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 for III & IV Semesters

2018 SCHEME

INDUSTRIAL ENGINEERING AND MANAGEMENT

VISION

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

MISSION

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

QUALITY POLICY

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

CORE VALUES

Professionalism, Commitment, Integrity, Team Work, Innovation

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 for III & IV Semesters

2018 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: Institute of Industrial Engineers (IIE)

Abbreviations

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

INDEX

RV COLLEGE OF ENGINEERING®

(Autonomous Institution Affiliated to VTU, Belagavi)

INDUSTRIAL ENGINEERING AND MANAGEMENT

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.	18IM33	Principles of Fluid Mechanics & Thermodynamics	IM	3	0	0	**3**
4.	18IM34	Metrology & Measurements	IM	3	0	1	**4**
5.	18IM35	Work Systems Design	IM	4	0	1	**5**
6.	18IM36	Manufacturing Processes	IM	3	0	1	**4**
7.	18DMA37***	Bridge Course: Mathematics	MA	2	0	0	**0**
8.	18HS38#	Kannada	HSS	1	0	0	**0**
		Total Number of Credits		**19**	**01**	**03**	**23**
		Total number of Hours/Week		**19+3**	**2**	**7.5**	

*Engineering Mathematics - III

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

**

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

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

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

Mandatory audit course for all students

RV COLLEGE OF ENGINEERING®

(Autonomous Institution Affiliated to VTU, Belagavi)

INDUSTRIAL ENGINEERING AND MANAGEMENT

FOURTH SEMESTER CREDIT SCHEME							
Sl. No	**Course Code**	**Course Title**	**BOS**	**Credit Allocation**			**Total Credits**
				L	**T**	**P**	
1.	18IM41	Engineering Statistics	IM	4	1	0	**5**
2.	18BT42A*	Environmental Technology	BT	2	0	0	**2**
3.	18IM43	Engineering Economy and Costing	IM	3	0	0	**3**
4.	18IM44	Computer Aided Design and Manufacturing	IM	3	0	1	**4**
5.	18IM45	Decision Sciences - Deterministic Models	IM	3	0	1	**4**
6.	18IM46	Strength of Materials and Machine Design	IM	4	0	0	**4**
7.	18IM47	Design Thinking lab	IM	0	0	2	**2**
8.	18DCS48**	Bridge Course: C Programming	CS	2	0	0	**0**
9.	18HS49	Professional Practice-I Communication Skills	HSS	0	0	1	**1**
		Total Number of Credits		**19**	**01**	**05**	**25**
		Total number of Hours/Week		**19+2**	**2**	**12.5**	

*

Sl.No	COURSE TITLE	COURSE CODE	PROGRAMS
1	Engineering Materials	18ME42	EC, EE, EI & TE
2	Biology for Engineers	18BT42B	CS & IS
3	Environmental Technology	18BT42A	CV, ME, IM, CH, BT & AS

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

Sl.No	COURSE TITLE	COURSE CODE	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 period after the 4th semester

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

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

Unit-I	**10 Hrs**
Calculus of Variations: Introduction to variation of functionals, extremal of a functional, Euler's equation –special cases, problems. Geodesics, Hanging cable and Brachistochrone problems. Exploring geodesics graphically using MATLAB.	
Unit – II	**11 Hrs**
Fourier Series: Introduction, periodic function, even and odd functions. Dirichlet's conditions, Euler's formula for Fourier series, complex Fourier series, problems on time periodic signals (square wave, half wave rectifier, saw-tooth wave and triangular wave), Fourier sine series, Fourier cosine series. Exploring Fourier series using MATLAB.	
Unit –III	**11 Hrs**
Laplace and Inverse Laplace Transform: Existence and uniqueness of Laplace Transform (LT), transform of elementary functions, region of convergence. Properties - Linearity, scaling, s – domain shift, differentiation in the s – domain, division by t, differentiation and integration in the time domain. Transform of periodic functions (square wave, saw-tooth wave, triangular wave, full and half wave rectifier). Inverse Laplace transform – properties, evaluation using different methods. Convolution theorem (without proof), problems. Solution of ordinary differential equations. Exploring Laplace and inverse Laplace transform using MATLAB commands.	
Unit –IV	**10 Hrs**
Numerical Methods – I: Roots of algebraic and transcendental equations. Fixed point iteration method, Newton- Raphson method for multiple roots. Solution to system of linear equations – LU decomposition method, partition method. Sparse linear systems – Thomas algorithm for tridiagonal matrices. Computing numerical solutions using MATLAB.	
Unit –V	**10 Hrs**
Numerical Methods – II: Numerical solutions to partial differential equations – Finite difference approximation to derivatives, solution of Laplace equation in two dimension, heat and wave equations in one dimension (explicit methods). Exploring solution of PDE using MATLAB.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the fundamental concepts of variation of functionals, periodic phenomena, Laplace and inverse Laplace transforms and numerical techniques.
CO2:	Solve the problems on extremal of functional, Fourier series, Laplace and inverse Laplace transforms and basics of numerical methods.
CO3:	Apply the acquired knowledge to solve variational problems, half range series, differential

	equations using Laplace transform, system of linear equations and PDEs using finite difference technique.
CO4:	Analyze and interpret applications of functionals, complex Fourier series, IVP and BVP using LT, sparse linear systems and PDEs occurring in Engineering problems.

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

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

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

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

High-3 : Medium-2 : Low-1

Semester: III						
ENGINEERING MATERIALS (Theory) (Common to ME, CH & IM)						
Course Code	**:**	**18ME32**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**2:0:0**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**26L**		**SEE Duration**	**:**	**02 Hours**

Course Learning Objectives: The students will be able to	
1	Understand the behavior of materials for different loading conditions
2	Analyze different phase diagrams, related composition and microstructure
3	Understand heat treatment methods of steel and their properties
4	Understand solidification process in casting and material degradation
5	Discuss Non Destructive methods of testing materials

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

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

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

3	Material Science and Engineering, William F Smith, 4th Edition, 2008, Mc. Graw Hill Book Company, , ISBN0-07-066717-9

Continuous Internal Evaluation (CIE); Theory (50 Marks)
CIE is executed by way of quizzes (Q), tests (T) and Assignment (A). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks which will be reduced to 15marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 25 marks each and the sum of the marks scored from three tests is reduced to 30. The marks component for assignment is 05.
The total marks of CIE is 15(Q) + 30(T) + 05(A) = 50 marks.

