Course Title	FOURIER SERIES, TRANSFORMS, NUMERICAL AND OPTIMIZATION TECHNIQUES	Semester	III
Course Code	MVJ20MCH31	CIE	50
Total No. of Contact Hours	40 L : T : P :: 20 : 20 : 00	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	3	Exam. Duration	3 Hours

Course Objective is to: This course will enable students to

• Comprehend and use of analytical and numerical methods in different engineering fields

 • Apprehend and apply Fourier Series

• Realize and use of Fourier transforms and Z-Transforms

• Use of statistical methods in curve fitting applications

 • Use of numerical methods to solve algebraic and transcendental equations, vector integration and calculus of variation

Module-1	RBT Levels: L1, L2 & L3	8 Hours

Laplace Transforms: Definition and Laplace transforms of Elementary functions. Laplace transforms of $e^{at}f(t), t^n f(t)$ and $f(t)/t$, periodic functions and unit step function – problems.

Inverse Laplace Transforms: Inverse Laplace Transforms – Problems, Convolution theorem to find the inverse Laplace transforms and problems, solution of linear differential equations using Laplace Transforms.

Applications: The Laplace transform is particularly useful in solving linear ordinary differential equations.

Video link / Additional online information (related to module if any):

https://www.youtube.com/watch?v=HSGgORdJAQg

https://www.youtube.com/watch?v=Pq-tUQzeSRw

Module-2	RBT Levels: L1, L2 & L3	8 Hours

Fourier Series: Periodic functions, Dirichlet's condition, Fourier Series of periodic functions with period *2π* and with arbitrary period *2c*. Fourier series of even and odd functions. Half range Fourier Series, Practical harmonic Analysis.

Applications: The Fourier series has many such applications in harmonic analysis, vibration analysis, acoustics, optics etc.

Video link / Additional online information (related to module if any):

https://www.youtube.com/watch?v=4N-IwHUCFa0

https://www.youtube.com/watch?v=UGuOVeoo3QE

https://www.youtube.com/watch?v=x04dnqg-iPw

https://nptel.ac.in/courses/111106111/

Experimental learning (Videos):

http://esg.mit.edu/videos/fourier-series-modeling-nature/

https://www.khanacademy.org/science/electrical-engineering/ee-signals/ee-fourier-series/v/ee-fourier-series-intro

Module-3	RBT Levels: L1, L2 & L3	8 Hours

Fourier transforms:

Infinite Fourier transform, Infinite Fourier sine and cosine transforms, Inverse Fourier transforms, Inverse Fourier sine and cosine transforms, Convolution theorem and problems.

Applications: Fourier Transformation (FT) has huge application in studying to study vibrations in building/structures. Any kind of spectroscopy applied in chemical engineering (CE) is based in Fourier techniques.

Video link / Additional online information (related to module if any):

https://www.youtube.com/watch?v=spUNpyF58BY

https://www.youtube.com/watch?v=6spPyJH6dkQ

https://www.youtube.com/watch?v=WcNPUXfxCXA

Module-4	RBT Levels: L1, L2 & L3	8 Hours

Numerical Methods: Numerical solution of ordinary differential equations of first order and first degree, Taylor's series method, modified Euler's method. Runge - Kutta method of fourth order, Milne's and Adams-Bash forth predictor and corrector methods (No derivations of formulae-single step computation only.

Applications: Numerical Methods are used to provide 'approximate' results for the differential equation problems being dealt with and their necessity is felt when it becomes impossible or extremely difficult to solve a given problem analytically.

Video link / Additional online information (related to module if any):

https://www.youtube.com/watch?v=QugqSa3Gl-w

Module-5	RBT Levels: L1, L2 & L3	8 Hours

Numerical Methods: Numerical solution of second order ordinary differential equations, Runge-Kutta method and Milne's method. (No derivations of formulae-single step

computation only). **Optimization Techniques:**

Linear Programming, Mathematical formulation of linear programming problem (LPP), Types of solutions, Graphical Method, Simplex Method.

Applications:

Linear Programming is used in a variety of fields including food and agriculture, engineering, transportation problems, manufacturing and energy.

Video link / Additional online information (related to module if any):

https://www.youtube.com/watch?v=v63aU0TVFkw

Course outcomes:	
CO1	Use Laplace transform and inverse transforms techniques in solving differential equations.
CO2	Know the use of periodic signals and Fourier series to analyze circuits and system
CO3	Demonstrate Fourier Transform as a tool for solving Integral equations.
CO4	Identify appropriate numerical methods to solve ODE.
CO5	Solve the mathematical formulation of linear programming problem.

