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

INNER FRONT COVER PAGE

College Vision & Mission
(To be included from our side)

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

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

1. Imparting knowledge in basic and applied areas of Mechanical Engineering
2. Providing state-of-art laboratories and infrastructure for academics and research
3. Facilitating faculty development through continuous improvement programs
4. Promoting research, education and training in frontier areas of nanotechnology, advanced composites, surface technologies, MEMS and sustainable technology
5. Strengthening collaboration with industries, research organizations and institutes for internship, joint research and consultancy
6. 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.	PHY	Physics
21.	CHY	Chemistry
22.	MAT	Mathematics

INDEX

RV COLLEGE OF ENGINEERING®

(Autonomous Institution Affiliated to VTU, Belagavi)

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	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**
		No. of hrs per week		**18+4***	**6**	**4**	

*Engineering Mathematics - III

Sl.No	COURSE TITLE	COURSE CODE	PROGRAMS
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	PROGRAMS
1.	Environmental Technology	18BT32A	All circuit Branches
2.	Biology for Engineers	18BT32B	BT&AS
3.	Engineering Materials	18ME32	ME & IM

*** Bridge Course Audit couse 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

RV COLLEGE OF ENGINEERING®

(Autonomous Institution Affiliated to VTU, Belagavi)

MECHANICAL ENGINEERING

FOURTH SEMESTER CREDIT SCHEME							
Sl. No.	Course Code	Course Title	BoS	Credit Allocation			**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	18HS47	Professional Practice-I	HSS	0	0	1	**1**
9	18DCS48***	Bridge Course C Programming	CS	0	0	0	**0**
		Total No. of Credits		17	3	6	**26**
		No. of hrs per week		**17+2***	**6**	**12+2***	

*ENGINEERING MATHEMATICS – IV

Sl.No	COURSE TITLE	COURSE CODE	PROGRAMS
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

**

Sl.No	COURSE TITLE	COURSE CODE	PROGRAMS
1.	Engineering Materials	18EC42	EC,EE,EI,TE
2.	Biology for Engineers	18BT42B	CS,IS
3.	Environmental Technology	18BT42A	All Non circuit branches

*** Bridge Course

Sl.No	COURSE TITLE	COURSE CODE	PROGRAMS
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 (After 4th semester)

18ME47 Design thinking lab	
18 ME47	Industrial Internet of things
18 ME47	Automotive Mechatronics
18 ME47	Product development
18 ME47	Electrical Mobility
18 ME47	Design of mechanisms

Semester: III						
ENGINEERING MATHEMATICS – III						
Course Code	**:**	18MA31C		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	4:1:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	36L+24T+35 P		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The student 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 various concepts.

Unit-I	
CALCULUS OF VARIATIONS Introduction to variation of functionals, extremal of a functional, Euler's equation – special cases, problems. Geodesics – problems, Hanging cable and Brachistochrone problems. Exploring geodesics graphically using MATLAB.	**09 h**
Unit – II	
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.	**12 h**
Unit –III	
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.	**12 h**
Unit –IV	
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.	**09 h**
Unit –V	
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.	**09 h**

Course outcomes: On completion of the course, the student should have acquired the ability to	
1	Understand the fundamental concepts of variation of functionals, periodic phenomena, Laplace and inverse Laplace transforms of different functions, need for numerical techniques.
2	Demonstrate the knowledge of extremal of functional, concept of Dirichlet's conditions to obtain Fourier series of continuous and discontinuous functions, the properties of Laplace and inverse Laplace transforms, root finding methods and finite differences for partial derivatives.
3	Apply Euler's equation to solve variational problems, Euler's formula to obtain half range series, Laplace and inverse Laplace transform technique to solve differential equations, solution to system of linear equations and finite difference technique to solve PDEs.
4	Analyze and interpret applications of functionals, complex Fourier series, solution of IVP and BVP using LT, solution to 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 Assignment. 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 marks of CIE are 100.

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: III						
ENGINEERING MATERIALS						
Course Code	**:**	18ME32		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	2:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	28L+0T+0P		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives:	
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	
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	**06 hr**
UNIT-II	
Phase Diagram and Fe-C equilibrium diagram: Phase, Gibbs phase rule, Solid solutions, Hume Rothery Rules, Isomorphous alloy system, Binary eutectic and Eutectoid system (Problems to find chemical composition and relative amount of phases present). 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.	**07 hr**
UNIT-III	
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.	**07 hr**
UNIT-IV	
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- Galavanic, Intergranular, pitting, stress related corrosion. Corrosion control- Materials selection, protective coating.	**04 hr**
UNIT-V	
NON DESTRUCTIVE TESTING: Non Destructive Testing basic principles and testing method for Radiographic testing, Ultrasonic testing, Magnetic particle inspection and Liquid penetrant inspections	**04h**

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

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

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

CIE is executed by way of quizzes (Q), tests (T) and Assignment. 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 the three tests is reduced to 60. The marks component for assignment is 10. The total marks of CIE are 50.

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

SEE for 50 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 the entire unit having the 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						
Course Code	**:**	18ME33		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	4:0:1		**SEE**	**:**	**100 Marks**
Total Hours	**:**	56 L+0T+28P		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives:	
1	Understand mechanics of deformable bodies and apply them in analysis and design problems
2	Analyze bodies subjected to two dimensional stress systems.
3	Understand behaviour of structural members in flexure and Torsion.
4	Evaluate slope and deflection in beams subjected to loading.
5	Understand stability of columns and struts.
6	Predict the stress distribution in beams, pressure vessels and shafts

PART A	
UNIT-I	
Review of stress, strain & Elastic Constants: Stress, Strain, relationship among elastic constants, Volumetric strain. (No questions to be set on these topics) **Thermal stresses and strains** (compound bars not included). Numericals	**09 h**
UNIT-II	
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)	**14 h**
UNIT-III	
Bending stress in beams: Introduction, Assumptions in simple bending theory, Derivation of Bernoulli's equation, 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 overhanging beams subjected to point loads, UDL and couple. Numerical problems.	**14 h**
UNIT-IV	
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).	**09 h**
UNIT -V	

