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RV COLLEGE OF ENGINEERING®

(An Autonomous Institution Affiliated to VTU, Belagavi)

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

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



Bachelor of Engineering (B.E)

CHEMICAL ENGINEERING

(2018 Scheme)

III & IV Semester

ACADEMIC YEAR 2020-2021

RV COLLEGE OF ENGINEERING®

Estd. 1963

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(An Autonomous Institution Affiliated to VTU, Belagavi)

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

2020
Ranked
70th in
Engineering
Category

One of the most preferred Technical Institutions

Accredited
by
NBA

PROGRAMS OFFERED

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

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

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

Five RVCE Alumni
cleared civil Services
Exam in 2019-20

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

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

Use of ICT in Teaching
Learning Process



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

Established Centre of Excellence in
Microelectronics & Internet of things

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

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

UPSC Results (2019) : RVCE - Alumni

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

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

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

Human Resource



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



RV-Mercedes Benz Centre for Automotive Mechatronics





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

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 values 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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IV Semester			
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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.	18HS38A / 18HS38V	Kannada Course: AADALITHA KANNADA (18HS38A) / VYAVAHARIKA KANNADA (18HS38V)	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

**

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

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

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FOURTH SEMESTER CREDIT SCHEME							
Sl. No	Course Code	Course Title	BOS	Credit Allocation			Total Credits
				L	T	P	
1.	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, 44 th Edition, 2015, Khanna Publishers, ISBN: 81-7409-195-5.
2	Higher Engineering Mathematics, B.V. Ramana, 11 th Edition, 2010, Tata McGraw-Hill, ISBN: 13-978-07-063419-0; ISBN: 10-0-07-063419-X.
3	Advanced Engineering Mathematics, Erwin Kreyszig, 9 th Edition, 2007, John Wiley & Sons, ISBN: 978-81-265-3135-6.
4	Numerical methods for scientific and engineering computation, M.K. Jain, S.R.K. Iyenger and R.K. Jain, 6 th Edition, 2012, New Age International Publishers, ISBN: 9788122433234, 8122433235.

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

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

Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

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

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

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

High-3 : Medium-2 : Low-1

Semester: III					
ENGINEERING MATERIALS					
(Theory)					
(Common to ME, CH & IM)					
Course Code	:	18ME32		CIE	: 50 Marks
Credits: L:T:P	:	2:0:0		SEE	: 50 Marks
Total Hours	:	26L		SEE Duration	: 02 Hours
Course Learning Objectives: The students will be able to					
1	Understand the behavior of materials for different loading conditions				
2	Analyze different phase diagrams, related composition and microstructure				
3	Understand heat treatment methods of steel and their properties				
4	Understand solidification process in casting and material degradation				
5	Discuss Non Destructive methods of testing materials				

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

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

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

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. Palladiumcatalysed 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 (Hantzsch synthesis) Thiophene (Paal Knorr synthesis, Hinsberg synthesis), Pyridine (Hantzsch synthesis, from acetaldehyde), Indole (Fischer synthesis, Nenitzescu synthesis, Reiser's synthesis), Quinoline (Skraup 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, Squaraine, 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 (Dieldrin). 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) Terpenoids 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, 7 th Edition, 2010, Pearson Education India; ISBN-13: 978-8131704813
2	Heterocyclic Chemistry, Raj K Bansal, 4 th 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 4 th 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 Bernoulli equations, 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 rates by 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, Velocity of sound, Ideal gas equations. Flow through variable-area conduits. Adiabatic frictional flow. Isothermal frictional flow (elementary treatment only)		

