RV COLLEGE OF ENGINEERING®

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

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

2018 SCHEME

CHEMICAL ENGINEERING

VISION

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

MISSION

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

QUALITY POLICY

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

CORE VALUES

Professionalism, Commitment, Integrity, Team Work, Innovation

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2018 SCHEME

DEPARTMENT OF
CHEMICAL ENGINEERING

DEPARTMENT VISION

Imparting quality technical education in Chemical Engineering to promote leadership in research, innovation and sustainable technology through team work.

Department Mission

- Impart quality education in basic and applied areas of Chemical Engineering.
- .Enable students and faculty to achieve proficiency in Chemical Engineering through innovative teaching and state of the art laboratories.
- Encourage faculty and students to make career in research through development of novel process and products.
- Develop inclusive technologies with a focus on sustainability.
- Collaborate with industries and research institute to cater social needs.
- Inculcate leadership qualities, entrepreneurial skills, societal and ethical vaues in students and faculty.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: Exhibit knowledge of basic sciences, concepts and principles of Chemical Engineering.

PEO 2: Comprehend, analyze, design and implement engineering systems with a focus on research, innovation and sustainability.

PEO 3: Work in multidisciplinary team and cater to the needs of process industries with appropriate safety, health and environmental regulations.

PEO 4: Demonstrate effective communication skills, leadership qualities and develop into successful entrepreneurs.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO	Description
PSO1	Gain knowledge of Chemical Engineering fundamentals and demonstrate problem formulation capabilities
PSO2	Analyse and solve engineering problems with a focus on environment and sustainability
PSO3	Contribute to multidisciplinary research using relevant Chemical Engineering tools

ABBREVIATIONS

Sl. No.	Abbreviation	Meaning
1.	VTU	Visvesvaraya Technological University
2.	BS	Basic Sciences
3.	CIE	Continuous Internal Evaluation
4.	SEE	Semester End Examination
5.	CE	Professional Core Elective
6.	GE	Global Elective
7.	HSS	Humanities and Social Sciences
8.	CV	Civil Engineering
9.	ME	Mechanical Engineering
10.	EE	Electrical & Electronics Engineering
11.	EC	Electronics & Communication Engineering
12.	IM	Industrial Engineering & Management
13.	EI	Electronics & Instrumentation Engineering
14.	CH	Chemical Engineering
15.	CS	Computer Science & Engineering
16.	ET	Electronics and 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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RV COLLEGE OF ENGINEERING®

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CHEMICAL ENGINEERING

THIRD SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			**Total Credits**
				L	**T**	**P**	
1.	18MA31C*	Engineering Mathematics - III	MA	4	1	0	**5**
2.	18ME32**	Engineering Materials	ME	2	0	0	**2**
3.	18CH33	Technical Chemistry (Theory & Practice)	CY	4	0	1	**5**
4.	18CH34	Momentum Transfer (Theory & Practice)	CH	4	0	1	**5**
5.	18CH35	Process Calculations (Common to CH & BT)	CH	3	0	0	**3**
6.	18CH36	Chemical Plant Utilities	CH	3	0	0	**3**
7.	18DMA37***	Bridge Course: Mathematics	MA	2	0	0	**0**
8.	18HS38 #	Kannada Course	HSS	1	0	0	**1**
Total Number of Credits				**21**	**1**	**2**	**24**
Total number of Hours/Week				**21+2*** **	**2**	**5**	

*Engineering Mathematics - III

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

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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, CH & IM

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

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

There are two text books prescribed by VTU for the Kannada Course:
1. Samskruthika Kannada (**AADALITHA KANNADA**);
2. Balake Kannada (**VYAVAHARIKA KANNADA**);

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

RV COLLEGE OF ENGINEERING®

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CHEMICAL ENGINEERING

FOURTH SEMESTER CREDIT SCHEME							
Sl. No	**Course Code**	**Course Title**	**BOS**	**Credit Allocation**			**Total Credits**
				L	**T**	**P**	
1.	18MA41C*	Engineering Mathematics-IV	MA	4	1	0	**5**
2.	18BT42A**	Environmental Technology	BT	2	0	0	**2**
3.	18CH43	Process Heat Transfer (Theory & Practice)	CH	3	0	1	**4**
4.	18CH44	Particulate Technology (Theory & Practice)	CH	3	0	1	**4**
5.	18CH45	Thermodynamics (Common to CH & BT)	CH	3	1	0	**4**
6.	18CH46	Chemical Technology	CH	3	0	0	**3**
7.	18CH47	Design Thinking lab	CH	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				**18**	**2**	**5**	**25**
Total number of Hours/Week				**18+2*** **	**4**	**10+1***	

* ENGINEERING MATHEMATICS – IV

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

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

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

Course Learning Objectives: The students will be able to

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

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

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

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

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

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

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

High-3 : Medium-2 : Low-1

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

Course Learning Objectives: The students will be able to

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

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

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

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

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

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

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

High-3 : Medium-2 : Low-1

Semester: III						
TECHNICAL CHEMISTRY (Theory and Practice)						
Course Code	**:**	18CH33		**CIE**	**:**	100 +50Mark
Credits: L: T: P	**:**	4:0:1		**SEE**	**:**	100 +50 Marks
Total Hours	**:**	52L+30P		**SEE duration**	**:**	03Hrs

Course Learning Objectives: The students will be able to

1	To understand basic principles relating to the nature, reactivity, mechanisms, structures and chemical transformations of organic molecules.
2	To study the importance of synthetics reagents and their applications and also to provide the information on therapeutic activity of heterocyclic compounds which are used in drugs.
3	To understand the importance, synthesis and applications of chemicals used in day to day life.
4	To study the importance of synthetics reagents and their applications and also to provide the information on therapeutic activity of heterocyclic compounds which are used in drugs.
5	To learn about the applications of coordination compounds, including catalytic reactions for organic synthesis and polymerization.

UNIT – I	**11 Hrs**

Reaction mechanism:

Electron displacements in organic molecules – inductive, electromeric, mesomeric and hyper conjugative effects – Types of organic reactions- Addition, Substitution, elimination (with one example to each). Reaction mechanism, types of reaction mechanisms and rate equations.
Palladaiumcatalysed C-C Bond formation- Suzuki, Sonogashira reactions with mechanism.
Oxidation of alkenes to alcohols- Oxymercuration and demercuration, hydroboration and oxidation (Markonikoff's and anti-Markonikoff's rules)
Metal hydride reductions- Lithiumaluminium hydride, sodium borohydride.
Nitrogen insertion reactions-Beckmann rearrangement, Hoffman rearrangement
Oxygen insertion reactions- Bayer-Villiger reaction. Safety and environmental aspects regarding the above reagents.

UNIT – II	**11 Hrs**

Active Methylene Compounds:
Preparation, reactivity and applications of Ethyl acetoacetate and Diethyl Malonate.
Heterocyclic Compounds:
Synthesis, properties, importance and applications of Pyrrole (Hantsz synthesis) Thiophene (Paal Knorr synthesis, Hinsberg synthesis), Pyridine (Hantzch synthesis, from acetaldehyde), Indole (Fischer synthesis, Nenitzescu synthesis, Reisert's synthesis), Quinoline (Skraups synthesis, Friedlander synthesis, Conard-Limpach synthesis).

UNIT – III	**11 Hrs**

Chemicals in day to day life:
Dyes: Colour and its relation with electromagnetic radiation, chromophore, chromogen and auxochrome. Modern theory of colour and constitution. Classification based on structure and methods of application. Preparation of azo dyes-congo red and methylorange. Triphenylmethyl dyes-malachite green and phenolphthalein. Anthraquinone dyes-alizarin and indigo dye. Structure and applications of Fluorescein, Rhodamine, Squarain, Phthalocyanine dyes.

Soaps and detergents: Manufacture of soap by Kettle process; Types of soaps - Liquid soaps, Toilet soaps-opaque and transparent; Mechanism of cleansing action of soap. Synthetic detergents – Ionic detergents-anionic and cationic; Nonionic detergents with examples. Difference between soaps and detergents.