Text Books:	
1	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition, 2013.
2	S. D. Sharma, "Operations Research", Kedar Nath and Ram NathPublishers, Seventh Revised Edition 2014.
Reference Books:	
1	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.
2	Bali N. P. & Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 8th Edition
3	Jain R. K.& Iyengar S.R.K., Advanced Engineering Mathematics, Narosa Publishing House, 2002.
CIE Assessment:	
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests	

- Quizzes/mini tests (10 marks)
- Assignments (10 Marks)

SEE Assessment:
i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.
ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.
iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	0	3	0	0	0	0	0	0	0	1
CO2	3	3	0	3	0	0	0	0	0	0	0	0
CO3	2	3	0	3	0	0	0	0	0	0	0	1
CO4	3	3	0	3	0	0	0	0	0	0	0	0
CO5	3	3	0	2	0	0	0	0	0	0	1	1

High-3, Medium-2, Low-1

Course Title	CHEMICAL PROCESS CALCULATION	Semester	III
Course Code	MVJ20CH32	CIE	50
Total No. of Contact Hours	50 L : T : P :: 40 : 10 : 0	SEE	50
No. of Contact Hours/week	5	Total	100
Credits	4	Exam. Duration	3 Hours

Course objective is to:

- Learn basic laws about the behavior of gases, liquids and solids.
- Apply material and energy balances concepts to formulate and solve problems related to chemical engineering process.

Module-1	RBT Level: L1, L2, L3	10 Hours

Units and dimensions: Fundamental and derived units, Conversion, Dimensional consistency of equations, Dimensionless groups and constants, conversions of equations. **Basic chemical calculations:** Concept of mole, composition of mixtures of solids, liquids and gases - percentage by weight, mole and volume, Ideal gas law calculations. Composition of mixtures and solutions - Normality, Molarity, Molality and ppm. Concentration scales based on specific gravity.

Laboratory Sessions/ Experimental learning: Preparation of solutions in the lab to understand the concept of composition of mixtures.

Applications: Basics of chemistry of solid, liquid and gases can be applied to any engineering or basic science application which require knowledge of mixtures, unit conversion etc

Video link / Additional online information:

https://nptel.ac.in/courses/103103165/

https://youtu.be/AFm87ncbcRE

https://guides.lib.purdue.edu/c.php?g=352816&p=2377943

Module-2	RBT Level: L1, L2, L3	10 Hours

Vapor Pressure: Definition of vapor pressure, partial pressure, Psychrometry. **Material Balance Without Reaction:** General material balance equation for steady and unsteady state, Typical steady state material balances on mixing, distillation, extraction, crystallization, Drying & related Problems.

Laboratory Sessions/ Experimental learning: Demonstrate the concept of distillation, extraction and Drying by conducting simple experiments in mass transfer lab.

Applications: Psychometry knowledge will help to understand refrigeration concept related to mechanical engineering. The material balance of unit operation will help in the design and simulation of those processes.

Video link / Additional online information:

https://nptel.ac.in/courses/103103165/

https://youtu.be/SUys-sqi0rQ

https://www.youtube.com/watch?v=XtfBYZuA7rI

Module-3	RBT Level: L1, L2, L3	10 Hours

Typical steady state material balances on evaporation, absorption and leaching and problems. Steady State Material Balance with Reaction: Principles of stoichiometry, Concept of limiting and excess reactants and inert, fractional and percentage conversion, fractional yield and percentage yield, Selectivity, related problems.

Laboratory Sessions/ Experimental learning: Demonstrate the concept of adsorption and leaching by conducting simple experiments in mass transfer lab.

Show the working of Single effect evaporator in the Heat transfer lab.

Applications: The material balance of unit operation and processes will help in the design and simulation of those processes. It enables them to understand the raw materials required, yield etc of a given process.

Video link / Additional online information:

https://nptel.ac.in/courses/103103165/

https://youtu.be/p72wC36W83Q

https://nptel.ac.in/courses/102106069/

Module-4	RBT Level: L1, L2, L3	10 Hours

Fuels and Combustion: Ultimate and Proximate analysis of fuels, Material balances on combustion processes: Material balances based on combustion reactions, Solving problems. Material balances with and without reactions involving bypass, recycle and purging.

Laboratory Sessions/ Experimental learning: Experiment with reactions in simple reactor to understand the concept of limiting reactant, conversion & Excess reactant.

Applications: Fuel characteristics and its effectiveness in heating purposes can be applied various mechanical as well as chemical fields

Video link / Additional online information:

| https://nptel.ac.in/courses/103103165/ |
| https://youtu.be/N9du6edNgqc |
| https://youtu.be/WhypzrXOVXQ |
| https://nptel.ac.in/courses/102106069/ |

Module-5	RBT Level: L1, L2, L3	10 Hours

Energy balance: Thermo physics: Energy, energy balances, heat capacity of gases, liquid and mixture solutions. Kopp's rule, latent heats, heat of fusion and heat of vaporization, Trouton's rule, latent heat of vaporization using Clausius - Clapeyron equation. **Thermo chemistry:** Calculation and applications of heat of reaction, combustion, formation, Kirchhoff's equation, Effect of temperature on heat of reaction. Adiabatic and non-adiabatic reactions. Theoretical and actual flame temperatures.