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

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

High-3 : Medium-2 : Low-1

III Semester						
PRINCIPLES OF FLUID MECHANICS AND THERMODYNAMICS (Theory)						
Course Code	**:**	**18IM33**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40L**		**SEE Duration**	**:**	**03 Hours**

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	**06 Hrs**
Introduction, Basic Concepts & Properties of Fluid: Definition of fluid, density, Specific weight, specific volume, specific gravity, viscosity, surface tension, capillarity compressibility, bulk modulus, vapour pressure, cavitation, classification of fluids, No-slip condition, definition of fluid pressure, pascal's law, hydrostatic law, pressure measurements using simple and u-tube differential manometers. Simple numerical	
UNIT-II	**10 Hrs**
Dynamics of Fluid Flow: Derivation of Euler's equation of motion, Bernoulli equation for real fluids, applications of Bernoulli equation-venturimeter, orifice meter, pitot-tube. Simple numerical **Flow through Pipes:** Introduction, loss of energy in pipes, Darcy-weisbach formula, minor energy losses due to sudden enlargement, sudden contraction (No derivation), entrance to a pipe and exit of a pipe, concept of hydraulic gradient and total energy line. Simple numerical	
UNIT-III	**10 Hrs**
Basic Concepts of Thermodynamics: System, control volume, properties, processes, cycles, thermodynamic equilibrium, Quasi-static process, temperature, zeroth law of thermodynamics, thermometers and thermometric properties, temperature scales, Numerical. **First Law of Thermodynamics:** Closed system undergoing a cycle, change of state, energy – a property of system, enthalpy and specific heats, PMMM1, Flow processes- energy analysis of steady flow systems. Examples- Turbine, compressor, nozzle-Numerical.	
UNIT-IV	**07 Hrs**
Second law of thermodynamics: Thermal energy reservoirs, heat engine-thermal efficiency, pump-coefficient of performance, statements, equivalence of two statements, PMMM2, carnot cycle, reversible and irreversible processes, Numerical.	
UNIT-V	**07 Hrs**
Work and Heat Transfer: Work transfer, pdv-work or displacement work, path and point functions, pdv-work in various Quasi-static processes, Other types of work transfers- electrical work, shaft work, paddle wheel work or stirring work, flow work, heat transfer, similarities and dissimilarities between heat and work transfers. Simple numericals.	

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.	A Textbook of Fluid Mechanics, Dr. R.K.Bansal, 1st Edition, 2008, Laxmi Publications, ISBN8131802949, 9788131802946
3.	Thermodynamics - An Engineering Approach, Yunus A Cencgal and Michael A. Boles, 5th Edition, 2006, Tata McGraw Hill publications, ISBN: 0072884959.
4.	Engineering Thermodynamics, Nag P K, Tata McGraw Hill, 4th Edition, 2011,ISBN-13:978-0-07-026062-7: ISBN-10:0-07-026062-1

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

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

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

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

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

Low-1 Medium-2 High-3

III Semester						
METROLOGY AND MEASUREMENTS (Theory & Practice)						
Course Code	**:**	**18IM34**		**CIE**	**:**	**100 + 50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100 + 50 Marks**
Total Hours	**:**	**40L + 26P**		**SEE Duration**	**:**	**03 + 03 Hours**

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	**08 Hrs**
Concept of Measurements: General concept – Generalised measurement system, Static and dynamic characteristics – Errors in measurement – Statistical evaluation of measurement data – Standards and calibration. Classification of transducers, Selection of transducers, Resistive, capacitive & inductive transducers, Piezoelectric, Hall effect, optical and digital transducers, Elements of data acquisition system, A/D, D/A converters – Smart sensors.	
UNIT-II	**09 Hrs**
Limits, Fits & Gauges: System of Limits, Fits, Tolerance and Gauging: Definition of tolerance, Specification in assembly, Principle of interchangeability and selective assembly, limits of size, Indian standards, concept of limits of size and tolerances, definition of fits, hole basis system, shaft basis system, types of fits and their designation (IS 919-1963), geometric tolerance, position-tolerances. 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, Introduction to GD&T.	
UNIT-III	**09 Hrs**
Interferometry, Comparators & Form Measurements: Interferometery, optical flats, Autocollimator, Comparators: Mechanical, pneumatic and electrical types, applications. Sine bar. 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.	
UNIT-IV	**08 Hrs**
Advances in Metrology: Precision instruments based on laser-Principles- laser interferometer-application in linear, angular measurements and machine tool metrology Coordinate measuring machine (CMM)- Constructional features – types, applications – digital devices- computer aided inspection,3D Metrology. Introduction to MEMS Sensors and Nano Sensors, Schematic of the design of sensor, application.	
UNIT-V	**06 Hrs**
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.	

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	Discuss the principles and practices of metrology in manufacturing environment and analyze uncertainty in an appropriate manner.
CO2	Describe the operating principles of range of widely used instrumentation techniques and illustrate 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, 2004, Artech House, ISBN 1-58053-536-4

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

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

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

Scheme of Semester End Examination (SEE); Practical Exam for 50 Marks
SEE for the practical courses will be based on experiment conduction with proper results, is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.
Semester End Evaluation (SEE): Theory (100 Marks) + Practical (50 Marks) = Total 150 Marks

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

Low-1 Medium-2 High-3

III Semester						
WORK SYSTEMS DESIGN (Theory & Practice)						
Course Code	**:**	**18IM35**		**CIE**	**:**	**100 + 50 Marks**
Credits: L:T:P	**:**	**4:0:1**		**SEE**	**:**	**100 + 50 Marks**
Total Hours	**:**	**54L + 26P**		**SEE Duration**	**:**	**03 + 03 Hours**

Course Learning Objectives: The students will be able to	
1	Develop concepts related to principles of productivity & work study.
2	Apply the concepts related to operational analysis & measuring work for designing the work systems.
3	Review the emerging concepts and principles in work system design for productivity improvement.

UNIT-I	**09 Hrs**
Introduction: Scope of Industrial Engineering, Evolution of Industrial Engineering approach. Nature of work, Physical work systems, Work systems as a field of professional practice, Type of Occupation, Productivity concepts, Manual Work Systems, Worker-Machine Systems, Automated Work systems, Cycle time analysis of Manual work and in Worker machine systems(including numerical), Service operations , Office work, Work study**.**	
UNIT-II	**13 Hrs**
Methods Engineering and Operations Analysis: Evolution and Scope of Methods Engineering, Systematic Approach in Methods Engineering, Techniques of Methods Engineering, Selecting Alternative Improvement Proposals, Basic Data Collection and Analysis Techniques, Methods Engineering and Automation. **Charting and Diagramming Techniques for Operations Analysis:** Overview of the techniques, Network diagrams, Traditional Charting and Diagramming techniques, Block diagrams and Process maps. **Motion Study and Work Design:** Basic motion elements and Work analysis, Principles of motion economy and work Design. (Case Studies)	
UNIT-III	**12 Hrs**
Introduction to Work Measurement: Determination of Time Standards – Methods, Work Measurement Techniques, Prerequisites for valid time standards, Allowances in Time Standards, Accuracy and Precision, Application of Speed Ratio. **Direct Time Study:** Procedure, Determination of Number of Work Cycle to be Timed, Performance Rating, Time Study Equipment. (Numericals) **Predetermined Motion Time Systems:** Over view, Methods – Time Measurements, Maynard Operations Sequence Technique**.**	
UNIT-IV	**09 Hrs**
Standard Data Systems: Standard Data Systems overview, steps, elements classifications. **Work Sampling:** Statistical Basis of work sampling, Application issues in work sampling (including numericals). **Learning Curves:** Determining the Learning Rate, Factors effecting the Learning Curve, Applications, Time standards vs. Learning Curve.	
UNIT-V	**09 Hrs**
Computerized Work Measurement and Standards Maintenance: Computer Systems for Direct Time Study and Work Sampling, Computerized Systems Based on Predetermined Motion Times, Work Measurement Based on Expert Systems, Maintenance of Time Standards. **Lean Production:** Over view of Lean Manufacturing Concepts – Concept of Waste, JIT production, Automation, Worker Involvement, Relevance of motion and Time Studies for Lean Environment, Value Stream Mapping and other tools for lean manufacturing, Principles of Lean manufacturing.	
WORK SYSTEMS DESIGN Laboratory	
Part -I	
1. Exercises on Recording Techniques	

2. Exercises on Method Engineering and Operations Analysis. (Manual Assemblies and Office Work)
Part-II
3. Exercises on Timing Practice, Rating. 4. Exercises on standard time determination for simple operations using different work measurement techniques.