Insecticides: Definition, Classification synthesis, governing factors, uses, limitations of organophosphate (malathion), N-methyl carbamate (Carbaryl), Neo-nicotinoid (Imidacloprid)

and Cyclopentadienes (Dialdrin). Hazards and environmental Safety aspects of insecticides and pesticides. **Drugs:** Synthesis and uses of paracetamol, sulphanilamide and Ibuprofen. Antihistamines – their meaning and examples. Safety and environmental aspects of dyes, insecticides and drugs and remedial measures.

UNIT – IV	**10 Hrs**
Natural products: **i) Alkaloids** Introduction, Occurrence, General properties, Extraction. Nicotin-Occurrence, Isolation and Synthesis. Conine-Occurrence, Isolation, Properties. Quinine and Morphine-Structure and uses. **ii) Terpinoids** Introduction, Classification, Isolation, Isoprene rule, General properties. Citral-Isolation, Properties,uses and Synthesis. Limonene-Isolation, Uses and Synthesis. Camphor-Structure and Synthesis. Menthol-Occurrence, Structure, Properties and Uses. **iii) Steroids** Introduction and Occurrence. Cholesterol-Structure and Importance.	
UNIT – V	**9 Hrs**
Coordination chemistry: Introduction-coordinate bond and ligands, stability of coordination compounds. Isomerism in coordination compounds. Theories of coordination compounds- valence bond theory, crystal field theory and ligand field theory. Electronic and magnetic properties of coordination compounds. Biological systems and coordination chemistry. Applications of coordination compounds as dyes, in polymer synthesis and in catalysis (Ziegler, walker and Oxo processes) and in medicine.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the basic principles of organic/inorganic reactions and their mechanisms.
CO2:	Applying the knowledge of organic/inorganic chemistry in solving societal, public health and environmental issues
CO3:	Analyzing the chemical engineering problems related with chemistry and to propose solutions
CO4:	Developing solutions for problems associated with synthetic organic chemistry, dyes, soaps, detergents, insecticides and metal organics.

Reference Books	
1	Organic Chemistry, Morrison and Boyd,7th Edition, 2010, Pearson Education India; ISBN-13: 978-8131704813
2	Heterocyclic Chemistry, Raj K Bansal, 4th revised Edition, 2008,Anshan Ltd, ISBN 13: 978-1848290013
3	Advanced Organic Chemistry, ArunBahl and B.S. Bahl, S. Chand & Company Ltd, 2014, ISBN 13: 9788121935159.
4	Inorganic chemistry, J E Huheey, E A Keiter, R L Keiter Harper and Row publisher 4th Edition, 1997, ISBN-13:978-0471199571.

Laboratory Component	
1	Preparation of acetanilide from aniline and cauterization by IR spectroscopy.
2	Preparation of m-dinitrobenzene from nitrobenzene.
3	Preparation of benzoic acid from benzaldehyde.
4	Preparation of 7-hydroxy-4-methyl coumarin and to monitor the reaction by TLC
5	Estimation of purity of phenol by bromination method.
6	Estimation of amino group and number of amino groups by acetylation
7	Estimation of Alcohol Content in Wine by acetylation method.
8	Estimation of Nickel in steel by gravimetric method.
9	Preparation of cobalt (II) complex and its structural characterization using UV-Vis spectrophotometer.
10	Preparation of nickel (II) chloride complex and its characterization through conductivity measurements.

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

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

High-3: Medium-2 : Low-1

.Semester: III						
MOMENTUM TRANSFER (Theory and Practice)						
Course Code:	**:**	18CH34		**CIE**	**:**	100+50Marks
Credits: L:T:P:	**:**	4:0:1		**SEE**	**:**	100 +50 Marks
Total Hours:	**:**	52L+30P		**SEE Duration**	**:**	03+03 Hours

Course Learning Objectives: The students will be able to	
1	Explain variations of pressure in static fluids
2	Classify various types of fluid and explain its flow behavior
3	Understand the nature of fluid flow in different conduits, packed columns and open channels
4	Predict time of emptying tanks
5	Measure flow rates using appropriate measuring instruments
6	Explain the application and functions of pumps
7	Obtain functional relationships using dimensional analysis

UNIT-I	**11 Hrs**
FLUID STATICS AND ITS APPLICATIONS: Introduction to Unit operations, Concept of Momentum Transfer, Nature of fluids and pressure concept, Variation of pressure with height – hydrostatic equilibrium, Barometric equation, Measurement of fluid pressure – manometers. Decanter, Continuous gravity decanter, Centrifugal decanter **FLUID FLOW PHENOMENA:** Types of fluids – shear stress and velocity gradient relation, Newtonian and non – Newtonian fluids, Viscosity of gases and liquids. Types of flow – laminar and turbulent flow. Reynolds number, Boundary layer separation and wake formation.	
UNIT-II	**10 Hrs**
Basic Equations of Fluid Flow: Average velocity, Mass velocity, Continuity equation, Euler and Bernoulliequations, Modified equations for real fluids with correction factors. **Flow of Incompressible Fluids in Conduits and Thin Layer**: Laminar flow through circular and non-circular conduits, Hagen Poiseuille equation. Turbulent flow. Friction factor charts, friction due to change in velocity or direction. Calculation of Frictional losses and Pump work using Bernoulli equation	
UNIT-III	**10 Hrs**
Flow of Fluids Past Immersed Bodies: Pressure drop studies in packed bed –Ergun, Kozeny-Carman and Blake-Plummer Equations, Fluidization, Conditions for fluidization, Minimum fluidization velocity, Types of fluidization, Applications of fluidization, Slurry transport, Pneumatic conveying **Introduction to Unsteady State Flow**: Time to empty the liquid from a tank, Rectangular, Cylindrical(Horizontal and Vertical) and Hemi spherical.	
UNIT-IV	**10Hrs**
Transportation and Metering of Fluids: Pipes, Fitting and valves, Measurement of liquid and gas flow ratesby Pitot tube, Orifice meter, Venturi meter and Rota meter. Flow through open channels–weirs and notches. Performance characteristics of pumps–positive displacement and centrifugal pumps. Fans, Compressor and Blowers	
UNIT-V	**11Hrs**
Dimensional Analysis: Dimensional homogeneity, Rayleigh's and Buckingham π– methods. Significance of different dimensionless numbers. Elementary treatment of similitude between model and prototype. **Flow of Compressible Fluids:** Continuity equation, Concept of Mach number, Total energy balance, Velocityof sound, Ideal gas equations. Flow through variable-area conduits. Adiabatic frictional flow. Isothermal frictional flow (elementary treatment only)	

LABORATORY EXPERIMENTS
1. Flow through circular pipes
2. Flow through helical coils
3. Flow measurement using Venturi meter
4. Flow measurement using Orifice meter
5. Local velocity measurement using Pitot tube
6. Flow over notches
7. Determination of Hydraulic coefficients
8. Flow through Packed bed
9. Flow through Fluidized bed
10. Performance study of centrifugal pump
11. Flow through pipe fittings
12. Flow measurement of compressible fluids
13. Performance study of Air lift pump
14. Performance study of Positive displacement pump
15. Flow through non circular pipes

Course Outcomes: After completing the course, the students will be able to	
CO1	Recall the concepts of fluid statics and dynamics.
CO2	Explain the fundamental equations of fluid flow.
CO3	Analyze the flow behavior in various geometries and packed columns
CO4	Apply fluid flow principles in flow measurement, power required for transportation and energy losses.