Analysis of columns and struts: Introduction, Euler's theory 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's theory, Rankine's formula. Numerical problems	**10 h**

PART – B	
MECHANICS OF MATERIALS LABORATORY	
Section I	**20h**
1. Hardness Tests (Brinell, Rockwell, Vicker)	
2. Tension test on Mild steel and HYSD (High Yield Strength Deformed) bars	
3. Compression test of Mild Steel, HYSD, Cast iron.	
4. Torsion test on Mild Steel circular sections.	
5. Bending Test on Wood Under two point loading.	
6. Shear Test on Mild steel.	
7. Impact test on Mild Steel (Charpy & Izod)	
8. Wear Test using Pin on disc Tribometer	
Section – II (Non-destructive testing)	**8h**
1. Magnetic Particle Test	
2. Ultrasonic Test	
3. Dye Penetrant Test	
4. Eddy current inspection for metals	

Course Outcomes: After completing the course, the students will be able to	
1	Identify the different engineering materials, describe their properties and predict their behaviour under different types of loading
2	Compute the stresses, strains, moments, deflections, etc. and derive the expressions used from the fundamentals.
3	Select materials, sizes and sections for various applications such as beams, shafts, pressure vessels, columns, etc. and justify the selection
4	Determine mechanical properties by destructive and non-destructive methods

Reference Books	
1.	Strength of Materials, S.S. Bhavikatti, 2012, Vikas Publications House Pvt. Ltd. New Delhi, ISBN 9788125927914
2.	Elements of Strength of Materials, Timoshenko and Young , 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 Assignment. 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 marks of CIE are 100.

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: III						
CONCEPTS OF METROLOGY AND MACHINE DRAWING						
Course Code	**:**	18ME34		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:1		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L+0T+26P**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives:	
1	Inspection of engineering parts with various precision instruments.
2	Design of part, tolerances and fits
3	Students have an ability to apply knowledge of Modeling, science & engineering.
4	Student can modeled the drawing even in CAD software by applying the basic knowledge of machine drawing.
5	Students will able to demonstrate an ability to design and conduct experiments, analyze and interpret data and assembly and disassembly drawings knowledge will be provided.

PART A	
UNIT-I	
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, interchange ability. **Transducers:** Characteristics transfer efficiency, primary and secondary transducers, Electrical, mechanical transducers, Signal transmission and processing: Devices and systems**.** Signal Display & Recording Devices	**07h**
Unit-II	
Comparators: Mechanical, pneumatic and electrical types, applications. Angular measurements:-Sine bar, optical bevel protractor. Slip gauges and classification, interferometery, optical flats. **Limits, fits and tolerances**: Definition of tolerance, Principle of interchangability 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, Types of gauges-plain plug gauge, ring gauge, snap gauge, limit gauge and gauge materials. **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.	**11h**
UNIT-III	

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 – digital devices-computer aided inspection, 3D Metrology. **Measurement of Torque, Force & Temperature related properties** Force, torque: -mechanical, pneumatic, hydraulic and electrical type-Temperature: bimetallic strip, pressure thermometers, thermocouples, electrical resistance thermister.	**11h**
UNIT-IV	
Machine Drawing Fundamentals-I Need of Graphical Language, Importance Machine Drawing, Tools (from Instruments to Current Softwares). 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, Interrupted views and Braking of Shaft, Pipe, Bar, Surface finishing & Machining symbols. Classification of nuts, terminology used in the drawing of nuts and bolts. Drawing of orthographic projections of a bolt, empierical relations of dimensions of nut and bolt with respect to bolt head diameter.	07 h
UNIT-V	
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. Rivet and Riveting, applications, terminology. Classifications (Lap and Butt joints), Numericals. Types of Welded Joints, Representation of Welds, Symbols and its conventions	06h

PART – B	
	26 h
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. – 6 h	
2. Keys: Parallel, Taper, Gib-Head key, Cone key, pin-key and Woodruff key: 6 h	
3. Joints: Cotter joint (socket and spigot), Knuckle joint (pin joint)- 6 h	
4. Couplings: Flange Coupling, Sleeve coupling, Pin (bush) type flexible coupling, Split muff coupling and Universal coupling. – 8 h	

Course Outcomes: After completing the course, the students will be able to	
CO1	Design tolerances and fits for selected product quality
CO2	Choose appropriate method and instruments for inspection of various gear elements and thread elements.
CO3	Analysis of complex design systems related to mechanical Engineering.
CO4	Making use of appropriate laboratory tools and design innovative methods

Reference Books	
1.	Engineering Metrology and Measurements by NV Raghavendra, L Krishna murthy, Oxford publishers. ISBN-13: 978-0-19-808549-2
2.	Machine Drawing –Dhawan, S.Chand Publications, ISBN 9789385676499
3.	N V Raghavendra and L Krishnamurthy, Engineering Metrology and Measurements, ISBN: 9780198085492

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

CIE is executed by way of quizzes (Q), tests (T) and Assignment. 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 marks of CIE are 100.

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: III						
THERMAL ENGINEERING I						
Course Code	**:**	18ME35		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42 L+0T+0P**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students should be able to

1. Familiarize with various definitions involved in thermodynamics including work and heat
2. Apply first and second law of thermodynamics to various processes.
3. Demonstrate the skills to explain corollaries of second Law of thermodynamics.
4. Explain the concept of Entropy, available and un-available energy
5. Understand the behavior of pure substances with the help of property diagrams
6. Differentiate between real and ideal gases

UNIT-I	
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	06h
UNIT-II	
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 undergoing 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	10h
UNIT-III	
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 kind II, Numericals **Carnot cycle** – Corollaries of Second law of thermodynamics, Absolute thermodynamic temperature scale, International temperature scale, Numericals	10h
UNIT-IV	
Entropy: Clausius Inequality, Entropy - a 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.	08h
UNIT-V	

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.	08h

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

References:	
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, Yunus A Cengel and Boles M.A, 7th Edition, 2009 , Tata McGraw Hill, ISBN-13:978-0-07-107254-0; ISBN-10:0-07-107254-3
3	Fundamentals of Thermodynamics , R.E Sonntag , C. Borgnakke and G.J. Van Wylen, 2003, John Wiley, ISBN:0-471-15232-3
4	Engineering Thermodynamics, Rajput R.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 Assignment. 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 marks of CIE are 100.

