to

1	Motivate students to learn Kannada language with active involvement.
2	Learn basic communication skills in Kannada language (Vyavaharika Kannada).
3	Importance of learning local language Kannada.

VYAVAHARIKA KANNADA (BALAKE Kannada)
(to those students who does not know Kannada)

Unit-I — **4Hrs**

Parichaya(Introduction):
Necessity of learning local language, Tips to learn the language with easy methods, Hints for correct and polite conversation, History of kannada language.

Unit – II — **4Hrs**

Kannada alphabtets and Pronunciation:
Kannada aksharmale, Kannada stress letters (vattakshara), Kannada Khagunitha, Pronunciation, memorisation and usage of the Kannada letters.

Unit – III — **4Hrs**

Kannada vocabulary for communication:
Singular and Plural nouns, Genders, Interrogative words, Antonyms, Inappropriate pronunciation, Number system, List of vegetables, Fractions, Menu of food items, Names of the food items, words relating to time, words relating to directions, words relating to human's feelings and emotion, Parts of the human body, words relating to relationship.

Unit –IV — **4Hrs**

Kannada Grammar in Conversations:
Nouns, Pronouns, Use of pronouns in Kannada sentences, Adjectives and its usage, Verbs, Adverbs, Conjunctions, Prepositions, Questions constructing words, Simple communicative sentences in kannada. Activities in Kannada, Vocabulory, Conversation.

Course Outcomes: After completing the course, the students will be able to

1	Usage of local language in day today affairs.
2	Construction of simple sentences according to the situation.
3	Usage of honorific words with elderly people.
4	Easy communication with everyone.

Reference Books:

1	Vyavaharika Kannada patyapusthaka, L. Thimmesh, and V. Keshavamurthy, Prasaranga Visveshvaraya University, Belgaum.
2	Kannada Kali**,** K. N. Subramanya, S. Narahari, H. G. Srinivasa Prasad, S. Ramamurthy and S. Sathyanarayana, 5th Edition, 2019, RV College of Engineering Bengaluru.
3	Spoken Kannada**,** Kannada Sahithya Parishat, Bengaluru.

ವ್ಯಾವಹಾರಿಕ ಕನ್ನಡ (Kannada Version)

ಅಧ್ಯಾಯ – I — **4Hrs**

ಸ್ಥಳೀಯ ಅಥವಾ ಪ್ರಾದೇಶಿಕ ಭಾಷಾ ಕಲಿಕೆಯ ಅವಶ್ಯಕತೆ, ಭಾಷಾ ಕಲಿಕೆಯ ಸುಲಭ ವಿಧಾನಗಳು, ಸಂಭಾಷಣೆಗಾಗಿ ಸುಲಭ ಸೂಚ್ಯಗಳು ಕನ್ನಡ ಭಾಷೆಯ ಇತಿಹಾಸ.

ಅಧ್ಯಾಯ – II	**4Hrs**

ಕನ್ನಡ ಅಕ್ಷರಮಾಲೆ ಹಾಗೂ ಉಚ್ಚಾರಣೆ:

ಕನ್ನಡ ಅಕ್ಷರಮಾಲೆ, ಒತ್ತಕ್ಷರ, ಕಾಗುಣಿತ, ಉಚ್ಚಾರಣೆ, ಸ್ವರಗಳು ಉಚ್ಚಾರಣೆ, ವ್ಯಂಜನಗಳ ಉಚ್ಚಾರಣೆ.

ಅಧ್ಯಾಯ – III	**4Hrs**

ಸಂಭಾಷಣೆಗಾಗಿ ಕನ್ನಡ ಪದಗಳು:

ಏಕವಚನ, ಬಹುವಚನ, ಲಿಂಗಗಳು (ಸ್ತ್ರೀಲಿಂಗ, ಪುಲ್ಲಿಂಗ) ಪ್ರಶ್ನಾರ್ಥಕ ಪದಗಳು, ವಿರುದ್ಧಾರ್ಥಕ ಪದಗಳು, ಅಸಮಂಜಸ ಉಚ್ಚಾರಣೆ, ಸಂಖ್ಯಾ ವ್ಯವಸ್ಥೆ, ಗಣಿತದ ಚಿಹ್ನೆಗಳು, ಭಿನ್ನಾಂಶಗಳು.

ತರಕಾರಿಗಳ ಹೆಸರುಗಳು, ತಿಂಡಿಗಳ ಹೆಸರುಗಳು, ಆಹಾರಕ್ಕೆ ಸಂಬಂಧಿಸಿದ ಪದಗಳು, ಕಾಲ/ಸಮಯಕ್ಕೆ ಸಂಬಂಧಿಸಿದ ಪದಗಳು, ದಿಕ್ಕುಗಳ ಹೆಸರುಗಳು, ಭಾವನೆಗೆ ಸಂಬಂಧಿಸಿದ ಪದಗಳು, ಮಾನವ ಶರೀರದ ಭಾಗಗಳು, ಸಂಬಂಧದ ಪದಗಳು, ಸಾಮಾನ್ಯ ಸಂಭಾಷಣೆಯಲ್ಲಿ ಬಳಸುವಂತಹ ಪದಗಳು.

ಅಧ್ಯಾಯ – IV	**4Hrs**

ಸಂಭಾಷಣೆಯಲ್ಲಿ ಕನ್ನಡ ಬಳಕೆ:

ನಾಮಪದಗಳು, ಸರ್ವನಾಮಗಳು, ನಾಮವಿಶೇಷಣಗಳು, ಕ್ರಿಯಾಪದಗಳು, ಕ್ರಿಯಾವಿಶೇಷಣಗಳು, ಕನ್ನಡದಲ್ಲಿ ಸಂಯೋಜನೆಗಳು, ಉಪಸರ್ಗಗಳು, ಪ್ರಶ್ನಾರ್ಥಕ ಪದಗಳು, ವಿಚಾರಣೆಯ / ವಿಚಾರಿಸುವ / ಬೇಡಿಕೆಯ ವಾಕ್ಯಗಳು. ಕನ್ನಡದಲ್ಲಿ ಚಟುವಟಿಕೆಗಳು, ಶಬ್ದಕೋಶ, ಸಂಭಾಷಣೆ.

ವ್ಯವಹಾರಿಕ ಕನ್ನಡದ ಕಲಿಕಾ ಫಲಿತಾಂಶಗಳು :	
CO1:	ನಿತ್ಯ ಜೀವನದಲ್ಲಿ ಆಡುಭಾಷೆಯ ಬಳಕೆ.
CO2:	ಸಂದರ್ಭ, ಸನ್ನಿವೇಶಕ್ಕನುಗುಣವಾಗಿ ಸರಳ ಕನ್ನಡ ವಾಕ್ಯಗಳ ಬಳಕೆ.
CO3:	ಗೌರವ ಸಂಬೋಧನೆಯ ಬಳಕೆ.
CO4:	ಇತರರೊಡನೆ ಸುಲಭ ಸಂವಹನ.

ಆಧಾರ ಪುಸ್ತಕಗಳು :	
1	ವ್ಯವಹಾರಿಕ ಕನ್ನಡ ಪಠ್ಯಪುಸ್ತಕ, ಎಲ್.ತಿಮ್ಮೇಶ್ ಮತ್ತು ವಿ.ಕೇಶವಮೂರ್ತಿ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿದ್ಯಾಲಯ, ಬೆಳಗಾಂ.
2	ಕನ್ನಡ ಕಲಿ, ಕೆ.ಎನ್.ಸುಬ್ರಹ್ಮಣ್ಯಂ, ಎನ್.ಎಸ್.ನರಹರಿ, ಎಚ್.ಜಿ.ಶ್ರೀನಿವಾಸ ಪ್ರಸಾದ್, ಎಸ್.ರಾಮಮೂರ್ತಿ ಮತ್ತು ಎಸ್.ಸತ್ಯನಾರಾಯಣ, 2ನೇ ಮುದ್ರಣ 2019, ರಾ.ವಿ.ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು.
3	ಮಾತನಾಡುವ ಕನ್ನಡ, ಕನ್ನಡ ಸಾಹಿತ್ಯ ಪರಿಷತ್, ಬೆಂಗಳೂರು.

Continuous Internal Evaluation (CIE); (50 Marks)

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

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

SEE for 50 marksis executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 25 marks covering the complete syllabus. Part – B consists of essay type questions, one from each unit for 5 marks adding up to 25 marks.

