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RV COLLEGE OF ENGINEERING®

(An Autonomous Institution Affiliated to VTU, Belagavi)

Approved by AICTE, New Delhi, Accredited By NBA, New Delhi

RV Vidyaniketan Post, 8th Mile, Mysuru Road, Bengaluru - 560 059.



Bachelor of Engineering (B.E)

INDUSTRIAL ENGINEERING & MANAGEMENT

(2018 Scheme)

III & IV Semester

ACADEMIC YEAR 2020-2021

RV COLLEGE OF ENGINEERING®

Estd. 1963

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(An Autonomous Institution Affiliated to VTU, Belagavi)

RV Vidyaniketan Post, 8th Mile, Mysuru Road, Bengaluru- 560 059.

2020
Ranked
70th in
Engineering
Category

One of the most preferred Technical Institutions

Accredited
by
NBA

PROGRAMS OFFERED

B.E. Programs : AS, BT, CH, CS, CV, EC, EE, EI, ET, IM, IS, ME.
M.Tech (16), MCA, M.Sc. (Engg.)

Ph.D. Programs : All Departments are recognized as
Research Centres by VTU

Best NCC Institution for
Karnataka & Goa Directorate
for the year 2017-19

Five RVCE Alumni
cleared civil Services
Exam in 2019-20

Ranked in top 10 Pvt.
College in the country
by various magazines

Ranked 3rd in Sports &
Cultural Activities
under VTU (2018-19)

Use of ICT in Teaching
Learning Process



Holistic development of students through
NCC, NSS Cultural activities, Community
service & Sports.

Established Centre of Excellence in
Microelectronics & Internet of things

MoUs: 96+ with
Industries / Academic
Institutions in India
& abroad

Executed more than Rs. 40
crores worth sponsored
research projects &
consultancy works
since 3 Years

UPSC Results (2019) : RVCE - Alumni

Name : Rahul Sharanappa Shankanur
Rank : 17
Branch : ECE
Batch : 2012

Name : Raghavendra
Rank : 739
Branch : ECE
Batch : 2012

Name : Harshavardhana B.J.
Rank : 352
Branch : CSE
Batch : 2015

Human Resource



RVCE - Greaves Cotton Ltd Centre of excellence in e-mobility



RV-Mercedes Benz Centre for Automotive Mechatronics



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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

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III Semester			
Sl. No.	Course Code	Course Title	Page No.
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3.	18IM33	Principles of Fluid Mechanics & Thermodynamics	5
4.	18IM34	Metrology & Measurements	7
5.	18IM35	Work Systems Design	10
6.	18IM36	Manufacturing Processes	13
7.	18DMA37 ***	Bridge Course Mathematics	16
8.	18HS38 [#]	Kannada	K1-K4

IV Semester			
Sl. No.	Course Code	Course Title	Page No.
1.	18IM41	Engineering Statistics	20
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3.	18IM43	Engineering Economy and Costing	24
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5.	18IM45	Decision Sciences - Deterministic Models	28
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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.	18HS38A / 18HS38V	Kannada Course: AADALITHA KANNADA (18HS38A) / VYAVAHARIKA KANNADA (18HS38V)	HSS	1	0	0	1
		Total Number of Credits		19	01	03	24
		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

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

1. Samskruthika Kannada (AADALITHA KANNADA-18HS38A);
2. Balake Kannada (VYAVAHARIKA KANNADA-18HS38V);

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

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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	

* ENGINEERING MATHEMATICS – IV

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

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Sl.No	COURSE TITLE	COURSE CODE	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, 44 th Edition, 2015, Khanna Publishers, ISBN: 81-7409-195-5.
2	Higher Engineering Mathematics, B.V. Ramana, 11 th Edition, 2010, Tata McGraw-Hill, ISBN: 13-978-07-063419-0; ISBN: 10-0-07-063419-X.
3	Advanced Engineering Mathematics, Erwin Kreyszig, 9 th 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, 6 th 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, 6 th 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, 4 th Edition, 2008, Mc. Graw Hill Book Company, , ISBN0-07-066717-9
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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 Cengal and John M Cimbala, 2 nd Edition, 2006, Tata McGraw Hill publications, ISBN: 978-0-07-070034-5.
2.	A Textbook of Fluid Mechanics, Dr. R.K.Bansal, 1 st Edition, 2008, Laxmi Publications, ISBN8131802949, 9788131802946
3.	Thermodynamics - An Engineering Approach, Yunus A Cengal and Michael A. Boles, 5 th Edition, 2006, Tata McGraw Hill publications, ISBN: 0072884959.
4.	Engineering Thermodynamics, Nag P K, Tata McGraw Hill, 4 th 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: Interferometry, 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/FTIR/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., 17 th edition, 1994, Khanna Publishers, ISBN: 71-7409-024-x
2.	Mechanical Measurements, Beckwith T.G, and N. Lewis Buck, 5 th Edition, 1991, Addison Wesley, ISBN: 81-7808-055-9
3.	Electrical and Electronic Measurements and Instrumentation, A.K.Sawhney, 18 th 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, 4 th revised Edition, 1992, ILO, ISBN: 9221071081.
3.	Motion and Time study for Lean Manufacturing, Fred E. Meyers and James R. Stewart, 3 rd Edition, 2002, Prentice Hall, ISBN: 0-13-031670-9.
4.	Niebel's Methods, Standards, and Work Design, Benjamin W Niebel; Andris Freivalds, 13 th 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-constructural 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: <ol style="list-style-type: none"> Compression/ Shear /Tensile tests Permeability test Grain fineness test 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, 2 nd Edition, 1998, TMH, ISBN: 0-07-463180-2.
2.	Manufacturing Processes, J.P. Kaushish, 2 nd Edition, 2010, PHI Learning Pvt. Ltd, ISBN: 978-81-203-4082-4
3.	Fundamentals of Metal Machining & Machine Tools, G. Boothroyd, 3 rd Edition 2004, Mc Graw Hill, ISBN: 978-1-5-7442659 -3.
4.	Production Technology, HMT, 5 th 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, 44 th Edition, 2015, ISBN: 978-81-933284-9-1.
2	Higher Engineering Mathematics, B.V. Ramana, 11 th 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, 7 th Edition, 2010, ISBN: 978-81-31808320.
4	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 10 th Edition, 2016, ISBN: 978-0470458365.

