R.V.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 for III & IV Semesters

2016 SCHEME

INDUSTRIAL ENGINEERING AND MANAGEMENT

VISION

Imparting innovation and value based education in Industrial Engineering and Management for steering organizations to global standards with an emphasis on sustainable and inclusive development.

MISSION

- To impart scientific knowledge, engineering and managerial skills for driving organizations to global excellence.
- To promote a culture of training, consultancy, research and entrepreneurship interventions among the students.
- To institute collaborative academic and research exchange programs with national and globally renowned academia, industries and other organizations.
- To establish and nurture centers of excellence in the niche areas of Industrial and Systems Engineering.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

PEO1. Conceive, design, implement and operate integrated systems, focus on appropriate measures of performance at strategic, tactical and operational levels.
PEO2. Develop competency to adapt to changing roles for achieving organizational excellence.
PEO3. Design and develop sustainable technologies and solutions for betterment of society.
PEO4. Pursue entrepreneurial venture with a focus on creativity and innovation for developing newer products, processes and systems.

PROGRAM SPECIFIC OUTCOMES (PSO)

PSO	Description
PSO1	Design, develop, implement and improve integrated systems that include people, materials, information, equipment and energy.
PSO2	Apply statistical and simulation tools, optimization and meta heuristics techniques for analysis of various systems leading to better decision making.
PSO3	Demonstrate the engineering relationships between the management tasks of planning, organization, leadership, control, and the human element in various sectors of economy.

Lead Society: IIE

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Abbreviations (Change accordingly)

Sl. No.	Abbreviation	Meaning
1.	**VTU**	Visvesvaraya Technological University
2.	**CIE**	Continuous Internal Evaluation
3.	**SEE**	Semester End Examination
4.	**IEM**	Industrial Engineering and Management
5.	**BS**	Basic Sciences
6.	**HSS**	Humanities and Social Sciences
7.	**MAT**	Engineering Mathematics
8.	**ES**	Engineering Science
9.	**CV**	Civil Engineering
10.	**CHY**	Chemistry
11.	**EC**	Electronics and Communication Engineering
12.	**EE**	Electrical and Electronics Engineering
13.	**CSE**	Computer Science and Engineering
14.	**ME**	Mechanical Engineering
15.	**PHY**	Engineering Physics
16.	**BT**	Biotechnology
17.	**CO**	Course Outcome
18.	**PO**	Program Outcome

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*Mandatory Audit course for lateral entry diploma students.

R V College of Engineering, Bengaluru-560 059
(Autonomous Institution Affiliated to VTU, Belagavi)
Department of Industrial Engineering and Management

THIRD SEMESTER CREDIT SCHEME

Sl. No.	Course Code	Course Title	BoS	CREDIT ALLOCATION				
				L	T	P	S	Total Credits
1.	16MA31C	Applied Mathematics-III	MAT	3	1	0	0	4
2.	16EM32B	Engineering Materials	ME	2	0	0	0	2
3.	16ME33	Mechanics of Materials	ME	3	0	1	1	5
4.	16IM34	Principles of Fluid Mechanics and Thermodynamics	IEM	3	0	0	1	4
5.	16IM35	Measurements & Metrology	IEM	3	0	1	1	5
6.	16IM36	Manufacturing Processes	IEM	3	0	1	1	5
7.	16DMA37	Bridge Course Mathematics *	MAT	2	0	0	0	0
Total number of Credits								**25**
Total Number of Hours / Week				**17+2**	**2**	**6**	**16****	

FOURTH SEMESTER CREDIT SCHEME

Sl. No.	Course Code	Course Title	BoS	CREDIT ALLOCATION				
				L	T	P	S	Total Credits
1.	16IM41	Basics of Machine Design & Drawing	IEM	3	0	1	0	4
2.	16ET42	Environmental Technology	BT	2	0	0	0	2
3.	16IM43	Engineering Statistics	IEM	3	1	0	1	5
4.	16IM44	Computer Integrated Manufacturing	IEM	3	0	1	1	5
5.	16IM45	Design of Work Systems	IEM	3	0	1	0	4
6.	16IM46	Operations Research	IEM	3	1	0	1	5
7.	16HS47	Professional Practice-II (Communication Skills and Professional Ethics)	HSS	0	0	0	0	1
8.	16DCS48	Bridge Course C Programming *	CSE	2	0	0	0	0
Total number of Credits								**26**
Total Number of Hours / Week				**17+2**	**4**	**6**	**12****	

*Mandatory Audit course for lateral entry diploma students
**Non contact hours

Semester: III		
APPLIED MATHEMATICS – III **(Theory)** **(COMMON TO AS, BT, CH, CV, IM, ME)**		
Course Code: 16MA31C		**CIE Marks: 100**
Credits: L:T:P:S: 3:1:0:0		**SEE Marks: 100**
Hours: 36L		**SEE Duration: 3Hrs**

Course Learning Objectives:	
1	Identify and solve initial value problems, physically interpret the solution, using Laplace Transforms and Inverse Laplace transforms.
2	Evaluate extremal of integrals involving functionals with applications to physical situations.
3	Understand the basics of Matrix theory, Eigen values and Eigen vectors, its applications for finding solution of system of linear equations.
4	Analyse the given set of experimental data and fit suitable approximating curves.

Unit-I	
Laplace Transform: Existence and uniqueness of Laplace Transform (LT), Transform of elementary functions, RoC. Properties of LT : Linearity, change of scale and first shifting. Transform of function multiplied by t^n, division by t, derivatives and integral. LT of periodic function, Heaviside unit step function, Unit impulse function. Heaviside shift (second shift) theorem.	**07 Hrs**
Unit – II	
Inverse Laplace Transform: Definition, properties of inverse Laplace transform, evaluation using different methods. Convolution theorem, problems. Application to solve ordinary linear differential equations and simultaneous differential equations.	**07 Hrs**
Unit -III	
Calculus of Variation: Introduction of variation of functions, extremal of a functional, Euler's equation-special cases-problems. Geodesics-problems, Hanging cable problem, Brachistochrome problem.	**07 Hrs**
Unit –IV	
Linear Algebra: Rank of matrices-rank of matrix by Echelon form, consistency of system of linear equations- homogeneous and non-homogeneous equations, Gauss elimination, Gauss Jordan, Gauss Seidel methods, Eigen values and Eigen vectors-properties, largest Eigen value by Power method.	**08 Hrs**
Unit –V	
Statistics: Curve fitting by method of least squares, fitting of curves-linear, parabolic, exponential, power functions, correlation, regression analysis – problems.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the fundamental concepts of Laplace and inverse Laplace transforms, variation of functions, elementary transformation of matrices, method of least squares.
CO2:	Demonstrate the properties of Laplace and inverse Laplace transforms, knowledge of extremal of functional, Eigen values, Eigen vectors and correlation.
CO3:	Apply Laplace and inverse Laplace transform technique to solve differential equations, Euler's equation to solve variational problems, matrix methods to solve system of linear equations, regression analysis for curve fitting.
CO4:	Analyse and interpret- solution of IVP and BVP, solution of functionals, solution of linear systems, statistical data occurring in Engineering problems.

Reference Books	
1	Higher Engineering Mathematics, B.S. Grewal, 40th Edition, 2007, Khanna Publishers, ISBN: 81-7409-195-5.
2	Higher Engineering Mathematics, B. V. Ramana, 2008, Tata McGraw-Hill, ISBN: 13-978-07-063419-0.
3	Advanced Engineering Mathematics, Erwin Kreyszig, 9th Edition, 2007, John Wiley & Sons, ISBN: 978-81-265-3135-6.
4	Introduction to Probability and Statistics, Lipshutz and Schiller (Schaum's outline series), ISBN:0-07-038084-8.

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 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.