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

KINEMATIC OF MACHINES						
Course Code	**:**	18ME36		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**44L+0T+0P**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students should 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

UNIT-I

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.	06h

UNIT-II

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	12 h

UNIT-III

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.	12h

UNIT-IV

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	06h

UNIT-V	
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	08h

Course Outcomes: After completing the course, the students will be able to	
1	Define the basic mechanisms for developing a machine.
2	Construct velocity and acceleration diagram for mechanism.
3	Design and synthesize mechanisms for specific type of relative motion
4	Estimate kinematic parameters for industrial mechanisms

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

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

CIE is executed by way of quizzes (Q), tests (T) and Assignment. 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 marks of CIE are 100.

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

ENGINEERING MATHEMATICS – IV						
Course Code	**:**	**18MA41C**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**4:1:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**44 L+12T+0P**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The student will be able to

1	Understand certain 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 various concepts.

Unit-I	
LINEAR PROGRAMMING Mathematical formulation of Linear Programming Problem (LPP). Solving LPP using Graphical, Simplex and Big M methods. Exploring optimization techniques using MATLAB.	**09 h**
Unit –II	
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).	**12 h**
Unit –III	
STATISTICS Central moments, mean, variance, coefficients of skewness and kurtosis in terms of moments. Curve fitting by method of least squares, fitting of curve – polynomial, exponential and power functions, correlation and linear regression analysis, application problems. Simulation using MATLAB.	**12 h**
Unit –IV	
PROBABILITY AND DISTRIBUTIONS Random variables – discrete and continuous. Probability distribution function, cumulative distribution function. Binomial, Poisson, Exponential and Normal distributions. Simulation using MATLAB.	**09 h**
Unit –V	

JOINT PROBABILITY DISTRIBUTION AND MARKOV CHAIN	**09 h**
Joint distribution of random variables – Expectation, covariance and correlation. Markov chain – Stochastic matrices, higher transition probabilities, regular stochastic matrices, probability vector.	

Course outcomes: On completion of the course, the student should have acquired the ability to

1	Understand the concept of formulation of linear programming problems (LPP), analytic functions, statistical measures, method of least squares and random variables.
2	Solve LPP graphically, construct analytic functions, find correlation between two variables and probability distribution functions.
3	Apply gained knowledge for curve fitting, to find optimal solution of LPP using simplex method, Taylor's and Laurent's series and different distributions.
4	Estimate optimal solution of LPP using Big M method, regression lines, singularities, residues, regular stochastic matrices and probability vector.

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 Assignment. 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 marks of CIE are 100.

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						
Environmental Technology						
Course Code	**:**	**18BT42A**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**2:0:0:0**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**44 L+0T+0P**		**SEE Duration**	**:**	**90 min**

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	6 h
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	6 h
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	6 h
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	5 h
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	4 h
Resource recovery system: Processing techniques, material 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.	Gilbert, M.M. Introduction to environmental engineering and science, Pearson Education. India: 3rd Edition (2015). ISBN: 9332549761, ISBN-13: 978-9332549760.	
2.	Howard S. Peavy, Donald R. Rowe and George Tchobanoglous. 2000. Environmental Engineering, McGraw Hill Education, First edition (1 July 2017). ISBN-10**:** 9351340260, ISBN-13**:** 978-9351340263	
	Reference Books	
1.	G. Tyler Miller (Author), Scott Spoolman (Author), (2012) Environmental Science – 15th edition, Publisher: Brooks Cole, ISBN-13: 978-1305090446 ISBN-10: 130509044	
2.	Vijay Kulkarni and T. V. Ramachandra 2009. Environment Management. TERI Press; ISBN: 8179931846, 9788179931844	
3.	Suresh K. Dhameja (Author), Environmental Engineering and Management. S.K. Kataria and sons (2010). ISBN-10**:** 8185749450**,** ISBN-13: 978-8185749457.	
4.	Linvil Gene Rich 2003. Environmental Systems Engineering, McGraw-Hill; ISBN: 9780070522503	

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

CIE is executed by way of quizzes (Q), tests (T) and Assignment. 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 marks of CIE are 50.

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

SEE for 50 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

MANFACTURING PROCESS						
Course Code	**:**	**18ME43**		**CIE**	**:**	**100 +50**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100 +50**
Total Hours	**:**	**42L+0T**		**SEE**	**:**	**3h+2h**

Course Learning Objectives: The students should be able to	
1	Understand, analyse the concepts used in metal cutting, cutting tool geometry and metrology to solve real time metal cutting problems
2	Apply knowledge of tool life, tool wear, machinability to minimise the machining cost, improve production rate
3	Understand metal cutting processes, machine tools and metrology to evaluate the selection of machine tools for a specific product
4	Classify and explain the working principle of different NTM processes and interpret their suitability for micro-machining different materials and geometries