AADALITHA KANNADA
(Common to all branches)

ಆಡಳಿತ ಕನ್ನಡ (ಕನ್ನಡಿಗರಿಗಾಗಿ)

ಆಡಳಿತ ಭಾಷಾ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು: ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ

1	ಆಡಳಿತ ಕನ್ನಡದ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.
2	ಕನ್ನಡ ಭಾಷೆಯ ವ್ಯಾಕರಣದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು.
3	ಕನ್ನಡ ಭಾಷಾ ಬರಹದಲ್ಲಿ ಕಂಡುಬರುವ ದೋಷಗಳು ಹಾಗೂ ಅವುಗಳ ನಿವಾರಣೆ ಮತ್ತು ಲೇಖನ ಚಿಹ್ನೆಗಳನ್ನು ಪರಿಚಯಿಸುವುದು.
4	ಸಾಮಾನ್ಯ ಅರ್ಜಿಗಳು, ಸರ್ಕಾರಿ ಮತ್ತು ಅರೆಸರ್ಕಾರಿ ಪತ್ರ ವ್ಯವಹಾರದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು.
5	ಭಾಷಾಂತರ, ಪ್ರಬಂದ,ರಚನೆ, ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ ಮತ ್ತುಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.

ಆಡಳಿತ ಕನ್ನಡ
(ಕನ್ನಡ ಕಲಿತವರಿಗೆ)

ಅಧ್ಯಾಯ –I	**4Hrs**

ಕನ್ನಡ ಭಾಷೆ – ಸಂಕ್ಷಿಪ್ತ ವಿವರಣೆ:

ಪ್ರಸ್ತಾವನೆ–ಕನ್ನಡ ಭಾಷೆ, ಶ್ರಾವಣ (ಕವನ)– ದ.ರಾ.ಬೇಂದ್ರೆ (ಕವಿ), ಬೆಲ್ಜಿಯ ಹಾಡು (ಕವನ) –ಸಿದ್ದಲಿಂಗಯ್ಯ (ಕವಿ)
ಆಡಳಿತ ಭಾಷೆಕನ್ನಡ, ಆಡಳಿತ ಭಾಷೆಯ ಲಕ್ಷಣಗಳು, ಆಡಳಿತ ಭಾಷೆಯ ಪ್ರಯೋಜನಗಳು.

ಅಧ್ಯಾಯ –II	**4 Hrs**

ಭಾಷಾ ಪ್ರಯೋಗದಲ್ಲಾಗುವ ಲೋಪದೋಷಗಳು ಮತ್ತು ಅವುಗಳ ನಿವಾರಣೆ:

ಪ್ರಸ್ತಾವನೆ– ಕಾಗುಣಿತದತಪ್ಪು ಬಳಕೆಯಿಂದಾಗುವ ಲೋಪದೋಷಗಳು ಅಥವಾ ಸಾಧುರೂಪಗಳ ಬಳಕೆ, ಅಲ್ಪ ಪ್ರಾಣ ಮತ್ತು ಮಹಾಪ್ರಾಣಗಳ ಬಳಕೆಯಲ್ಲಿನ ವ್ಯತ್ಯಾಸದಿಂದಾಗುವ ಲೋಪದೋಷಗಳು, ಲೇಖನ ಚಿಹ್ನೆಗಳು, ಕನ್ನಡ ಭಾಷೆಯಲ್ಲಿನ ಲೋಪದೋಷಗಳು ಗೌರವ ಸೂಚಕಗಳ ಬಳಕೆ, ಭಾಷಾ ಬರದಲ್ಲಿ ಅನುಸರಿಸಬೇಕಾದ ಇನ್ನಿತರಕ್ರಮ, ಲೇಖನ ಚಿಹ್ನೆಗಳು ಮತ್ತು ಅವುಗಳ ಉಪಯೋಗ.

ಅಧ್ಯಾಯ –III	**4Hrs**

ಪತ್ರ ವ್ಯವಹಾರ:

ಪ್ರಸ್ತಾವನೆ– ಖಾಸಗಿ ಪತ್ರ ವ್ಯವಹಾರ, ಆಡಳಿತ ಪತ್ರಗಳು, ಅರ್ಜಿಯ ವಿವಿಧ ಬಗೆಗಳು ಮತ್ತು ಮಾದರಿಗಳು.

ಅಧ್ಯಾಯ –IV	**4Hrs**

ಪ್ರಬಂಧ, ಸಂಕ್ಷಿಪ್ತ ಪ್ರಬಂಧರಚನೆ ಮತ್ತು ಭಾಷಾಂತರ:

ಕನ್ನಡ ಶಬ್ಧಸಂಗ್ರಹ, ಜೋಡಿನುಡಿಗಳು, ಅನುಕರಣಾವ್ಯಯಗಳು, ಸಮಾನಾರ್ಥಕ ಪದಗಳು, ನಾನಾರ್ಥಗಳು, ವಿರುದ್ಧಪದಗಳು, ತತ್ಸಮ–ತದ್ಭವಗಳು, ದ್ವಿರುಕ್ತಿಗಳು, ನುಡಿಗಟ್ಟುಗಳು, ಶಬ್ಧಸಮೂಹಕ್ಕೆ ಒಂದು ಶಬ್ಧ, ಅನ್ಯದೇಶೀಯ ಪದಗಳು, ದೇಶೀಯಪದಗಳು.

ಆಡಳಿತ ಕನ್ನಡದ ಕಲಿಕಾ ಫಲಿತಾಂಶಗಳು:

CO1:	ಕನ್ನಡ ಬರಹದಲ್ಲಿ ವ್ಯಾಕರಣದ ಬಳಕೆ.
CO2:	ಕನ್ನಡದಲ್ಲಿ ಪತ್ರ ಬರೆಯುವಿಕೆ.
CO3:	ಕನ್ನಡ ಸಾಹಿತ್ಯ ಹಾಗೂ ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಆಸಕ್ತಿ ಮೂಡುವುದು.

ಆಧಾರ ಪುಸ್ತಕಗಳು :

1	ಆಡಳಿತ ಕನ್ನಡ ಪಠ್ಯಪುಸ್ತಕ, ಎಲ್.ತಿಮ್ಮೇಶ್ ಮತ್ತು ವಿ.ಕೇಶವಮೂರ್ತಿ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿದ್ಯಾಲಯ, ಬೆಳಗಾಂ.
2	ಕನ್ನಡ ಅನುಭವ, ಕೆ.ಎನ್.ಸುಬ್ರಹ್ಮಣ್ಯಂ, ಎನ್.ಎಸ್.ನರಹರಿ, ಎಚ್.ಜಿ.ಶ್ರೀನಿವಾಸಪ್ರಸಾದ್, ಎಸ್.ರಾಮಮೂರ್ತಿ ಮತ್ತು ಎಸ್.ಸತ್ಯನಾರಾಯಣ, 2ನೇ ಮುದ್ರಣ 2019, ರಾ.ವಿ.ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು.

Continuous Internal Evaluation (CIE); (50 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Activity. A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks and the sum of the marks scored from two quizzes is reduced to 10. The two tests are conducted for 50 marks each and the sum of the marks scored from two tests is reduced to 30. The marks component for Activity is 10. **Total CIE is 10(Q) +30(T) +10(A) = 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 contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 10 marks covering the complete syllabus. Part – B is for 40 marks. It consists of essay type questions. Student has to answer any 4 questions out of 5 questions, each question carries 10 marks.

Semester: IV						
ENGINEERING MATHEMATICS – IV (Theory) (Common to AS, CH, CV & ME)						
Course Code	**:**	18MA41C		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	4:1:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	52L+13T		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Understand practical situations in various areas of engineering and science to formulate linear programming problems to get optimum solution.
2	Apply the knowledge of differential and integral calculus to functions of complex variables.
3	Analyze the set of data and fit suitable approximating curves.
4	Interpret concept of probability to solve random physical phenomena and implement the proper distribution model.
5	Use mathematical IT tools to analyze and visualize the above concepts.

Unit-I	**10 Hrs**
Linear Programming: Mathematical formulation of Linear Programming Problem (LPP). Solving LPP using Graphical, Simplex and Big M methods. Exploring optimization techniques using MATLAB.	
Unit – II	**11 Hrs**
Complex Analysis: Analytic function – Cauchy-Riemann equations in Cartesian and polar forms, harmonic functions. Construction of analytic functions by Milne-Thomson method. Complex potential, stream and potential functions. Complex integration – Cauchy's theorem, Taylor's and Laurent's series, singularities, poles, residues, residue theorem, problems (all theorems without proof).	
Unit –III	**11 Hrs**
Statistics: Central moments, mean, variance, coefficients of skewness and kurtosis in terms of moments. Curve fitting by method of least squares, fitting of curves – polynomial, exponential and power functions. Correlation and linear regression analysis, application problems. Simulation using MATLAB.	
Unit –IV	**10 Hrs**
Probability and Distributions: Random variables – discrete and continuous. Probability distribution function, cumulative distribution function. Binomial, Poisson, Exponential and Normal distributions. Simulation using MATLAB.	
Unit –V	**10 Hrs**
Joint Probability Distribution and Markov Chain: Joint distribution of random variables – Expectation, covariance and correlation. Markov chain – Stochastic matrices, higher transition probabilities, regular stochastic matrices, probability vector.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the concept of linear programming problems (LPP), analytic functions, statistical measures, curve fitting and random variables.
CO2:	Solve problems on LPP graphically, analytic functions, correlation between two variables and probability distribution functions.
CO3:	Apply gained knowledge for curve fitting, solution of LPP using simplex method, Taylor's and Laurent's series and different distributions.
CO4:	Estimate optimal solution of LPP using Big M method, regression lines, residues and regular stochastic matrices.