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

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

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

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

Semester: III					
VYAVAHARIKA KANNADA (Common to all branches)					
Course Code	:	18HS38V		CIE	: 50 Marks
Credits: L:T:P	:	1:0:0		SEE	: 50 Marks
Total Hours	:	16Hrs		CIE Duration	: 90 Minutes
Course Learning Objectives of Vyavaharika Kannada: The students will be able to					
1	Motivate students to learn Kannada language with active involvement.				
2	Learn basic communication skills in Kannada language (Vyavaharika Kannada).				
3	Importance of learning local language Kannada.				
VYAVAHARIKA KANNADA (BALAKE Kannada) (to those students who does not know Kannada)					
Unit-I					4Hrs
Parichaya(Introduction): Necessity of learning local language, Tips to learn the language with easy methods, Hints for correct and polite conversation, History of kannada language.					
Unit – II					4Hrs
Kannada alphabtets and Pronunciation: Kannada aksharmale, Kannada stress letters (vattakshara), Kannada Khagunitha, Pronunciation, memorisation and usage of the Kannada letters.					
Unit – III					4Hrs
Kannada vocabulary for communication: Singular and Plural nouns, Genders, Interrogative words, Antonyms, Inappropriate pronunciation, Number system, List of vegetables, Fractions, Menu of food items, Names of the food items, words relating to time, words relating to directions, words relating to human’s feelings and emotion, Parts of the human body, words relating to relationship.					
Unit –IV					4Hrs
Kannada Grammar in Conversations: Nouns, Pronouns, Use of pronouns in Kannada sentences, Adjectives and its usage, Verbs, Adverbs, Conjunctions, Prepositions, Questions constructing words, Simple communicative sentences in kannada. Activities in Kannada, Vocabulary, Conversation.					
Course Outcomes: After completing the course, the students will be able to					
1	Usage of local language in day today affairs.				
2	Construction of simple sentences according to the situation.				
3	Usage of honorific words with elderly people.				
4	Easy communication with everyone.				
Reference Books:					
1	Vyavaharika Kannada patyapusthaka, L. Thimmesh, and V. Keshavamurthy, Prasaraanga Visveshvaraya University, Belgaum.				
2	Kannada Kali, K. N. Subramanya, S. Narahari, H. G. Srinivasa Prasad, S. Ramamurthy and S. Sathyanarayana, 5 th Edition, 2019, RV College of Engineering Bengaluru.				
3	Spoken Kannada, Kannada Sahithya Parishat, Bengaluru.				