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 methods engineering and operational analysis in re-designing of work systems.
CO3	Apply engineering work measurement principles in analysing and measurement of work.
CO4	Analyze the work processes using advanced work study tools and techniques.
CO5	Demonstrate an understanding of emerging concepts and applications in designing work systems.

Reference Books	
1.	Work Systems – The Methods, Measurement & Management of Work, Mikell P Groover, 2017, Pearson India Education, ISBN: 978-93-325-8124-1
2.	Introduction to Work Study, George Kanawaty, 4th revised Edition, 1992, ILO, ISBN: 9221071081.
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.	Niebel's Methods, Standards, and Work Design, Benjamin W Niebel; Andris Freivalds, 13th Edition, 2014, McGraw-Hill, ISBN: 9780073376363.

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

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

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

Scheme of Semester End Examination (SEE); Practical Exam for 50 Marks
SEE for the practical courses will be based on experiment conduction with proper results, is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.
Semester End Evaluation (SEE): Theory (100 Marks) + Practical (50 Marks) = Total 150 Marks

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

Low-1 Medium-2 High-3

III Semester						
MANUFACTURING PROCESSES (Theory & Practice)						
Course Code	**:**	**18IM36**		**CIE**	**:**	**100 + 50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100 + 50 Marks**
Total Hours	**:**	**40L + 26P**		**SEE Duration**	**:**	**03 + 03 Hours**

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	**06 Hrs**
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.	
UNIT-II	**10 Hrs**
Metal fabrication Processes: classification, principles of resistance welding, resistance spot welding, resistance seam welding, projection welding, flash welding, Defects in welding.	
UNIT-III	**10 Hrs**
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.	
UNIT-IV	**07 Hrs**
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.	
UNIT-V	**07 Hrs**
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.	

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

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

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

Scheme of Semester End Examination (SEE); Practical Exam for 50 Marks
SEE for the practical courses will be based on experiment conduction with proper results, is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.
Semester End Evaluation (SEE): Theory (100 Marks) + Practical (50 Marks) = Total 150 Marks

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

Low-1 Medium-2 High-3

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

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

Unit-I	**05 Hrs**
Differential Calculus: Taylor and Maclaurin series for function of single variable. Partial derivatives – Introduction, simple problems. Total derivative, composite functions. Jacobians – simple problems.	
Unit – II	**05 Hrs**
Vector Differentiation: Introduction, simple problems in terms of velocity and acceleration. Concepts of gradient, divergence – solenoidal vector function, curl – irrotational vector function and Laplacian, simple problems.	
Unit –III	**06 Hrs**
Differential Equations: Higher order linear differential equations with constant coefficients, solution of homogeneous equations - Complementary functions. Non homogeneous equations –Inverse differential operator method of finding particular integral based on input function (force function).	
Unit –IV	**05 Hrs**
Numerical Methods: Solution of algebraic and transcendental equations – Intermediate value property, Newton-Raphson method. Solution of first order ordinary differential equations – Taylor series and 4^{th} order Runge-Kutta methods. Numerical integration – Simpson's $1/3^{rd}$, $3/8^{th}$ and Weddle's rules. (All methods without proof)**.**	
Unit –V	**05 Hrs**
Multiple Integrals: Evaluation of double integrals, change of order of integration. Evaluation of triple integrals. Applications – Area, volume and mass – simple problems.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the concept of partial differentiation, double integrals, vector differentiation, solutions of higher order linear differential equations and requirement of numerical methods.
CO2	Solve problems on total derivatives of implicit functions, Jacobians, homogeneous linear differential equations, velocity and acceleration vectors.
CO3	Apply acquired knowledge to find infinite series expansion of functions, solution of non-homogeneous linear differential equations and numerical solution of equations.
CO4	Evaluate triple integrals, area, volume and mass, different operations using del operator on scalar and vector point functions, numerical solution of differential equations and numerical integration.

Reference Books	
1	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2015, ISBN: 978-81-933284-9-1.
2	Higher Engineering Mathematics, B.V. Ramana, 11th Edition, 2010, Tata McGraw-Hill, ISBN: 978-0-07-063419-0.
3	N.P. Bali & Manish Goyal, A Text Book of Engineering Mathematics, Lakshmi Publications, 7th Edition, 2010, ISBN: 978-81-31808320.
4	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 10th Edition, 2016, ISBN: 978-0470458365.

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

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

III Semester						
KANNADA (KALI, LIPI AND ANUBHAVA) **(Common to all branches)**						
Course Code	**:**	**18HS38**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**1:0:0**		**SEE**	**:**	**NA**
Total Hours	**:**	**18Hrs**		**CIE Duration**	**:**	**90 Minutes**
Course Learning Objectives: The students will be able to						
1	Learn basic communication skills in Kannada language (Vyavaharika Kannada).					
2	Read and understand simple words and sentences of newspaper and hoardings in Kannada language					
3	Enable to Identify grammar or common language structure.					
4	Appreciate the importance of Kannada language and literature.					
5	Imbibe ethical, moral, national and cultural values through various forms of literature through Kannada language.					

KANNADA KALI (spoken Kannada) (to those students who does not know Kannada)	
Unit-I	**06 Hrs**
1. **namaskaara** Introducing the self, enquiring about mother tongue, native place, profession etc., interrogative particles 2. **niivucennaagiddiiraa?** Enquiring about the welfare, personal pronouns, possessive forms 3. **nimageeenubeeku?** 4. **nimagekannadagottaa?** 5. **nanagemeeshTrakelasaishTa** 'yes'/'no'/'not' type of interrogative and assertive sentences, modal verbs and negations.	
Unit – II	**06 Hrs**
6. **oLLeya*college*** Qualitative and quantitative adjectives 7. **aakaaSadabaNNaniili** Locative case markers, post positions and colours 8. **ivattueshTanetaariikhu?** Cardinal numbers, numeral adjectives, ordinal numbers, human numerals, weekdays and kinship words 9. ***College*bassueshTuganTege ide?** Dative case markers, 10. **naanubengaLuuralliiddiini** Present tense, habitual future tense form of verb root IRU	
Unit –III	**06 Hrs**
11. ***RV college*allioouttiini** Introducing few frequently used verb forms like nooDu, maaDu, hoogu, koDu, keeLu, kuDi, hoDi, bari etc.,. Simple present tense and habitual future tense form of human and non-human verbs. 12. ***Record*bariibeeku** Definitive, permissive and prohibitive form of verbs 13. **bengaLuurigeyaavaagabandri?** Past tense form of verbs(human and non-human) 14. **dinanityadasambhaashaNe** Few simple conversations retlated to day-to-day activities 15. Few ritual words/sentences which are frequently used in spoken Kannada **Note**: Introducing few ritualistic words/sentences/phrases in each lesson.	
<u>KANNADA LIPI</u> (to those students who know only speaking and does not know reading & writing)	
Unit –I	**04 Hrs**