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, IEM, BT, CH, AS, CV)**		
Course Code: 16EM32B		**CIE Marks: 50**
Credits: L:T:P:S: 2:0:0:0		**SEE Marks: 50**
Hours: 24L		**SEE Duration: 2 Hrs**

Course Learning Objectives: The students should be able to	
1	Familiarize with atomic structure of metals, imperfections, diffusion mechanisms and theories of plastic deformation
2	Construct phase diagram of different alloy system
3	Differentiate between steel and cast iron with the help of Iron carbon Diagram
4	Explain Time Temperature Transformation diagram and different types of heat treatment processes
5	Explain composition, properties and application of ferrous and non-ferrous materials
6	Explain concept of corrosion in materials and their prevention
7	Select materials for automotive, aerospace, marine and domestic applications

UNIT-I	
Crystallography, defects in materials and deformation: Crystal structure - BCC, FCC and HCP structures - Unit cell – Crystallographic planes and directions, Miller indices. Crystal imperfections, point, line, planar and volume defects - Grain size, ASTM grain size number. Frank Reed source of dislocation, Elastic and Plastic deformation, Slip and Twinning, strain hardening and Bauschinger effect	**06 Hrs**
UNIT-II	
Alloys and Phase Diagrams: Constitution of alloys - solid solutions - Substitutional and Interstitial Phase diagrams - construction of isomorphus phase diagram, Lever rule, Iron- Iron carbide equilibrium diagram, different types of invariant reactions, slow cooling of steels	**04 Hrs**
UNIT-III	
Heat Treatment: Full annealing, Stress relief annealing, Normalizing, Hardening and Tempering of steel. Isothermal transformation diagram of eutectoid steel - cooling curves imposed on I.T diagram, Critical cooling rate, Hardenability, Jomminy end quench test - austempering, martempering, case hardening, carburising, nitriding, cyaniding. Flame and Induction hardening.	**06 Hrs**
UNIT-IV	
Ferrous and Non Ferrous Metals: Alloying of steel (Mn, Si, Cr, Mo, V, Ti and W) - stainless steels and tool steels - High Speed Low alloy (HSLA). Cast Iron- Gray, white, malleable, spheroidal, graphite cast iron. Composition, Properties and applications of Copper and Copper alloys-Brass and Bronze, Aluminium and Aluminium alloys, Titanium and Titanium alloys.	**04 Hrs**
UNIT-V	
Corrosion: Types of corrosion- Galvanic corrosion, Pitting corrosion, Erosion corrosion, Crevice corrosion; intergranular and transgranular corrosion, hydrogen cracking and embrittlement, corrosion prevention. Materials for Automotive, aerospace, marine and domestic applications.	**04 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the concepts of crystal structure, microstructure and deformation.
CO2	Construct phase diagram of alloy systems and Iron Carbon phase diagram.
CO3	Develop TTT diagram
CO4	Select ferrous and Non-ferrous materials and their alloys for different application.

Reference Books	
1.	Material Science and Engineering, William F Smith , 4th Edition, 2008, Tata McGraw Hill, ISBN: 978-0-07-066717-4;
2.	Introduction to Physical Metallurgy, Sidney H Avner, 1997,Tata McGraw Hill, ISBN: 978-0-07-463006-8;
3.	Materials Science and Engineering An Introduction, William D. Callister, Jr, 6th Edition, 2004, John Wiley and Sons, Inc., ISBN: 9812-53-052-5

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 05 marks adding up to 15 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 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 are 50.

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**	**1**				**2**					**1**
CO2	**3**	**3**	**1**							**1**		
CO3	**2**	**3**			**2**							
CO4		**3**	**1**			**2**						**1**

Low-1 Medium-2 High-3

Semester: III		
MECHANICS OF MATERIALS (Theory and Practice)		
Course Code:	**16ME33**	**CIE Marks: 100 + 50**
Credits: L:T:P:S:	**3:0:1:1**	**SEE Marks: 100 + 50**
Hours:	**36L**	**SEE Duration: 3 Hrs**

Course Learning Objectives: The students should be able to	
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). Numerical problems **Two Dimensional Stress System:** Introduction, Stress components on inclined planes, Principal Stresses, Principal planes, Mohr's circle of stress Numerical problems	**06 Hrs**
UNIT-II	
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) **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. Numerical problems.	**10 Hrs**
UNIT-III	
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. **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).	**10 Hrs**
UNIT-IV	
Torsion of shafts: Assumptions in theory of pure torsion, Torsion equations, Torsional rigidity and modulus of rupture, Power transmitted, Comparison of solid and hollow circular shafts. Numerical problems.	**05 Hrs**

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	**05 Hrs**

PART – B	
MECHANICS OF MATERIALS LABORATORY	
Section I	**12Hrs**
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)	**4Hrs**
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): Total marks: 100+50=150

Theory – 100 Marks

CIE is executed by way of quizzes (Q), tests (T) and Self-Study(S). 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 Self-study is 20. The total CIE for theory is 100.

Laboratory- 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 of marks over number of weeks is considered for 40 marks. At the end of the semester a test is conducted for 10 marks. Total marks for the laboratory is 50.

Semester End Evaluation (SEE): Total marks: 100+50=150

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.

Laboratory- 50 Marks

Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

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

Low-1 Medium-2 High-3

III Semester		
PRINCIPLES OF FLUID MECHANICS AND THERMODYNAMICS (Theory)		
Course Code: 16IM34		**CIE Marks:** 100
Credits: L:T:P:S: 3:0:0:1		**SEE Marks:** 100
Hours: 39L		**SEE Duration:** 03Hrs

Course Learning Objectives: The students will be able to	
1	Recognize the various types of fluid flow problems encountered in practice.
2	Apply the conservation of mass equation to balance the incoming and outgoing flow rates in a flow system.
3	Develop the general energy balance applied to closed system.
4	Apply the first law of thermodynamic to open and closed system.
5	Apply the second law of thermodynamics to cycles & cyclic devices

UNIT-I	
Introduction, Basic Concepts & properties of fluid: Definition of fluid, Application areas of fluid mechanics, The No-slip condition, classification of fluids, Density & Specific gravity, vapor pressure and capitation, Compressibility &Bulk modulus, Viscosity, Surface tension & capillarity. Numerical problems based on fluid properties only.	**07 Hrs**
UNIT-II	
Mass, Bernoulli Equations: Conservation of mass, The Linear momentum equation, conservation of energy, Mass & volume flow rates, deforming control volumes, mass balance for steady flow process, Acceleration of fluid particle, Derivation of Bernoulli equation, Force balance across streamlines, unsteady compressible flow, Limitation on the use of Bernoulli equation, Hydraulic Grade Line and Energy grade Line, Application of Bernoulli equation, General energy equation.	**09 Hrs**
UNIT-III	
Introduction, Basic Concepts of Thermodynamics: Thermodynamics & Energy, Application and areas of thermodynamic, Systems and control volumes, Properties of a system, Density & Specific gravity, State & Equilibrium, process and cycles, temperature & the Zeroth law of thermodynamic. Temperature Scales, forms of energy, energy transfer by heat, energy transfer by work, Mechanical forms of work.	**07 Hrs**
UNIT-IV	
Energy on analysis of closed systems: Moving boundary work, energy balance for closed system, specific heats, Internal Energy, Enthalpy, & Specific heats of Ideal gases, Energy analysis of steady flow systems, and Energy analysis of Unsteady flow processes.	**07 Hrs**
UNIT-V	
The Second law of thermodynamics: Introduction to the second law, Thermal Energy Reservoirs, Heat engines, thermal efficiency, Kelvin Planck statement, Refrigerators & heat pumps, coefficient of performance, Clausius statement, equivalence of the two statements, Perpetual motion machines, Reversible & irreversible process, The Carnot cycle, The Carnot heat engine, Refrigerator and heat pump.	**09 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Explain the properties of fluid in engineering design.
CO2:	Evaluate measures resulting from the first law of thermodynamics on closed systems.
CO3:	Apply the second law of thermodynamics for control volumes undergoing steady state flow processes.

Reference Books	
1.	Fluid Mechanics – Fundamentals & Application, Yunus A Cencgal and John M Cimbala, 2nd Edition, 2006, Tata McGraw Hill publications, ISBN: 978-0-07-070034-5.
2.	Thermodynamics - An Engineering Approach, Yunus A Cencgal and Michael A. Boles, 5th Edition, 2006, Tata McGraw Hill publications, ISBN: 0072884959.
3	A Textbook of Fluid Mechanics, Dr.R.K.Bansal, 1st Edition, 2008, Laxmi Publications, ISBN8131802949, 9788131802946

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

CIE is executed by way of quizzes (Q), tests (T) and Self-Study(S). 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 Self-study is 20. The total marks of CIE are 100.

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.

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

Low-1 Medium-2 High-3

III Semester		
MEASUREMENTS AND METROLOGY (Theory and Practice)		
Course Code: 16IM35		**CIE Marks:** 100+50
Credits: L:T:P:S: 3:0:1:1		**SEE Marks:** 100+50
Hours: 36L		**SEE Duration:** 03Hrs+03Hrs
Course Learning Objectives: The students will be able to		
1	Explain the concepts of measurement and gauging instruments.	
2	Define the relevance of various measurement systems & standards with regards to practical applications.	
3	Apply the principles of metrology and measurements in manufacturing industries.	