LABORATORY EXPERIMENTS	
	<ol style="list-style-type: none"> 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., 7 th Edition, 2007, McGraw Hill, New York. ISBN 13: 9789339213237
2.	Chemical Engineering, Coulson J.M. and Richardson J.F., Vol.2, 5 th Edition, 2003, Asian Books (P) Ltd., New Delhi. ISBN 10: 0080379575
3.	Introduction to Chemical Engineering, Badger W.I. and Banchero J.T., 7 th Edition, 2007, Tata McGraw Hill, New York. ISBN 13: 978-0070029958
4.	Engineering Fluid Mechanics, Kumar K.I., 3 rd 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 ΔH_R 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., 4 th 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. 2 nd Edition, 2004, CBS Publishers and distributors, New Delhi, ISBN-81-239-0953-5
3.	Basic Principles and Calculations in Chemical Engineering, Himmelblau D.M., 6 th Edition, 2002, Prentice Hall of India, New Delhi, ISBN-81-203-1145-0
4.	Bioprocess Engineering Basic Concepts, Shuler M.L., and Kargi F., 2 nd 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, 1 st Edition, 2002, CRC press, ISBN: 1560320699
2	Basic Refrigeration and Air Conditioning, P N Ananthanarayanan, 4 th Edition, 2013, McGraw Hill Education (India) Private Limited, ISBN: 9383286563
3	Mass Transfer Operations, Robert Treybal, 3 rd Edition, 2017, McGraw Hill Education, ISBN: 1259029158
4	Securing Utility and Energy Infrastructures, Larry Ness, 1 st 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, 44 th Edition, 2015, ISBN: 978-81-933284-9-1.
2	Higher Engineering Mathematics, B.V. Ramana, 11 th Edition, 2010, Tata McGraw-Hill, ISBN: 978-0-07-063419-0.
3	N.P. Bali & Manish Goyal, A Text Book of Engineering Mathematics, Lakshmi Publications, 7 th Edition, 2010, ISBN: 978-81-31808320.
4	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 10 th Edition, 2016, ISBN: 978-0470458365.

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

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

Total CIE is 20(Q) +30(T)=50 Marks.

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

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

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

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

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

Continuous Internal Evaluation (CIE); (50 Marks)

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

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

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

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

Continuous Internal Evaluation (CIE); (50 Marks)

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

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

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

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, 44 th Edition, 2015, Khanna Publishers, ISBN: 81-7409-195-5.
2	Higher Engineering Mathematics, B.V. Ramana, 11 th Edition, 2010, Tata McGraw-Hill, ISBN: 13-978-07-063419-0; ISBN: 10-0-07-063419-X.
3	Advanced Engineering Mathematics, Erwin Kreyszig, 9 th Edition, 2007, John Wiley & Sons, ISBN: 978-81-265-3135-6.
4	Probability, Statistics and Random Processes, T. Veerarajan, 3 rd 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 of insulation		
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, Dimensional numbers-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 and tube heat exchangers, Construction details, Condensers, type of condensers. Design of Heat Transfer Equipment: Elementary design of double pipe heat exchanger. Shell and tube heat exchanger 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., 7 th Edition, 2007, McGraw Hill, New York, ISBN: 0072848235,
2.	Unit Operations of Chemical Engineering, Coulson J.M and Richardson J.F., Vol.1, 6 th Edition, 2006, Indian Reprint Elsevier New Delhi, ISBN: 9780080131856
3.	Process Heat Transfer, Kern D.Q., 7 th Edition 2004, McGraw Hill, New York,. ISBN: 0070341907
4.	Heat Transfer, Rao Y.V.C., 1 st 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 marks is executed by means of an examination. The Question paper for the course contains two parts, Part A and Part B. Part A consists of objective type questions for 20 marks covering the complete syllabus. Part B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

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

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

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

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	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 and cumulative 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 comminution, characteristics of comminuted products. Laws of size reduction, 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, Impact, 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, chain 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 filtration Constant 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 floatation, 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., 7 th Edition, 2007, McGraw Hill, International, New York, ISBN-13: 978-0072848236
2.	Introduction to Chemical Engineering, Badger W.L., and Banchero J.T, 7 th Edition, 2005, McGraw Hill, International Edition, Singapore, ISBN-13: 978-0070850279
3.	Chemical Engineering Vol. II, Coulson J.M. and Richardson J.F., 5 th Edition, 2002, Asian Books Pvt. Ltd. New Delhi, ISBN-9780750644440
4.	Unit Operations, Brown G.G., 1 st Edition, 2009, CBS Publishers, New Delhi, ISBN 13: 9788123910994