Reference Books	
1	Higher Engineering Mathematics, B.S. Grewal, 44th Edition, 2015, Khanna Publishers, ISBN: 81-7409-195-5.
2	Higher Engineering Mathematics, B.V. Ramana, 11th Edition, 2010, Tata McGraw-Hill, ISBN: 13-978-07-063419-0; ISBN: 10-0-07-063419-X.
3	Advanced Engineering Mathematics, Erwin Kreyszig, 9th Edition, 2007, John Wiley & Sons, ISBN: 978-81-265-3135-6.
4	Probability, Statistics and Random Processes, T. Veerarajan, 3rd Edition, 2008, Tata McGraw-Hill, ISBN: 978-0-07- 066925-3.

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

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

Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

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

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

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

High-3 : Medium-2 : Low-1

Semester: IV						
ENVIRONMENTAL TECHNOLOGY (Theory) (Common to Non Circuit Branches)						
Course Code	**:**	18BT42A		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	2:0:0		**SEE**	**:**	**50 Marks**
Total Hours	**:**	26L		**SEE Duration**	**:**	**02 Hours**

Course learning objectives: The student will be able to

1	Understand the various components of environment and the significance of the sustainability of healthy environment.
2	Recognize the implications of different types of the wastes produced by natural and anthropogenic activity.
3	Learn the strategies to recover the energy from the waste.
4	Design the models that help mitigate or prevent the negative impact of proposed activity on the environment.

Unit-I	**05 Hrs**
Introduction: Environment - Components of environment, Ecosystem. Impact of anthropogenic activities on environment (agriculture, mining and transportation), Environmental education, Environmental acts & regulations, role of non-governmental organizations (NGOs), EMS: ISO 14000, Environmental Impact Assessment. Environmental auditing.	
Unit – II	**06 Hrs**
Environmental pollution: 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**: Water conservation techniques, water borne diseases & water induced diseases, arsenic & fluoride problems in drinking water and ground water contamination, advanced waste water treatment techniques.	
Unit -III	**06 Hrs**
Waste management, Solid waste management, e waste management & biomedical waste management – sources, characteristics & disposal methods. Concepts of Reduce, Reuse and Recycling of the wastes. **Energy** – Different types of energy, conventional sources & non conventional sources of energy, solar energy, hydro electric energy, wind energy, Nuclear energy, Biomass & Biogas Fossil Fuels, Hydrogen as an alternative energy.	
Unit –IV	**05 Hrs**
Environmental design: Principles of Environmental design, Green buildings, green materials, Leadership in Energy and Environmental Design (LEED), soilless cultivation (hydroponics), organic farming, use of biofuels, carbon credits, carbon foot prints, Opportunities for green technology markets, carbon sequestration.	
Unit –V	**04 Hrs**
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 of Biomass conversion, e waste.	

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.
CO2:	Differentiate the various types of wastes and suggest appropriate safe technological methods to manage the waste.
CO3:	Aware of different renewable energy resources and can analyse the nature of waste and propose methods to extract clean energy.

CO4:	Adopt the appropriate recovering methods to recover the essential resources from the wastes for reuse or recycling.

Text Books	
1	Introduction to environmental engineering and science, Gilbert, M.M., 3rd Edition , 2015, Pearson Education. India: ISBN: 9332549761, ISBN-13: 978-9332549760.
2	Environmental Engineering, Howard S. Peavy, Donald R. Rowe and George Tchobanoglous. 1st Edition (1 July 2017), 2000, McGraw Hill Education, ISBN-10**:** 9351340260, ISBN-13**:** 978-9351340263

Reference Books	
1	Environmental Science, G. Tyler Miller , Scott Spoolman, 15th Edition, 2012, Brooks Cole, ISBN-13: 978-1305090446 ISBN-10: 130509044
2	Environment Management. Vijay Kulkarni and T. V. Ramachandra , 2009. TERI Press; ISBN: 8179931846, 9788179931844
3	Environmental Engineering and Management. Suresh K. Dhameja, 2010, S.K. Kataria and sons ISBN-10**:** 8185749450**,** ISBN-13: 978-8185749457.
4	Environmental Systems Engineering, Linvil Gene Rich 2003, McGraw-Hill; ISBN: 9780070522503

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

CIE is executed by way of quizzes (Q), tests (T) and experiential learning(EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks which will be reduced to 15marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 25 marks each and the sum of the marks scored from three tests is reduced to 30. The marks component for assignment is 05.

The total CIE for theory is 15(Q) +30(T)+05(EL) =50 marks

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

SEE for 50 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 10 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 08marks adding up to 40 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

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

High-3: Medium-2: Low-1

Semester: IV						
MANUFACTURING PROCESSES (Theory and Practice)						
Course Code	**:**	18ME43		**CIE**	**:**	**100 +50 Marks**
Credits: L:T:P	**:**	3:0:1		**SEE**	**:**	**100 +50 Marks**
Total Hours	**:**	39L+26P		**SEE Duration**	**:**	**03+03 Hours**

Course Learning Objectives: The students will be able to

1	Classify manufacturing processes, design, analyze gating systems for casting and explain different special casting processes.
2	Understand and apply principles concerned with metal forming processes, sheet metal dies to solve real time forming problems.
3	Understand, analyse the concepts used in metal cutting to minimise the machining cost and improve production rate.
4	Classify and explain the working principle of different NTM processes, welding processes and defects.

Unit-I	**06 Hrs**
Classification of Manufacturing Processes **Patterns** – Types, allowances. **Moulding sand** – Properties, types of moulds, **Moulding Machines**: Jolting, Squeezing, Jolt & Squeezing and Sand Slinging, **Cores** – types, function. **Special Casting Processes**: CO_2 Moulding, Shell Moulding, Investment Casting, Hot and Cold Chamber die casting Processes; Centrifugal casting; Continuous Casting. **Gating and Riser Design for Casting:** Elements of Gating System, Types of Gates and gating systems. **Pouring time calculations** – Top Gating, Bottom Gating and Relation (condition) to Avoid Aspiration Effect (Derivations and Numericals), Risers, **Solidification Time of Casting** – Chvorinov's Rule and Caine's method (Numericals). **Casting Defects** – Types, Causes and Remedies.	
Unit – II	**09 Hrs**
Bulk deformation processes - Forging: Processes and operations, Lubrication in Metal Forming Operations. Analysis of Pressure distribution in Rectangular Block forging under Sliding Condition. (Derivation & Numericals) **Extrusion:** Types, Defects in Extruded Products. **Drawing:** Wire drawing, Rod and Tube Drawing. **Rolling Mills:** Types, Defects in Rolling. **Flat Rolling Terminology** – Draft (Reduction), Forward and Backward Slip, Roll strip contact length, Bite angle, Ragging, Neutral Plane and Angle of Nip (Numericals). **Sheet Metal Forming**: Press tool operations; Punch and Die Clearances, **Sheet Metal Drawing** – Drawing, Cupping and Deep drawing. **Draw Die Design** –Factors considered for designing a Draw Die (Numericals). Defects in drawing. **Sheet Metal Dies** – Progressive, Compound and Combination Dies. Bending and Bending Allowance, Rubber Forming.	
Unit -III	**11 Hrs**
Metal Cutting: Mechanics of Chip Formation, Types of chips, Orthogonal and Oblique cutting. **Merchant's thin shear plane model –** Assumptions, Force Calculations, Shear Angle, Chip thickness ratio, Velocity relationships, Strain rate, Work done in shear, Friction and total work done (Numericals). Cutting Tool Geometry, Significance of various tool angles. Cutting Tool Materials. **Tool Wear,** Taylor's Tool Life equation (Numericals), Machinability, Machinability Index. **Surface finish –** Ideal surface finish in turning (Numericals). Thermal Aspects in metal cutting, Tool work Thermocouple Method for measuring chip-tool interface temperature. **Cutting Fluids** – Functions & Types **Economics of Machining –**Minimisation of the Machining Cost, Maximising the Production Rate (Numericals).	