PART A	
UNIT-I	
Metal Cutting: Introduction to Chip Formation, Types of chips, Orthogonal and Oblique cutting. Single point cutting tool nomenclature. **Mechanics of Orthogonal Metal 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 – Problems. **Cutting Tool Materials –** Properties, High-Speed Steel, Cemented Carbides, Coated Carbides, Ceramics, Diamond and Cubic Moron Nitride (CBN). **Thermal Aspects –** Methods for measuring chip-tool interface temperature, Tool-work thermocouple method.	**07h**
UNIT-II	
Tool Wear – Crater wear, Flank wear and Wear mechanism. **Tool Life –** Definition, Tool failure criteria, Variables affecting Tool Life, Taylor's Tool Life equation – Problems. **Machinability –** Factors affecting machinability, Machinability Index. Cutting Fluids – Functions, Types of cutting fluids and Cutting fluid selection. **Economics of Machining –** Minimisation of the Machining Cost, Maximising the Production Rate and Maximising the Production Rate – Problems. **Drilling –** Twist drill geometry, Types of Drills, Drilling time estimation – Problems, Torque and thrust during drilling – Problems. **Broaching Machine –** Introduction, Classification and working principle of broaching machines, nomenclature of a pull broach.	**11h**
UNIT-III	
Milling Machine: Introduction, Types of Milling machines and Milling cutters, Milling cutter nomenclature, Milling operations. **Milling Mechanics –** Slab milling and Face milling – Problems. **Milling Time and Power Estimation –** Slab milling and Face milling – Problems. **Dividing Head** – Types of Indexing – Direct or Rapid Indexing, Simple indexing, Compound indexing and angular indexing – Problems. Milling cutter nomenclature. **Gear Generation Methods –** Rack cutter generation process, Pinion cutter generation process, Gear hobbing and Gear Shaping. **Grinding:** Classification of Grinding**,** 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.	**11h**
UNIT-IV	

Non-Traditional Machining Processes: Need and classification of unconventional machining processes. **Electric Discharge Machining (EDM) –** Principle, Schematic, Dielectric fluid, electrodes, Wire EDM. **Electrochemical Machining (ECM) –** Principle, ECM equipment, Electrolyte, Tools, ECM System Analysis – Material Removal Rate (MRR) and Gap resistance – Problems. **Chemical Machining (CHM) –** Chemical Milling and Chemical Blanking, Masks and Etchants, **Ultrasonic Machining (USM) –** Principle, Schematic. **Abrasive Water Jet Machining (AWJM)** – Principle, Schematic. **Laser Beam Machining (LBM)** – Principle, Schematic.	**06h**
UNIT-V	
Manufacturing processes: Classification of Manufacturing Processes. **Metal-Casting Processes:** Advantages, Limitations, applications and casting terminology. **Patterns –** Pattern Materials, Types of patterns, Pattern allowances, Core prints. **Moulding sand:** Types of moulding sands, Properties of moulding sands, Moulding sand composition. **Moulding Machines:** Jolting, Squeezing, Jolt & Squeezing and Sand Slinger. **Cores –** Functions and Desired Characteristics of Cores, Core sands, Types of Cores, Core Prints and Chaplets. **Die Casting** – Pressure Die casting processes (Hot and cold chamber), Centrifugal casting – True Centrifugal, Semi-centrifugal and centrifuging, Continuous Casting.**Special Casting Processes:** CO_2 Moulding, Shell Moulding, Investment Casting., Slush Casting. **Casting Defects –** Types, Causes and remedies.	**07h**

PART – B	
SECTION – I (MACHINE SHOP)	**20h**
Lathe operations: 1. Facing, 2. Plain Turning, 3. Step Turning, 4. Drilling, 5. Boring, 6. Internal Thread Cutting, 7. External Thread Cutting, 8. Knurling, 9. Eccentric Turning. **Milling, Shaping and Grinding Machine Operations:** 1. Cutting of spur gear teeth using Horizontal Milling machine. 2. Making rectangular slot using Vertical Milling Machine.	
SECTION– II (Fundary lab)	**8h**
1. Preparation of sand mould without pattern 2. Preparation of sand mould with pattern and Wax casting 3. Compression, shear and permeability test on the moulding sand specimen 4. Clay and Moisture content test on the moulding sand 5. Grain fineness number test (Sieve analysis)	

Course Outcomes: After completing the course, the students will be able to	
1	Define the terms associated with metal cutting tools, cutting fluids, in both Conventional and Un-conventional Machining Processes and explain the various Manufacturing Processes.
2	Analyse & Apply the Principles of Metal Cutting in Lathe, Milling, Broaching, measurements, Gear generation and Un-conventional Machining Processes to real time
3	Assess, Compare and Select appropriate Manufacturing Process.
4	Adapt the Principles of Turning, Milling, Shaping, Grinding and Develop the Mechanical Components.

Reference Books

1.	P N Rao, "Manufacturing Technology – Metal cutting and Machine Tools Vol 2", 3rd edition, McGraw Hill Education (India) Private Limited, 2013, ISBN-13: 978-9383286621 and ISBN-10: 9383286628.
2.	Amitabha Ghosh and Ashok Kumar Mallik, "Manufacturing Science", 2nd edition, Affiliated East-West Press Private Limited, 2010, ISBN: 979-81-7671-063-3.
3.	Swadesh Kumar Singh, "A Text Book on Production Engineering", 2nd edition, LNEC Publication, 2014, ISBN – 13: 979-1137483644.
4.	S.K. Hajara Choudhury, A.K. Hajara Choudhury and Nirjhar Roy, "Elements of Workshop Technology – Vol II Machine Tools", 13th edition, Media Promotors & Publishers Pvt Ltd, 2010, ISBN-81.85099-15-4.
5.	Beckwith, Marangoni and Lienhard, "Mechanical Measurements", 6th edition, Pearson Education India; 2013, ISBN-10: 9332518521 ISBN-13: 978-9332518520.

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

CIE is executed by way of quizzes (Q), tests (T) and Assignment. 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 marks of CIE are 100.