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.	**07 Hrs**
UNIT-II	
Linear and Angular Measurements Definition of metrology-Linear measuring instruments: Vernier, micrometer, interval measurement, Slip gauges and classification, interferometery, optical flats, limit gauges-Comparators: Mechanical, pneumatic and electrical types, applications. Angular measurements:-Sine bar, optical bevel protractor, angle Decker – Taper measurements,	**06 Hrs**
UNIT-III	
Form Measurements Measurement of screw threads-Thread gauges, floating carriage micrometer-measurement of gears-tooth thickness-constant chord and base tangent method-Gleason gear testing machine – radius measurements-surface finish, straightness, flatness and roundness measurements.	**07 Hrs**
UNIT-IV	
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. Introduction to MEMS Sensors and Nano Sensors, Schematic of the design of sensor, application.	**10 Hrs**
UNIT-V	
Measurement of Power, Flow & Temperature Related Properties Force, torque, power:-mechanical, pneumatic, hydraulic and electrical type-Temperature: bimetallic strip, pressure thermometers, thermocouples, electrical resistance thermister.	**06 Hrs**

MEASUREMENTS AND METROLOGY LABORATORY
1. Measurement of angle using Sine Bar and Sine centre
2. Measurement of Angle using Universal Bevel Protractor
3. Measurement of straightness using Autocollimator/Laser interferometry. Gage R & R using MiniTab.
4. Determination of modulus of Elasticity of a mild steel specimen using strain gauge (Cantilever Beam)
5. Calibration of Pressure Transducer
6. Calibration of Thermocouple. Gage R & R using MiniTab.
7. Calibration of Linear Variable Differential Transformer (LVDT)

8. Programming and Simulation of Bottle-filling process using PLC. **9.** Simulate level measurement and indication of emergency shutdown feature using Lab VIEW**.** **10.** Programming and Simulation of Automatic Material Sorting by Conveyor using PLC. **11.** Measurement of various parameters of machine tool components using VMM **12.** Demonstration on SCM/XRD/FTRI/SOM

Course Outcomes: After completing the course, the students will be able to	
CO1:	Explain the principles and practices of metrology in manufacturing environment and analyze uncertainty in an appropriate manner.
CO2:	Illustrate the operating principles of widely used instrumentation techniques and how to use them in the design of measurement systems.
CO3:	Compare the production process, the product function and the product design, and to select appropriate measurement quantities and tools for these purposes.
CO4:	Evaluate and respond to the need for rigorous and formal metrology concepts in designing and using measurement systems

Reference Books	
1.	Engineering Metrology, Jain R.K., 17th Edition, 1994, Khanna Publishers, ISBN: 71-7409-024-x
2.	Mechanical Measurements, Beckwith T.G, and N. Lewis Buck, 5th Edition, 1991, Addison Wesley, ISBN: 81-7808-055-9
3.	Electrical and Electronic Measurements and Instrumentation, A.K.Sawhney,18th Edition, 2008, Dhanpat Rai and Sons, ISBN 8177000160
4.	MEMS Mechanical Sensors, Stephen Beeby, 1st Edition, 2004, Artech House, ISBN 1-58053-536-4

Continuous Internal Evaluation (CIE): Total marks: 100+50=150

Theory – 100 Marks

CIE is executed by way of quizzes (Q), tests (T) and Self-Study(S). 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 Self-study is 20. The total CIE for theory is 100.

Laboratory- 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 of marks over number of weeks is considered for 40 marks. At the end of the semester a test is conducted for 10 marks. Total marks for the laboratory is 50.

Semester End Evaluation (SEE): Total marks: 100+50=150

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.

Laboratory- 50 Marks

Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

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

Low-1 Medium-2 High-3

III Semester		
MANUFACTURING PROCESSES (Theory & Practice)		
Course Code: 16IM36		**CIE Marks:** 100+50
Credits: L:T:P:S: 3:0:1:1		**SEE Marks:** 100+50
Hours: 34L		**SEE Duration:** 03Hrs+03Hrs

Course Learning Objectives: The students will be able to	
1	Develop the concepts related to forming & welding processes and practices.
2	Explain the methodologies and stages involved in primary manufacturing processes.
3	Define cutting parameters influencing metal cutting.
4	Explain the methodologies and stages involved in secondary manufacturing processes

UNIT-I	
Introduction: - Production and assembly processes, classification of production processes, selection of a process for production. Recyclability issues, Maintenance of various equipments. **Metal Casting Process:** Casting terminology, sand mould making procedure. Pattern: Pattern allowances, core prints, pattern materials, types of patterns, pattern color code. **Molding Materials & Core Making:** Molding sand composition, testing sand properties, sand preparation, molding sand properties, molding machines, types of cores, core prints, chaplets, metalostatic forces. **Gating system Design:** Elements of gating system, gates, pouring time, choke area, sprue, gating ratios, Caine's method for riser design.	**07 Hrs**
UNIT-II	
Metal forming processes: Hot working & cold working, principle of rolling & applications, forging operations **Metal fabrication Processes:** classification, principles of resistance welding, resistance spot welding, resistance seam welding, projection welding, flash welding, Defects in welding.	**07 Hrs**
UNIT-III	
Theory of metal cutting: Single point tool nomenclature, geometry, orthogonal & oblique cutting, mechanism of chip formation, types of chips, Merchants analysis, shear angle relationship. Tool wear & tool failure effects of cutting parameters, Tool life criteria, Taylor's tool life equation, problems on Merchants analysis & tool life evaluation **Cutting tool materials:** Desired properties, types of cutting tool materials- HSS carbides, coated carbides, ceramics. Cutting fluids- properties, types & selection. Machinability, factors affecting machinability.	**06 Hrs**
UNIT-IV	
Production lathes: Capstan & turret lathes-constructional features, tool & work holding devices, tool layout. **Drilling machines:** Classification, constructional features. Types of drill, drill bit nomenclature, geometry of twist drill. Drilling & related operations. Problems on calculating the machining time.	**07 Hrs**
UNIT-V	
Milling machines: Classification, constructional features. Milling cutters & nomenclatures. Milling operations - up milling & down milling concepts. Indexing: Purpose of indexing, indexing methods. Problems on indexing. **Grinding machines:** Types of Abrasives, Bonding process, classification, constructional features of surface, cylindrical & centre less grinding machines & operations.	**07 Hrs**

MANUFACTURING PROCESS LABORATORY Part – I - Experiments on Foundry & Sand testing
1. Testing of Moulding sand and Core sand Preparation of specimen and conduction of the following tests: a) Compression/ Shear /Tensile tests b) Permeability test c) Grain fineness test d) Clay content test 2. Preparation of moulds - two box method: using split pattern. Match plate pattern & Cores.
Part – II - Experiments on secondary manufacturing processes
1. Preparation of models involving the following lathe operations: Plain Turning, Taper Turning, Step Turning, Thread Cutting, Facing, Knurling, and Eccentric Turning.
2. Cutting of gear teeth using milling machine
3. Demonstration of surface grinding.
4. Demonstration of CNC turning machine.

Course Outcomes: After completing the course, the students will be able to	
CO1:	Explain the basic principles and methodology of various manufacturing processes that are used for the production of mechanical parts and products.
CO2:	Compare and contrast the advantages and limitations of different manufacturing processes
CO3:	Solve the problems on processing time and economics of processing of material with respect to a manufacturing process.
CO4:	Apply the design concept of various manufacturing processes when a specific product has to be manufactured.

Reference Books	
1.	Manufacturing Technology: Foundry Forming and Welding, P.N. Rao, 2nd Edition, 1998,TMH, I SBN: 0-07-463180-2.
2.	Manufacturing Processes, J.P.Kaushish, 2nd Edition, 2010, PHI Learning Pvt. Ltd, ISBN: 978-81-203-4082-4
3.	Fundamentals of Metal Machining & Machine Tools, G. Boothroyd, 3nd Edition 2004, Mc Graw Hill, ISBN: 978-1-5-7442659 -3.
4.	Production Technology, HMT, 5th Edition, 2004,Tata McGraw Hill, ISBN: 0-07-096443-2.

Continuous Internal Evaluation (CIE): Total marks: 100+50=150

Theory – 100 Marks

CIE is executed by way of quizzes (Q), tests (T) and Self-Study(S). 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 Self-study is 20. The total CIE for theory is 100.

Laboratory- 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 of marks over number of weeks is considered for 40 marks. At the end of the semester a test is conducted for 10 marks. Total marks for the laboratory is 50.

Semester End Evaluation (SEE): Total marks: 100+50=150

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.

Laboratory- 50 Marks

Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

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

Low-1 Medium-2 High-3

Semester: III		
BRIDGE COURSE MATHEMATICS I / II		
Course Code: 16DMA37/48		**CIE Marks: 100**
Credits: L:T:P:S: 2:0:0:0		**SEE Marks: 100**
Audit Course		**SEE Duration: 03Hrs**

Course Learning Objectives: The students will be able to	
1	Understand the existence of polar coordinates as possible 2 - D geometry, approximate a function of single variable in terms of infinite series.
2	Gain knowledge of multivariate functions, types of derivatives involved with these functions and their applications.
3	Recognize linear differential equations, apply analytical techniques to compute solutions.
4	Acquire concepts of vector functions, vector fields and differential calculus of vector functions in Cartesian coordinates.
5	Explore the possibility of finding approximate solutions using numerical methods in the absence of analytical solutions of various systems of equations.
Prerequisites: Hyperbolic functions, Trigonometric formulas, methods of differentiation, methods of integration, reduction formulae, vector algebra.	