Unit –IV	**06 Hrs**
Milling: Plain Milling cutter nomenclature, Milling Time Estimation **–** Slab milling and Face milling – (Numericals). **Indexing** – Direct or Rapid Indexing, Simple indexing, Compound indexing, Differential indexing and angular indexing (Numericals). **Drilling –** Twist drill geometry, Drilling Time, Torque and Thrust (Numericals). **Grinding:** Types of abrasives, bonding processes, Creep feed grinding, Designation and Selection of grinding wheel, Wheel Balancing, Dressing and Truing of grinding wheel, **Surface Finishing Processes –** Lapping, Honing, Super finishing, Polishing and Buffing.	
Unit –V	**07 Hrs**
Unconventional machining - Need and classification. **EDM,** Wire EDM, **ECM –** Material Removal Rate (MRR) and Gap resistance (Numericals), **CHM –** Chemical Milling and Chemical Blanking, **USM, LBM**. **Electric Arc Welding:** Characteristic curves of constant-current and constant voltage, arc welding transformer (Numericals); **Arc Welding Processes** – Shielded metal arc welding (SMAW), Inert Gas Arc Welding – Tungsten Inert Gas (TIG) welding and Metal Inert Gas (MIG) arc welding, Submerged arc welding (SAW), Principal zones in the weld joint and typical grain structure, Welding defects. **Resistance welding –** Principle and types of resistance welding.	

Practice	
SECTION – I (MACHINE SHOP)	**14 Hrs**
Lathe operations:1. Step,Taper Turning and Knurling 2. External Thread Cutting 3. Internal Thread Cutting 4. Eccentric Turnig **Milling Operations:**1. Cutting of spur gear teeth using Horizontal Milling Machine. 2. Making rectangular slot usingVertical MillingMachine.	
SECTION– II (Foundary lab)	**12 Hrs**
1. Preparation of sand mould without pattern. 2. Preparation of sand mould with pattern. 3. Compression, Shear and Permeability test on the moulding sand specimen. 4. Clay and Moisture content test on moulding sand. 5. Grain fineness test (Sieve analysis).	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the terminology related to metal casting, forming, welding and metal cutting.
CO2:	Analyse and apply principles of casting, forming, welding, and metal cutting to specific applications.
CO3:	Assess, compare and select appropriate manufacturing Processes.
CO4:	Adapt the principles of Casting, forming, welding, and metal cutting to develop the mechanical components.

Reference Books	
1	Manufacturing Technology, Vol. 1 – Foundry, Forming, and Welding, P N Rao, 5th Edition, 2019, McGraw Hill Education (India) Private Limited, ISBN-13: 978-93-5316-050-0.
2	Manufacturing Technology, Vol. 2 Metal Cutting and Machine Tools, P N Rao, 4th Edition,2019, McGraw Hill Education(India) Pvt. Limited,ISBN-13: 978-93-5316-052-4.
3	Manufacturing Science", Amitabha Ghosh and Ashok Kumar Mallik, 2nd Edition, 2010, East-West Press Limited, ISBN: 978-81-7671-063-3.
4	A Text Book on Production Engineering, Swadesh Kumar Singh, 3rd Edition, 2016, Made Easy Publication, ISBN– 978-93-5147-217-9.
5	Manufacturing Science – I, Forming, Casting and Welding", G.S Sawhney, 2015, I.K. International Publishing House Pvt. Ltd. ISBN: 978-93-82332-53-4.

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

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

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

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

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

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

High-3: Medium-2: Low-1

Semester: IV						
THERMAL ENGINEERING II (Theory and Practice)						
Course Code	**:**	18ME44		**CIE**	**:**	**100 +50 Marks**
Credits: L:T:P	**:**	3:1:1		**SEE**	**:**	**100 +50 Marks**
Total Hours	**:**	39L+17T +26P		**SEE Duration**	**:**	**03+03 Hours**

Course Learning Objectives: The students will be able to	
1	Analysis of thermal efficiencyofgas powerand vaporpowercycles
2	Evaluate performance of IC engines
3	Explainworkingprincipleof reciprocating aircompressorandanalyseitsperformance
4	Understand working principle of Refrigeration andAir-conditioningsystems and evaluate the performance
5	Explain basic modes and fundamental laws of heat transfer
6	Analysis of thermal efficiencyofgas powerand vaporpowercycles

Unit-I	**08 Hrs**
Gas power Cycles: Efficiency of air-standard cycles – Carnot cycle, Otto, Diesel and Dual cycles – Derivation of air standard efficiency, MEP (no derivation) of the cycles, comparison of cycles, Numericals	
Unit – II	**14 Hrs**
Gas Turbines: Open cycle constant pressure gas turbines, theoretical and actual cycles, Advantages and disadvantages of closed cycle compared to open cycle, Multi stage expansion with reheating, multistage compression with intercooling, Numericals. **Jet and Rocket propulsion:** Principles and working of turbojet, turbofan, turboprop, Ram jet and pulse jet, simple turbojet cycle, Thrust power, propulsive power, thermal efficiency, propulsive efficiency and over all efficiency, Rocket propulsion (No Numericals)	
Unit -III	**14 Hrs**
Performance testing of IC Engines: Testing of two stroke and four stroke C.I and S.I engines, Calculations of BP, IP, thermal efficiency, SFC, MEP and heat balance sheet, methods to find IP, Numericals **Vapor Power Cycles:** Carnot vapour power cycle – Simple Rankine cycle, comparison of Rankine and Carnot vapour cycle, Analysis and performance of Rankine cycle, Ideal and practical regenerative Rankine cycle, Reheat and regenerative cycle, Numericals	
Unit –IV	**10 Hrs**
Refrigeration: Air Cycle Refrigeration, Reversed Carnot Cycle, Reversed Brayton Cycle, Vapour Compression Refrigeration system - Refrigerating effect, power required, COP, Vapour Absorption Refrigeration, Properties of refrigerants, Numericals **Pyschrometrics:** Atmospheric air and Psychrometric properties, dry bulb temperature and wet bulb temperature, Dew point temperature, partial pressures, specific humidity and relative humidity, Degree of saturation, Adiabatic saturation temperature, Use of Psychrometric charts. (Simple numericals)	
Unit –V	**10 Hrs**
Reciprocating Air Compressors: Classification,Work input with and without clearance, volumetric efficiency, Adiabatic, isothermal and mechanical efficiency, work input in multi-stage compression with intercooling, Intermediate pressure forminimum work input, Numericals **Combustion Thermodynamics:** Stoichiometric air/fuel ratio for combustion of fuels-excess air,exhaust gas analysis, (conversion of mass analysis to volumetric analysis and vice versa). Calorific value, Combustion efficiency. Combustion Reactions, Enthalpy of formation, Entropy of formation, Internal energy of combustion. Adiabatic flame temperature, Simple Numericals	

Practice		
SECTION-I		**12Hrs**
1	Determination of flash point and firepointoflubricatingoil byusing AbelPenskyor Cleveland apparatus. (Opencup)	
2	Determination of flash point and firepoint ofhigh speed diesel (HSD) byusing PenskyMartins apparatus. (Closed cup)	
3	Determination ofcalorificvalueofsolid or liquidfuel using BombCalorimeter.	
4	Determination ofviscosityofvariousgrades oflubricatingoils usingRedwood, Sayboltand Torsion Viscometers.	
5	Valvetimingdiagram ofa4 strokeI.C. Engine.	
6	Performancetest on aVaporCompression Refrigerator.	
SECTION-I		**16Hrs**
1. Performancetests onI.C.Engines		
➢ Fourstrokewatercooled single cylinder diesel engine		
➢ Four stroke, four cylinder petrol engine (Including Morse test)		
➢ Four stroke, four cylinder diesel engine (Including Morse test)		
➢ Computerised single cylinder diesel engine (Including combustion characteristics)		
2. Performancetest ontwostagereciprocatingaircompressor.		
3. Performance test on air blower		

Course Outcomes: After completing the course, the students will be able to	
CO1:	Explain basic thermodynamic cycles to evaluate work and efficiency/ performance.
CO2:	Analyse modifications of basic thermodynamic cycles for optimising work and Increasing efficiency/ performance.
CO3:	Determine properties of fuels, and analyse performance parameters of IC engines and compressor
CO4:	Adapt knowledge of thermodynamic cycles to suggest solutions for real time thermodynamic problems