ವ್ಯವಹಾರಿಕ ಕನ್ನಡ (Kannada Version)	
ಅಧ್ಯಾಯ – I	4Hrs
ಸ್ಥಳೀಯ ಅಥವಾ ಪ್ರಾದೇಶಿಕ ಭಾಷಾ ಕಲಿಕೆಯ ಅವಶ್ಯಕತೆ, ಭಾಷಾ ಕಲಿಕೆಯ ಸುಲಭ ವಿಧಾನಗಳು, ಸಂಭಾಷಣೆಗಾಗಿ ಸುಲಭ ಸೂಚ್ಯಗಳು ಕನ್ನಡ ಭಾಷೆಯ ಇತಿಹಾಸ.	
ಅಧ್ಯಾಯ – II	4Hrs
ಕನ್ನಡ ಅಕ್ಷರಮಾಲೆ ಹಾಗೂ ಉಚ್ಚಾರಣೆ: ಕನ್ನಡ ಅಕ್ಷರಮಾಲೆ, ಒತ್ತಕ್ಷರ, ಕಾಗುಣಿತ, ಉಚ್ಚಾರಣೆ, ಸ್ವರಗಳು ಉಚ್ಚಾರಣೆ, ವ್ಯಂಜನಗಳ ಉಚ್ಚಾರಣೆ.	
ಅಧ್ಯಾಯ – III	4Hrs
ಸಂಭಾಷಣೆಗಾಗಿ ಕನ್ನಡ ಪದಗಳು: ಏಕವಚನ, ಬಹುವಚನ, ಲಿಂಗಗಳು (ಸ್ತ್ರೀಲಿಂಗ, ಪುಲ್ಲಿಂಗ) ಪ್ರಶ್ನಾರ್ಥಕ ಪದಗಳು, ವಿರುದ್ಧಾರ್ಥಕ ಪದಗಳು, ಅಸಮಂಜಸ ಉಚ್ಚಾರಣೆ, ಸಂಖ್ಯಾ ವ್ಯವಸ್ಥೆ, ಗಣಿತದ ಚಿಹ್ನೆಗಳು, ಭಿನ್ನಾಂಶಗಳು. ತರಕಾರಿಗಳ ಹೆಸರುಗಳು, ತಿಂಡಿಗಳ ಹೆಸರುಗಳು, ಆಹಾರಕ್ಕೆ ಸಂಬಂಧಿಸಿದ ಪದಗಳು, ಕಾಲ/ಸಮಯಕ್ಕೆ ಸಂಬಂಧಿಸಿದ ಪದಗಳು, ದಿಕ್ಕುಗಳ ಹೆಸರುಗಳು, ಭಾವನೆಗೆ ಸಂಬಂಧಿಸಿದ ಪದಗಳು, ಮಾನವ ಶರೀರದ ಭಾಗಗಳು, ಸಂಬಂಧದ ಪದಗಳು, ಸಾಮಾನ್ಯ ಸಂಭಾಷಣೆಯಲ್ಲಿ ಬಳಸುವಂತಹ ಪದಗಳು.	
ಅಧ್ಯಾಯ – IV	4Hrs
ಸಂಭಾಷಣೆಯಲ್ಲಿ ಕನ್ನಡ ಬಳಕೆ: ನಾಮಪದಗಳು, ಸರ್ವನಾಮಗಳು, ನಾಮವಿಶೇಷಣಗಳು, ಕ್ರಿಯಾಪದಗಳು, ಕ್ರಿಯಾವಿಶೇಷಣಗಳು, ಕನ್ನಡದಲ್ಲಿ ಸಂಯೋಜನೆಗಳು, ಉಪಸರ್ಗಗಳು, ಪ್ರಶ್ನಾರ್ಥಕ ಪದಗಳು, ವಿಚಾರಣೆಯ / ವಿಚಾರಿಸುವ / ಬೇಡಿಕೆಯ ವಾಕ್ಯಗಳು. ಕನ್ನಡದಲ್ಲಿ ಚಟುವಟಿಕೆಗಳು, ಶಬ್ದಕೋಶ, ಸಂಭಾಷಣೆ.	
ವ್ಯವಹಾರಿಕ ಕನ್ನಡದ ಕಲಿಕಾ ಫಲಿತಾಂಶಗಳು :	
CO1:	ನಿತ್ಯ ಜೀವನದಲ್ಲಿ ಆಡುಭಾಷೆಯ ಬಳಕೆ.
CO2:	ಸಂದರ್ಭ, ಸನ್ನಿವೇಶಕ್ಕೆನುಗುಣವಾಗಿ ಸರಳ ಕನ್ನಡ ವಾಕ್ಯಗಳ ಬಳಕೆ.
CO3:	ಗೌರವ ಸಂಬೋಧನೆಯ ಬಳಕೆ.
CO4:	ಇತರರೊಡನೆ ಸುಲಭ ಸಂವಹನ.

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

Continuous Internal Evaluation (CIE); (50 Marks)

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

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

SEE for 50 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 only objective type questions for 40 marks covering the complete syllabus. Part – B consists of essay type questions for 10 marks.