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

THERMAL ENGINEERING II						
Course Code	**:**	**18ME44**		**CIE**	**:**	**100 +50 Marks**
Credits: L:T:P	**:**	**3:1:1**		**SEE**	**:**	**100 +50 Marks**
Total Hours	**:**	**40L+16 +28P**		**SEE Duration**	**:**	**3h+2h**

Course Learning Objectives: The students should be able to

1. Analysis of thermal efficiency of gas power and vapor power cycles
2. Evaluate performance of IC engines
3. Explain working principle of reciprocating air compressor and analyse its performance
4. Understand working principle of Refrigeration and Air-conditioning systems and evaluate the performance
5. Explain basic modes and fundamental laws of heat transfer

Part A

UNIT-I	
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	08h
UNIT-II	
Gas Turbines: open cycle constant pressure gas turbines, theoretical and actual cycles, Advantages and disadvantages of closed cycle compared to open cycle, Multistage expansion with reheating, multistage compression with intercooling, Numericals. **Jet and Rocket propulsion:** Principles and working of turbojet, turbofan, turboprop, Ramjet and pulse jet, simple turbojet cycle, Thrust power, propulsive power, thermal efficiency, propulsive efficiency and overall efficiency, Rocket propulsion (No Numericals)	14h
UNIT-III	
Performance testing of I.C. 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	14h
UNIT-IV	
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)	10h
UNIT-V	

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 for minimum 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	10h
Tutorials are conducted for Unit I (02 h), Unit II(04h), Unit III (04h), Unit IV (03h) and Unit V (03h)	

PART – B	
Thermal Engineering Lab	
Section-I	**12Hrs**
1. Determination of flash point and fire point of lubricating oil by using Abel Pensky or Cleveland apparatus. (Open cup)	
2. Determination of flash point and fire point of high speed diesel (HSD) by using Pensky Martins apparatus. (Closed cup)	
3. Determination of calorific value of solid or liquid fuel using Bomb Calorimeter.	
4. Determination of viscosity of various grades of lubricating oils using Redwood, Saybolt and Torsion Viscometers.	
5. Valve timing diagram of a 4 stroke I.C. Engine.	
6. Performance test on a Vapor Compression Refrigerator.	
Section II	**16Hrs**
1. Performance tests on I.C.Engines	
➢ Four stroke water cooled 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. Performance test on two stage reciprocating air compressor.	
3. Performance test on air blower	

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

References:

1	Basic and Applied Thermodynamics, P.K.Nag, 2010, Tata McGraw Hill Publication ISBN: 9780070151314
2	Engineering Thermodynamics , Yunus Cengel, Michael Boles, 7th Edition,2011,Tata McGraw Hill Company, ISBN: 9780071072540
3	Fundamentals of Engineering Thermodynamics, Moron M.J , Shapiro H.N, Boettner D.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 Assignment. 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 marks of CIE are 100.

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

DYNAMIC OF MACHINES						
Course Code	**:**	**18ME45**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:1:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L+14T+0P**		**SEE Duration**	**:**	**3hours**

Course Learning Objectives: The students should 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

PART A	
UNIT-I	
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	**07h**
UNIT-II	
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	**11h**
UNIT-III	
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 **06** .	**11h**
UNIT-IV	
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 .	**06h**

UNIT-V	
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	**07h**

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

Reference Books

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

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

CIE is executed by way of quizzes (Q), tests (T) and Assignment. 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 marks of CIE are 100.

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

FLUID MECHANICS						
Course Code	**:**	**18ME46**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**2:1:1**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L+14T+14P**		**SEE Duration**	**:**	**3hours**

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	
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	**08 h**
UNIT-II	
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	**10 h**
UNIT-III	
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	**10 h**
UNIT-IV	
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	**08 h**
UNIT-V	
Flow through Pipes: Darcy-Weisbach equation; Chezy's formula; Laminar flow through pipes; Hagen-Poiseulle equation; Friction factor, Minor losses. Numericals	**06 h**

Turbulent Flow through Pipes: Characteristics of turbulent flow; Turbulent velocity profile; Turbulent shear stress; Moody's chart, (no numerical)	

PART – B- LABORATORY	
FLUID MECHANICS LABORATORY	
	14 Hrs
1. Calibration of Venturimrter	
2. Calibration of Orifice meter	
3. Calibration of V-Notch	
4. Determination of co-efficient of friction due to flow of fluids in pipes	
5. Determination of co-efficient of minor losses due to flow of fluids through pipes.	
6. Impact of jet on vanes	

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

Reference Books	
1.	Yunus A. Cengel and John M. Cimbala, "Fluid Mechanics", Tata Mc-Graw Hill 2006; ISBN:9780071284219
2.	Modi and Seth, "Fluid Mechanics and Hydraulic Machines", Standard Book House 2007; ISBN -81-7867-023-2
3.	K. Subramanya, "Theory and Application of Fluid Mechanics", TMH Outline Series, 1993; ISBN-13: 978-0-07-460369-7, ISBN: 0-07-460369-8
4.	F. M. White, "Fluid Mechanics"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 Assignment. 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 marks of CIE are 100.

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

Design Thinking Lab – Automotive Mechatronic Systems						
Course Code	**:**	**18ME47X**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**0 : 0:2**		**SEE**	**:**	**50 Marks**
Total Hours	**:**			**SEE Duration**	**:**	

Course Learning Objectives: The students should be able to

1. Identify tools, fasteners, automotive components and linkages
2. Understand the basics of automotive mechatronic systems
3. Perform analysis on major aggregates accounting for their design and functionality
4. Read and interpret wiring diagram to physically identify electrical fuses, relay switches and actuators on the car
5. Demonstrate the use of diagnosis tool to access mechatronic systems on a high end car

Course Contents

Part A(All students should be exposed)

1. Car body styles, body dimensioning and maintenance tools
2. Study of chassis structure and under body linkages
3. Types of tyres and their nomenclature
4. Electronic engine controls and On Board Diagnostic (OBD) systems
5. Braking system – master cylinder, brake calipers (floating and fixed types) and ABS
6. Intake, exhaust system and glow plugs
7. Suspension systems – Mc-Phersun strut and Air-matic suspension
8. Differential mechanism
9. Cylinder and piston
10. Solenoid controlled relay switches – 4 / 5 pin relay switches