UNIT-I	
Differential Calculus: Taylor and Maclaurin's series for function of single variable. Partial derivatives – Introduction, simple problems. Total derivative, Composite functions, Jacobian's- simple problems.	**05 Hrs**
UNIT-II	
Multiple Integrals: Evaluation of double and triple integrals – direct problems, change of order in double integral, change of variables to polar, cylindrical and spherical coordinate systems.	**05 Hrs**
UNIT-III	
Differential Equations: Higher order linear differential equations with constant coefficients, Complementary function and Particular integral, problems. Equations with variable coefficients – Cauchy and Legendre differential equations, problems.	**06 Hrs**
UNIT-IV	
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.	**05 Hrs**
UNIT-V	
Numerical Methods: Algebraic and transcendental equations – Regula-Falsi method, Newton-Raphson method. Ordinary Differential Equations – Taylor's, modified Euler's and 4^{th} order Runge-Kutta methods. Numerical Integration – Simpson's $1/3^{rd}$, $3/8^{th}$ and Weddle's rules.	**05 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Demonstrate the understanding of the basics of polar coordinates, partial differentiation, multiple integrals, vector differentiation, classification and types of solutions of higher order linear differential equations, requirement of numerical methods and few basic definitions.
CO2:	Solve problems on total derivatives of implicit functions, double integrals by changing order of integration, homogeneous linear differential equations, velocity and acceleration vectors.
CO3:	Apply acquired knowledge to find infinite series form of functions, multiple integrals by changing order, solution of non-homogeneous linear differential equations, and numerical solution of equations.
CO4:	Evaluate multiple integrals by changing variables, different operations using del operator and numerical solutions of differential equations and numerical integration.

Reference Books	
1.	Higher Engineering Mathematics, B.S. Grewal, 40th Edition, Khanna Publishers, 2007, ISBN: 81-7409-195-5.
2.	Advanced Engineering Mathematics, R. K. Jain & S.R.K. Iyengar, Narosa Publishing House, 2002, ISBN: 817-3-19-420-3. Chapters: 1, 2, 8, 15.
3.	Advanced Engineering Mathematics, Erwin Kreyszig, 9th Edition, John Wiley & Sons, 2007, ISBN: 978-81-265-3135-6. Chapters: 6, 10, 12.
4.	A Text Book of Engineering Mathematics, N.P Bali & Manish Goyal, 7th Edition, Lakshmi Publications, 2010, ISBN: 978-81-7008-992-6. Chapters: 6, 18, 16, 8, 26.

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE consists of Two Tests each for 50 marks (20 marks for Quiz + 30 marks for descriptive questions)

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 each unit have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

Semester: IV		
BASICS OF MACHINE DESIGN & DRAWING (Theory & Practice)		
Course Code: 16IM41		**CIE Marks:** 100+50
Credits: L:T:P:S: 3:0:1:0		**SEE Marks:** 100+50
Hours: 36L		**SEE Duration:** 03+03 Hrs

Course Learning Objectives: The students will be able to	
1	Describe the functions of various mechanical elements in a machine
2	Explain the relation between properties and dimensions of components
3	Analyze and quantify the forces, stresses and related parameters which are necessary to design shafts, springs, drives systems and mechanical joints.
4	Demonstrate ability to develop designs for various mechanical systems

UNIT-I	
Design for Static Strength: Static load, Strength, factor of safety; Stress concentration, determination of stress concentration factor. Theories of failure – maximum normal stress theory, maximum shear stress theory, distortion energy theory; failure of brittle materials; failure of ductile materials. **Design for Fatigue Strength:** Introduction to S-N Diagram, low cycle fatigue, high cycle fatigue, endurance limit, endurance strength, modifying factors: size effect, surface effect, stress concentration effects, fluctuating stresses, Goodman and Soderberg's relationship; stresses due to combined loading, cumulative fatigue damage.	**06 Hrs**
UNIT-II	
Design for Shafts and Keys: Torsion of shafts, design of strength and rigidity with steady loading. ASME & BIS codes for design of transmission shafting, shafts under fluctuating loads and combined loads. **Keys:** Types of keys, design of keys. **Design of Couplings:** Types of couplings, Design of Rigid and Flexible couplings, Flanged couplings, bush and pin type of couplings.	**07 Hrs**
UNIT-III	
Design of Springs: Types of springs, stresses in helical springs – circular and non-circular cross-section, Tension and compression springs, fluctuating and impact loads, Design of Leaf Springs. **Belts, Rope and Chain Drives:** Power transmitted by belt and rope drives, conditions for max. power transmission, tension- initial and centrifugal; types of chains, power transmitted.	**08 Hrs**
UNIT-IV	
Design of Spur & Helical Gears **Spur Gears:** Definition, stresses in gear tooth, Lewis equation, form factor, velocity ratios, types of tooth systems **Helical Gears**: Number of teeth, design based on strength, dynamics and wear loads, normal and transverse pitch, module, herringbone gears, different forces on helical gear teeth.	**08 Hrs**
UNIT-V	
Threaded Fasteners: Stresses in threaded fasteners, effects of initial tension, effect of compression, effect of fatigue loading, shear and impact loading. **Riveted Joints & Welded joints**: Types of riveted joints, failure of riveted joints, efficiency, boiler joints, structural joints, eccentrically loaded riveted joints – Types, strength of butt and fillet welds, eccentrically loaded welded joints.	**07 Hrs**

BASICS OF MACHINE DESIGN & DRAWING LABORATORY	
Section – I Introduction to Machine Drawing; Section of Solids – cubes, pyramids, cones, cylinders. Orthographic Projections of machine elements.	**08 Hrs**

Section – II	16 Hrs
Design and Assembly Drawings of – Screw Jack, Connecting Rod, Tail Stock of Lathe, Plummer Block, Machine Vice.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Explain the design procedure for specific mechanical elements and sub-systems
CO2:	Design specific mechanical elements based on required specifications
CO3:	Analyze different types of forces and its influence on the component design
CO4:	Examine and relate importance of component design to complete system.

Reference Books	
1.	Mechanical Engineering Design, Joseph E Shigley and Charles R. Mischke., 5th Edition, 2003, McGraw Hill International Edition, ISBN: 0070568995
2.	Design of Machine Elements, M.F.Spotts, T.E. Shoup, L.E. Hornberger, S.R. Jayaram and C.V. Venkatesh, 8th Edition, 2006, Pearson Education, ISBN: 9788177584219
3.	Machine Drawing, K R Gopalakrishna, 2010, Subhas Publications, ISBN-13:EBK00OLD46
4.	Design Data Hand Book, K. Mahadevan and K.Balaveera Reddy, CBS Publication, ISBN: 8123923155

Continuous Internal Evaluation (CIE): Total marks: 100+50=150

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 CIE for theory is 100.

Laboratory- 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 of marks over number of weeks is considered for 40 marks. At the end of the semester a test is conducted for 10 marks. Total marks for the laboratory is 50.

Semester End Evaluation (SEE): Total marks: 100+50=150

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.

Laboratory- 50 Marks

Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

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

Low-1 Medium-2 High-3

IV Semester		
ENVIRONMENTAL TECHNOLOGY (Theory)		
Course Code: 16ET42		**CIE Marks: 50**
Credits: L:T:P:S: 2:0:0:0		**SEE Marks: 50**
Hours: 25L		**SEE Duration: 02Hrs**

Course Learning Objectives: The students 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	
Introduction: Ecosystem – Types and structure of ecosystem. Components of environment, Environmental education, Environmental act & regulations. Global environmental issues, ISO 14000, Environmental Impact Assessment and Challenges.	**05 Hrs**
UNIT II	
Environmental pollution: Causes, effects and control measures of Air, noise and land pollution. Air Pollution. Clean air act, Pollution standard index. Indoor air quality. Global atmospheric change - Global warming, Acid rain &Ozone depletion and their controlling measures.	**05 Hrs**
UNIT III	
Water pollution and management: Pollutants in surface & ground water, water borne diseases. Water purification systems: physical & chemical treatment - aeration, solids separation, settling operations, coagulation, softening, filtration, disinfection, The common technologies for purification of drinking water - Ultraviolet radiation treatment, Reverse Osmosis. Rain water harvesting, water recycling, STP plant.	**05 Hrs**
UNIT IV	
Renewable energy sources and technology for generation of energy: Different types of energy, conventional sources & non conventional sources of energy, solar energy, wind energy, hydro electric energy, Geothermal Energy, Nuclear energy, Fossil Fuels & Biomass energy.	**05 Hrs**
UNIT V	
Solid waste management: Types, causes, control and processing. Typical generation rates, estimation of solid waste quantities, factors that affect generation rates. Management - On site handling, collection, storage and processing techniques, ultimate disposal, landfills. Reduction and recycling of waste – waste to composite, energy.	**05 Hrs**

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.

Reference Books	
1.	Introduction to environmental engineering and science, Gilbert, M.M., Pearson Education. 2nd Edition, 2004, ISBN: 8129072770.
2.	Environmental Engineering, Howard S. Peavy, Donald R. Rowe and George Tchobanoglous, 2000, McGraw Hill Series in water resources and Environmental Engg., ISBN: 0070491348
3.	Environmental Science – 15th edition, G. Tyler Miller, Scott Spoolman, 2012,Publisher: Brooks Cole, ISBN-13: 978-1305090446 ISBN-10: 130509044
4.	Environment Management, Vijay Kulkarni and T. V. Ramachandra, 2009, TERI Press, ISBN: 8179931846, 9788179931844

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 05 marks adding up to 15 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 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 are 50.