Reference Books	
1.	Unit Operations of Chemical Engineering, McCabe and Smith W.L., 7th Edition, 2007, McGraw Hill, New York. ISBN 13: 9789339213237
2.	Chemical Engineering, Coulson J.M. and Richardson J.F., Vol.2, 5th Edition, 2003, Asian Books (P) Ltd., New Delhi. ISBN 10: 0080379575
3.	Introduction to Chemical Engineering, Badger W.I. and Banchero J.T., 7th Edition, 2007, Tata McGraw Hill, New York. ISBN 13: 978-0070029958
4.	Engineering Fluid Mechanics, Kumar K.I., 3rd Edition, 2009, Eurasia Publishing House (P) Ltd., New Delhi. ISBN 8121901006

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	1	1	1	1	1	-	1	1	-	-	-	1
CO2	1	1	1	1	1	-	1	1	-	-	-	1
CO3	3	3	3	3	3	-	1	1	-	-	-	1
CO4	3	3	3	3	3	-	1	1	-	-	-	1

High-3: Medium-2 : Low-1

Semester: III						
PROCESS CALCULATIONS (Theory) (Common to CH & BT)						
Course Code	**:**	18CH35		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	39L		**SEE Duration**	**:**	3 Hrs.

Course Learning Objectives: The students will be able to	
1	Convert units from one system to the other.
2	Make material balances for unit operations and processes.
3	Make material balances for systems with bypass, recycle and recycle with purge
4	Calculate the adiabatic reaction temperatures/theoretical flame temperatures

UNIT-I	**7 Hrs**
Units and Dimensions: Fundamental and derived units, inter conversion of units from one system to another (FPS, CGS, MKS, SI).Conversion of equations **Basic Chemical Calculations:** Concept of mole. Expressions for composition of mixtures of solids, liquids and gases, percentage by weight, mole and volume. Composition of mixtures and solutions-Normality, Molarity, Molality and ppm. Concentration scales based on specific gravity-Baume, Twaddle, Brix and API gravity scales	
UNIT-II	**8 Hrs**
Vapor Pressure: Definition of vapor pressure, partial pressure, relative saturation, % saturation, humidity, molal humidity, relative humidity, % humidity, Psychrometry. Simple problems solving using psychrometric charts. Evaporation and condensation processes **Material balance without reaction:** Introduction to material balances, general material balance techniques for material balance without reaction, problems on mixing, distillation	
UNIT-III	**8 Hrs**
Material balance without reaction: Extraction, crystallization, evaporation, absorption and leaching **Material balance Involving Chemical reactions:** Principles of Stoichiometry, definitions of limiting and excess reactants, fractional and percentage conversion, yield and selectivity **Fuels and combustion:** Ultimate and proximate analyses of fuels. Problems based on various unit processes(excluding combustion problems)	
UNIT-IV	**8 Hrs**
Material balances with and without reactions involving bypass, recycle and purging.	
UNIT-V	**8 Hrs**
Energy Balance: General energy balance equation for steady state. Thermo physics and Thermo chemistry, heat capacity, estimation of heat capacity for solids, liquids, gases and their mixtures. Standard heat of formation, standard heat of reaction, standard Heat of combustion, and calorific value of fuels. Calculation of ΔHR at elevated temperatures. Adiabatic reaction temperature and adiabatic flame temperature and their calculations	

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the unit conversions, basic principles of unit operations and processes
CO2	Recall the fundamentals of unit operation, processes and their calculations
CO3	Apply the conservation principles to solve problems.
CO4	Analyze the unit operations and processes to carry out material and energy balance.

Reference Books	
1.	Stoichiometry, Bhatt B. I., Vora S. M., 4th Edition,2004, Tata McGraw Hill Publishing Ltd., New Delhi , ISBN 0-07-462039-8
2.	Chemical Process Principles Part I , Material and Energy Balances, Hougen O. A., Waston K.M. and Ragatz R.A. 2nd Edition, 2004, CBS Publishers and distributors, New Delhi, ISBN-81-239-0953-5
3.	Basic Principles and Calculations in Chemical Engineering, Himmelblau D.M., 6th Edition, 2002, Prentice Hall of India, New Delhi, ISBN-81-203-1145-0
4.	Bioprocess Engineering Basic Concepts, Shuler M.L., and Kargi F., 2nd Edition, 2002, Prentice Hall of India, New Delhi, ISBN-0130819085

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											
CO2	1		2	2			1			2	2	
CO3	1							2	2	2	1	
CO4	1	2				2						2

High-3: Medium-2 : Low-1

Semester: III						
CHEMICAL PLANT UTILITIES (Theory)						
Course Code	**:**	18CH36		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	39L		**SEE Duration**	**:**	3.00 Hours

Course Learning Objectives: The students will be able to

1	Understand the need for various utilities in a chemical plant.
2	Describe the role of various utilities in process industry.
3	Explain the importance of heating, cooling and gas handling devices for a chemical plant.
4	Describe the functions of each utility in a plant.

Unit-I	**08 Hrs**
Introduction **Utilities:** Different utilities, Role of utilities in process plant operations and criteria for selection and estimation of suitable utilities. **Water:** Water resources, Process water, Cooling water, Drinking water and boiler feed water quality standards, Types and selection of pumps, piping and accessories. **Air:** Compressed air, Blower air, Fan air, Types of compressor and vacuum pumps and selection, Power requirements, Performance and related calculations.	
Unit – II	**08 Hrs**
Steam and Power Steam generation in chemical plants. Types of boilers and waste heat boilers. Fuels-types and characteristics, Calorific value, Proximate and ultimate analysis, cogeneration power plants. Boiler performance related calculations. Economy of steam generation with different fuels, related calculation	
Unit –III	**08 Hrs**
Refrigeration and Insulation Different refrigeration systems and their characteristics, Air-conditioning systems. Coefficient of performance, Power requirements and refrigeration effect- related calculations for each type of refrigeration system, Refrigerant properties and selection. Insulation materials, selection, economics of insulation, Insulating factors, Properties and classification, Cold insulation and cryogenic insulation.	
Unit –IV	**08 Hrs**
Compressors and Vacuum Pumps Types of compressors and vacuum pumps and their performance characteristics. Methods of vacuum development and their limitations, materials handling under vacuum, piping systems, lubrication and oil removal in compressors in pumps.	
Unit –V	**07 Hrs**
Air and Water Cooling Types of air coolers, construction and working of air coolers, cooling towers working principle, operating principles of cooling towers, types of cooling tower and their operation, hot water distribution systems, air flow distribution systems	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Recall the utilities necessary for chemical plant.
CO2:	Explain the energy utility requirement and material properties to safeguard chemical plants.
CO3:	To gain knowledge on heating, cooling and air conditioning systems.
CO4:	Identify and use utility equipment in process industries.

Reference Books	
1	Industrial Hazards and Plant Safety, Banerjee S, 1st Edition, 2002, CRC press, ISBN: 1560320699
2	Basic Refrigeration and Air Conditioning, P N Ananthanarayanan, 4th Edition, 2013, McGraw Hill Education (India) Private Limited, ISBN: 9383286563
3	Mass Transfer Operations, Robert Treybal, 3rd Edition, 2017, McGraw Hill Education, ISBN: 1259029158
4	Securing Utility and Energy Infrastructures, Larry Ness, 1st Edition, 2006, Wiley-Inter science, ISBN: 047170525X

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

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

High-3: Medium-2 : Low-1

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

Course Learning Objectives: The students will be able to

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

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

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

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

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

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

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

Semester: III

VYAVAHARIKA KANNADA
(Common to all branches)

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

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

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

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

Unit-I — **4Hrs**

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

Unit – II — **4Hrs**

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

Unit – III — **4Hrs**

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

Unit –IV — **4Hrs**

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

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

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

Reference Books:

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

ವ್ಯಾವಹಾರಿಕ ಕನ್ನಡ (Kannada Version)

ಅಧ್ಯಾಯ – I — **4Hrs**

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

ಅಧ್ಯಾಯ – II	**4Hrs**

ಕನ್ನಡ ಅಕ್ಷರಮಾಲೆ ಹಾಗೂ ಉಚ್ಚಾರಣೆ:

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

ಅಧ್ಯಾಯ – III	**4Hrs**

ಸಂಭಾಷಣೆಗಾಗಿ ಕನ್ನಡ ಪದಗಳು:

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

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

ಅಧ್ಯಾಯ – IV	**4Hrs**

ಸಂಭಾಷಣೆಯಲ್ಲಿ ಕನ್ನಡ ಬಳಕೆ:

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

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

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

Continuous Internal Evaluation (CIE); (50 Marks)

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

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

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

AADALITHA KANNADA
(Common to all branches)

ಆಡಳಿತ ಕನ್ನಡ (ಕನ್ನಡಿಗರಿಗಾಗಿ)

ಆಡಳಿತ ಭಾಷಾ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು: ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ

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

ಆಡಳಿತ ಕನ್ನಡ
(ಕನ್ನಡ ಕಲಿತವರಿಗೆ)

ಅಧ್ಯಾಯ –I	**4Hrs**

ಕನ್ನಡ ಭಾಷೆ – ಸಂಕ್ಷಿಪ್ತ ವಿವರಣೆ:

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

ಅಧ್ಯಾಯ –II	**4 Hrs**

ಭಾಷಾ ಪ್ರಯೋಗದಲ್ಲಾಗುವ ಲೋಪದೋಷಗಳು ಮತ್ತು ಅವುಗಳ ನಿವಾರಣೆ:

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

ಅಧ್ಯಾಯ –III	**4Hrs**

ಪತ್ರ ವ್ಯವಹಾರ:

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

ಅಧ್ಯಾಯ –IV	**4Hrs**

ಪ್ರಬಂಧ, ಸಂಕ್ಷಿಪ್ತ ಪ್ರಬಂಧರಚನೆ ಮತ್ತು ಭಾಷಾಂತರ:

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

ಆಡಳಿತ ಕನ್ನಡದ ಕಲಿಕಾ ಫಲಿತಾಂಶಗಳು:

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

ಆಧಾರ ಪುಸ್ತಕಗಳು :

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

Continuous Internal Evaluation (CIE); (50 Marks)

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

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

SEE for 50 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 10 marks covering the complete syllabus. Part – B is for 40 marks. It consists of essay type questions. Student has to answer any 4 questions out of 5 questions, each question carries 10 marks.

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

Course Learning Objectives: The students will be able to

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

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

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

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

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

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

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

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

High-3 : Medium-2 : Low-1

Semester IV						
ENVIRONMENTAL TECHNOLOGY (Theory) (Common to CV, ME, IM, CH, BT & AS)						
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.

Reference 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
3	G. Tyler Miller (Author), Scott Spoolman (Author), (2012) Environmental Science – 15th Edition, Publisher: Brooks Cole, ISBN-13: 978-1305090446 ISBN-10: 130509044
4	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

Semester: IV						
PROCESS HEAT TRANSFER (Theory and Practice)						
Course Code	**:**	18CH43		**CIE**	**:**	100+50 Marks
Credits: L:T:P	**:**	3:0:1		**SEE**	**:**	100+50 Marks
Total Hours	**:**	39L+30P		**SEE Duration**	**:**	03+03 Hours
Course Learning Objectives: The students will be able to						
1	Recognize modes of heat transfer					
2	Explain heat flux, thermal resistances and temperature profiles for various geometries					
3	Predict and estimate the properties, heat transfer co-efficient and dimensions of components of heat exchange equipment					
4	Select appropriate materials, geometry and flow pattern in various heat transfer applications					
5	Design heat transfer equipments and components for various applications					

UNIT-I	**8Hrs**
Introduction: Various modes of heat Transfer. Conduction, Convection and Radiation **Conduction:** Fourier's law, Steady state unidirectional heat flow through single and multiple layer slabs,cylinders & spheres for constant and variable thermal conductivity compound walls. **Insulation:** Properties of insulation materials. Types of insulation, Critical and optimum thickness ofinsulation	
UNIT-II	**8Hrs**
Unsteady State Conduction: Elementary treatment of 1-Dimensional and 2-Dimensional problems .Lumped heat parameter model, Heat Transfer through infinite slabs. **Extended Surfaces:** Fins- Types of fins-Derivation of fin efficiency for longitudinal fins. Fin effectiveness. **Convection:** Individual and Overall heat transfer coefficients- LMTD, LMTD correction factor, Dimensionalnumbers-Dimensional analysis. Empirical correlations for forced and natural convection. Analogy between momentum and heat transfer-Reynold, Coulborn, Prandtl analogies	
UNIT-III	**7Hrs**
Heat Transfer with Phase Change: Boiling phenomenon, nucleate boiling and film boiling, Condensation-Film and drop wise condensation. Nusselt's equation. **Heat Transfer Equipment:** Double pipe heat exchanger. Shell and tube heat exchangers. Types of shell andtube heat exchangers, Construction details, Condensers, type of condensers. **Design of Heat Transfer Equipment:** Elementary design of double pipe heat exchanger. Shell and tube heatexchanger and condensers.	
UNIT-IV	**8Hrs**
Evaporators: Types of evaporators, Performance of tubular evaporator- evaporator capacity, evaporator economy, Methods of feeding, Effect of Liquid head and boiling point elevation on capacity. Vapor compression evaporators	
UNIT-V	**8Hrs**
Radiation: Properties and definitions-Absorptivity-Reflectivity-Emissivity-Emissive power and intensity of radiation-Black body radiation-Gray body radiation- Stefan-Boltzmann law, Weins displacement law, Kirchoff's law, View factors, Radiation between surfaces	
LABORATORY EXPERIMENTS	
1. Natural Convection in Bare Tube 2. Natural Convection in Tubes with Fins 3. Vertical Condenser 4. Horizontal Condenser. 5. Shell and Tube Condenser 6. Emissivity Determination 7. Packed Bed Heat Transfer	

8. Double Pipe Heat Exchanger.
9. Heat Transfer in Jacketed Vessel
10. Transient Heat Conduction
11. Insulation Thickness
12. Heat Transfer in Fluidized Bed
13. Evaporator
14. Heat Transfer in jacketed vessel

Course Outcomes: After completing the course, the students will be able to	
CO1	Define and describe various modes of heat transfer
CO2	Evaluate the heat flux, thermal resistances and temperatures at various locations
CO3	Predict and estimate properties, heat transfer co-efficient of Heat Exchangers,
CO4	Design heat transfer equipments and components for various applications

Reference Books	
Title, Author, Edition, year, publisher, ISBN	
1.	Unit Operations of Chemical Engineering, McCabe and Smith W.L., 7th Edition, 2007,McGraw Hill, New York, ISBN: 0072848235,
2.	Unit Operations of Chemical Engineering, Coulson J.M and Richardson J.F., Vol.1, 6th Edition, 2006, Indian Reprint Elsevier New Delhi, ISBN: 9780080131856
3.	Process Heat Transfer, Kern D.Q., 7th Edition 2004, McGraw Hill, New York,. ISBN: 0070341907
4.	Heat Transfer, Rao Y.V.C., 1st Edition, 2010, Universities Press (India) Ltd., New Delhi, ISBN:9780072848236

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 marksis executed by means of an examination. The Question paper for the course contains two parts, Part A and Part B. Part A consists of objective type questions for 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	3	3	-	1	1	1	1	-	-	-	-
CO2	3	3	1	-	1	1	1	1	-	-	-	1
CO3	3	3	1	3	3	1	-	-	-	-	-	1
CO4	3	3	1	3	3	1	-	-	-	-	-	-

High-3 : Medium-2 : Low-1

Semester: IV						
PARTICULATE TECHNOLOGY (Theory and Practice)						
Course Code	**:**	18CH44		**CIE**	**:**	100+50Marks
Credits: L:T:P	**:**	3:0:1		**SEE**	**:**	100+50Marks
Total Hours	**:**	39L+30P		**SEE Duration**	**:**	03+03 Hours