Semester: III					
AADALITHA KANNADA (Common to all branches)					
Course Code	:	18HS38A		CIE	: 50 Marks
Credits: L:T:P	:	1:0:0		SEE	: 50 Marks
Total Hours	:	16Hrs		CIE Duration	: 90 Minutes
ಆಡಳಿತ ಕನ್ನಡ (ಕನ್ನಡಿಗರಿಗಾಗಿ)					
ಆಡಳಿತ ಭಾಷಾ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು: ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ					
1	ಆಡಳಿತ ಕನ್ನಡದ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.				
2	ಕನ್ನಡ ಭಾಷೆಯ ವ್ಯಾಕರಣದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು.				
3	ಕನ್ನಡ ಭಾಷಾ ಬರಹದಲ್ಲಿ ಕಂಡುಬರುವ ದೋಷಗಳು ಹಾಗೂ ಅವುಗಳ ನಿವಾರಣೆ ಮತ್ತು ಲೇಖನ ಚಿಹ್ನೆಗಳನ್ನು ಪರಿಚಯಿಸುವುದು.				
4	ಸಾಮಾನ್ಯ ಅರ್ಜಿಗಳು, ಸರ್ಕಾರಿ ಮತ್ತು ಅರೆಸರ್ಕಾರಿ ಪತ್ರ ವ್ಯವಹಾರದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು.				
5	ಭಾಷಾಂತರ, ಪ್ರಬಂಧ, ರಚನೆ, ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ ಮತ್ತು ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.				
ಅಧ್ಯಾಯ -I					4Hrs
ಕನ್ನಡ ಭಾಷೆ - ಸಂಕ್ಷಿಪ್ತ ವಿವರಣೆ: ಪ್ರಸ್ತಾವನೆ-ಕನ್ನಡ ಭಾಷೆ, ಶ್ರಾವಣ (ಕವನ)- ದ.ರಾ.ಬೇಂದ್ರೆ (ಕವಿ), ಬೆಳ್ಳಿಯ ಹಾಡು (ಕವನ) -ಸಿದ್ದಲಿಂಗಯ್ಯ (ಕವಿ) ಆಡಳಿತ ಭಾಷೆಕನ್ನಡ, ಆಡಳಿತ ಭಾಷೆಯ ಲಕ್ಷಣಗಳು, ಆಡಳಿತ ಭಾಷೆಯ ಪ್ರಯೋಜನಗಳು.					
ಅಧ್ಯಾಯ -II					4 Hrs
ಭಾಷಾ ಪ್ರಯೋಗದಲ್ಲಾಗುವ ಲೋಪದೋಷಗಳು ಮತ್ತು ಅವುಗಳ ನಿವಾರಣೆ: ಪ್ರಸ್ತಾವನೆ- ಕಾಗುಣಿತದ ತಪ್ಪು ಬಳಕೆಯಿಂದಾಗುವ ಲೋಪದೋಷಗಳು ಅಥವಾ ಸಾಧುರೂಪಗಳ ಬಳಕೆ, ಅಲ್ಪ ಪ್ರಾಣ ಮತ್ತು ಮಹಾಪ್ರಾಣಗಳ ಬಳಕೆಯಲ್ಲಿನ ವ್ಯತ್ಯಾಸದಿಂದಾಗುವ ಲೋಪದೋಷಗಳು, ಲೇಖನ ಚಿಹ್ನೆಗಳು, ಕನ್ನಡ ಭಾಷೆಯಲ್ಲಿನ ಲೋಪದೋಷಗಳು ಗೌರವ ಸೂಚಕಗಳ ಬಳಕೆ, ಭಾಷಾ ಬರಹದಲ್ಲಿ ಅನುಸರಿಸಬೇಕಾದ ಇನ್ನಿತರಕ್ರಮ, ಲೇಖನ ಚಿಹ್ನೆಗಳು ಮತ್ತು ಅವುಗಳ ಉಪಯೋಗ.					
ಅಧ್ಯಾಯ -III					4Hrs
ಪತ್ರ ವ್ಯವಹಾರ: ಪ್ರಸ್ತಾವನೆ- ಖಾಸಗಿ ಪತ್ರ ವ್ಯವಹಾರ, ಆಡಳಿತ ಪತ್ರಗಳು, ಅರ್ಜಿಯ ವಿವಿಧ ಬಗೆಗಳು ಮತ್ತು ಮಾದರಿಗಳು.					
ಅಧ್ಯಾಯ -IV					4Hrs
ಪ್ರಬಂಧ, ಸಂಕ್ಷಿಪ್ತ ಪ್ರಬಂಧರಚನೆ ಮತ್ತು ಭಾಷಾಂತರ: ಕನ್ನಡ ಶಬ್ದಸಂಗ್ರಹ, ಜೋಡಿಸುಡಿಗಳು, ಅನುಕರಣಾವ್ಯಯಗಳು, ಸಮಾನಾರ್ಥಕ ಪದಗಳು, ನಾನಾರ್ಥಗಳು, ವಿರುದ್ಧಪದಗಳು, ತತ್ಸಮ-ತದ್ಭವಗಳು, ದ್ವಿರುಕ್ತಿಗಳು, ನುಡಿಗಟ್ಟುಗಳು, ಶಬ್ದಸಮೂಹಕ್ಕೆ ಒಂದು ಶಬ್ದ, ಅನ್ಯದೇಶೀಯ ಪದಗಳು, ದೇಶೀಯಪದಗಳು.					
ಆಡಳಿತ ಕನ್ನಡದ ಕಲಿಕಾ ಫಲಿತಾಂಶಗಳು:					
CO1:	ಕನ್ನಡ ಬರಹದಲ್ಲಿ ವ್ಯಾಕರಣದ ಬಳಕೆ.				
CO2:	ಕನ್ನಡದಲ್ಲಿ ಪತ್ರ ಬರೆಯುವಿಕೆ.				
CO3:	ಕನ್ನಡ ಸಾಹಿತ್ಯ ಹಾಗೂ ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಆಸಕ್ತಿ ಮೂಡುವುದು.				
ಆಧಾರ ಪುಸ್ತಕಗಳು :					
1	ಆಡಳಿತ ಕನ್ನಡ ಪಠ್ಯಪುಸ್ತಕ, ಎಲ್.ತಿಮ್ಮೇಶ್ ಮತ್ತು ವಿ.ಕೇಶವಮೂರ್ತಿ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿದ್ಯಾಲಯ, ಬೆಳಗಾಂ.				
2	ಕನ್ನಡ ಅನುಭವ, ಕೆ.ಎನ್.ಸುಬ್ರಹ್ಮಣ್ಯಂ, ಎನ್.ಎಸ್.ನರಹರಿ, ಎಚ್.ಜಿ.ಶ್ರೀನಿವಾಸಪ್ರಸಾದ್, ಎಸ್.ರಾಮಮೂರ್ತಿ ಮತ್ತು ಎಸ್.ಸತ್ಯನಾರಾಯಣ, 2ನೇ ಮುದ್ರಣ 2019, ರಾ.ವಿ.ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು.				

Continuous Internal Evaluation (CIE); (50 Marks)

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

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

SEE for 50 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 10 marks covering the complete syllabus. Part – B is for 40 marks. It consists of simple grammar and essay type questions.

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, 5 th 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, 4 th Edition, 2007, Asia Student Edition, ISBN: 978-81-265-2315-3.
3.	Statistics for Management, Richard I Levin, David S Rubin, 7 th Edition, 1997, Prentice Hall India, ISBN: 9780134762920.
4.	Probability and Statistics for Engineers and Scientists, Walpole, Myers, Myers, Ye, 8 th 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 ., 5 th 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, 2 nd Edition, 2000, Tata McGraw-Hill, ISBN 0070402248
4.	Mechanical Estimating & Costing, T.R.Banga, S.C.Sharma, 16 th 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, 1 st Edition, 2000, McGraw Hill, ISBN – 0070728577.
2.	Computer Aided Design and Manufacturing, K. Lalit Narayan, K Mallikarjuna Rao & M.M.M Sarcar, 1 st edition, 2008, PHI New Delhi, ISBN-978-81-203-3342-0
3.	Automation, Production System and Computer Integrated Manufacturing, Mikell.P.Groover, 3 rd Edition, 2007, PHI New Delhi, ISBN – 0132393212
4.	CAD / CAM, Mikell. P. Grover & E.W. Zimmer, 2 nd 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 Starting 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	
<ul style="list-style-type: none"> 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.
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Reference Books