Part B (Student select any one the following for Development)

Cycle - I

11. Starter motor
12. Fly wheel and belt driven auxiliaries
13. High pressure fuel pump
14. Fuel injection systems
15. Camtronics - Operation of timing belt and valves
16. Alternator

Cycle-II

17. Air conditioning system
18. Coolant circulation circuit
19. Brake booster
20. Super charger and turbo charger
21. Bharat IV emission norms and exhaust gas analyser

Part C

22. Clutch mechanism
23. Torque converter
24. Components of manual transmission
    a. Synchromesh mechanisms, gear ratio, AMT / CVT
24. Automatic Transmission – Sun, planetary and ring gears
    a. Ravigneaux gear system, Gear ratio calculations
25. Automotive diagnosis system

Course Outcomes: After completing the course, the students will be able to	
1	Demonstrate the use of automotive service tools and operation of inspection lift in a car bay
2	Account for the design of automotive components
3	Read and interpret wiring diagram to fix simple electrical faults
4	Demonstrate the use of diagnosis tool to communicate with mechatronic systems

References:	
1	'Automotive Technology: Principles, Diagnosis, and Service', 5th Edition by James D. Halderman
2	'Bosch Automotive electronic hand book' 1st edition 2002
3	'Automotive Technology: A Systems Approach' by Jack Erjavec
4	'Understanding Automotive Electronics' by William B Ribbens 5th edition

Semester: IV						
Design Thinking Lab – New Product Design						
Course Code	**:**	**18ME46**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**0 : 0:2**		**SEE**	**:**	**50 Marks**
Total Hours	**:**			**SEE Duration**	**:**	

Course Learning Objectives:	
1	Identify the products and possible materials
2	Understand the basics of product design and modelling
3	Analyse the product function and its properties
4	Demonstrate the working model

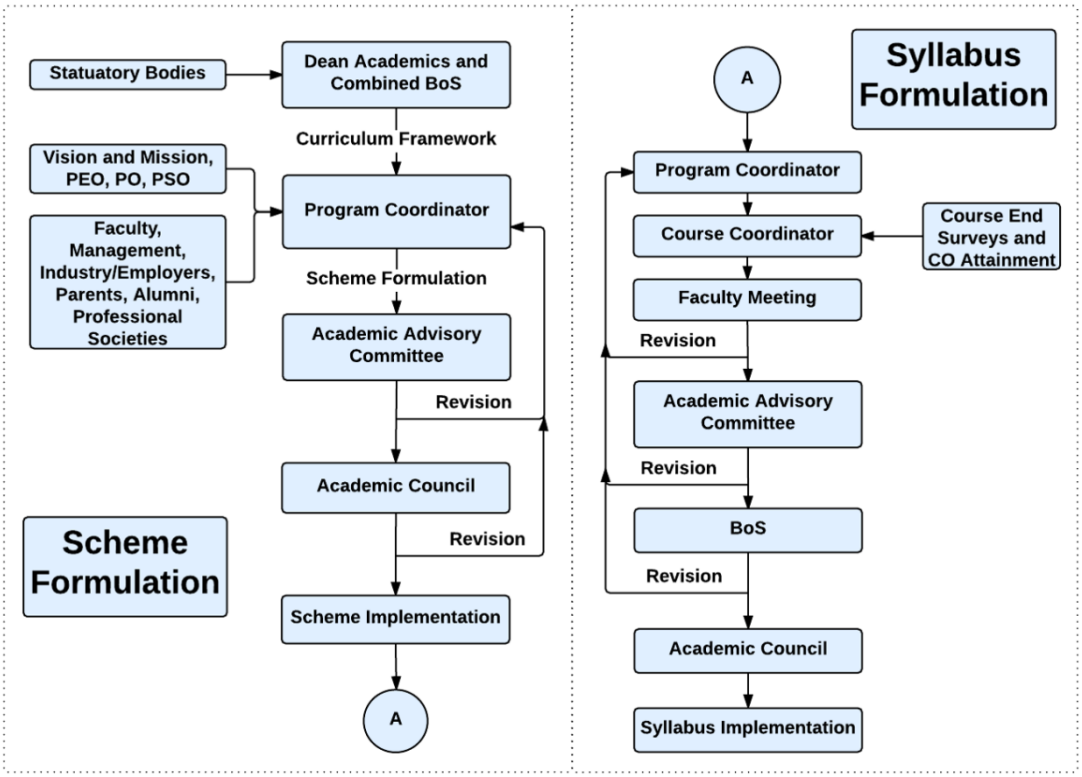
Course Contents
Part A(All students should be exposed)
1. Bench marking
2. Selection of materials
3. Computer aided engineering design (CAD, Solidworks, and 3D Experience-CATIA)
4. Assembly and simulation
5. Finite element analysis
6. Rapid prototyping
Part B (Each student to work on one of the following products)
1. Multi-function universal quick adjustable wrench spanner set
2. A pocket friendly, adjustable wrench
3. Adjustable pocket hole jig kit
4. Foldable dining furniture
5. Solar powered water purifier
6. Multipurpose indexing device lathe, milling, drilling attachment mechanical project
7. Joystick operated motorised wheelchair
8. Manual rice planter equipment
9. Wireless multipurpose agriculture robot