Course Learning Objectives: The students will be able to	
1	Analyze particle size of coarse, medium and fine sized particles
2	Choose appropriate equipment for size reduction and estimate power requirements
3	Determine the settling velocity of particles in fluids and design thickeners
4	Select suitable filtration equipment
5	Estimate power requirements for agitation and mixing equipment and analyze conveying equipment

UNIT-I	**08 Hrs**
Particle Characterization: Particle shape and size, shape factor and sphericity. Standard screens, differential andcumulative sieve analysis, Number of particles and specific surface of mixture of particles. Screens – ideal and actual screens, Effectiveness of screen, industrial screening equipment, Motion of screen, Grizzly, Gyratory screen, Vibrating screen, Trommels, Sub sieve analysis – Air permeability method, Sedimentation and elutriation methods.	
UNIT-II	**08 Hrs**
Size Reduction: Forces and criteria for communition, characteristics of comminuted products. Laws of sizereduction, Work Index. Methods of operating crushers – Free crushing, Choke feeding, Open circuit grinding, Closed circuit grinding, Wet and dry grinding, Equipments for size reduction – Jaw crusher, Gyratory crusher, Smooth roll crusher, Impactor, Attrition mill, Ball mill- Critical speed of ball mill, Ultra fine grinders, Fluid energy mill, Colloid mill, Cutters – Knife cutter. **Storage and conveying of solids**: Open and closed storage, Bulk and bin storage of solids. Belt conveyors, chin conveyors, Screw conveyors, hydraulic conveyors, pneumatic conveying. Principle and operation of all the above conveyors	
UNIT-III	**08 Hrs**
Motion of Particles through Fluids: Mechanics of particle motion, equation for one dimensional motion of particles through a fluid in gravitational and centrifugal field. Terminal velocity, Drag coefficient, Motion of spherical particles in Stoke's region, Newton's region and Intermediate region, Criterion for settling regime, Hindered settling, Modification of equation for hindered settling. Equal settling velocity of particles, problems of separation according to size.. **Sedimentation:** Batch settling test, Application of batch settling test to design of a continuous thickener, Coe and Clevenger theory, Kynch theory Thickener design. Flocculation and Flocculating agents.	
UNIT-IV	**08 Hrs**
Filtration: Classification of filtration, Batch and continuous filtration, pressure and vacuum filtrationConstant rate, constant pressure filtration characteristics of filter media, industrial filters, Plate and Frame filter press, leaf filter, Rotary drum filter. Filter aids, Principles of cake filtration, Modification of Kozeny – Carman Equation for filtration. Estimation of cake resistance and medium resistance. Washing of filter cakes. **Mechanical Separations:** Magnetic separation, electrostatic separation, Jigging, Heavy media separation,Froth floatation, additives used during flotation, Floatation cells, Cyclones and hydro cyclones.	
UNIT-V	**07 Hrs**
Agitation and mixing: Application of agitation, Agitation equipment, Types of impellers – Propellers,Paddles and Turbines, Flow patterns in agitated vessels, Prevention of swirling, Standard turbine design, Power correlation and power calculation, Mixing of solids, Types of mixers – Change can mixers, Muller mixers, Mixing index, Ribbon blender, Internal screw mixer, Tumbling	

mixer. **Size enlargement** (only principles) – Flocculation, Briquetting, Pelletization. Granulation.
LABORATORY EXPERIMENTS
1. Particle Size Analysis using Sieves 2. Screen effectiveness studies 3. Particle Size Analysis using Air Elutriator 4. Particle Size Analysis using ICI sedimentation 5. Particle Size Analysis using Beaker decantation 6. Determination of Specific surface area using Air permeability set up 7. Size reduction using Ball mill 8. Size reduction using Jaw crusher 9. Size reduction using Drop weight crusher 10. Batch Sedimentation Test and thickener design. 11. Separation of solids using Cyclone 12. Heavy media Separation using Froth floatation cell 13. Determination of specific cake and medium resistance using Leaf filter 14. Determination of specific cake and medium resistance using Plate and frame filter press. 15. Determination of Grindability Index 16. Determination of Viscosity of oil using settling

Course Outcomes: After completing the course, the students will be able to	
CO1	Characterise particles using size distribution techniques
CO2	Chose equipment and methods for size reduction, conveying, separation and mixing of particles.
CO3	Estimate the settling velocity, energy requirements for size reduction, mixing and thickener size.
CO4	Analysis of motion of particles through fluids, filtration characteristics and filtration equipment.

Reference Books	
1.	Unit Operations of Chemical Engineering, McCabe and Smith W.L., 7th Edition, 2007, McGraw Hill, International, New York, *ISBN*-13: 978-0072848236
2.	Introduction to Chemical Engineering, Badger W.L., and Banchero J.T, 7th Edition, 2005, McGraw Hill, International Edition, Singapore, *ISBN*-13: 978-0070850279
3.	Chemical Engineering Vol. II, Coulson J.M. and Richardson J.F., 5th Edition, 2002, Asian Books Pvt. Ltd. New Delhi, *ISBN*-9780750644440
4.	Unit Operations, Brown G.G., 1st Edition , 2009, CBS Publishers, New Delhi, *ISBN* 13: 9788123910994

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

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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 marksis executed by means of an examination. The Question paper for the course contains two parts, Part A and Part B. Part A consists of objective type questions for 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	**1**											
CO2	**1**		**2**	**2**			**1**			**2**	**2**	
CO3	**1**							**2**	**2**	**2**	**1**	
CO4	**1**	**2**				**2**						**2**

High-3 : Medium-2 : Low-1

Semester: IV						
THERMODYNAMICS (Theory) (Common to CH &BT)						
Course Code	**:**	18CH45		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	3:1:0		**SEE**	**:**	100 Marks
Total Hours	**:**	39L+24T		**SEE Duration**	**:**	3 Hrs

Course Learning Objectives: The students will be able to	
1	Explain the principles of thermodynamics for ideal and non ideal liquids,
2	Analyse the fundamental equations governing thermodynamics: e.g., the Maxwell equations, equations of state.
3	Perform energy balances on process systems recognizing the constraints implied by the second law
4	Perform feasibility studies on chemical engineering processes
5	Evaluate the application of fugacity and activity coefficients

UNIT-I	**9 Hrs**
Introductory Concepts of Thermodynamic Systems and variables: Work, Heat, Internal Energy, Enthalpy, Thermodynamic Equilibrium, Intensive and extensive property, state and path function, Reversible and Irreversible Processes, Phase-Rule, Significance of Chemical Engineering Thermodynamics, Statement for Laws of Thermodynamics. **First Law:** Cyclic process, Closed and Open Systems, Steady flow process Work done in various processes. **Equations of State:** Ideal gas law, Vanderwaals, Virial, RedlichKwong, equation of state.	
UNIT-II	**8 Hrs**
The Second Law of Thermodynamics: Statement, heat engines, heat pumps, mathematical statement for second law, Clausius and Kelvin's inequality, Carnot cycle, Calculation of ideal work, lost work. **Maxwell Relations and Fluid Properties relations:** Relations for Internal energy, Enthalpy, Entropy. Gibbs Helmhlotz equation, Clausius, ClausiusClapeyron equation	
UNIT-III	**8 Hrs**
Vapour-Liquid Equilibria (VLE): P-x-y, T-x-y, x-y diagrams, positive and negative deviation from ideality, Azeotropes. Raoult's Law, Henrys Law, Modified Raoult's Law **Single Phase Mixtures and Solutions:** Gibbs-Duhem Equation, Partial molar properties, Chemical Potential, Criteria for Thermodynamic Equilibrium. **Non-ideal Solutions**: Residual property and Excess Properties, Fugacity, fugacity coefficient, Methods for estimation of fugacity, Activity, Activity Coefficient.	
UNIT-IV	**7 Hrs**
Solution thermodynamics Applications, Liquid phase properties from VLE data, Models for excess Gibbsenergy: Vanlaar, Margules, Wilson, Wohls Three suffix equation, Consistency test for VLE data. **Chemical Reaction Equilibria:** The reaction coordinate, application of equilibrium criteria to chemicalreactions, The standard Gibbs-Energy Change and the Equilibrium constant, Effect of temperature on the equilibrium constant, evaluation of equilibrium constants, Relation of equilibrium constants to composition, equilibrium conversions for single reactions, phase rule and Duhem's theorem for reacting system.	
UNIT-V	**7 Hrs**
Gibbs free energy Applications: Photosynthesis, glycolysis, oxidative phosphorylation and ATP hydrolysis, substrate cycling, Donnan equilibrium, Enzyme substrate interaction, Molecular pharmacology, Hemoglobin, ELISA, DNA, Polymerase chain reaction, free energy of transfer of amino acids, Protein solubility & stability, protein dynamics.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Recall the Laws of thermodynamics and evaluate the heat, work, entropy, internal energy inter-conversions for various processes
CO2	Evaluate the thermodynamic properties for real gases using various equations of state and establish the thermodynamic relations
CO3	Evaluate the thermodynamic properties of pure substances, solutions (two phase) and mixtures involving reactions
CO4	Formulate the thermodynamic properties for equipment design