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											
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 Helmholtz 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 chemical reactions, 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., 7 th Edition, 2005, McGraw Hill, New York, ISBN:978-0071247085
2.	Chemical Engineering Thermodynamics, Rao Y.V.C., 2 nd Edition, 4 th Reprint, 2009, New Age International Publication, Nagpur,.ISBN. 9788173714610
3.	Textbook of Chemical Engineering Thermodynamics, Narayanan K.V., 3 rd Edition, 8 th Reprint, 2006, Prentice Hall of India Private Limited, New Delhi, ISBN 978-8120347472
4.	Engineering Thermodynamics, Nag P.K., 3 rd Edition, 2007, Tata McGraw Hill Book Co., New Delhi, ISBN: 978-125906256
5	Biological Thermodynamics, Donald T Hayne., 2 nd 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 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	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, 5 th Edition, 2017, Mc. Graw Hill, ISBN: 1259029455
2	Dryden's Outlines of Chemical Technology, M. GopalaRao Marshall Sittig, 2 nd 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, 5 th 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 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	-	-	-	-	-	-	-	-	-	-	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 department
4. Each group should follow the stages of Empathy, Design, Ideate, prototype and Test for completion of DTL.
5. After every stage of DTL, the committee constituted by the department along with the coordinators would evaluate for CIE. The committee shall consist of respective coordinator & two senior faculty members as examiners. The evaluation will be done for each student separately.
6. The team should prepare a Digital Poster and a report should be submitted after incorporation of any modifications suggested by the evaluation committee.

The Design Thinking lab tasks would involve:

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

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

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

Scheme of Evaluation for CIE Marks:

Evaluation will be carried out in three phases:

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

Scheme of Evaluation for SEE Marks:

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

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

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

11a.1	Write a C program to find the length of the string without using library function.
1b.	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
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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, 4 th Edition, 2000, Mcgraw Hill Education, ISBN-13: 9780070411838.
4.	Understanding Pointers in C, Yashavant P. Kanetkar, 4 th edition, 2003, BPB publications, ISBN-13: 978-8176563581
5.	C IN DEPTH, S.K Srivastava, Deepali Srivastava, 3 rd Edition, 2013, BPB publication, ISBN9788183330480

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

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

Total CIE is 10(Q) + 30(T) + 10(P) = 50 Marks.

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

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

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

High-3: Medium-2 : Low-1

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		

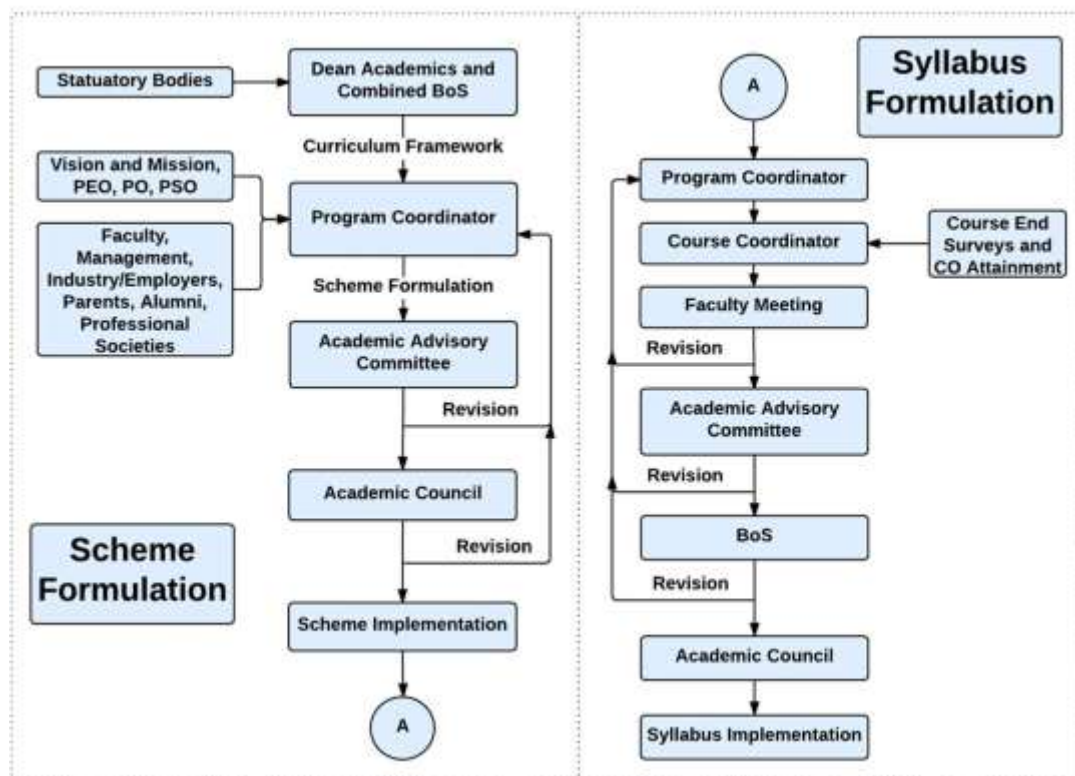
Course Outcomes: After completing the course, the students will be able to	
CO1:	Inculcate skills for life, such as problem solving, decision making, stress management
CO2:	Develop leadership and interpersonal working skills and professional ethics.
CO3:	Apply verbal communication skills with appropriate 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, 1 st Edition, 2016, ISBN: 9789380914787
3.	Crucial Conversation: Tools for Talking When Stakes are High, Kerry Patterson, Joseph Grenny, Ron Mcmillan, McGraw-Hill Publication, 2012 Edition, ISBN: 9780071772204
4.	Aptimithra: Best Aptitude Book, Ethnus, Tata McGraw Hill, 2014 Edition, ISBN: 9781259058738