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 8 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	1	-	-	-	-	-	3	-	2	-		-
CO2	2	3	3	2	1	-	3	3	2	-	2	1
CO3	-	3	1	3	-	2	3	3	2	-	1	2
CO4	1	-	2	1	3	-	2	-	2	-	-	2

High-3 : Medium-2 : Low-1

IV Semester		
ENGINEERING STATISTICS (Theory)		
Course Code: 16IM43		**CIE Marks:** 100
Credits: L:T:P:S: 3:1:0:1		**SEE Marks:** 100
Hours: 36L+24T		**SEE Duration:** 03Hrs

Course Learning Objectives: The students will be able to	
1	Explain the concepts related to data summarization, data handling and estimation techniques for statistical processing.
2	Apply the concepts of probability, distributions and their applications to derive point and interval estimates
3	Analyze problems using descriptive and inferential statistical processing of data.

UNIT-I	
Data Summary and Presentation: Tabular and Graphical display: Stem and Leaf diagrams, Histograms, Box plots, Radar diagrams. Interpretation of graphical output from software packages such as Minitab **Concepts of Probability and Random Variables:** Sample spaces and Events, Interpretations of probability, Addition rules, Conditional probability, Multiplication and Total probability rules, Independence, Bayes Theorem. Random Variables, Discrete and continuous random variables. Probability distributions and mass functions, Numerical Problems	**08 Hrs**
UNIT-II	
Discrete Probability Distributions: Discrete uniform distribution, Binominal distribution, Poisson distribution, Geometric, Hyper geometric, Applications, Numerical Problems. **Continuous Probability Distributions:** Continuous Uniform distribution, Normal distribution, Normal approximations, Exponential, Erlang, Gamma, Weibull distributions, Applications, Numerical Problems. Usage of software tools to demonstrate probability distributions (demonstrations and assignments only)	**08 Hrs**
UNIT-III	
Estimation Theory: Statistical Inference, Random sampling, Properties of Estimators, Method of Moments, Method of Maximum Likelihood, Sampling distribution, Central Limit Theorem, Sampling distribution of means, Numerical Problems.	**06 Hrs**
UNIT-IV	
Simple Linear Regression and Correlation: Empirical models, Simple Linear Regression, Properties of Least square Estimators and Estimation of variances, Common abuses of regression, Prediction of new observations, Correlation, Numerical Problems. Interpretation of graphical output from software packages such as Minitab	**07 Hrs**
UNIT-V	
Statistical Inference for a single sample: Hypothesis testing, Confidence intervals, Inference on the mean of a population (variance known and unknown), Inference on the variance of a normal population, Testing for Goodness of Fit, Numerical Problems. Interpretation of graphical output from software packages such as Minitab	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Describe and report data set using data analysis, presentation and interpretation techniques to understand various phenomena in the fields of science and engineering.
CO2:	Apply various statistical processing techniques to handle a set of data to estimate probabilities.
CO3:	Apply an appropriate statistical tool and analyze a specific set of data to estimate and draw conclusions about population parameters
CO4:	Draw inferences about population parameters and relations between variables based on analysis of sample data

Reference Books	
1.	Engineering Statistics, Douglas C. Montgomery, George C. Runger, Norma Faris Hubele, 5th Edition, 2011, John Wiley & Sons, Inc., ISBN-13: 978- 0-470-63147-8
2.	Applied statistics and Probability for Engineers, Douglas C Montgomery, George C Runger, Wiley, 4th Edition, 2007, Asia Student Edition, ISBN: 978-81-265-2315-3.
3.	Statistics for Management, Richard I Levin, David S Rubin, 7th Edition, 1997, Prentice Hall India, ISBN: 9780134762920.
4.	Probability and Statistics for Engineers and Scientists, Walpole, Myers, Myers, Ye, 8th Edition, 2007, Pearson Education Inc., ISBN: 978-81-317-1552-9.
5.	Softwares : Microsoft Excel / Minitab / Systat / Matlab / R

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

CIE is executed by way of quizzes (Q), tests (T) and Self-Study(S). 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 Self-study is 20. The total marks of CIE are 100.

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.

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

Low-1 Medium-2 High-3

IV Semester		
COMPUTER INTEGRATED MANUFACTURING (Theory and Practice)		
Course Code: 16IM44		**CIE Marks:** 100+50
Credits: L:T:P:S: 3:0:1:1		**SEE Marks:** 100+50
Hours: 36L		**SEE Duration:** 03Hrs+03Hrs

Course Learning Objectives: The students will be able to	
1	Realize about what is CIM and its importance for today's manufacturing industry
2	Learn the various automation systems used in flow lines, material handling and assembly.
3	Explore the future trends in Manufacturing & Service sectors.
4	Explored about the use of computers in the manufacturing support activities like Process Planning, Material Requirement Planning, Shop floor data collection and quality control.

UNIT-I	
Fundamentals of CAD: Introduction, The cad system definition, Reasons for implementing cad. Design process (Shigley Model), Application of computers in design, benefits of cad. **Principle of Interactive computer Graphics:** Graphic primitives, Line drawing algorithms, Bresenham's circle algorithm, Ellipse generating algorithms, Scan conversion, Rendering, Z buffer algorithm Antialiasing, Reflection, Shading.	**08 Hrs**
UNIT-II	
Finite Element Modeling & Analysis: Introduction, General procedure for finite element analysis, Mesh generation Techniques, Automatic Mesh Generation, Mesh requirements, Three dimensional shape Description and Mesh generation, Natural coordinates, Isoperimetric Elements , Cad application to FEM, Finite Element modeling, General structure of a Finite Element Analysis Procedure.	**06 Hrs**
UNIT-III	
Numerical & Computer control in Production system: NC procedure, NC coordinate systems, Elements & Classification of NC system, Functions & Features of CNC, Industrial applications of CNC, DNC Concepts, and Components & Types of DNC. **NC part programming & computer aided part programming:** Manual part programming, Computer Assisted part programming, Computer assisted NC part programming, APT Language, NC part programming using CAD/CAM, Tool path generation ,Computer Automated part programming. Technology of CAM.	**08 Hrs**
UNIT-IV	
Automation: Introduction, Types of Automation, Organization & information processing in manufacturing, Production concepts, Automation Strategies. Automated flow lines, work part Transport, Transfer Mechanism, and Buffer Storage. **Automated Assembly System:** Types, Parts feeding Devices, Analysis of Single Station Assembly Machine, Analysis of Multi station Assembly machine.	**07 Hrs**
UNIT-V	
Computerized Manufacturing Planning System: Computer Aided Process Planning, retrieval types, Generative type. **Flexible Manufacturing Systems:** Definition, FMS workstations, Materials handling & storage system, Computer control, Applications & benefits. **Shop Floor Control:** Factory Data Collection System, Bar code technology, bar code symbol, bar code reader.	**06 Hrs**

COMPUTER INTEGRATED MANUFACTURING LABORATORY
Part – I
Analysis of Simple & Compound bars Subjected to Axial Loads. Analysis of Trusses subjected to point loads. Analysis of Beams Subjected to concentrate & UDL loads. Analysis of Shafts subjected to twisting moment.

Part – II
Two experiments on Simulation of Turning and milling operation on CNC Train software. Four experiments on CNC turning & milling machines.
Suggested Software Packages: Ansys, CNC train.

Course Outcomes: After completing the course, the students will be able to	
CO1:	Explain the technologies as used and applied to the area of Computer Integrated Manufacturing
CO2:	Describe the Elements of CNC technology and their role in CIM environment
CO3:	Apply the principles of automation in manufacturing technology to improve overall organizational productivity
CO4:	Analyze manufacturing strategies for automation for various industry environments
CO5:	Evaluate alternative automation strategies for the volume variety production environment

Reference Books	
1.	CAD / CAM, Ibrahim Zeid, 1st Edition, 2000, McGraw Hill, ISBN – 0070728577.
2.	Computer Aided Design and Manufacturing, K. Lalit Narayan, K Mallikarjuna Rao & M.M.M Sarcar, 1st edition, 2008, PHI New Delhi, ISBN-978-81-203-3342-0
3.	Automation, Production System and Computer Integrated Manufacturing, Mikell.P.Groover, 3rd Edition, 2007, PHI New Delhi, ISBN – 0132393212
4.	CAD / CAM, Mikell. P. Grover & E.W. Zimmer, 2nd Edition, 2003, PHI, New Delhi, ISBN: 0131101307

Continuous Internal Evaluation (CIE): Total marks: 100+50=150

Theory – 100 Marks

CIE is executed by way of quizzes (Q), tests (T) and Self-Study(S). 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 Self-study is 20. The total CIE for theory is 100.

Laboratory- 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 of marks over number of weeks is considered for 40 marks. At the end of the semester a test is conducted for 10 marks. Total marks for the laboratory is 50.

Semester End Evaluation (SEE): Total marks: 100+50=150

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.