Reference Books	
	Title, Author, Edition, year, publisher, ISBN
1.	Introduction to Chemical Engineering Thermodynamics J Smith.M. and Vanness H.C., 7th Edition, 2005, McGraw Hill, New York, ISBN:978-0071247085
2.	Chemical Engineering Thermodynamics, Rao Y.V.C., 2nd Edition, 4th Reprint, 2009, New Age International Publication, Nagpur,.ISBN. 9788173714610
3.	Textbook of Chemical Engineering Thermodynamics, Narayanan K.V., 3rd Edition, 8th Reprint, 2006, Prentice Hall of India Private Limited, New Delhi, ISBN 978-8120347472
4.	Engineering Thermodynamics, Nag P.K., 3rd Edition, 2007, Tata McGraw Hill Book Co., New Delhi, ISBN: 978-125906256
5	Biological Thermodynamics, Donald T Hayne., 2nd edition, 2008, Cambridge University Press, ISBN:978-0-521-88446-4

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.

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

SEE for 100 marksis executed by means of an examination. The Question paper for the course contains two parts, Part A and Part B. Part A consists of objective type questions for 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	**2**	**2**	**2**	**1**	**1**							
CO2	**2**	**2**	**2**	**1**	**2**							
CO3	**2**	**2**	**2**									
CO4	**1**	**1**		**2**	**2**							

High-3 : Medium-2 : Low-1

Semester: IV						
CHEMICAL TECHNOLOGY (Theory)						
Course Code	**:**	18CH46		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	39L		**SEE Duration**	**:**	3.00 Hours

Course Learning Objectives: The students will be able to

1	Apply the knowledge of basic engineering to understand unit operations used in the chemical industry.
2	To acquire a basic knowledge of unit process to develop process flow diagrams.
3	Distinguish manufacture methods based on engineering problems and yield of products.
4	Develop simple process plant lay-outs for industry.

Unit-I	**07 Hrs**
Introduction: Symbols, Flow sheeting and PI Diagram. **Chloro-Alkali Industries:** Sodium Chloride, Soda ash, Caustic soda and Chlorine. **Industrial Gases:** Carbon dioxide, Hydrogen, Oxygen and Nitrogen.	
Unit – II	**08 Hrs**
Acids and Soap Industries **Acids :** Sulfuric acid, Nitric acid, Hydrochloric acid and Phosphoric acid by electric furnace method. **Soaps and detergents :** Soaps and detergents, manufacture of soaps and heavy duty detergents, linear alkyl benzenes (LAB).	
Unit –III	**09 Hrs**
Fertilizers: Ammonia, Urea, Ammonium Nitrate, Ammonium Phosphate, Ammonium Sulfate, DAP, Super phosphate and Triple Super Phosphate	
Unit –IV	**07 Hrs**
Sugar and Starch Industries: Production of cane sugar, chemistry of starch. Manufacturing of industrial starch and its applications.	
Unit –V	**08 Hrs**
Polymer and Paper Manufacture: **Polymers and Rubber:** PVC, natural rubber, synthetic rubber and rubber compounding. **Pulp and paper:** Raw materials, manufacture of pulp, paper and structural boards.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Recall the fundamentals of unit operations and unit processes
CO2:	Explain process flow sheet for important industrial chemicals
CO3:	Analyze processes for challenges and engineering problems
CO4:	Compare manufacture processes and provide recommendations for the best process

Reference Books	
1	Shreve's Chemical Process Industries, Austin T George, 5th Edition, 2017, Mc. Graw Hill, ISBN: 1259029455
2	Dryden's Outlines of Chemical Technology, M. GopalaRao Marshall Sittig, 2nd Edition, 1997, East-West Press Publications, New Delhi, ISBN: 8185938790.
3	Textbook of Chemical Technology, G.N. Pandey, Vols. II, 2000, Vikas Publishing House Pvt Ltd, ISBN:0706986873
4	Encyclopedia of Chemical Technology, Kirk and Othmer, Vol. 20, 5th Edition, 2006, ISBN: 04711485039.

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 marksis executed by means of an examination. The Question paper for the course contains two parts, Part A and Part B. Part A consists of objective type questions for 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	2	-	-	-	-	-	-	-	-	-	-	1
CO2	1	-	3	-	1	-	1	-	-	1	2	-
CO3	1	-	-	1	-	-	-	-	-	-	2	-
CO4	-	3	-	-	-	-	-	1	1	-	-	-

High-3: Medium-2 : Low-1

Semester: IV						
Design Thinking Lab						
Course Code	**:**	**18CH47**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**0:0:2**		**SEE**	**:**	**50 Marks**
Hours	**:**	**26P**		**SEE Duration**	**:**	**02 Hours**

Course Learning Objectives: To enable the students to:	
1	***Knowledge Application:*** Acquire the ability to make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to provide solutions of societal concern
2	***Communication:*** Acquire the skills to communicate effectively and to present ideas clearly and coherently to a specific audience in both the written and oral forms.
3	***Collaboration:*** Acquire collaborative skills through working in a team to achieve common goals.
4	***Independent Learning:*** Learn on their own, reflect on their learning and take appropriate action to improve it.

Guidelines for Design Thinking Lab:

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

The Design Thinking lab tasks would involve:

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

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

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

Scheme of Evaluation for CIE Marks:

Evaluation will be carried out in three phases:

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

Scheme of Evaluation for SEE Marks:

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

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

Semester: IV						
C PROGRAMMING **Bridge Course** **(Common to all branches)**						
Course Code	**:**	18DCS48		**CIE Marks**	**:**	**50**
Credits: L:T:P	:	2:0:0		**SEE Marks**	**:**	**50**
Audit Course				**SEE Duration**	**:**	**2.00 Hours**

Course Learning Objectives: The students will be able to

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

Unit – I	**4 Hrs**
Introduction to Reasoning, Algorithms and Flowcharts: Skill development – Examples related to Arithmetical Reasoning and Analytical Reasoning. Fundamentals of algorithms and flowcharts **Introduction to C programming:** Basic structure of C program, Features of C language, Character set, C tokens, Keywords and Identifiers, Constants, Variables, Data types.	
Unit – II	**4 Hrs**
Handling Input and Output Operations Formatted input/output functions, Unformatted input/output functions with programming examples using different input/output functions. **Operators and Expressions** Arithmetic operators, Relational operators, Logical Operators, Assignment operators, Increment and decrement operators, Conditional operators, Bit-wise operators, Arithmetic expressions. Evaluation of expressions, Precedence of arithmetic operators, Type conversion in expressions, Operator precedence and associativity.	
Unit – III	**6 Hrs**
Programming Constructs **Decision Making and Branching** Decision making with 'if' statement, Simple 'if' statement, the 'if…else' statement, nesting of 'if…else' statements, The 'else if' ladder, The 'switch' statement, The '*?:'* operator, The '*goto'* statement. **Decision making and looping** The while statement, The do while statement, The 'for' statement, Jumps in loops**.**	
Unit – IV	**6 Hrs**
Arrays One dimensional arrays, Declaration of one dimensional arrays. Initialization of one dimensional arrays, Two dimensional arrays, Initializing two dimensional arrays. **Character Arrays and Strings** Declaring and Initializing String Variables, Reading Strings from Terminal, Writing strings to screen, String handling functions.	
Unit – V	**8 Hrs**
User-defined functions Need for User Defined Functions, Definition of functions, Return values and their types, Function calls, Function declaration. Examples. **Introduction to Pointers:** Introduction, Declaration and initialization of pointers. Examples **Structures and Unions:** Introduction, Structure and union definition, Declaring structure and union variables, Accessing structure members. Example programs.	