1.	Operation Research An Introduction, Taha H A, 8 th Edition, 2004, PHI, ISBN: 0130488089.
2.	Operations Research: Principles and Practice, Ravindran, Phillips, Solberg, 2 nd Edition, 2007, John Wiley & Sons, ISBN8126512563
3.	Introduction to Operation Research, Hiller and Liberman, 8 th Edition, 2004, Tata McGraw Hill, ISBN : 0073017795.
4.	Operations Research Theory and Application, J K Sharma, 2 nd Edition, 2003, Pearson Education Pvt Ltd, ISBN: 0333-92394-4.
5.	Principles, Methodology and Applications of Operations Research, Prof. J Govardhan, 3 rd 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 between them, Elastic constants, Volumetric strain. (No questions to be set 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 (Nonnumerical 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., 5 th Edition, 2003, McGraw Hill International Edition, ISBN: 0070568995
4.	Introduction to Machine Design, V. B. Bhandari, 2 nd 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

Semester: IV					
Design Thinking Lab					
Course Code	:	18IM47		CIE	: 50 Marks
Credits: L:T:P	:	0:0:2		SEE	: 50 Marks
Hours	:	26P		SEE Duration	: 02 Hours
Course Learning Objectives: To enable the students to:					
1	Knowledge Application: Acquire the ability to make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to provide solutions of societal concern				
2	Communication: Acquire the skills to communicate effectively and to present ideas clearly and coherently to a specific audience in both the written and oral forms.				
3	Collaboration: Acquire collaborative skills through working in a team to achieve common goals.				
4	Independent Learning: Learn on their own, reflect on their learning and take appropriate action to improve it.				

Guidelines for Design Thinking Lab:

1. The Design Thinking Lab (DTL) is to be carried out by a team of two-three students.
2. Each student in a team must contribute equally in the tasks mentioned below.
3. Each group has to select a theme that will provide solutions to the challenges of societal concern. Normally three to four themes would be identified by the by the department
4. Each group should follow the stages of Empathy, Design, Ideate, prototype and Test for completion of DTL.
5. After every stage of DTL, the committee constituted by the department along with the coordinators would evaluate for CIE. The committee shall consist of respective coordinator & two senior faculty members as examiners. The evaluation will be done for each student separately.
6. The team should prepare a Digital Poster and a report should be submitted after incorporation of any modifications suggested by the evaluation committee.

The Design Thinking lab tasks would involve:

1. Carry out the detailed questionnaire to arrive at the problem of the selected theme. The empathy report shall be prepared based on the response of the stake holders.
2. For the problem identified, the team needs to give solution through thinking out of the box innovatively to complete the ideation stage of DTL
3. Once the idea of the solution is ready, detailed design has to be formulated in the Design stage considering the practical feasibility.
4. If the Design of the problem is approved, the team should implement the design and come out with prototype of the system.
5. Conduct thorough testing of all the modules in the prototype developed and carry out integrated testing.
6. Demonstrate the functioning of the prototype along with presentations of the same.
7. Prepare a Digital poster indicating all the stages of DTL separately. A Detailed project report also should be submitted covering the difficulties and challenges faced in each stage of DTL.
8. Methods of testing and validation should be clearly defined both in the Digital poster as well as the report.

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

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

Scheme of Evaluation for CIE Marks:

Evaluation will be carried out in three phases:

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

Scheme of Evaluation for SEE Marks:

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

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

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 delimiters, 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.	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.
6b.	Write a C program to generate the patterns using for loops. Example: (to print * if it is even number) 1 ** 333 **** 55555
7a.	Write a C program to find the Greatest common divisor(GCD)and Least common multiplier(LCM)
7b.	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.	Write a C program to find the length of the string without using library function.
11b.	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, 4 th Edition, 2000, Mcgraw Hill Education, ISBN-13: 9780070411838.
4.	Understanding Pointers in C, Yashavant P. Kanetkar, 4 th edition, 2003, BPB publications, ISBN-13: 978-8176563581
5.	C IN DEPTH, S.K. Srivastava, Deepali Srivastava, 3 rd 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				