1. Introduction of Kannada alphabets (primary letters).	
Unit –II	**05 Hrs**
2. Combination of secondary symbols of vowels with consonants (‘kaagunita’).	
Unit –III	**05 Hrs**
3. Secondary symbols of consonants and its combination with other consonants both homogenous and heterogeneous (‘Somyouktaakshara’).	
Unit –IV	**04 Hrs**
4. Framing simple sentences and reading paragraphs.	
ಕನ್ನಡ ಅನುಭವ (ಕನ್ನಡ ಕಲಿತವರಿಗೆ)	
Unit –I	**06 Hrs**
೧. ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿ (ಇತಿಹಾಸ) – ಡಾ. ಎಂ.ಚಿದಾನಂದ ಮೂರ್ತಿ ೨. ವಿಜ್ಞಾನ ಬರವಣಿಗೆಗಳ ಭಾಷಾಂತರ(ವಿಜ್ಞಾನ ಸಾಹಿತ್ಯ) – ಜೆ. ಆರ್. ಲಕ್ಷ್ಮಣರಾವ್ ೩. ಮಂಕುತಿಮ್ಮನ ಕಗ್ಗ (ಕಾವ್ಯ) – ಡಾ. ಡಿ.ವಿ. ಗುಂಡಪ್ಪ ೪. ರಾಧಾಕೃಷ್ಣನ್ (ವ್ಯಕ್ತಿಚಿತ್ರ) – ಎ. ಎನ್. ಮೂರ್ತಿರಾವ್	
Unit –II	**06 Hrs**
೫. ಕುಚೇಲನ ಭಾಗ್ಯ (ಸಣ್ಣಕಥೆ) – ಮಾಸ್ತಿ ವೆಂಕಟೇಶ ಅಯ್ಯಂಗಾರ್ ೬. ಎದೆತುಂಬಿ ಹಾಡಿದೆನು (ಕಾವ್ಯ) – ಡಾ. ಜಿ. ಎಸ್ ಶಿವರುದ್ರಪ್ಪ ೭. (ಮುಕ್ತ ಪ್ರಬಂಧ) – ‘ಗೌತಮ’ ೮. ಮೂರ್ಖರ ರಾಜ್ಯದಲ್ಲಿ (ಜನಪದಕಥೆ) ೯. ವಚನ ಸಾಹಿತ್ಯ ಮತ್ತುದಾಸ ಸಾಹಿತ್ಯ – ಸರ್ವಜ್ಞ, ಬಸವಣ್ಣ ಮತ್ತು ಪುರಂದರದಾಸರು	
Unit –III	**06 Hrs**
೧೦. ಸರ್. ಎಂ. ವಿಶ್ವೇಶ್ವರಯ್ಯ (ವ್ಯಕ್ತಿಚಿತ್ರ) – ಎಸ್. ರಾಮಮೂರ್ತಿ ೧೧. ರತ್ನನ್ ಪರ್ಪಂಚ (ಪದ್ಯ) – ಜಿ. ಪಿ.ರಾಜರತ್ನಂ ೧೨. ಶಲ್ಯ ಪರ್ವ (ಮಹಾಭಾರತದಒಂದು ಪ್ರಸಂಗ)– ಎ. ಆರ್. ಕೃಷ್ಣಶಾಸ್ತ್ರಿ ೧೩. ಆಡಳಿತ ಕನ್ನಡ – ಎಚ್. ಜಿ. ಶ್ರೀನಿವಾಸ ಪ್ರಸಾದ್	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand and converse in Kannada at places/situations like canteen, mess, hotel, hostel, while travelling in auto/bus/train/bus station/railway station/post office/bank; conversing with general public, over phone etc.,.
CO2	Enable to write the proper sentences in Kannada language.
CO3	Learn Language and Grammar skills for writing Kannada language.
CO4	Create interest towards Kannada Literature and administrative language.

Reference Books	
1	Kannada Kali**,** H. G. Srinivasa Prasad & S. Ramamurthy, 5th Edition, 2019, RV College of Engineering Bengaluru.
2	Kannada Lipi, H. G. Srinivasa Prasad & S. Ramamurthy, 5th Edition, 2019, RV College of Engineering Bengaluru.
3	Kannada Anubhava**,** K. N. Subramanya, S. Narahari, H. G. Srinivasa Prasad, S. Ramamurthy and S. Sathyanarayana, 5th Edition, 2019, RV College of Engineering Bengaluru.
4	Spoken Kannada**,** Kannada Sahithya Parishat, Bengaluru.
5	Kannada Manasu**,** Prasaranga kannada vishwavidyalaya, Hampi.

Continuous Internal Evaluation (CIE); (50 Marks)

Award of **CIE** will be based on the two written test that will be conducted during the semester period. The CIE will be calculated based on the average score obtained in the two tests. In the case of Kannada Kali CIE will be based on oral examination process. The CIE will be based on average of two tests conducted during the semester period. **Total CIE marks: (T1+T2)/2. T1 is the marks obtained for Test 1 out of maximum of 50 marks. T2 is the marks obtained for Test 2 out of maximum of 50 marks.**

IV Semester						
ENGINEERING STATISTICS (Theory)						
Course Code	**:**	**18IM41**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**4:1:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**52L + 26T**		**SEE Duration**	**:**	**03 Hours**

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	**10 Hrs**
Data Summary and Presentation: Data types, tabular and graphical displays: 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	
UNIT-II	**13 Hrs**
Discrete Probability Distributions: Discrete uniform, Binominal, Poisson, Geometric, Negative binomial, Hyper geometric distributions, Applications, Numerical Problems. **Continuous Probability Distributions:** Continuous uniform, Normal, Normal approximations, Exponential, Erlang, Gamma, Weibull distributions, Applications, Numerical Problems. Usage of software tools to demonstrate probability distributions (software used for demonstrations and assignments only)	
UNIT-III	**12 Hrs**
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 and derived quantities, Numerical Problems. **Interval Estimation:** Confidence Intervals on mean (variance known and unknown), and variance of a Normal population	
UNIT-IV	**08 Hrs**
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	
UNIT-V	**09 Hrs**
Statistical Inference for a single sample: Hypothesis testing, Inference on the mean of a Normal population (variance known and unknown), Inference on the variance of a Normal population, Testing for Goodness of Fit, Tests of association, Numerical Problems. Interpretation of graphical output from software packages such as Minitab	

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

References 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 / Matlab / R
6.	Online resources: a) http://172.16.44.44/nnptel.html - choose NOC:Introduction to Data Analytics(Course sponsored by Aricent) b) https://newonlinecourses.science.psu.edu/statprogram/undergraduate-studies c) https://www.khanacademy.org/math/statistics-probability