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

11a.1 **1b.**	Write a C program to find the length of the string without using library function. Write a program to enter a sentence and print total number of vowels.
12.	Design a structure 'Complex' and write a C program to perform the following operations: i. Reading a complex number. ii. Addition of two complex numbers. iii. Print the result

13.	Create a structure called student with the following members student name, rollno, and a structure with marks details in three tests. Write a C program to create N records and Search on roll no and display all the records. a) Average marks in each test. b) Highest marks in each test

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

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

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

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

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

High-3: Medium-2 : Low-1

Semester: III and IV						
PROFESSIONAL PRACTICE – I COMMUNICATION SKILLS (Common to all Programmes)						
Course Code	**:**	18HS49		**CIE**	**:**	50
Credits: L:T:P	**:**	0:0:1		**SEE**	**:**	50
Total Hours	**:**	18 hrs /Semester		**SEE Duration**	**:**	2 Hours

Course Learning Objectives: The students will be able to

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

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

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

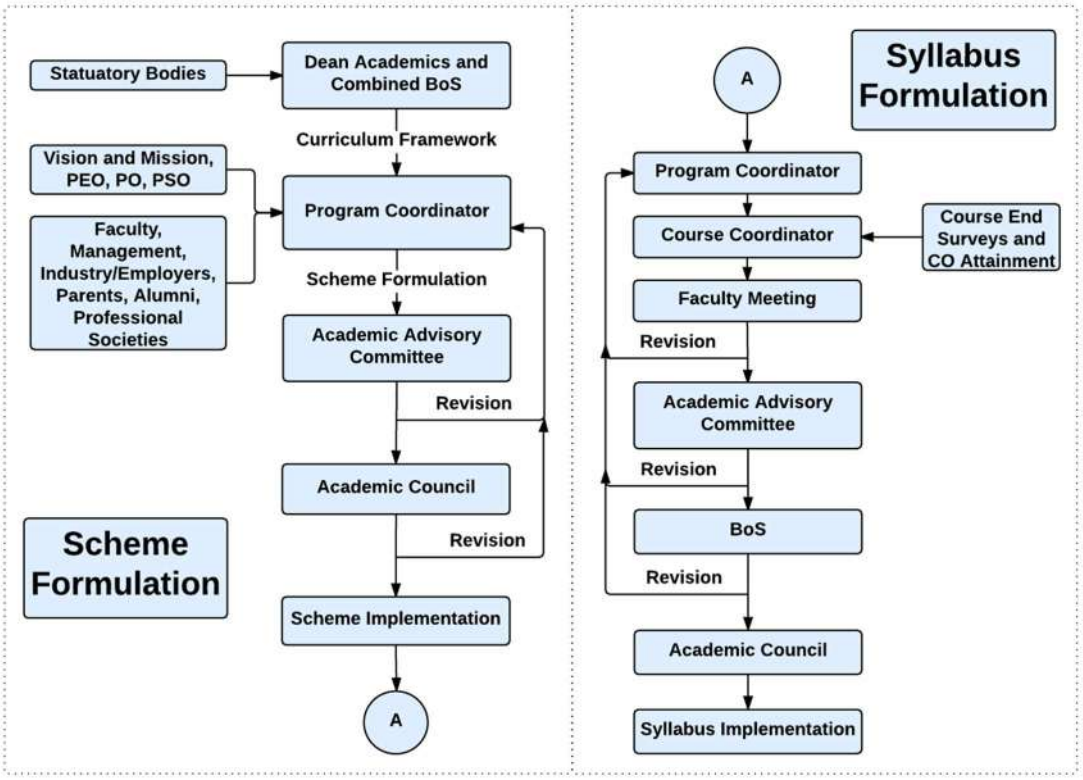
Reference Books	
1.	The 7 Habits of Highly Effective People, Stephen R Covey, Free Press, 2004 Edition, ISBN: 0743272455

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

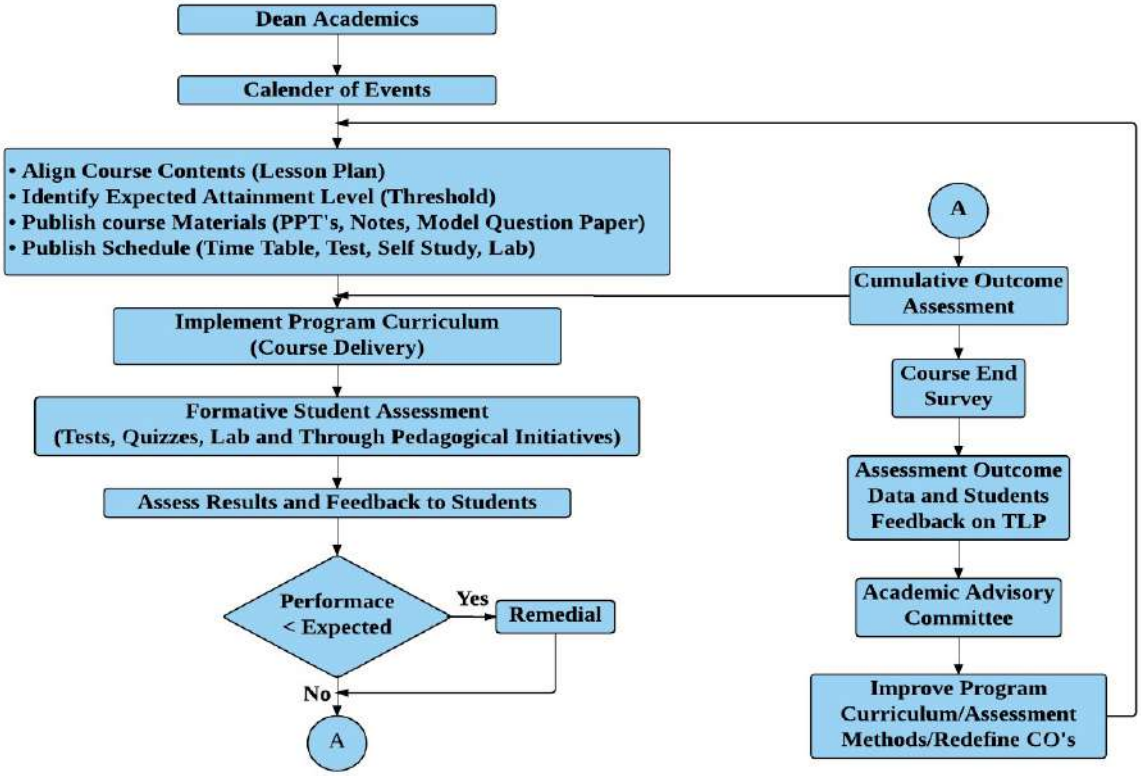
Scheme of Continuous Internal Examination and Semester End Examination