Reference Books	
1	Basic and Applied Thermodynamics, P.K.Nag, 2010, TataMcGraw Hill Publication ISBN:9780070151314
2	Engineering Thermodynamics, Yunus Cengel, Michael Boles, 7th Edition, 2011, Tata McGrawHill Company, ISBN:9780071072540
3	Fundamentals of Engineering Thermodynamics,Moron M.J, ShapiroH.N, BoettnerD.D.and Bailey M.B, 7th Edition, ISBN: 978-1-1183-7965-3
4	Fundamentals of Thermodynamics, R.E.Sonntag,C.Borgnakke and G.J.VanWylen ,2003 , John Wiley, ISBN:0-471-15232-3

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

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

Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

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

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

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

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

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

High-3 : Medium-2 : Low-1

Semester: IV						
DYNAMICS OF MACHINES (Theory)						
Course Code	**:**	18ME45		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:1:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	39L+13T		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Describe the need for performing static and dynamic analysis on a system
2	Calculate ratio of belt tensions in flat and V belt
3	Explain the working of flywheel, cam and the importance of balancing in machines with rotating members
4	Analyse forces with friction and without friction. Speed of Governor. Sensitiveness, stability, isochronism, hunting, controlling force curves for governor
5	Study Gyroscopic couple, effect of gyroscopic couple on plane disc, aeroplane and ship
6	Describe the need for performing static and dynamic analysis on a system

Unit-I	**07 Hrs**
Static Force Analysis: Static equilibrium, equilibrium of two and three force members; members with two forces and torque, free body diagram, static force analysis of four bar mechanism and slider crank mechanism without friction **Dynamic Force Analysis:** Dynamic force analysis of four bar mechanism and slider crank mechanism, dynamically equivalent system	
Unit – II	**11 Hrs**
Flywheels: Types of flywheel, Energy stored, Determination of size of flywheel for engine, Machines performing intermittent operation in a punching press **Belt & Rope Drives:**Types of belt drives – flat and V belt – Open belt and Cross belt. Velocity ratio, slip and creep and its effects on velocity ratio. Ratio of belt tensions. Initial tension, centrifugal tension. Power transmitted by belt drive. Condition for maximum power transmission, Rope drive: Ratio of tensions, Initial tension and centrifugal tension. Power transmitted. Condition for maximum power transmission	
Unit -III	**11 Hrs**
Balancing of Rotating Masses: Static and Dynamic balancing, Balancing of single rotating mass, Balancing in same plane and in different plane, Balancing of several rotating masses rotating at different planes **Balancing of Reciprocating Masses:** Inertia effect of crank and connecting rod of single cylinder engine, partial balancing of multi-cylinder engine (Primary and Secondary forces and couples), Balancing of V engine, Direct and Reverse crank method	
Unit –IV	**06 Hrs**
Governors: Types of governors, Centrifugal and Inertia types. Porter Governor and Hartnell Governor. Force analysis with friction and without friction. Speed of Governor. Sensitiveness, stability, Isochronism, Hunting, Controlling force curves for governor	
Unit –V	**07 Hrs**
Gyroscope: Vectorial representation of angular motion. Basic definitions. Gyroscopic couple. Effect of gyroscopic couple on plane disc, Aeroplane, Ship. Effect of gyroscopic couple on stability of a two wheeler and a four wheeler	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Define the terms associated with metal cutting tools, cutting fluids, in both Conventional and Un-conventional Machining Processes and explain the various Manufacturing Processes.
CO2:	Analyze Belt/rope drives, flywheels, rotating and reciprocating mechanism
CO3:	Evaluate kinematics and kinetics for various mechanisms.
CO4:	Design and synthesize industrial mechanisms.

Reference Books	
1	Theory of Machines, Thomas Bevan, 3rd Edition, 1984 CBS Publishers, , ISBN: 9788131729666
2	Theory of Machines, Rattan S.S., 3rd Edition, 2008, Tata McGraw Hill Publications, , ISBN: 9780070144774
3	Theory of Machines, Sadhu Singh, 2nd Edition, 2007,Pearson Education Publications, ISBN: 9788177581270
4	Theory of Machines, Thomas Bevan, 3rd Edition, 1984, CBS Publishers, ISBN: 9788131729666

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

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

The total CIE is 30(Q) +60(T) +10(EL) =100 Marks.

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

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

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

High-3 : Medium-2 : Low-1

Semester: IV						
FLUID MECHANICS (Theory and Practice)						
Course Code	**:**	18ME46		**CIE**	**:**	**100+50 Marks**
Credits: L:T:P	**:**	2:1:1		**SEE**	**:**	**100 +50 Marks**
Total Hours	**:**	26L+14T+14P		**SEE Duration**	**:**	**03+03 Hours**

Course Learning Objectives: The students will be able to

1	Understanding fundamental fluid mechanics.
2	Measurement of pressure and determination of hydrostatic forces and flow through pipes.
3	Apply laws of conservation of momentum, mass and energy to fluid flow systems and explain the measurement of fluid flow parameters.
4	Investigate the characteristics of flow though pipes.
5	Interpret compressibility of gases in terms of Mach number.
6	Apply dimensional analysis and similarity laws for conducting model tests.

Unit-I	**07 Hrs**
Basic Concepts and Fluid Properties: Definition of a fluid; Classification of fluid flows; No slip condition; System and control volume; Continuum. Density, Specific gravity, Vapour pressure, Viscosity, Surface Tension; Coefficient of compression, Effects of Cavitation and Capillarity, Numericals **Fluid Statics:** Hydrostatic forces on submerged horizontal, vertical, inclined and curved surfaces, determination of centre of pressure and total pressure, Numericals	
Unit – II	**10 Hrs**
Pressure Measurement: Pressure at a point; Pressure variation with depth; Manometer and other pressure measuring devices; Barometer and atmospheric pressures; Numericals **Buoyancy and Stability:** Stability of floating bodies, Meta centre and Meta centric height; experimental and analytical determination of meta centric height; stability of submerged bodies, Numericals	
Unit -III	**10 Hrs**
Fluid Kinematics: Lagrangian and Eulerian descriptions; Fundamentals of flow visualization; Stream line, Stream tube, Path line and Streak line; Stream function, Velocity potential, Circulation, Vorticity and Rotationality, Numericals **Fluid Dynamics:** General continuity equation in Cartesian coordinates; Euler's equation; Bernoulli's equation, Limitations of Bernoulli's equation, Applications of Bernoulli's equation; Venturimeter, Orifice Meter, Pitot tube and Pitot Static tube. Static, Dynamic and Stagnation pressures, Notches - V notch, Rectangular notch, introduction to Reynolds transport theorem, Numericals	
Unit –IV	**07 Hrs**
Introduction to Boundary Layer Theory: Flow over a flat plate: Boundary layer thickness, Displacement, Momentum and Energy thickness, Flow separation concept, Simple Numericals **Dimensional Analysis and Modeling:** Similitude; Geometric, Kinematic and Dynamic similarities; Buckingham pi theorem and its application to fluid mechanics problems; different forces acting in moving fluid, Dimensionless numbers; Model studies, Numericals	
Unit –V	**06 Hrs**
Flow through Pipes: Darcy-Weisbach equation; Chezy's formula; Laminar flow through pipes; Hagen-Poiseulle equation; Friction factor, Minor losses. Numericals **Turbulent Flow through Pipes:** Characteristics of turbulent flow; Turbulent velocity profile; Turbulent shear stress; Moody's chart, (no numerical)	

Practice	
SECTION-I & II	**14Hrs**
Calibration of Venturimrter	
Calibration of Orifice meter	
Calibration of V-Notch	
Determination of co-efficient of friction due to flow of fluids in pipes	
Determination of co-efficient of minor losses due to flow of fluids through pipes.	
Impact of jet on vanes	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Describe various properties of fluids for analysing fluid flow applications.
CO2:	Analyze the effect of fluid properties on static and dynamics of fluid flow.
CO3:	Analyze hydrostatic and dynamic solutions for fluid flow applications.
CO4:	Derive appropriate formulae for specific industrial fluid problems.

Reference Books	
1	Fluid Mechanics, Yunus A. Cengel and John M. Cimbala, 2006, Tata Mc-Graw Hill ISBN:9780071284219
2	Fluid Mechanics and Hydraulic Machines, Modi and Seth, 2007, Standard Book House ISBN -81-7867-023-2
3	Theory and Application of Fluid Mechanics, K. Subramanya, 1993, TMH Outline Series, ISBN-13: 978-0-07-460369-7, ISBN: 0-07-460369-8
4	Fluid Mechanics, F. M. White , McGraw Hill Education India Private Limited; ISBN-13:978-9385965494

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

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

Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Scheme of Continuous Internal Evaluation (CIE); Practical Test for 50 Marks

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

Total CIE is 30(AM) +10 (T) +10 (IE) =50 Marks.