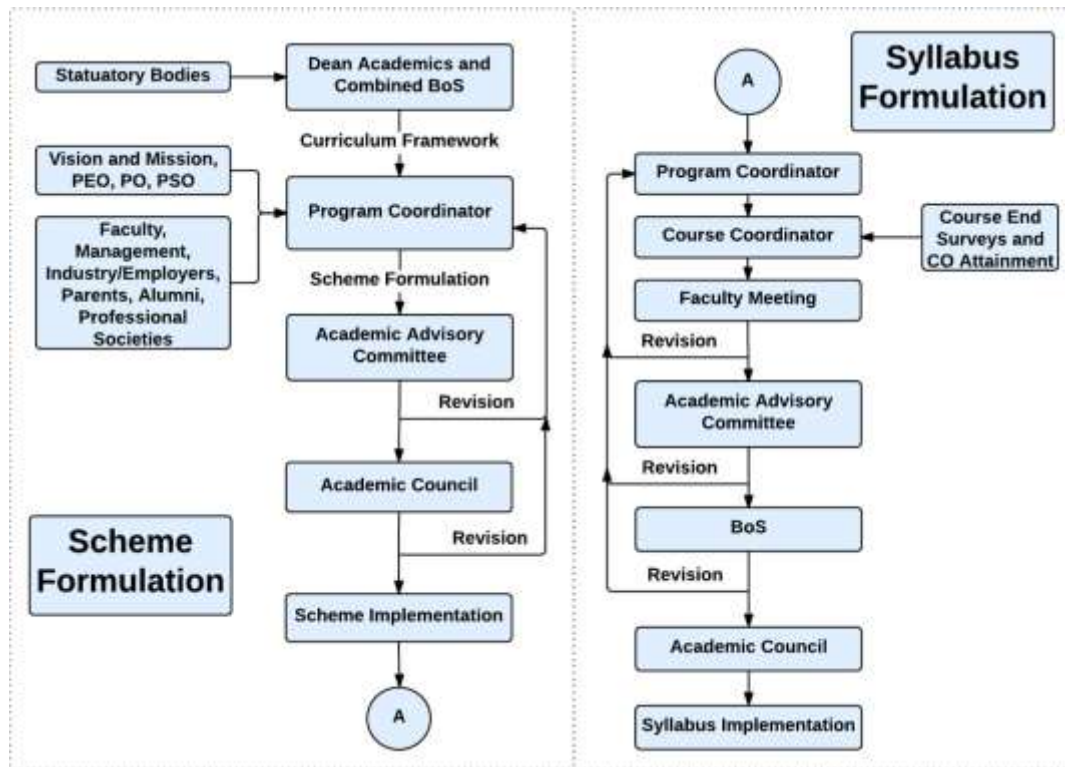
Course Outcomes: After completing the course, the students will be able to	
CO1	Inculcate skills for life, such as problem solving, decision making, stress management
CO2	Develop leadership and interpersonal working skills and professional ethics.
CO3	Apply verbal communication skills with appropriate 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, 1 st 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

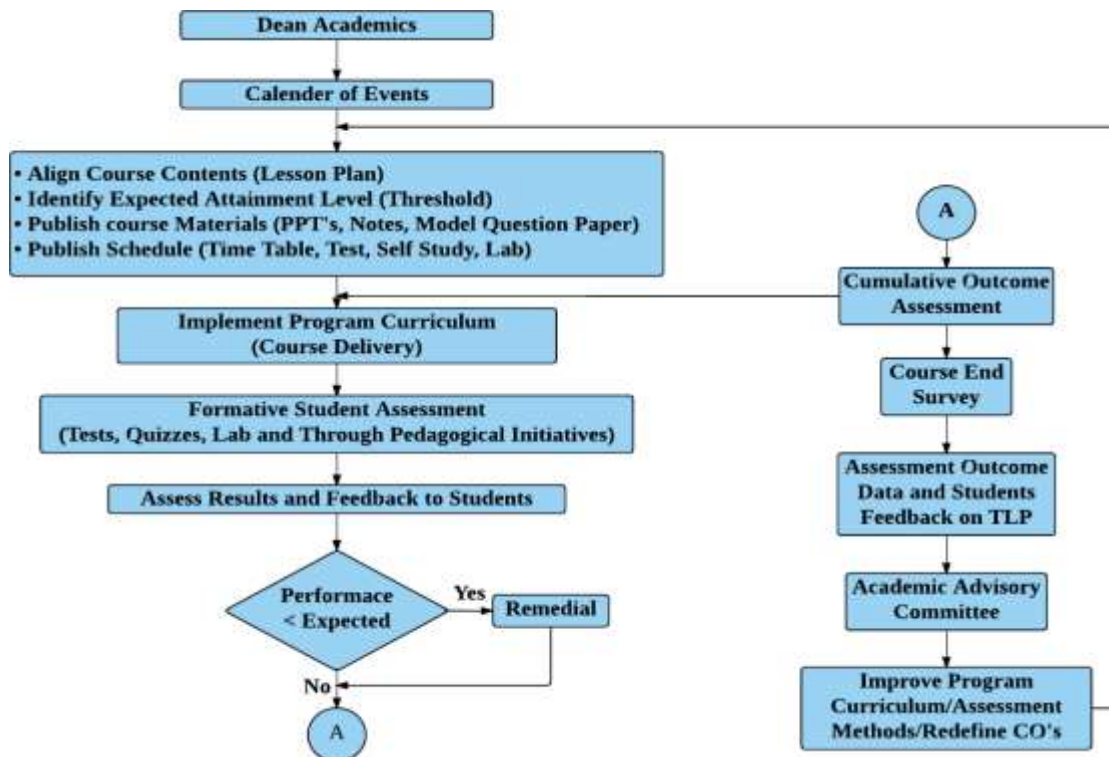
Scheme of Continuous Internal Examination and Semester End Examination

Phase	Activity	Weightage
Phase I III Sem	CIE will be conducted during the 3 rd 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 3 rd 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 4 th 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 4 th 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 (3 rd Sem and 4 th 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 (3 rd Sem and 4 th Sem) is consolidated for 50 marks (Average of CIE 1 and CIE 2 (CIE 1+CIE2)/2.	