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

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

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

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

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

Low-1 Medium-2 High-3

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

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

Unit-I	**05 Hrs**
Introduction: Environment - Components of environment, Ecosystem. Impact of anthropogenic activities on environment (agriculture, mining and transportation), Environmental education, Environmental acts & regulations, role of non-governmental organizations (NGOs), EMS: ISO 14000, Environmental Impact Assessment. Environmental auditing.	
Unit – II	**06 Hrs**
Environmental pollution: Air pollution – point and non point sources of air pollution and their controlling measures (particulate and gaseous contaminants). Noise pollution, Land pollution (sources, impacts and remedial measures). **Water management**: Water conservation techniques, water borne diseases & water induced diseases, arsenic & fluoride problems in drinking water and ground water contamination, advanced waste water treatment techniques.	
Unit -III	**06 Hrs**
Waste management, Solid waste management, e waste management & biomedical waste management – sources, characteristics & disposal methods. Concepts of Reduce, Reuse and Recycling of the wastes. **Energy** – Different types of energy, conventional sources & non conventional sources of energy, solar energy, hydro electric energy, wind energy, Nuclear energy, Biomass & Biogas Fossil Fuels, Hydrogen as an alternative energy.	
Unit –IV	**05 Hrs**
Environmental design: Principles of Environmental design, Green buildings, green materials, Leadership in Energy and Environmental Design (LEED), soilless cultivation (hydroponics), organic farming, use of biofuels, carbon credits, carbon foot prints, Opportunities for green technology markets, carbon sequestration.	
Unit –V	**04 Hrs**
Resource recovery system: Processing techniques, materials recovery systems, biological conversion (composting and anaerobic digestion). Thermal conversion products (combustion, incineration, gasification, pyrolysis, use of Refuse Derived Fuels). Case studies of Biomass conversion, e waste.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Identify the components of environment and exemplify the detrimental impact of anthropogenic activities on the environment.
CO2:	Differentiate the various types of wastes and suggest appropriate safe technological methods to manage the waste.
CO3:	Aware of different renewable energy resources and can analyse the nature of waste and propose methods to extract clean energy.
CO4:	Adopt the appropriate recovering methods to recover the essential resources from the wastes for reuse or recycling.

Text Books	
1	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

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

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

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

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

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

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

High-3: Medium-2: Low-1

IV Semester **ENGINEERING ECONOMY & COSTING** **(Theory)**						
Course Code	**:**	**18IM43**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L**		**SEE Duration**	**:**	**03 Hours**

Course Learning Objectives (CLO): Students are expected to	
1.	To inculcate an understanding of concept of money and its importance in the evaluation of projects.
2.	Analyze the present worth of an asset.
3.	Evaluate the alternatives based on the Equivalent Annual Worth.
4.	Illustrate concept of money and its importance in evaluating the projects.

Unit – I	**07 Hrs**
Introduction: Principles of Engineering Economy, Engineering Decision- Makers, Engineering and Economics, Problem solving and Decision making, Intuition and Analysis, Tactics and Strategy. **Interest and Interest Factors**: Interest rate, Simple interest, Compound interest, Cash- flow diagrams, Exercises and Discussion. Overview of Depreciation and Inflation.	
Unit – II	**11 Hrs**
Present worth comparison : Conditions for present worth comparisons, Basic Present worth comparisons, Present worth equivalence, Net Present worth, Assets with unequal lives, infinite lives, Future worth comparison, Pay – back comparison, Exercises, Discussions and problems.	
Unit – III	**11Hrs**
Equivalent annual worth comparisons: Equivalent Annual Worth Comparison methods, Situations for Equivalent Annual Worth Comparison Consideration of asset life, Comparison of assets with equal and unequal lives, Use of sinking fund method, Exercises, Problems. **Rate of return calculations**: Rate of return, Minimum acceptable rate of return, IRR, IRR misconceptions, Problems.	
Unit – IV	**07 Hrs**
Costing: Objectives of costing, Elements of costing, preparation of cost sheet. **Job Costing:** Introduction, Batch Costing, Process Costing, Cost accumulation in process costing, Activity Based Costing.	
Unit – V	**06 Hrs**
Standard Costing: Components of standard cost, Material cost variance, labour cost variance, overhead cost variance.	

Course Outcomes: After going through this course the student will be able to:	
CO1	Explain the time value of money, and how to sketch the cash flow diagram
CO2	Compare the alternatives using different compound interest factors, Select a feasible alternative based on the analysis.
CO3	Formulate a given problem for decision making
CO4	Select appropriate cost accounting system as per the industries requirement and perform costing.

Reference Books:	
1.	Engineering Economy, Riggs J.L ., 5th Edition, Tata McGraw Hill, ISBN 0-07-058670-5
2.	Engineering Economics, R Panneerselvam, Eastern Economy Edition 2001, PHI, ISBN – 81-203-1743-2.
3.	Cost Accounting, Khan M Y, 2nd Edition, 2000, Tata McGraw-Hill, ISBN 0070402248
4.	Mechanical Estimating & Costing, T.R.Banga, S.C.Sharma, 16th Edition, 2011, Khanna Publishers, ISBN 8174091009

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

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

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

Low-1 Medium-2 High-3

IV Semester						
COMPUTER AIDED DESIGN AND MANUFACTURING (Theory and Practice)						
Course Code	**:**	**18IM44**		**CIE**	**:**	**100 + 50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100 + 50 Marks**
Total Hours	**:**	**40L + 26P**		**SEE Duration**	**:**	**03 + 03 Hours**
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	**08 Hrs**
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.	
UNIT-II	**11 Hrs**
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.	
UNIT-III	**09 Hrs**
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 of automated assembly systems, Parts feeding Devices, Analysis of Single Station Assembly Machine, Analysis of Multi station Assembly machine.	
UNIT-IV	**06 Hrs**
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.	
UNIT-V	**06 Hrs**
Computerized Manufacturing Planning System: Computer Aided Process Planning, Retrieval type, 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.	

Computer Aided Design and 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); Theory (100 Marks)

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

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

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

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

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

Scheme of Semester End Examination (SEE); Practical Exam for 50 Marks

SEE for the practical courses will be based on experiment conduction with proper results, is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

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

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

Low-1 Medium-2 High-3

IV Semester						
DECISION SCIENCES - DETERMINISTIC MODELS (Theory and Practice)						
Course Code	**:**	**18IM45**		**CIE**	**:**	**100 + 50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100 + 50 Marks**
Total Hours	**:**	**40L+ 26P**		**SEE Duration**	**:**	**03 + 03 Hours**

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.

UNIT-I	**08 Hrs**
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. Usage of software tools to demonstrate LPP (demonstrations and assignments only)	
UNIT-II	**09 Hrs**
Simplex Method & Sensitivity Analysis: Simplex methods, Artificial Stating Solution - M Method & Two phase method, Sensitivity Analysis - Graphical sensitivity analysis, Algebraic sensitivity analysis. Interpretation of graphical output from software packages such as MS Excel	
UNIT-III	**09 Hrs**
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, Traveling Salesman Problem. Usage of software tools to demonstrate Transportation and Assignment problems	
UNIT-IV	**08 Hrs**
Project Management Using Network Analysis: Network construction, Determination of critical path and duration, floats, CPM - Elements of crashing, Usage of software tools to demonstrate N/W flow problems	
UNIT-V	**06 Hrs**
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.	

Experiential Learning: Case studies from Interface, International Journal of Operations Research, Mind Blowing & Expanding examples from Frank & Budnik.

Laboratory Work
• Introduction to Operations Research Packages - using MAT Lab, GAMS Excel and TORA • Exercise on application of Operations Research Models to various sector of economy including Manufacturing, Health Care, Infrastructure, Insurance, Banking, Retail, Agriculture and Governance

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand 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 modeling alternatives & select appropriate modeling techniques for a given situation.
CO4	Validate output from model to check feasibility of implementations.