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

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

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

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

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

High-3 : Medium-2 : Low-1

Semester: IV						
Design Thinking Lab						
Course Code	**:**	**18ME47**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**0:0:2**		**SEE**	**:**	**50 Marks**
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 so as to apply these skills to provide solutions of societal concern					
2	***Communication:*** Acquire the skills to communicate effectively and to present ideas clearly and coherently to a specific audience in both the written and oral forms.					
3	***Collaboration:*** Acquire collaborative skills through working in a team to achieve common goals.					
4	***Independent Learning:*** Learn on their own, reflect on their learning and take appropriate 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 of any 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 empathy report 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 has to be formulated in the Design stage considering the practical feasibility.
4. If the Design of the problem is approved, the team should implement the design and come out with prototype of the system.
5. Conduct thorough testing of all the modules in the prototype developed and carry out integrated testing.
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 also should 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 as the 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 of the domains in his / her future career.
CO 3:	Appling 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**

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**H**	**H**	**H**	**H**	**M**	**M**	**L**	**M**	**M**	**M**	**M**	**M**
CO2	**H**	**H**	**H**	**H**	**M**	**M**	**L**	**M**	**M**	**M**	**M**	**M**
CO3	**H**	**H**	**H**	**H**	**M**	**M**	**L**	**M**	**M**	**M**	**M**	**M**
CO4	**L**	**L**	**L**	**L**	**L**	**L**	**L**	**M**	**L**	**M**	**L**	**L**

Semester: III/IV						
C PROGRAMMING **Bridge Course** **(Common to all branches)**						
Course Code	**:**	18DCS37/48		**CIE Marks**	**:**	**50 Marks**
Credits: L:T:P	:	2:0:0		**SEE Marks**	**:**	**50 Marks**
Audit Course				**SEE Duration**	**:**	**2.00 Hours**

Course Learning Objectives: The students will be able to

1.	Develop arithmetic reasoning and analytical skills to apply knowledge of basic concepts of programming in C.
2.	Learn basic principles of problem solving through programming.
3.	Write C programs using appropriate programming constructs adopted in programming.
4.	Solve complex problems using C programming.

Unit – I	**4 Hrs**
Introduction to Reasoning, Algorithms and Flowcharts: Skill development – Examples related to Arithmetical Reasoning and Analytical Reasoning. Fundamentals of algorithms and flowcharts **Introduction to C programming:** Basic structure of C program, Features of C language, Character set, C tokens, Keywords and Identifiers, Constants, Variables, Data types.	
Unit – II	**4 Hrs**
Handling Input and Output Operations Formatted input/output functions, Unformatted input/output functions with programming examples using different input/output functions. **Operators and Expressions** Arithmetic operators, Relational operators, Logical Operators, Assignment operators, Increment and decrement operators, Conditional operators, Bit-wise operators, Arithmetic expressions. Evaluation of expressions, Precedence of arithmetic operators, Type conversion in expressions, Operator precedence and associativity.	
Unit – III	**6 Hrs**
Programming Constructs **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. **Decision making and looping** The while statement, The do while statement, The 'for' statement, Jumps in loops**.**	
Unit – IV	**6 Hrs**
Arrays One dimensional arrays, Declaration of one dimensional arrays. Initialization of one dimensional arrays, Two dimensional arrays, Initializing two dimensional arrays. **Character Arrays and Strings** Declaring and Initializing String Variables, Reading Strings from Terminal, Writing strings to screen, String handling functions.	

Unit – V	8 Hrs
User-defined functions Need for User Defined Functions, Definition of functions, Return values and their types, Function calls, Function declaration. Examples. **Introduction to Pointers:** Introduction, Declaration and initialization of pointers. Examples **Structures and Unions:** Introduction, Structure and union definition, Declaring structure and union variables, Accessing structure members. Example programs.	

PRACTICE PROGRAMS	
1.	Familiarization with programming environment, concept of naming the program files, storing, compilation, execution and debugging. Taking any simple C- code.(Example programs having the delimeters, format specifiers in printf and scanf)
2.	Debug the errors and understand the working of input statements in a program by compiling the C-code.
3.	Implement C Program to demonstrate the working of operators and analyze the output.
4.	Simple computational problems using arithmetic expressions and use of each operator (+,-,/,%) leading to implementation of a Commercial calculator with appropriate message: a)Read the values from the keyboard b) Perform all the arithmetic operations. c) Handle the errors and print appropriate message.
5.	Write a C program to find and output all the roots if a given quadratic equation, for non-zero coefficients. (Using if…*else* statement).
6a. **6b.**	Write a C program to print out a multiplication table for a given NxN and also to print the sum table using skip count 'n' values for a given upper bound. Write a C program to generate the patterns using for loops. Example: (to print * if it is even number) 1 ** 333 **** 55555
7a. **7b.**	Write a C program to find the Greatest common divisor(GCD)and Least common multiplier(LCM) Write a C program to input a number and check whether the number is palindrome or not.
8.	Develop a C program for one dimensional, demonstrate a C program that reads N integer numbers and arrange them in ascending or descending order using bubble sort technique.
9.	Develop and demonstrate a C program for Matrix multiplication: a) Read the sizes of two matrices and check the compatibility for multiplication. b) Print the appropriate message if the condition is not satisfied and ask user to re-enter the size of matrix. c) Read the input matrix d) Perform matrix multiplication and print the result along with the input matrix.
10.	Using functions develop a C program to perform the following tasks by parameter passing concept: a) To read a string from the user Print appropriate message for palindrome or not palindrome

11a.1 **1b.**	Write a C program to find the length of the string without using library function. Write a program to enter a sentence and print total number of vowels.
12.	Design a structure 'Complex' and write a C program to perform the following operations: i. Reading a complex number. ii. Addition of two complex numbers. iii. Print the result
13.	Create a structure called student with the following members student name, rollno, and a structure with marks details in three tests. Write a C program to create N records and a) Search on roll no and display all the records. b) Average marks in each test. c) Highest marks in each test

Course Outcomes: After Completing the course, the students will be able to	
CO 1:	Understand and explore the fundamental computer concepts and basic programming principles like data types, input/output functions, operators, programming constructs and user defined functions.
CO 2:	Analyze and Develop algorithmic solutions to problems.
CO 3:	Implement and Demonstrate capabilities of writing 'C' programs in optimized, robust and reusable code.
CO 4:	Apply appropriate concepts of data structures like arrays, structures implement programs for various applications

Reference Books	
1.	Programming in C , P. Dey, M. Ghosh, First Edition, 2007, Oxford University press, ISBN (13): 9780195687910.
2.	The C Programming Language, Kernighan B.W and Dennis M. Ritchie, Second Edition, 2005, Prentice Hall, ISBN (13): 9780131101630.
3.	Turbo C: The Complete Reference, H. Schildt, 4th Edition, 2000,Mcgraw Hill Education, ISBN-13: 9780070411838.
4.	Understanding Pointers in C, Yashavant P. Kanetkar, 4th Edition, 2003, BPB publications, ISBN-13: 978-8176563581
5.	C IN DEPTH, S.K Srivastava, Deepali Srivastava, 3rd Edition, 2013, BPB publication, ISBN9788183330480

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

CIE is executed by way of quizzes (Q), tests (T**)** and lab practice (P). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks the sum of the marks scored from quizzes would be reduced to 10 marks. The two tests are conducted for 30 marks each and the sum of the marks scored from two tests is reduced to 30. The programs practiced would be assessed for 10 marks (Execution and Documentation).

Total CIE is 10(Q) + 30(T) + 10(P) = 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.

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

High-3: Medium-2 : Low-1

Semester: III and IV						
PROFESSIONAL PRACTICE – I COMMUNICATION SKILLS (Common to all Programmes)						
Course Code	**:**	18HS49		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	0:0:1		**SEE**	**:**	**50 Marks**
Total Hours	**:**	18P		**SEE Duration**	**:**	**2.00 Hours**

Course Learning Objectives: The students will be able to

1	Understand their own communication style, the essentials of good communication and develop their confidence to communicate effectively.
2	Manage stress by applying stress management skills.
3	Ability to give contribution to the planning and coordinate Team work.
4	Ability to make problem solving decisions related to ethics.