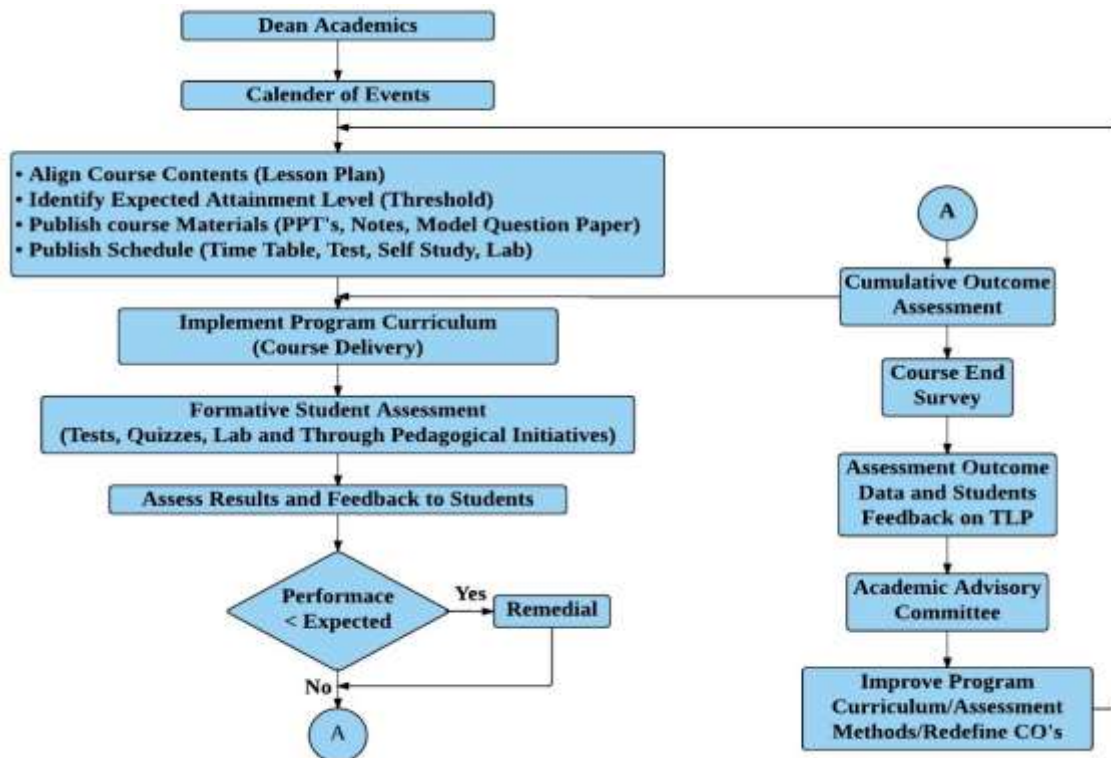
Scheme of Continuous Internal Examination and Semester End Examination