Laboratory- 50 Marks

Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2					1						
CO2	2		2									
CO3		3	2									
CO4			3			1						
CO5				2	2							

Low-1 Medium-2 High-3

IV Semester		
DESIGN OF WORK SYSTEMS (Theory & Practice)		
Course Code: 16IM45		**CIE Marks:** 100+50
Credits: L:T:P:S: 3:0:1:0		**SEE Marks:** 100+50
Hours: 36L		**SEE Duration:** 03+03 Hrs
Course Learning Objectives: The students will be able to		
1	Develop concepts related to principles of productivity & work study as a tool for increasing the efficiency and effectiveness in organizational systems.	
2	Incorporate the concepts related to measuring work using principles of work analysis.	
3	Create the knowledge useful in designing work systems for productivity improvement.	

UNIT-I	
Introduction: Concept and Scope of Industrial Engineering, Evolution of Industrial Engineering approach. Work system and Productivity concepts, techniques for productivity improvement. Productivity concepts in manufacturing and service environments, **Work Study:** Definition, objective and scope of work study. Human factors in work study. Influence of working conditions on work study.	**07 Hrs**
UNIT-II	
Method Study: Definition, objective and scope of method study. Steps involved in Method study, Selection of activity, Activity recording using charts and diagrams. **Principles of Motion Economy:** Introduction, Classification of movements. Two- hand process chart, Micromotion study, SIMO Chart, therbligs, cyclegraph and chronocyclegraph, Overview of Define, Install, and Maintain steps in Method study.	**08 Hrs**
UNIT-III	
Work Measurement &Work sampling: Definition, objective and benefits of work measurement. Work measurement techniques. Concept of Work sampling (including problems). **Time Study:** Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information, Qualified worker, standard rating, standard performance, scales of rating. Systems of rating, Factors affecting rate of working.	**08 Hrs**
UNIT-IV	
Standard Time Determination: Allowances and standard time determination. Time standards for man-machine systems (including problems). Standard data, Method time measurement (MTM), Computer aided Time Study (Software's), basics of MOST **Application of Motion and Time studies in manufacturing and service units- case examples.**	**08 Hrs**
UNIT-V	
Lean manufacturing: Over view of Lean manufacturing concepts, relevance of motion and time studies for lean environment, Value Stream Mapping and other tools for lean manufacturing, Principles of Lean manufacturing.	**06 Hrs**

DESIGN OF WORK SYSTEMS Laboratory
Part -I
1. Exercises on Recording Techniques (Process charts, Diagrams & Value stream mapping tools) 2. Exercises on conducting method study for assembling simple components and office work.
Part-II
3. Exercises on Timing Practice , Pace and Performance rating. 4. Exercises on determination of standard time for simple operations using different work measurement techniques (Stop watch, PMTS,etc).

Course Outcomes: After completing the course, the students will be able to	
CO1:	State the industrial engineering principles that influence the productivity improvement in organizations.
CO2:	Apply the method study guidelines in the analysis and redesigning of processes.
CO3:	Model work systems using standard tools for purposes of work system documentation, analysis, and design.
CO4:	Apply various types of engineering work measurements in analysing the time of tasks.
CO5:	Analyze the work processes using advanced work study tools and techniques

Reference Books	
1.	Introduction to work study, George Kanawaty, 4th revised Edition, 1992, ILO, ISBN: 9221071081.
2.	How to implement lean manufacturing, Lonnie Wilson, 2010, McGraw Hill publication, ISBN: 978-0-07-162508-1.
3.	Motion and Time study for Lean Manufacturing, Fred E.Meyers and James R.Stewart, 3rd Edition, 2002, Prentice Hall, ISBN:0-13-031670-9.
4.	Methods Standards and Work Design, B. Niebel and Freivalds, Niebel's, 12th Edition, 2009, McGraw-Hill, ISBN: 0071283226.
5.	Work Systems and the Methods, Measurement and Management of Work, M P Groover, 2007, Pearson Prentice Hall, ISBN: 0131406507

Continuous Internal Evaluation (CIE): Total marks: 100+50=150

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 CIE for theory is 100.

Laboratory- 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 of marks over number of weeks is considered for 40 marks. At the end of the semester a test is conducted for 10 marks. Total marks for the laboratory is 50.

Semester End Evaluation (SEE): Total marks: 100+50=150

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.

Laboratory- 50 Marks

Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3					2	1				2	
CO2		3	3		2				1		1	
CO3			3	1	1				2	1		
CO4	2	2			2	1			1			1
CO5	1	2	2		3	1	1					1

Low-1 Medium-2 High-3

IV Semester		
OPERATIONS RESEARCH (Theory)		
Course Code: 16IM46		**CIE Marks:** 100
Credits: L:T:P:S: 3:1:0:1		**SEE Marks:** 100
Hours: 36L + 24T		**SEE Duration:** 03Hrs

Course Learning Objectives: The students will be able to	
1	Develop the skills in the application of operations research models for complex decision making situations.
2	Implement the methodology and tools of operations research to assist decision-making.
3	Explain the various modelling frameworks applied to solve problems using operation research techniques.

UNIT-I	
Introduction: OR methodology, Definition of OR, Application of OR to Engineering and Managerial problems, Features of OR models, Limitations of OR. **Linear Programming:** Definition, Mathematical Formulation, Standard Form, Solution Space, Types of solution - Basic Feasible, Degenerate, Solution through Graphical Method,	**08 Hrs**
UNIT-II	
Simplex Method & Sensitivity Analysis: Simplex methods, Artificial Stating Solution - M Method & Two phase method, Sensitivity Analysis - Graphical sensitivity analysis, Algebraic sensitivity analysis	**08 Hrs**
UNIT-III	
Transportation Problem: Formulation of transportation model, Basic feasible solution using different methods, Optimality Methods, Unbalanced transportation problem, Degeneracy in transportation problems, Variants in Transportation Problems, Applications of Transportation problems. **Assignment Problem:** Formulation of the Assignment problem, Solution method of assignment problem-Hungarian Method, Solution method of assignment problem-Hungarian Method, Variants in assignment problem, Travelling Salesman Problem.	**07 Hrs**
UNIT-IV	
Project Management Using Network Analysis: Network construction, Determination of critical path and duration, floats, PERT- Estimation of project duration, variance, CPM - Elements of crashing.	**06 Hrs**
UNIT-V	
Queuing Theory: Queuing system and their characteristics, The M/M/I Queuing system, Steady state performance analyzing of M/M/1 queuing models, **Game Theory:** Introduction, Two person Zero Sum game, Pure strategies – Games with saddle point, Graphical Method, The rules of dominance, solution method of games without saddle point, Arithmetic method.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Explain the basic concepts of different models of operations research and their applications.
CO2:	Apply the models to incorporate rational decision making process in real life situations.
CO3:	Analyze various modelling alternatives & select appropriate modelling techniques for a given situation.
CO4:	Validate output from model to check feasibility of implementations.
CO5:	Create Operations Research models for a given situation.

Reference Books	
1.	Operation Research An Introduction, Taha H A, 8th Edition, 2004, PHI, ISBN: 0130488089.
2.	Operations Research: Principles and Practice, Ravindran, Phillips, Solberg, 2nd Edition, 2007, John Wiley & Sons, ISBN8126512563
3.	Introduction to Operation Research, Hiller and Liberman, 8th Edition, 2004, Tata McGraw Hill, ISBN : 0073017795.
4.	Operations Research Theory and Application, J K Sharma, 2nd Edition, 2003, Pearson Education Pvt Ltd, ISBN: 0333-92394-4.

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

CIE is executed by way of quizzes (Q), tests (T) and Self-Study(S). 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 Self-study is 20. The total marks of CIE are 100.

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.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1				2						
CO2	2	3	3									
CO3		2			2							
CO4			2									
CO5				1								

Low-1 Medium-2 High-3

IV Semester		
Professional Practice – II **COMMUNICATION SKILLS AND PROFESSIONAL ETHICS**		
Course Code: 16HS47		**CIE Marks:** 50
Credits: L:T:P:S: 0:0:1:0		**SEE Marks:** NA
Hours: 36 Hrs		**CIE Duration:** 02 Hrs

Course Learning Objectives: The students will be able to	
1	Develop communication style, the essentials of good communication and 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	
UNIT-I	
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.	**06 Hrs**
UNIT-II	
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.	**06 Hrs**
UNIT-III.A	
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.	**06 Hrs**
IV Semester	
UNIT-III.B	
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.	**06 Hrs**
UNIT-IV	
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 Counselling & Guidance, Career Orientation. Balancing Personal & Professional Life-	**06 Hrs**
UNIT-V	
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	**06 Hrs**

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

Scheme of Continuous Internal Examination (CIE)
Evaluation of CIE will be carried out in TWO Phases.

Phase	Activity	Weightage
I	Test 1 is conducted in III Sem for 50 marks (15 Marks Quiz and 35 Marks Descriptive answers) after completion of Unit-1, Unit-2 and Unit -3.A for 18 hours of training sessions.	50%
II	Test 2 is conducted in IV Sem for 50 marks ((15 Marks Quiz and 35 Marks Descriptive answers) after completion of Unit -3B, Unit - 4 and Unit-5 for 18 hours of training sessions.	50%
	At the end of the IV sem Marks of Test 1 and Test 2 is consolidated for 50 marks (Average of Test1 and Test 2 (T1+T2/2). The grading is provided by the Coe. The final CIE marks is scrutinized by the committee comprising of HSS- Chairman, Training Co-ordinator, respective department Staff Placement co-ordinator before submitting to CoE.	