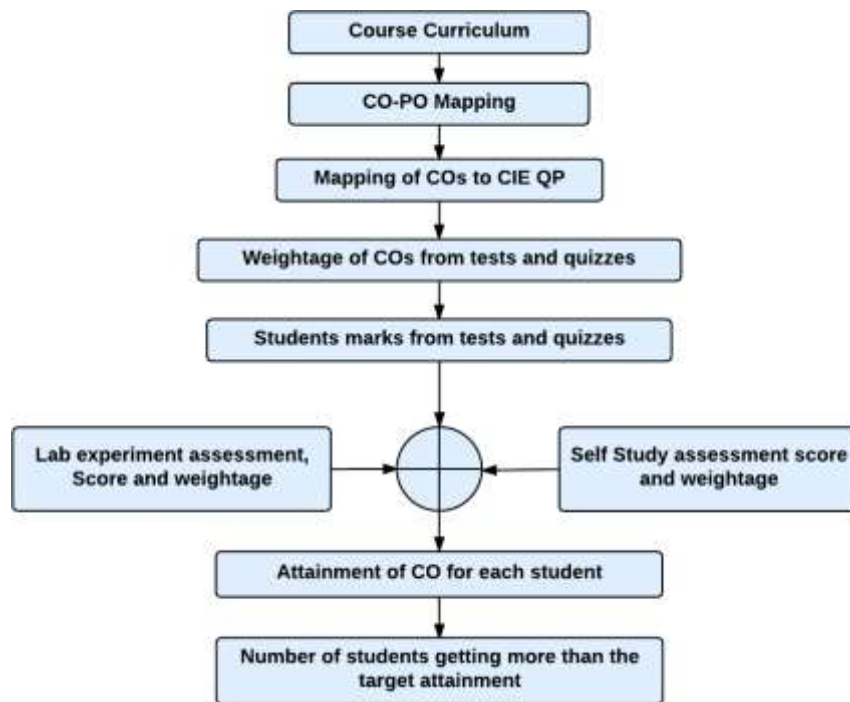
Curriculum Design Process



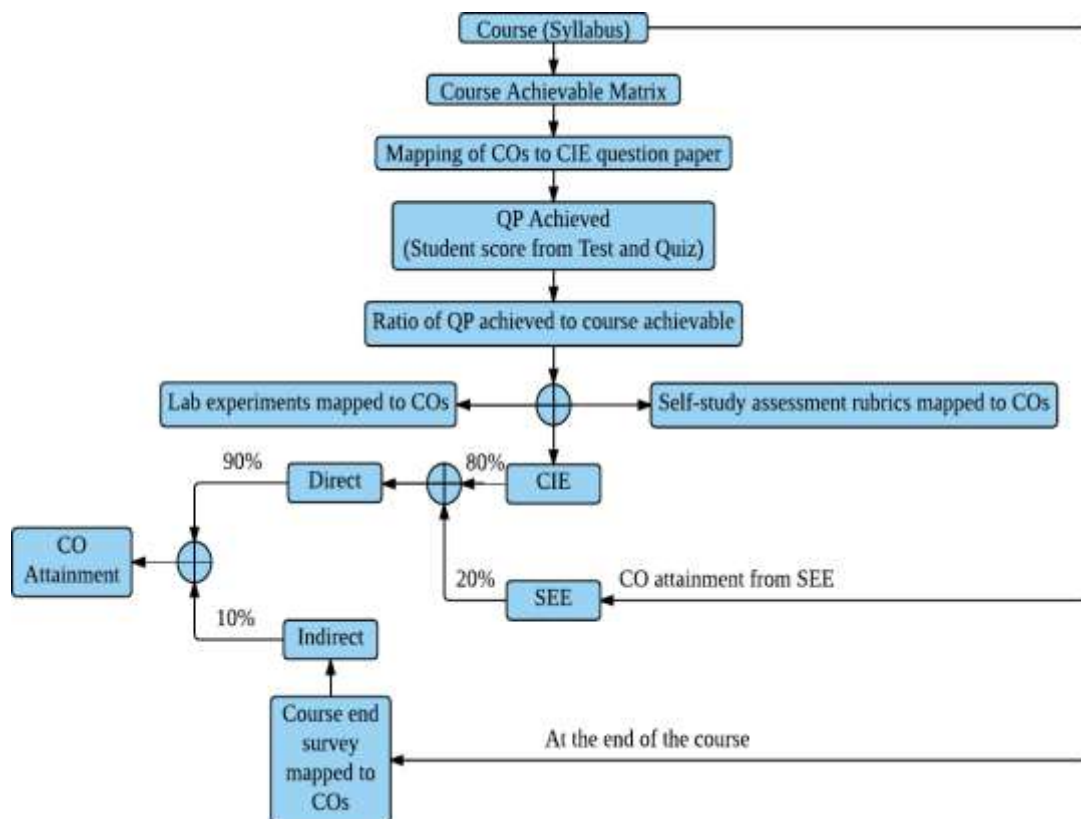
Academic Planning And Implementation



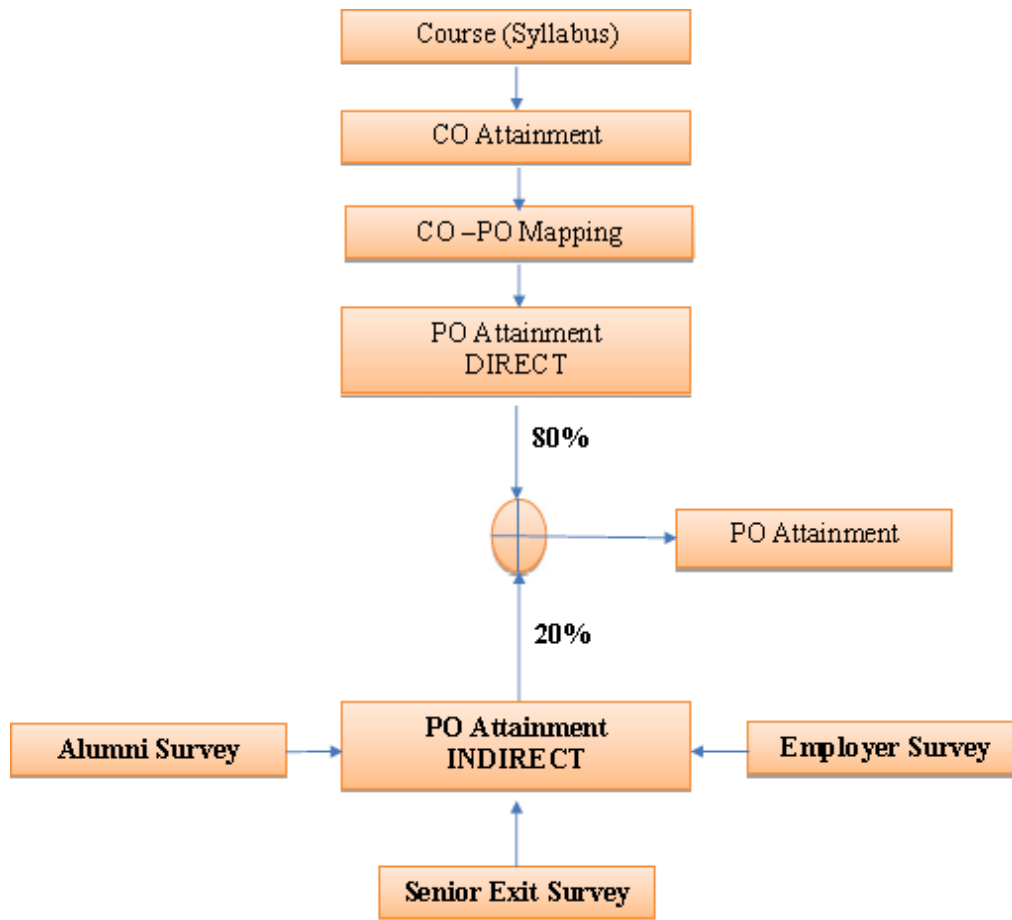
Process For Course Outcome Attainment



Final CO Attainment Process



Program Outcome Attainment Process



INNER BACK COVER PAGE

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.

Innovative Clubs of RVCE

1	Ashwa Racing	Ashwa Mobility Foundation (AMF) is a student R&D platform that designs and fabricates Formula theme race cars and future mobility solutions to tackle urban transportation problems.
2	Astra Robites	Team involved in the design, fabrication and building application specific robots.
3	Coding Club	To facilitate students the skills, confidence, and opportunity to change their world using coding and help them become successful in GSoC, ACM-ICPC, and other recognized coding competitions.
4	Entrepreneurship Development Cell	E-Cell is a student run body that aims to promote entrepreneurship by conducting workshops, speaker sessions and discussions on business and its aspects. We possess a mentor board to help startups grow.
5	Frequency Club	Team aims at contributing in both software and hardware domains mainly focusing on Artificial Intelligence, Machine Learning and it's advances.
6	Garuda	Design and development of supermileage urban concept electric car. Indigenous development of E-mobility products.
7	Jatayu	Build a low cost Unmanned Aerial Vehicle capable of Autonomous Navigation, Obstacle Avoidance, Object Detection, Localization, Classification and Air Drop of a package of optimum weight.
8	Solar Car	Build a roadworthy solar electric vehicle in order to build a green and sustainable environment.
9	Team Antariksh	Team Antariksh is a Space Technology Student Club whose goal is to understand, disseminate and apply the engineering skills for innovation in the field of Space technology. designing Nano-Satellite payload for ISRO PS4 Orbital platform, RVSAT-1 along with developing experimental rockets of various altitude.