CO5	Create innovative modeling frameworks 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.
5.	Principles, Methodology and Applications of Operations Research, Prof. J Govardhan, 3rd Edition, 2012, JEM Consultants.

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

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

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

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

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

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

Low-1 Medium-2 High-3

IV Semester						
STRENGTH OF MATERIALS and MACHINE DESIGN (Theory)						
Course Code	**:**	**18IM46**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**4:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**52L**		**SEE Duration**	**:**	**03 Hours**
Course Learning Objectives: The students will be able to						
1	Understand mechanics of deformable bodies and apply them in analysis and design problems					
2	Analyse bodies subjected to two-dimensional stress systems.					
3	Understand behavior of structural members in Torsion.					
4	Analyse and quantify the forces, stresses and related parameters which are necessary to design various mechanical systems					

UNIT-I	**08 Hrs**
Review of stress, strain &Elastic Constants: Stress, Strain, relations hipamon, Elastic constants, Volumetric strain. (No questions to beset on these topics) **Two Dimensional Stress System:** Introduction, Stress components on inclined planes, Principal Stresses, Principal planes, Mohr's circle of stress, Numerical problems. **Bending moment and shear force in beams :**Introduction, Types of beams, Loads and Reactions, Shear forces and bending moments, Rate of loading, Sign conventions, Relationship between shear force and bending moments, Shear force and bending moment diagrams subjected to concentrated loads, uniform distributed load (UDL) for different types of beams.(UVL not included)	
UNIT-II	**14 Hrs**
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 (Nonumerical 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. **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.	
UNIT-III	**11 Hrs**
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. **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.	
UNIT-IV	**08 Hrs**
Design of Springs: Types of springs, stresses in helical springs. Tension and compression springs, fluctuating and impact loads. **Design of Spur Gears:** Definition, stresses in gear tooth, Lewis equation, form factor, velocity ratios, types of tooth systems	
UNIT-V	**11 Hrs**
Threaded Fasteners: Stresses in threaded fasteners, effects of initial tension, effect of compression, effect of fatigue loading, shear and impact loading. **Design of Riveted, Welded Joints:** Types of riveted joints, failure of riveted joints, design of boiler joints; Types of welded joints, strength of butt, fillet welds, eccentric loaded welds	

Course Outcomes: After completing the course, the students will be able to	
CO1	Compute the stresses, strains, moments, deflections, etc. and derive the expressions used from the fundamentals.
CO2	Explain the design procedure for specific mechanical elements and sub-systems
CO3	Select materials, sizes and sections for various applications such as beams, shafts, and various mechanical systems and justify the selection
CO4	Design specific mechanical elements based on required specifications

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.	Mechanical Engineering Design, Joseph E Shigley and Charles R. Mischke., 5th Edition, 2003, McGraw Hill International Edition, ISBN: 0070568995
4.	Introduction to Machine Design, V. B. Bhandari, 2nd Edition, 2013, Tata McGraw-Hill Education(India) Private Limited, ISBN (13): 978-1-25-900636-4, ISBN(10): 1-25-900636-0
5.	Design Data Hand Book, K. Mahadevan and K.Balaveera Reddy, CBS Publication, ISBN: 8123923155

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

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

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

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

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

Low-1 Medium-2 High-3

IV Semester						
C PROGRAMMING **Bridge Course** **(Common to all branches)**						
Course Code		**18DCS37/48**		**CIE Marks**	**:**	**50 Marks**
Credits: L:T:P	**:**	**2:0:0**		**SEE Marks**	**:**	**50 Marks**
Audit Course				**SEE Duration**	**:**	**02 Hours**

Course Learning Objectives: The students will be able to

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

Unit – I	**04 Hrs**
Introduction to Reasoning, Algorithms and Flowcharts: Skill development – Examples related to Arithmetical Reasoning and Analytical Reasoning. Fundamentals of algorithms and flowcharts **Introduction to C programming:** Basic structure of C program, Features of C language, Character set, C tokens, Keywords and Identifiers, Constants, Variables, Data types.	
Unit – II	**04 Hrs**
Handling Input and Output Operations Formatted input/output functions, Unformatted input/output functions with programming examples using different input/output functions. **Operators and Expressions** Arithmetic operators, Relational operators, Logical Operators, Assignment operators, Increment and decrement operators, Conditional operators, Bit-wise operators, Arithmetic expressions. Evaluation of expressions, Precedence of arithmetic operators, Type conversion in expressions, Operator precedence and associativity.	
Unit – III	**06 Hrs**
Programming Constructs **Decision Making and Branching** Decision making with 'if' statement, Simple 'if' statement, the 'if…else' statement, nesting of 'if…else' statements, The 'else if' ladder, The 'switch' statement, The '*?:*' operator, The '*goto*' statement. **Decision making and looping** The while statement, The do while statement, The 'for' statement, Jumps in loops**.**	
Unit – IV	**06 Hrs**
Arrays One dimensional arrays, Declaration of one dimensional arrays. Initialization of one dimensional arrays, Two dimensional arrays, Initializing two dimensional arrays. **Character Arrays and Strings** Declaring and Initializing String Variables, Reading Strings from Terminal, Writing strings to screen, String handling functions.	
Unit – V	**08 Hrs**
User-defined functions Need for User Defined Functions, Definition of functions, Return values and their types, Function calls, Function declaration. Examples. **Introduction to Pointers:** Introduction, Declaration and initialization of pointers. Examples **Structures and Unions:** Introduction, Structure and union definition, Declaring structure and union variables, Accessing structure members. Example programs.	

PRACTICE PROGRAMS	
1.	Familiarization with programming environment, concept of naming the program files, storing, compilation, execution and debugging. Taking any simple C- code.(Example programs having the delimeters, format specifiers in printf and scanf)
2.	Debug the errors and understand the working of input statements in a program by compiling the C-code.
3.	Implement C Program to demonstrate the working of operators and analyze the output.
4.	Simple computational problems using arithmetic expressions and use of each operator (+,-,/,%) leading to implementation of a Commercial calculator with appropriate message: a)Read the values from the keyboard b) Perform all the arithmetic operations. c) Handle the errors and print appropriate message.
5.	Write a C program to find and output all the roots if a given quadratic equation, for non-zero coefficients. (Using if…*else* statement).
6a. **6b.**	Write a C program to print out a multiplication table for a given NxN and also to print the sum table using skip count 'n' values for a given upper bound. Write a C program to generate the patterns using for loops. Example: (to print * if it is even number) 1 ** 333 **** 55555
7a. **7b.**	Write a C program to find the Greatest common divisor(GCD)and Least common multiplier(LCM) Write a C program to input a number and check whether the number is palindrome or not.
8.	Develop a C program for one dimensional, demonstrate a C program that reads N integer numbers and arrange them in ascending or descending order using bubble sort technique.
9.	Develop and demonstrate a C program for Matrix multiplication: a) Read the sizes of two matrices and check the compatibility for multiplication. b) Print the appropriate message if the condition is not satisfied and ask user to re-enter the size of matrix. c) Read the input matrix d) Perform matrix multiplication and print the result along with the input matrix.
10.	Using functions develop a C program to perform the following tasks by parameter passing concept: a) To read a string from the user Print appropriate message for palindrome or not palindrome
11a. **11b.**	Write a C program to find the length of the string without using library function. Write a program to enter a sentence and print total number of vowels.
12.	Design a structure 'Complex' and write a C program to perform the following operations: i. Reading a complex number. ii. Addition of two complex numbers. iii. Print the result
13.	Create a structure called student with the following members student name, rollno, and a structure with marks details in three tests. Write a C program to create N records and a) Search on roll no and display all the records. b) Average marks in each test. c) Highest marks in each test

Course Outcomes: After Completing the course, the students will be able to	
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 implement programs for various applications

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

Continuous Internal Evaluation (CIE); Theory (50 Marks)
CIE is executed by way of quizzes (Q), tests (T) and lab practice (P). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks the sum of the marks scored from quizzes would be reduced to 10 marks. The two tests are conducted for 30 marks each and the sum of the marks scored from two tests is reduced to 30. The programs practiced would be assessed for 10 marks (Execution and Documentation).
Total CIE is 10(Q) + 30(T) + 10(P) = 50 Marks.