SEE: NA

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

Low-1 Medium-2 High-3

IV Semester		
C PROGRAMMING (Bridge Course) (Theory)		
Course Code: 16DCS37		**CIE Marks: 100**
Credits: L:T:P:S : 2:0:0:0 (Audit Course)		**SEE Marks: 100**
Hours: 24L		**SEE : 03 Hrs**

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	
Introduction to Reasoning, Algorithms and Flowcharts Skill development – Examples related to Arithmetical Reasoning and Analytical Reasoning. Fundamentals of algorithms and flowcharts.	**02 Hrs**
Introduction to C programming Basic structure of C program, Features of C language, Character set, C tokens, Keywords and Identifiers, Constants, Variables, Data types.	**01 Hrs**
Handling Input and Output operations Reading a character, Writing a character, Formatted input/output functions, Unformatted input/output functions.	**02 Hrs**
UNIT-II	
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.	**02 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 statement, The 'for' statement, Jumps in loops**.**	**03 Hrs**
UNIT-III	
Arrays One dimensional arrays, Declaration of one dimensional arrays. Initialization of one dimensional arrays, Two dimensional arrays, Initializing two dimensional arrays.	**02 Hrs**
Character Arrays and Strings Declaring and Initializing String Variables, Reading Strings from Terminal, Writing strings to screen, Arithmetic Operations on characters, String operations using with and without String handling functions.	**02 Hrs**
UNIT-IV	
User-defined functions Need for User Defined Functions, Definition of functions, Return values and their types, Function calls, Function declaration, Category of functions, Nesting of functions, Functions with arrays, Storage classes.	**03 Hrs**
Structures and Unions Introduction, Structure definition, Declaring structure variables, Accessing structure members, Structure initialization, Copying and comparing structure variables, Arrays of structure, Arrays within structures, Structures and functions, Unions.	**03 Hrs**

UNIT – V	
Pointers : Introduction , Accessing the address of a variable, Declaring and initializing of pointer variables, Accessing a variable using pointers, Chain of pointers, Pointer expressions, Pointer increments and scale factor, Pointers and arrays, Pointers and character strings.	**03 Hrs**
File Managements in C Basic concepts of files, Defining and opening a file, closing of a file, Input/Output operations on files.	**01 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1.	Understand and explore the fundamental computer concepts and basic programming principles like data types, input/output functions, operators, programming constructs and user defined functions.
CO2.	Analyze and Develop algorithmic solutions to problems.
CO3.	Implement and Demonstrate capabilities of writing 'C' programs in optimized, robust and reusable code.
CO4.	Apply appropriate concepts of data structures like arrays, structures, and files to implement programs for various applications.

Reference Books:	
1.	Programming in C, P. Dey, M. Ghosh, 1st Edition, 2007, Oxford University press, ISBN -13: 9780195687910.
2.	The C Programming Language, Kernighan B.W and Dennis M. Ritchie, 2nd 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.

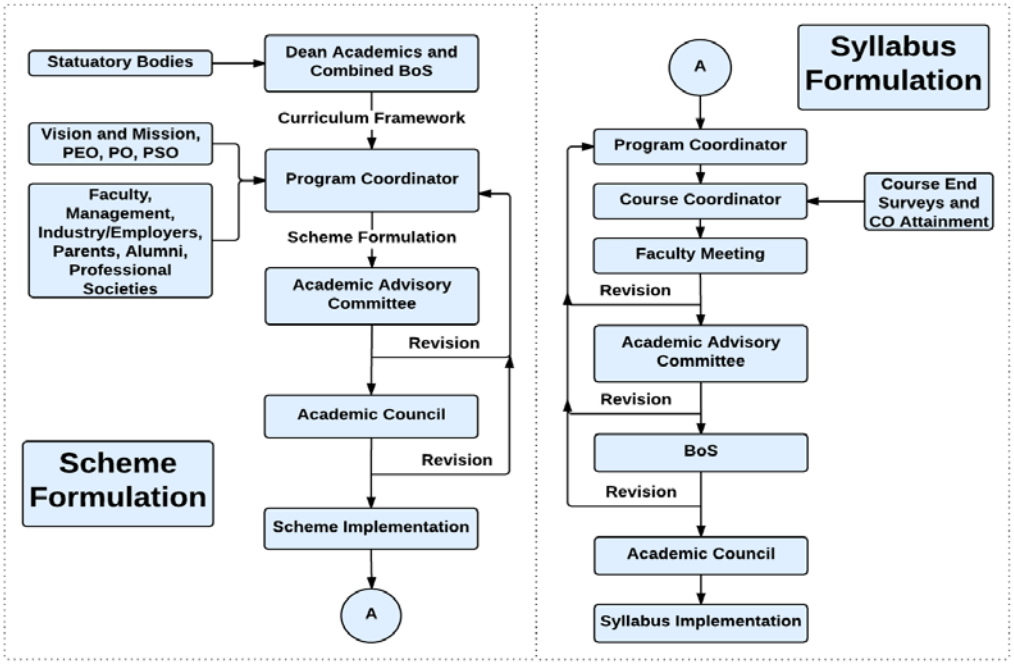
Scheme of Continuous Internal Evaluation:
CIE is executed by way of quizzes (Q), tests (T) and Assignment. A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The two tests are conducted and each test is evaluated for 30 marks adding up to 60 marks The marks component for assignment is 10. The total marks of CIE are 100.

Scheme of Semester End Examination:
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.

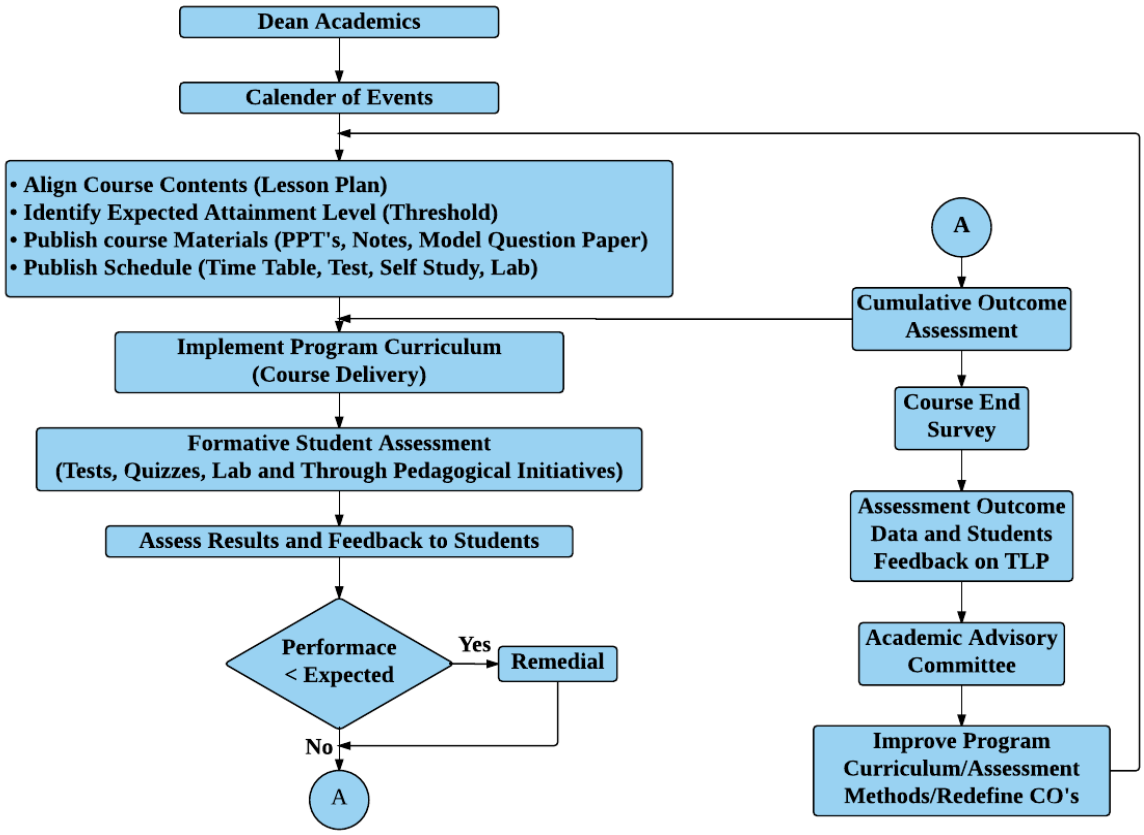
CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	2	1	-	-	-	-	2	-	1
CO2	3	2	2	2	2	-	-	-	2	1	-	1
CO3	3	2	2	2	2	1	1	-	2	2	1	2
CO4	3	3	3	2	2	1	1	-	2	2	1	2