10	Team Chimera	Building a Formula Electric Car through Research and Development in E-Mobility. Electrifying Formula Racing.
11	Helios Racing	Team involved in design, manufacturing and testing of All-Terrain Vehicles and other supportive tasks for the functioning of the team. Participating in BAJA competitions organized by SAE in India and the USA.
12	Team Hydra	Developing autonomous underwater vehicles and use it for various real world applications such as water purification, solid waste detection and disposal etc.
13	Team Krushi	Develop low cost equipments, which help farmers in cultivating and harvesting the crops. Use new technology applications to reduce the labour time hand cost for farmers. Aims at developing implants for Tractors.
14	Team vyoma	Design, fabrication and testing of radio controlled aircrafts and research on various types of unmanned aerial vehicles.
15	Team Dhruva	Organizing activities like quizzes based on astronomy.Stargazing and telescope handling sessions.Construction of a standard observatory. working on small projects with organizations like ICTS, IIA, ARIES etc.
16	Ham club	To popularize Amateur Radio as a hobby among students, alongside exploring technical innovations in the communications domain. Intended to provide human capital for service to the nation at times of natural calamities.

NCC



NSS



*"Not me but you"
"Education through
Community Service &
Community Service through education"*

Cultural Activity Teams

1. AALAP (Music club)
2. DEBSOC (Debating society)
3. CARV (Dramatics club)
4. FOOTPRINTS (Dance club)
5. QUIZCORP (Quizzing society)
6. ROTARACT (Social welfare club)
7. RAAG (Youth club)
8. EVOKE (Fashion team)
9. f/6.3 (Photography club)
10. CARV ACCESS (Film-making club)

VISION



Leadership in Technical Education, Interdisciplinary Research & Innovation, with a Focus on sustainable and Inclusive Technologies.

MISSION



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



RV COLLEGE OF ENGINEERING

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