III Semester	**6 Hrs**
Communication Skills: Basics, Method, Means, Process and Purpose, Basics of Business Communication, Written & Oral Communication, Listening. **Communication with Confidence & Clarity**- Interaction with people, the need the uses and the methods, Getting phonetically correct, using politically correct language, Debate & Extempore.	
	6 Hrs
Assertive Communication- Concept of Assertive communication, Importance and applicability of Assertive communication, Assertive Words, being assertive. **Presentation Skills-** Discussing the basic concepts of presentation skills, Articulation Skills, IQ & GK, How to make effective presentations, body language & Dress code in presentation, media of presentation.	
	6 Hrs
Team Work- Team Work and its important elements Clarifying the advantages and challenges of team work Understanding bargains in team building Defining behaviour to sync with team work Stages of Team Building Features of successful teams.	
IV Semester	**6 Hrs**
Body Language & Proxemics - Rapport Building - Gestures, postures, facial expression and body movements in different situations, Importance of Proxemics, Right personal space to maintain with different people.	
	6Hrs
Motivation and Stress Management: Self-motivation, group motivation, leadership abilities, Stress clauses and stress busters to handle stress and de-stress; Understanding stress - Concept of sound body and mind, Dealing with anxiety, tension, and relaxation techniques**.** Individual Counseling & Guidance, Career Orientation. Balancing Personal & Professional Life-	
	6 Hrs
Professional Practice - Professional Dress Code, Time Sense, Respecting People & their Space, Relevant Behaviour at different Hierarchical Levels. Positive Attitude, Self Analysis and Self-Management. **Professional Ethics** - values to be practiced, standards and codes to be adopted as professional engineers in the society for various projects. Balancing Personal & Professional Life	

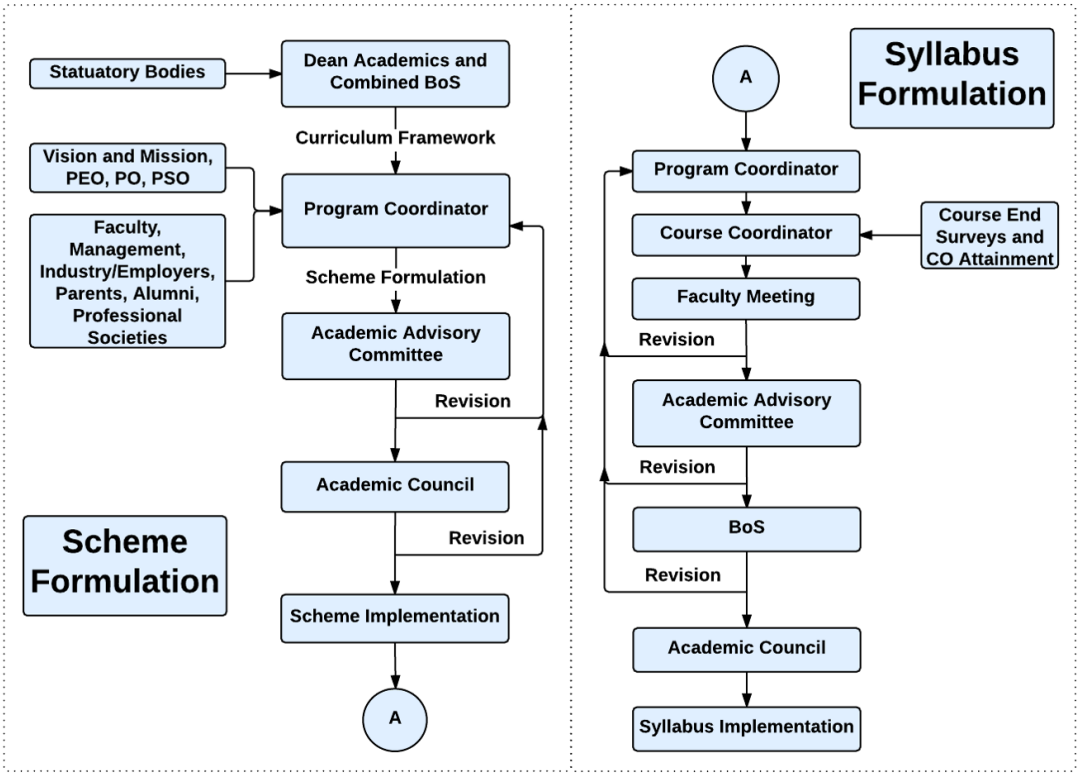
Course Outcomes: After completing the course, the students will be able to	
CO1:	Inculcate skills for life, such as problem solving, decision making, stress management
CO2:	Develop leadership and interpersonal working skills and professional ethics.
CO3:	Apply verbal communication skills with appropriate body language.
CO4:	Develop their potential and become self-confident to acquire a high degree of self

Reference Books	
1.	The 7 Habits of Highly Effective People, Stephen R Covey, Free Press, 2004 Edition, ISBN: 0743272455
2.	How to win friends and influence people, Dale Carnegie, General Press, 1st Edition, 2016, ISBN: 9789380914787
3.	Crucial Conversation: Tools for Talking When Stakes are High, Kerry Patterson, Joseph Grenny, Ron Mcmillan, McGraw-Hill Publication, 2012 Edition, ISBN: 9780071772204
4.	Aptimithra: Best Aptitude Book, Ethnus,Tata McGraw Hill, 2014 Edition, ISBN: 9781259058738

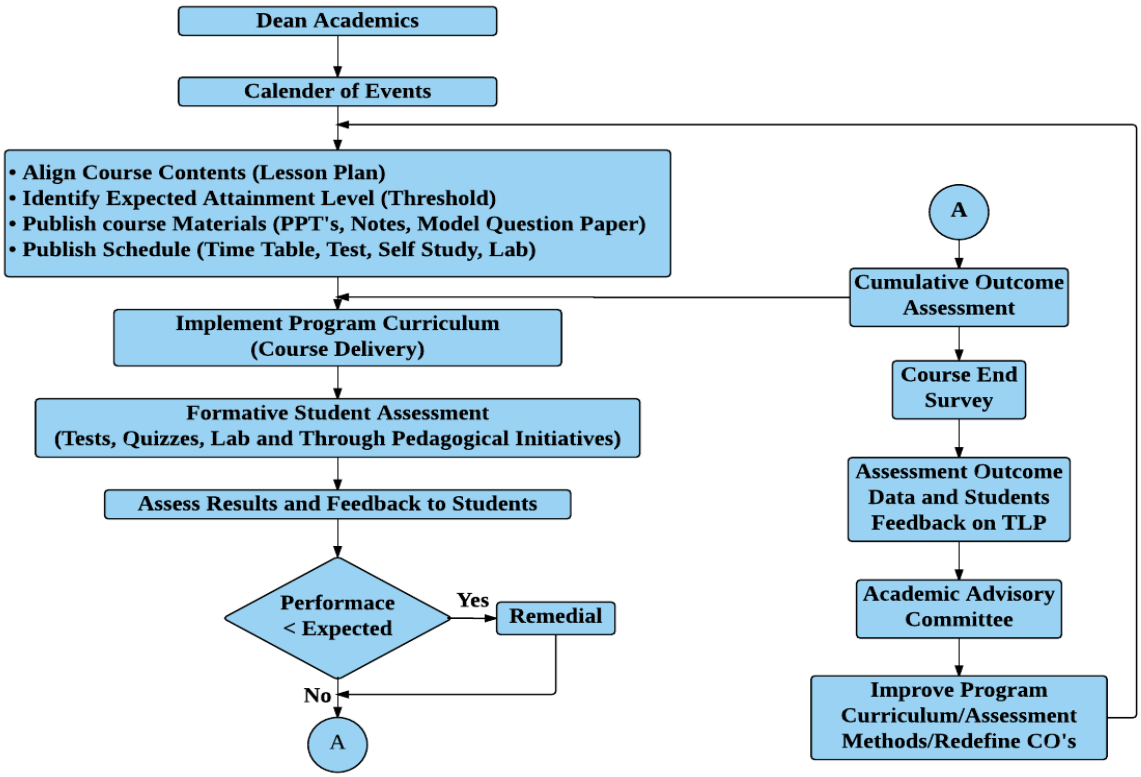
Scheme of Continuous Internal Examination and Semester End Examination

Phase	**Activity**	**Weightage**
Phase I **III Sem**	CIE will be conducted during the 3rd semester and evaluated for 50 marks. The test will have two components. The Quiz is evaluated for 15 marks and second component consisting of questions requiring descriptive answers is evaluated for 35 marks. The test & quiz will assess the skills acquired through the training module. SEE is based on the test conducted at the end of the 3rd semester The test will have two components a Quiz evaluated for 15 marks and second component consisting of questions requiring descriptive answers is evaluated for 35 marks.	50%
Phase II **IV Sem**	During the 4th semester a test will be conducted and evaluated for 50 marks. The test will have two components a Short Quiz and Questions requiring descriptive answers. The test & quiz will assess the skills acquired through the training module. SEE is based on the test conducted at the end of the 4th semester The test will have two components. The Quiz evaluated for 15 marks and second component consisting of questions requiring descriptive answers is evaluated for 35 marks	50%
Phase III **At the end of** **IV Sem**	At the end of the IV Sem Marks of CIE (3rd Sem and 4th Sem) is consolidated for 50 marks (Average of Test1 and Test 2 (CIE 1+CIE2)/2. At the end of the IV Sem Marks of SEE (3rd Sem and 4th Sem) is consolidated for 50 marks (Average of CIE 1 and CIE 2 (CIE 1+CIE2)/2.	