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

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

High-3: Medium-2 : Low-1

IV Semester						
PROFESSIONAL PRACTICE – I COMMUNICATION SKILLS (Common to all Programmes)						
Course Code	**:**	**18HS49**		**CIE**	**:**	**50**
Credits: L:T:P	**:**	**0:0:1**		**SEE**	**:**	**50**
Total Hours	**:**	**18 hrs /Semester**		**SEE Duration**	**:**	**2 Hours**
Course Learning Objectives: The students will be able to						
1	Understand their own communication style, the essentials of good communication and develop their confidence to communicate effectively.					
2	Manage stress by applying stress management skills.					
3	Ability to give contribution to the planning and coordinate Team work.					
4	Ability to make problem solving decisions related to ethics.					

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

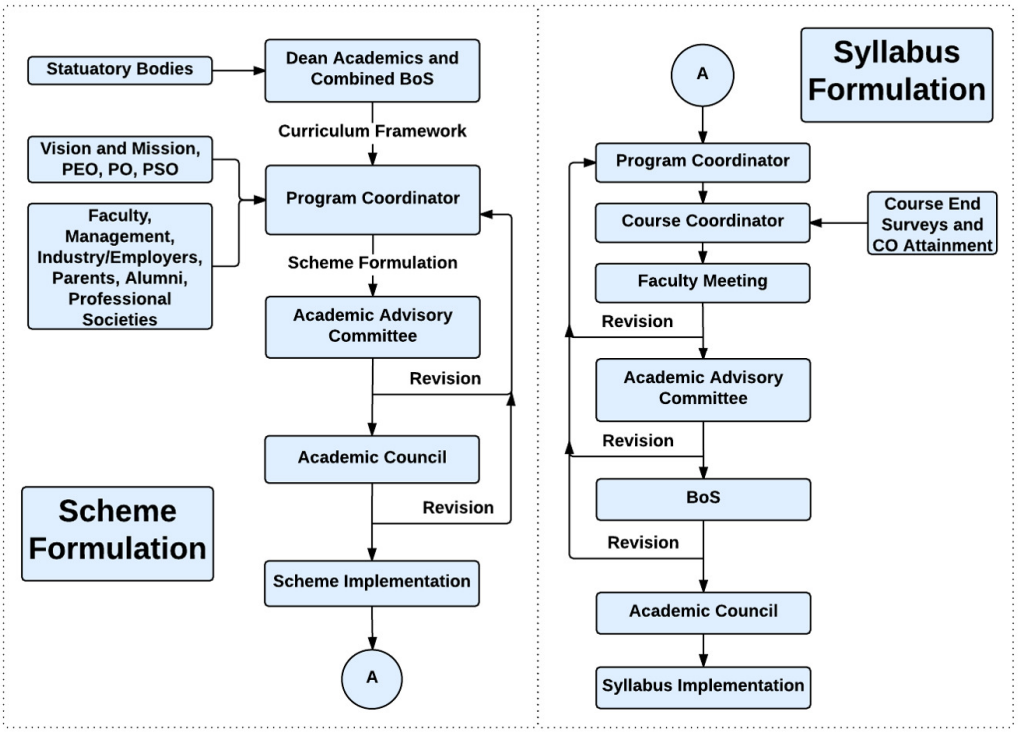
Course Outcomes: After completing the course, the students will be able to	
CO1	Inculcate skills for life, such as problem solving, decision making, stress management
CO2	Develop leadership and interpersonal working skills and professional ethics.
CO3	Apply verbal communication skills with appropriate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

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

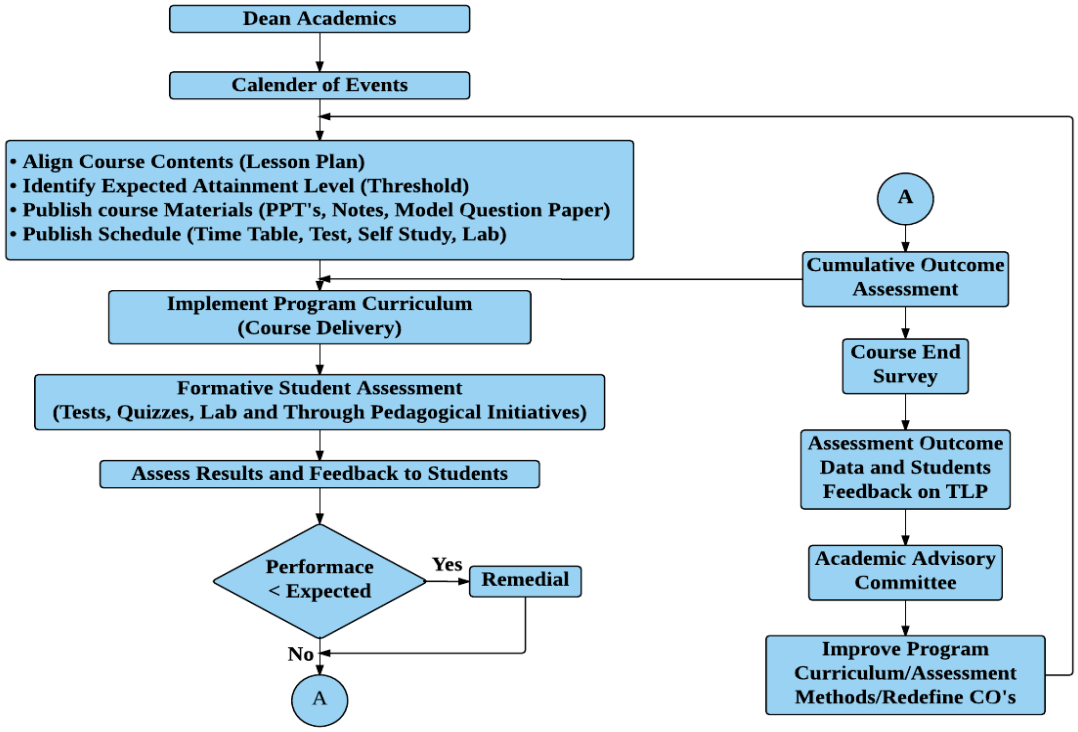
Scheme of Continuous Internal Examination and Semester End Examination