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

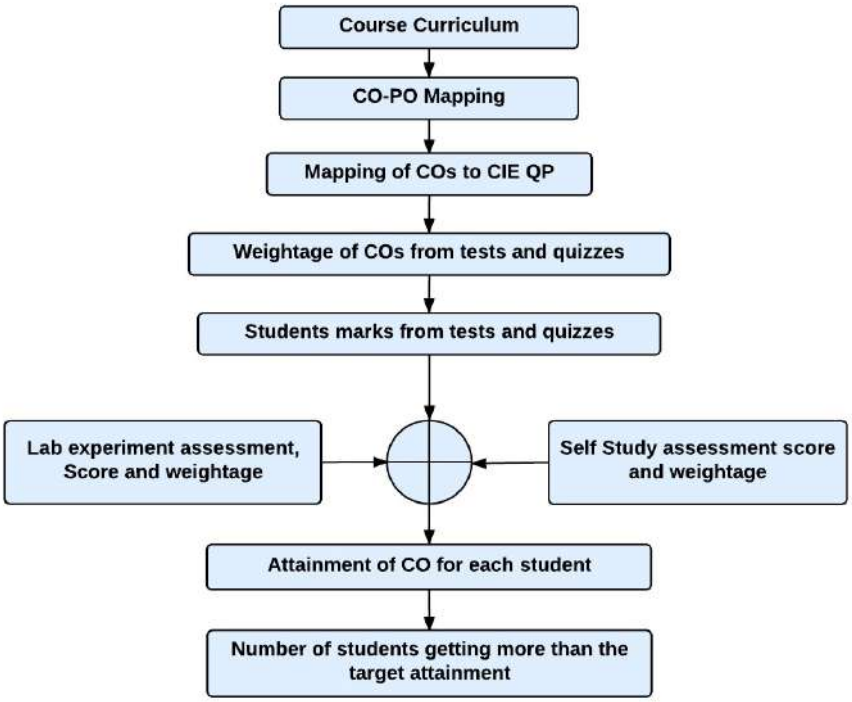
Curriculum Design Process



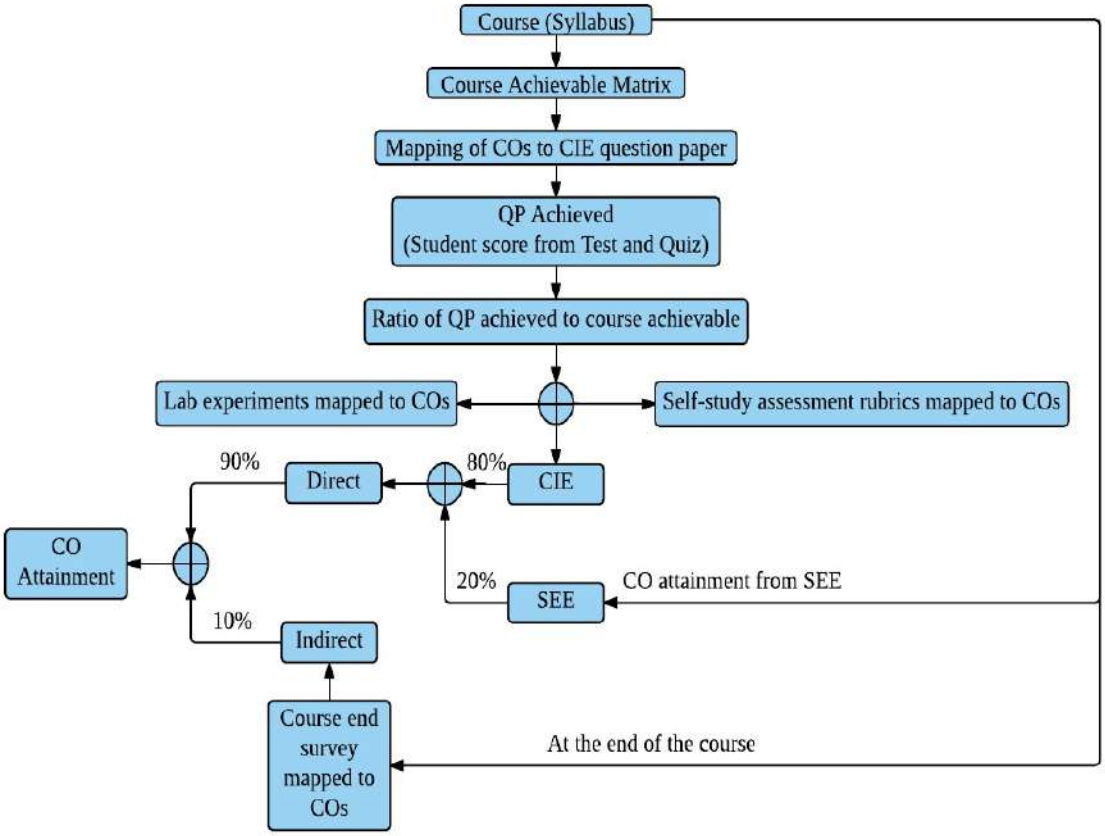
Academic Planning And Implementation



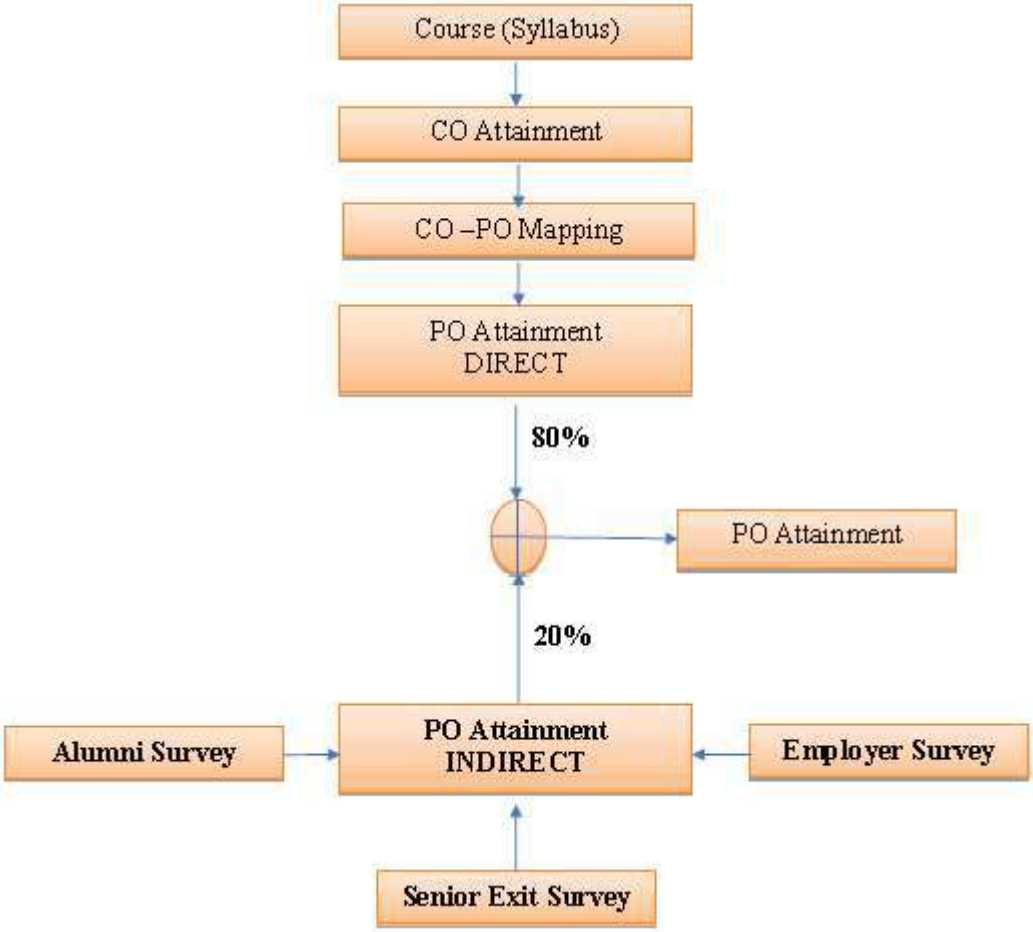
Process For Course Outcome Attainment



Final CO Attainment Process



Program Outcome Attainment Process



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PROGRAM OUTCOMES (POs)

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

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

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

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

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

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

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

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

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

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

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

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