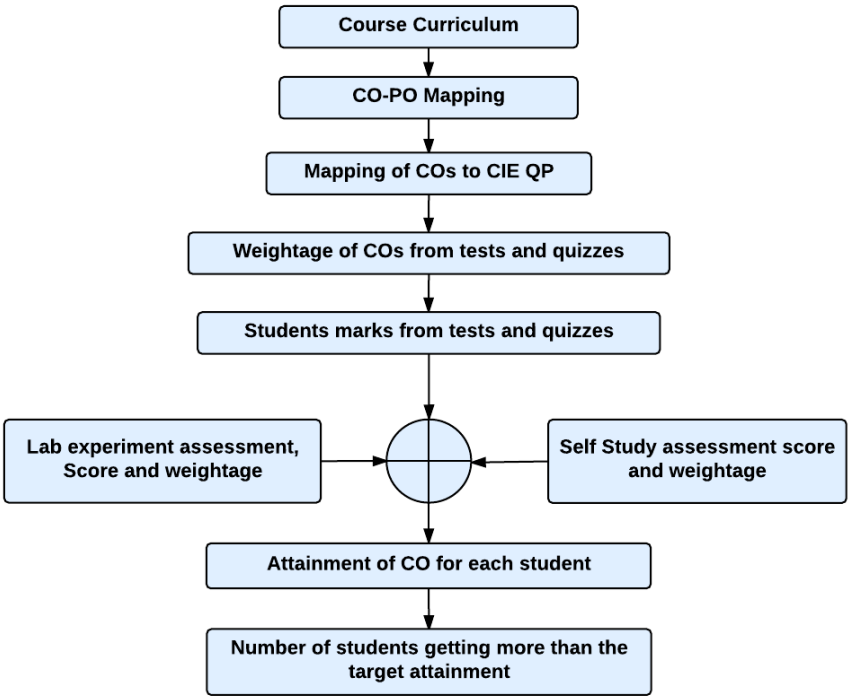
Curriculum Design Process



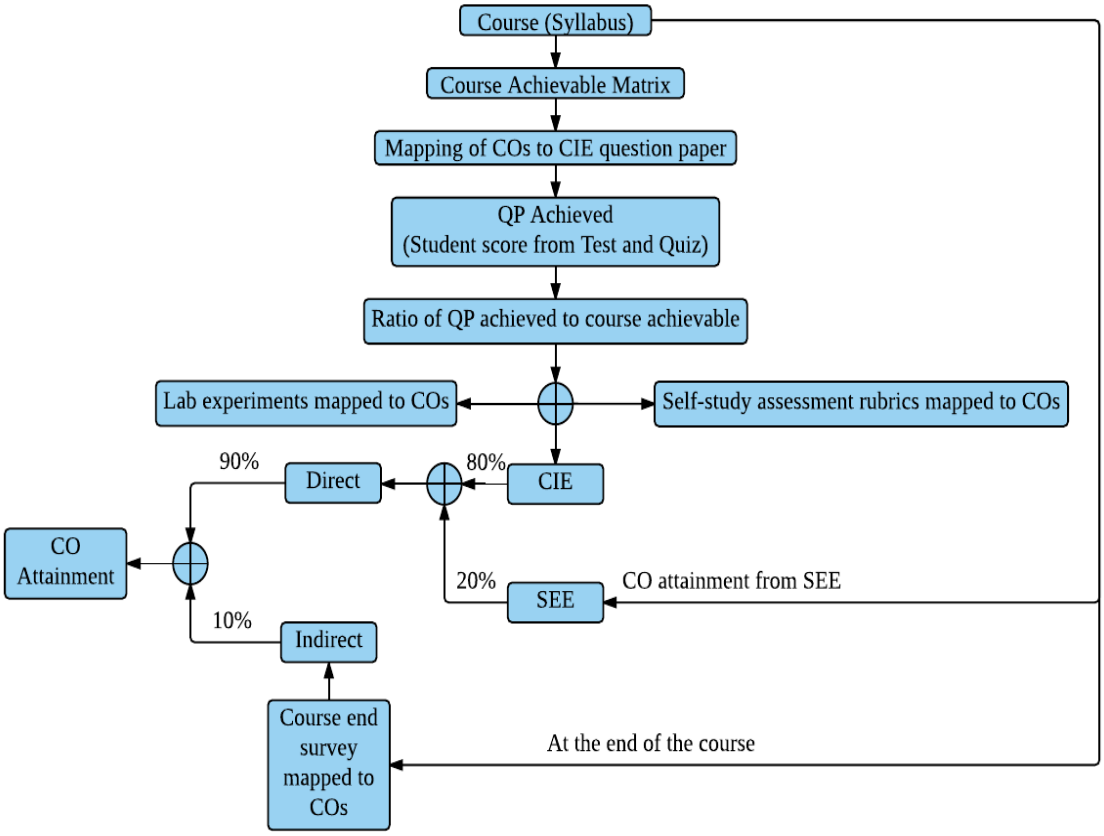
Academic Planning And Implementation



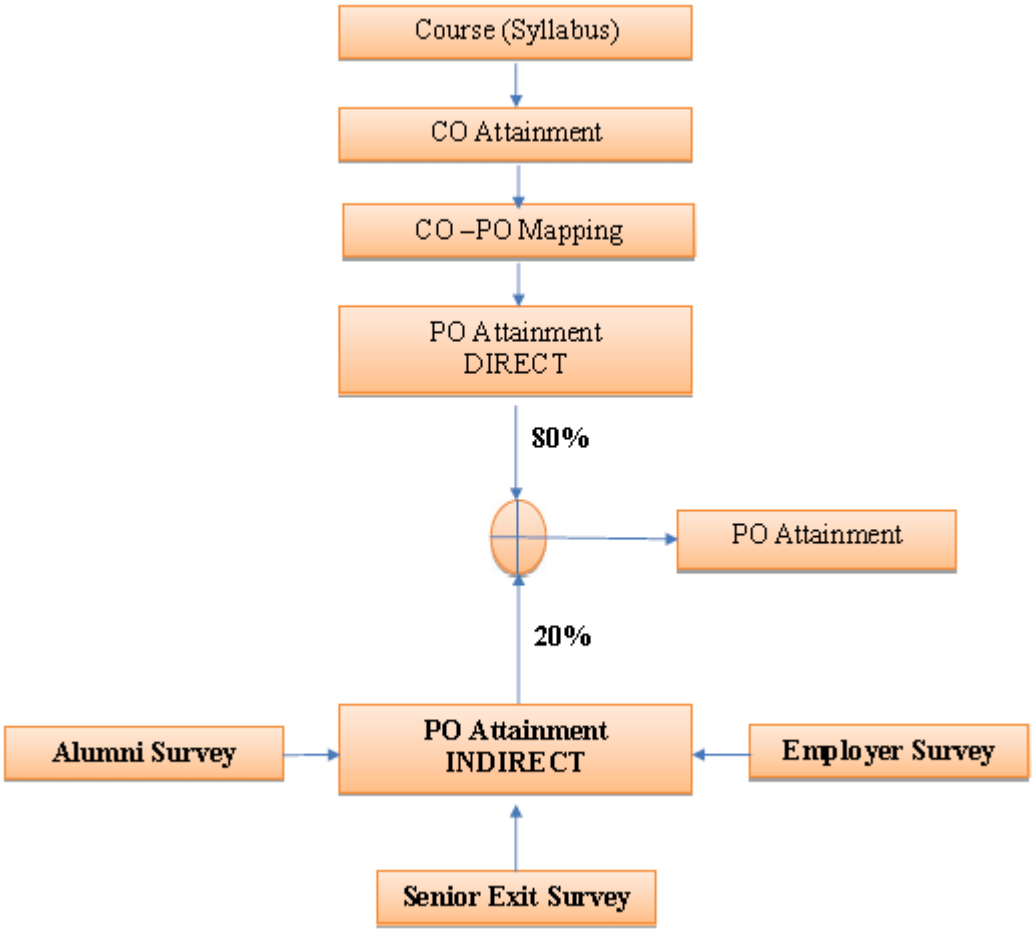
Process For Course Outcome Attainment



Final CO Attainment Process



Program Outcome Attainment Process



PROGRAM OUTCOMES (POs)

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

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

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

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

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

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

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

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

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

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

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

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