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

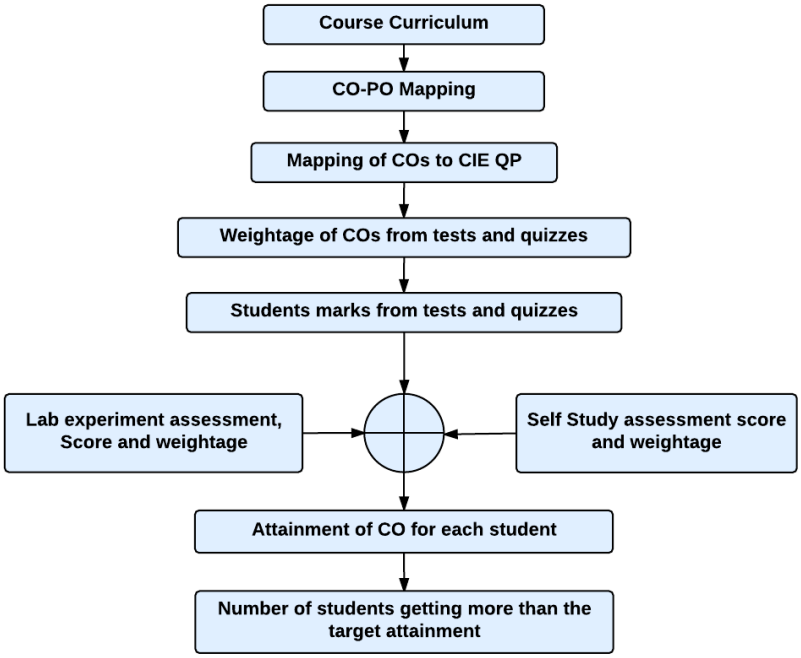
Curriculum Design Process



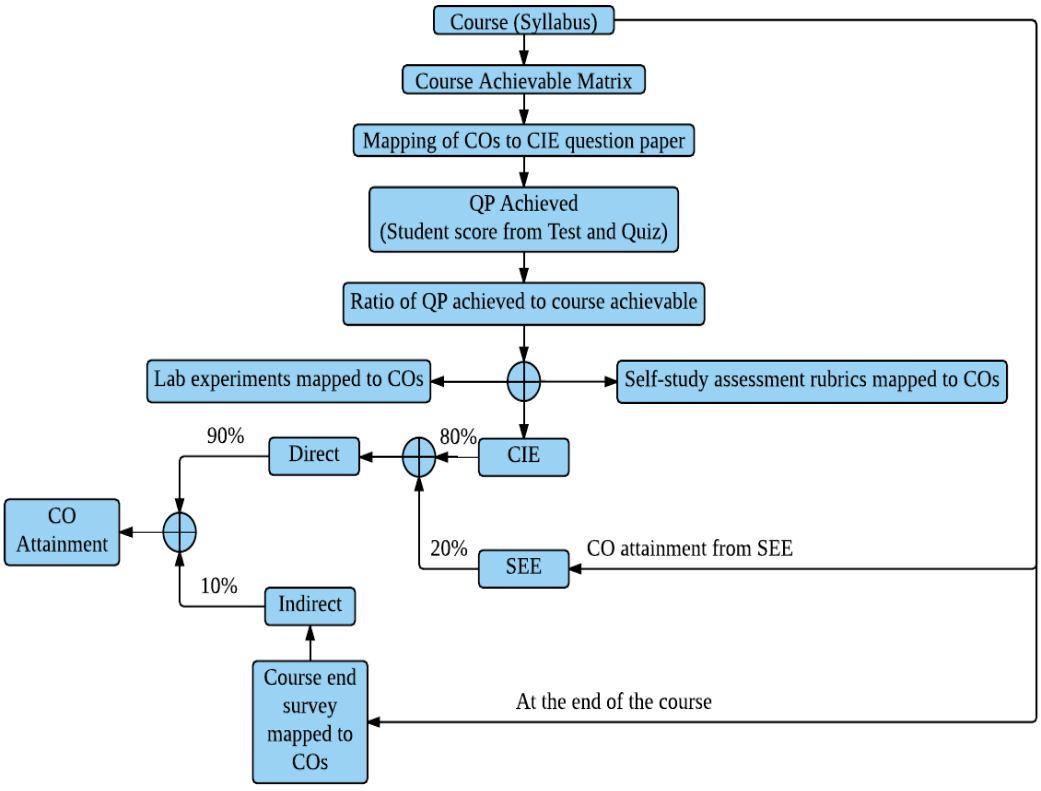
Academic Planning And Implementation



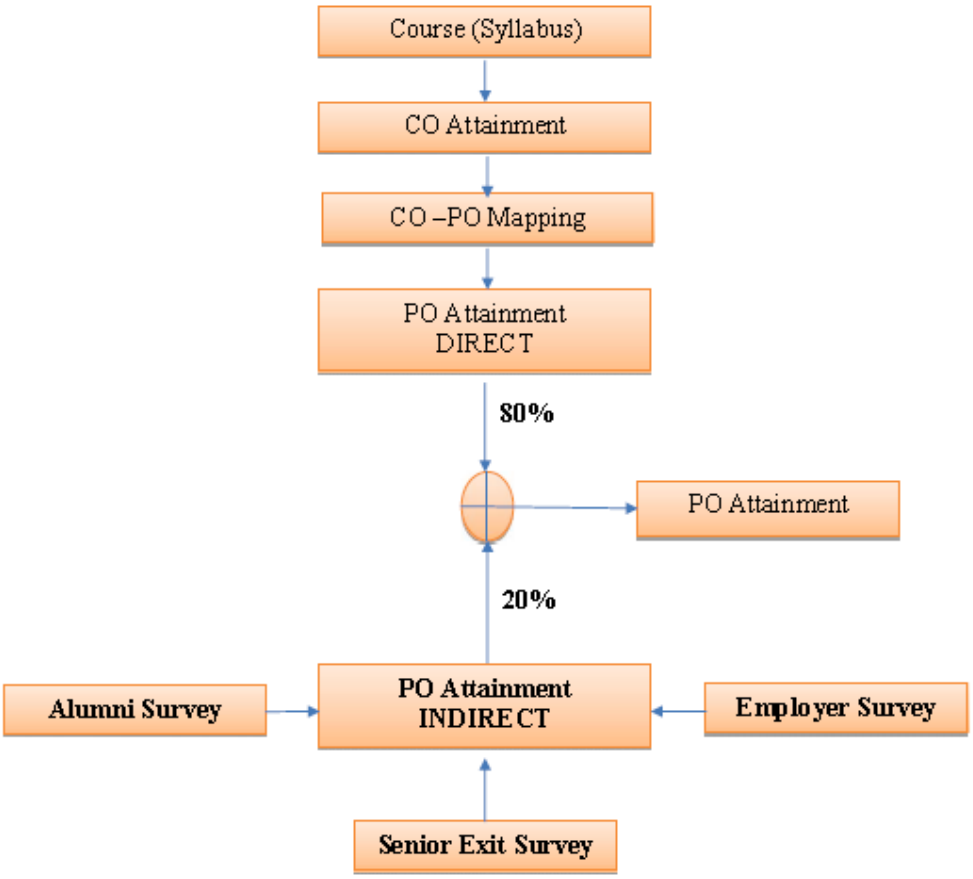
Process For Course Outcome Attainment



Final CO Attainment Process



Program Outcome Attainment Process



PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and Industrial Engineering concepts to the solution of complex engineering problems.

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

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

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

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

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

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

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

PO9. Individual and 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.