10. Floor cleaner robot

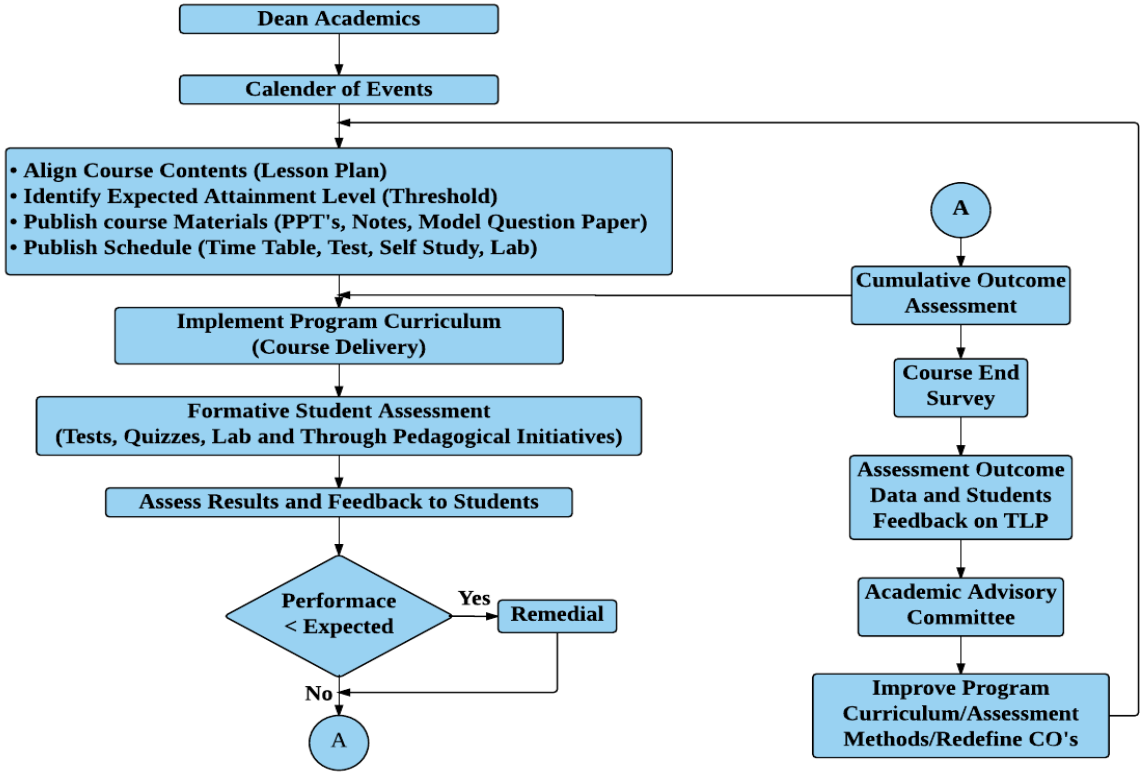
Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the concepts of new product development
CO2:	Design and develop new product concept
CO3:	Analyse the new concept developed
CO4:	Create working model of new product

Reference Books	
1	Harper C.A., Handbook of materials for product design, MGH, 2001, ISBN: 0071354069, 9780071354066
2	Karl T Ulrich, Steven D Eppinger, "Product Design & Development." Tata McGrawhill Education, Fifth edition, 2015, ISBN: 0078029066, 9780078029066
3	Jamnia, Ali, Introduction to product design and development for engineers, CRC Press/Taylor & Francis Group, 2018, ISBN: 9781138554214, 1138554219, 9781315148939
4	L. Jyothish Kumar, Pulak M. Pandey, David Ian Wimpenny, 3D Printing and Additive Manufacturing Technologies, Springer Nature Singapore Pte Ltd, ISBN 978-981-13-0304-3 ISBN 978-981-13-0305-0 (eBook)
5	Arlindo Silva; Ricardo Simões, Handbook of Research on Trends in Product Design and Development: Technological and Organizational Perspectives, Business science reference, 2011, ISBN: 978-1-61520-617-9