Low-1 Medium-2 High-3

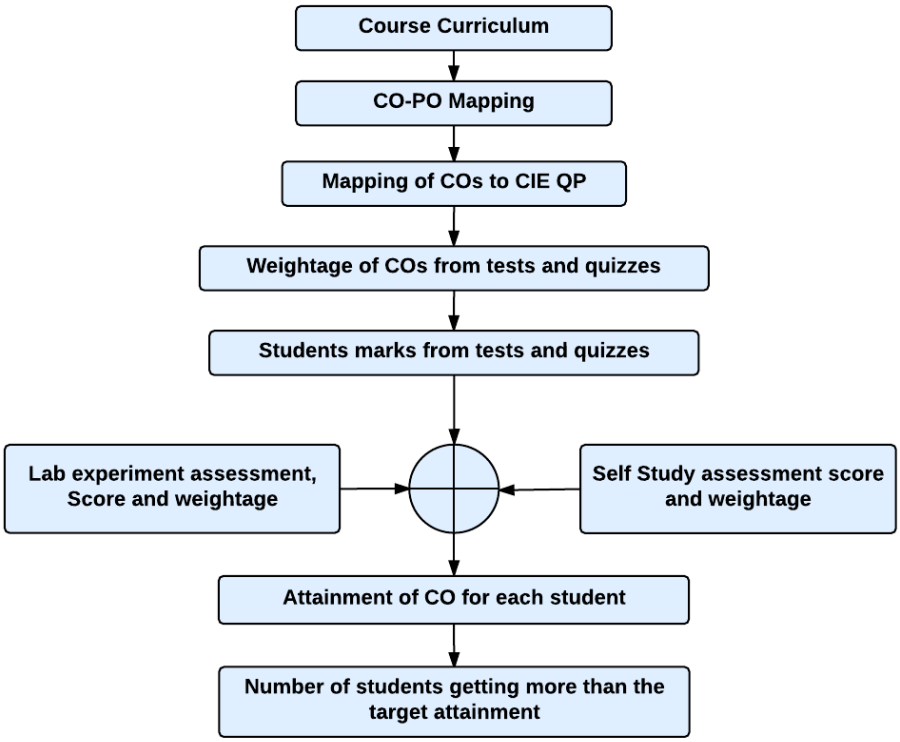
Curriculum Design Process



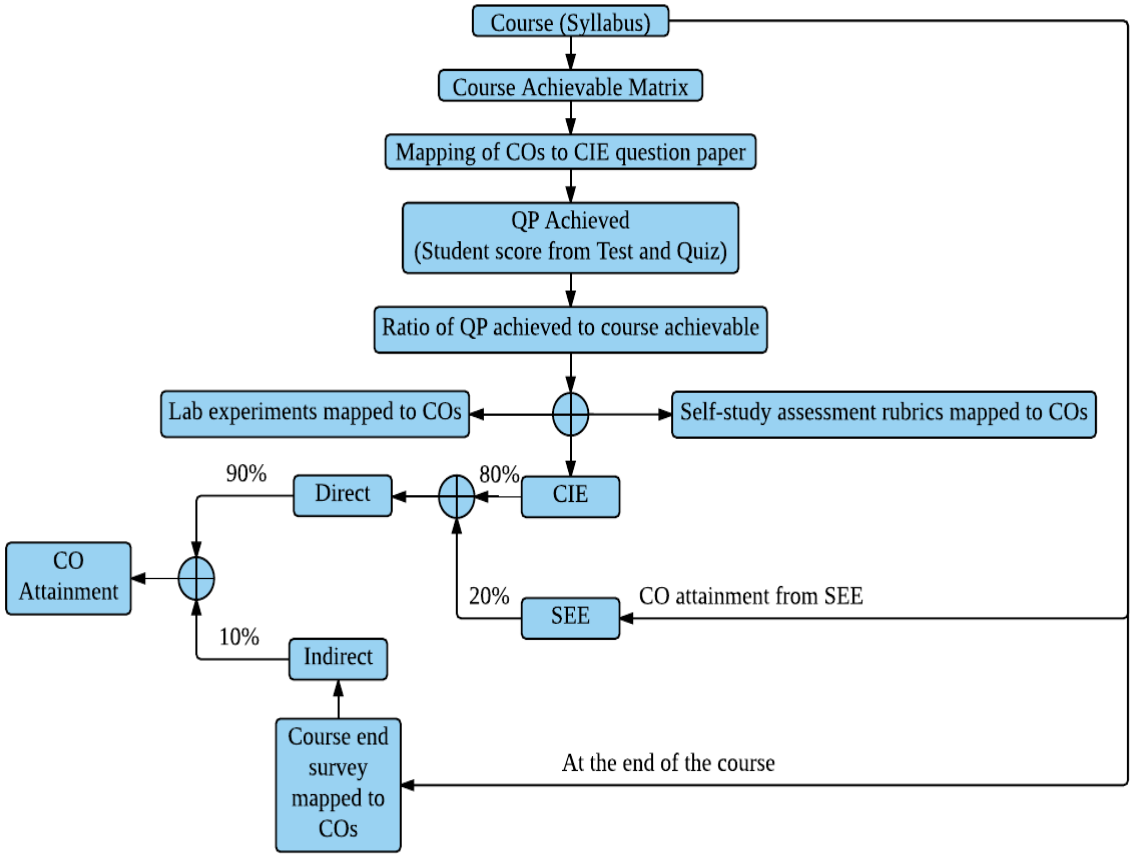
Academic Planning and Implementation



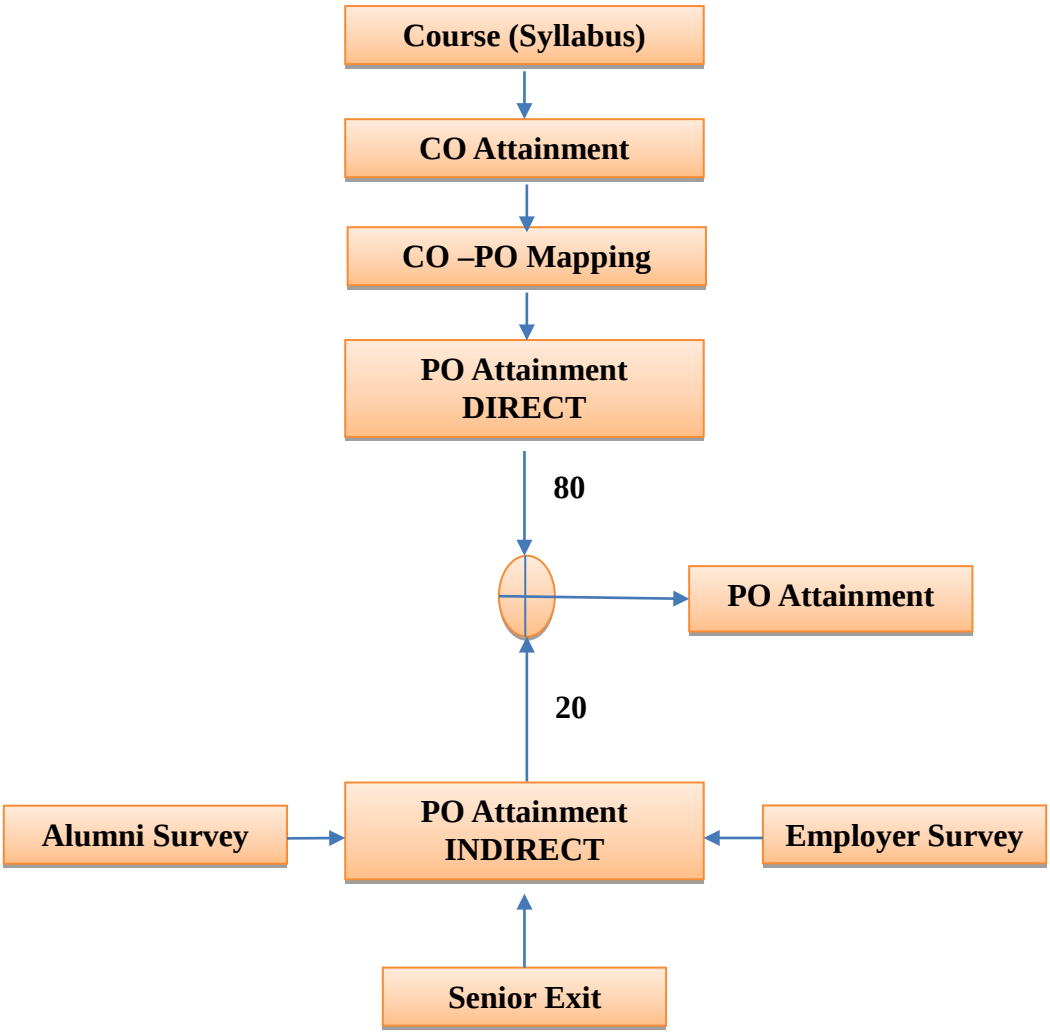
Process for Course Outcome Attainment



Final CO Attainment Process



Program Outcome Attainment Process



Guidelines for Fixing Targets

- The target may be fixed based on last 3 years' average attainment

PROGRAM OUTCOMES (PO)

PO1: **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: **Problem analysis**: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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