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

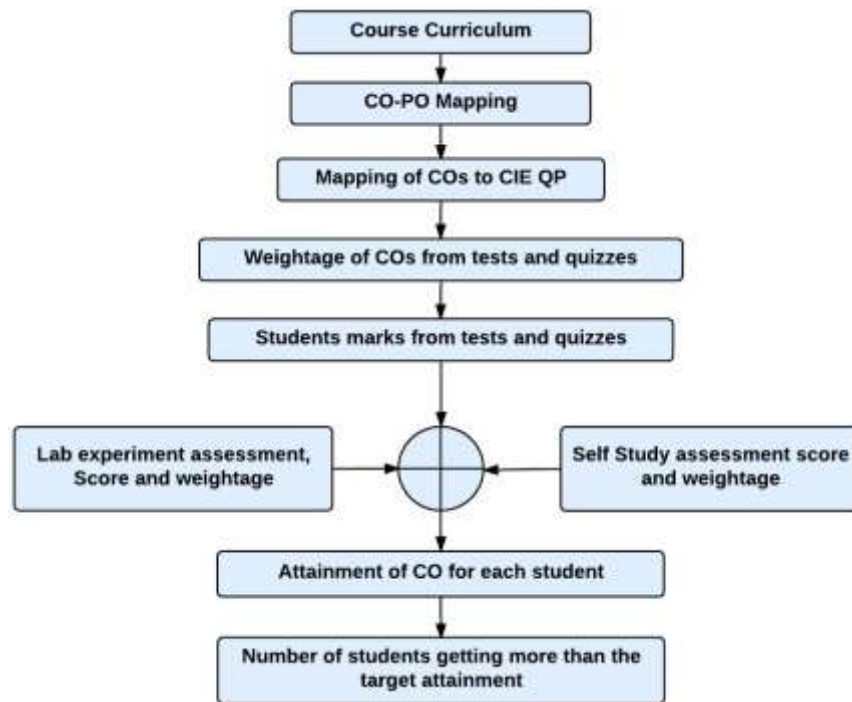
Curriculum Design Process



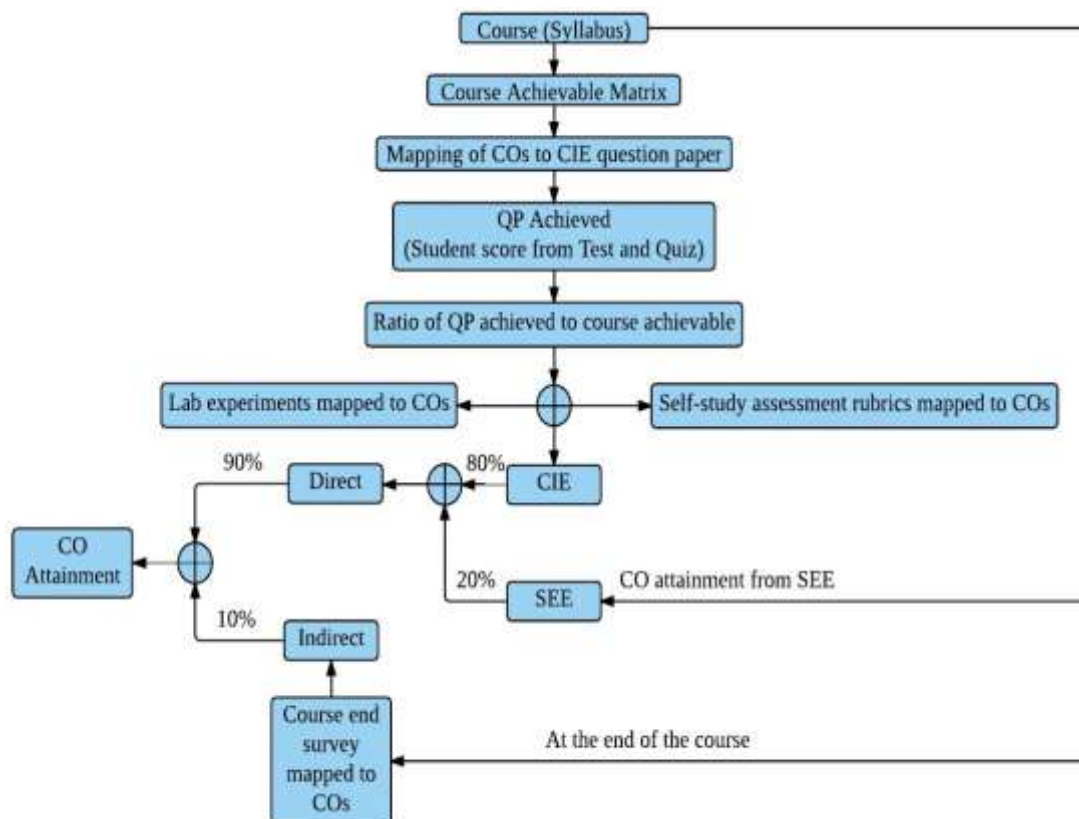
Academic Planning And Implementation



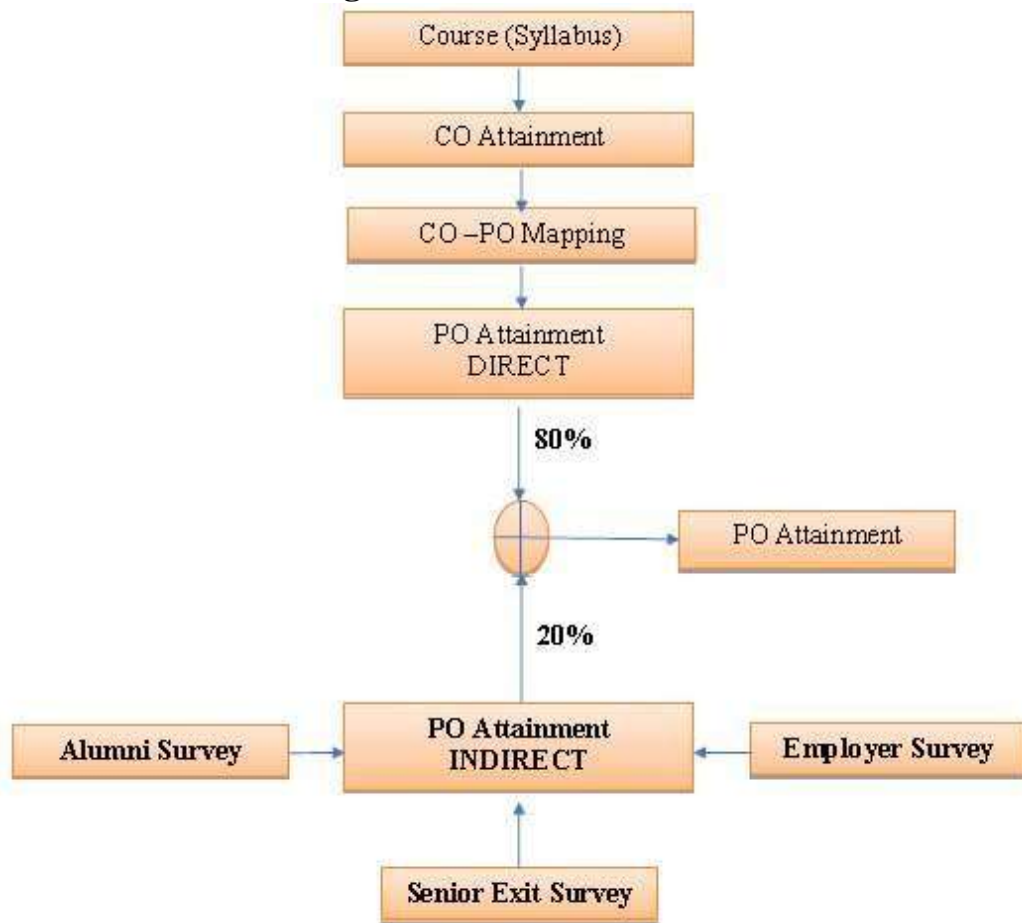
Process For Course Outcome Attainment



Final CO Attainment Process



Program Outcome Attainment Process



INNER BACK COVER PAGE

PROGRAM OUTCOMES (POs)

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.

Innovative Clubs of RVCE

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

NCC



NSS



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

Cultural Activity Teams

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

VISION



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

MISSION



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



RV COLLEGE OF ENGINEERING

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