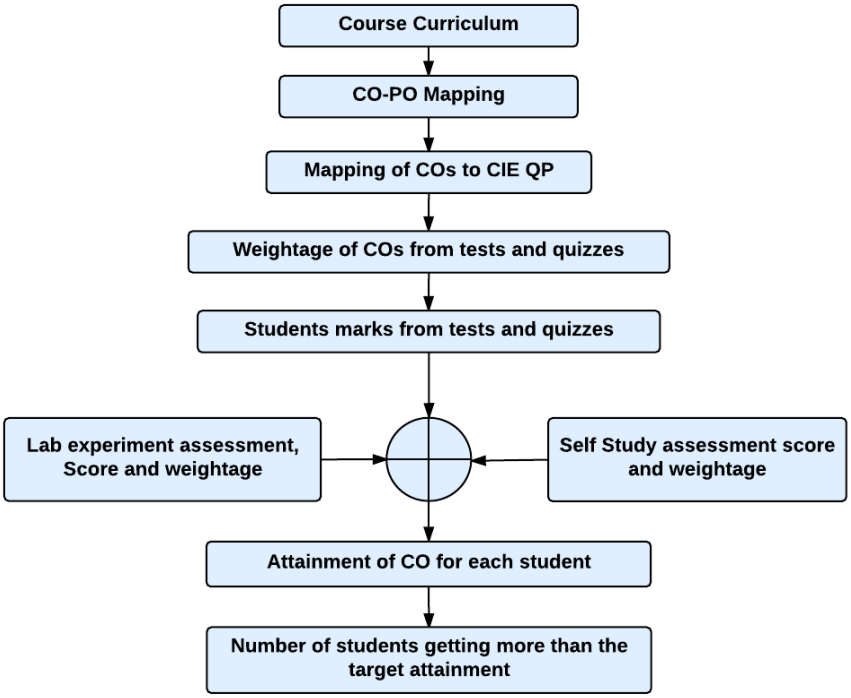
Curriculum Design Process



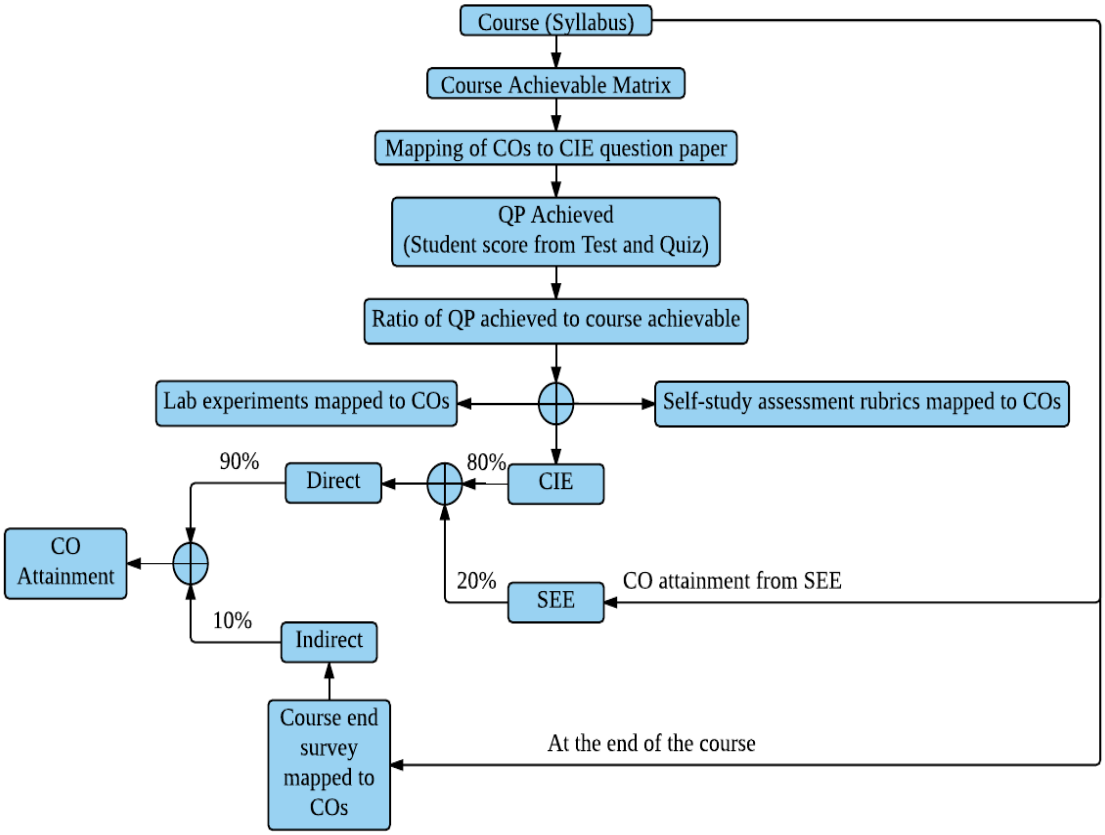
Academic Planning And Implementation



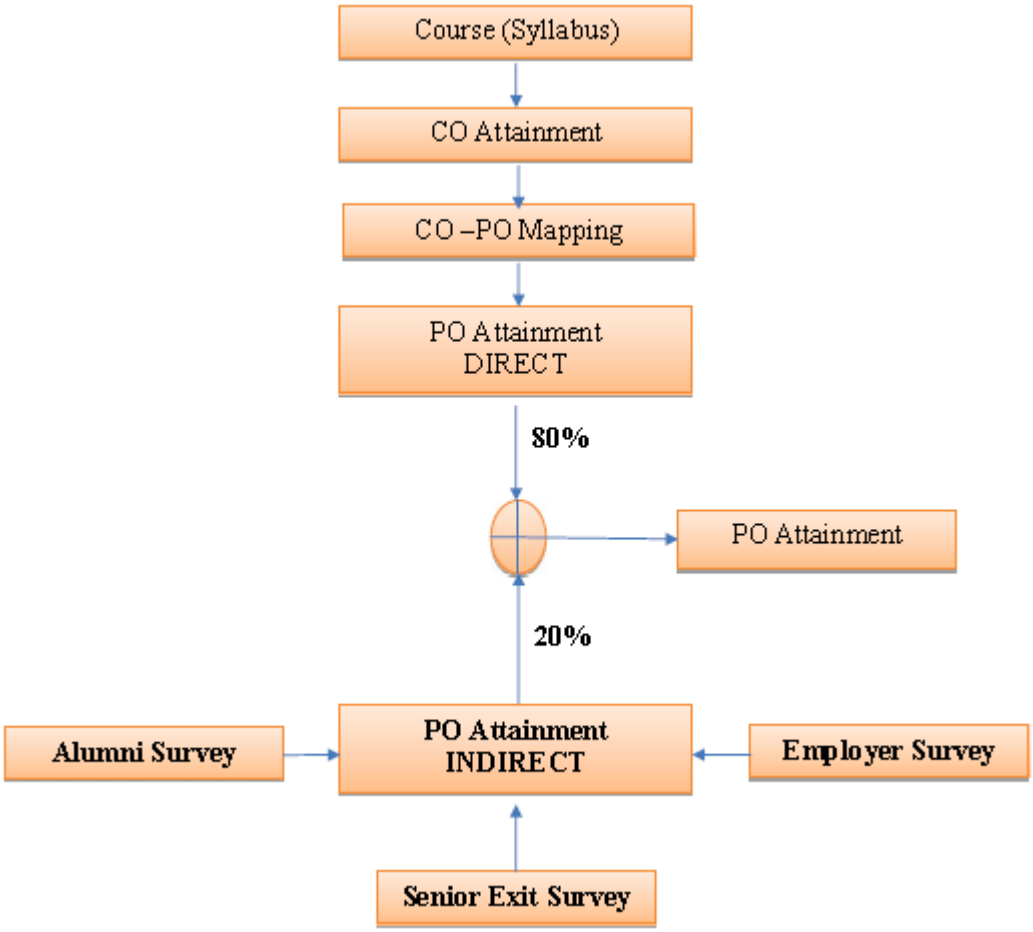
Process For Course Outcome Attainment



Final CO Attainment Process



Program Outcome Attainment Process



INNER BACK COVER PAGE

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.