Laboratory Sessions/ Experimental learning: Demonstrate working of bomb calorimeter to understand the fuel heat capacity measurement

Applications: Energy balance concept can be applied in any energy required processes and is basic step in chemical process design.

Video link / Additional online information:

https://nptel.ac.in/courses/103103165/

https://youtu.be/0H0OpEsG8ak

https://nptel.ac.in/courses/102106069/

Course outcomes:	
CO1	Comprehend the basic theories in stoichiometry and perform unit conversions and calculations.
CO2	Solve material balance problems of steady state unit operations like drying, mixing, evaporation, distillation, humidification etc.
CO3	Apply material balance concept to solve multistage operations like bypass, recycle and purging
CO4	Apply the concept of material balance for process with reactions.
CO5	Explain the concepts of thermo physics and thermo chemistry and solve steady state enthalpy balance problems

Text Books:	
1	Himmelblau, D. M., & Riggs, J. B. (2012). *Basic principles and calculations in chemical engineering*. FT press.
2	Felder, R. M., Rousseau, R. W., & Bullard, L. G. (2020). *Elementary principles of chemical processes*. John Wiley & Sons.
Reference Books:	

1	Bhatt, B. I., & Thakore, S. B. (2010). *Stoichiometry*. Tata McGraw-Hill Education.
2	Hougen, O. A., Watson, K. M., & Ragatz, R. A. (1962). *Chemical Processes Principles. Part I: Material and Energy Balances*. John Wiley and Sons.

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e., $\sum$ (Marks Obtained in each test)/3	CIE (50)	30
Quizzes – 3 Nos.		10
Mini Projects/ Case studies/Assignments – 3 Nos.		10
Semester End Examination	SEE (50)	50
	Total	100

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	MOMENTUM TRANSFER	Semester	III
Course Code	MVJ20CH33	CIE	50
Total No. of Contact Hours	40 L:T:P:: 20:20:00	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:
- Understand concepts on nature of fluids, type of fluid flow and boundary layer relations, pressure concepts and its measurement by various experimental methods and enhancement of problem-solving skills.
- Understand relationship between kinetic energy, potential energy, internal energy and work complex flow systems using Bernoulli's equation with application to industrial problems.
- Understand clear concepts on Flow of compressible and incompressible fluids in conduits and thin layers and friction factor variations with velocity and friction losses using Bernoulli's Equations and they will be demonstrated experimentally.
- Study Dimensional analysis and working of pumps, transportation and metering of fluids using various techniques and applications to industry.

Module-1	RBT Level: L1, L2, L3	8 Hours

Fluid statics and its applications: Concept of 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, Continuous gravity decanter, Centrifugal decanter.

Fluid flow phenomena: Type 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 stress, Eddy viscosity. Flow in boundary layers, Reynolds number, and Boundary layer separation and wake formation.

Experiential Learning: Venturi and Orifice meter, study correlation between Reynolds number and friction factor.

Applications: Students can understand the measurement of pressure using devices like manometers, and also the flow behaviour by analyzing Reynolds number.

Video link / Additional online information:		
http://vlabs.iitb.ac.in/vlab/chemical/exp1/index.html		
Module-2	RBT Level: L1, L2, L3	8 Hours

Basic equations of fluid flow: Average velocity, Mass velocity, Continuity equation, Euler and Bernoulli equations Modified equations for real fluids with correction factors, Pump work in Bernoulli equation, Angular momentum equation. **Flow of incompressible fluids in conduits and thin layers:** Laminar flow through circular and non-circular conduits, Hagen Poiseuille equation, Laminar flow of Non-Newtonian liquids, Turbulent flow in pipes and closed channels.

Experiential Learning: Experimentation to verify the generalized correlation between Reynolds number and friction factor in Annulus, circular and non-circular pipes.

Applications: To analyse the flow patterns of incompressible fluids in various conduits.

Video Links/Any other special information:

http://uorepc-nitk.vlabs.ac.in/exp1/index.html

Module-3	RBT Level: L1, L2, L3	8 Hours

Flow of incompressible fluids in conduits and thin layers (contd...): Friction factor chart, friction from changes in velocity or direction, Form friction losses in Bernoulli equation, Flow of fluids in thin layers. **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).

Experiential Learning: Study of finding co efficient of losses in straight pipes due to sudden enlargement, sudden contraction and bends.

Applications: Frictional losses due to change in area and direction of pipes in various pipes and conduits can be studied. Frictional losses due to change in area and direction of pipes in various pipes and conduits can be studied.

Video Links/Any other special information(Papers):

https://www.youtube.com/watch?v=mflbEZ7kUpU

Module-4	RBT Level: L1, L2, L3	8 Hours

Transportation and metering of fluids: Pipes, Fittings and valves, Flow measuring devices, venturi meter, orifice meter, rotameter and pitot tube. Elementary concept of target meter, vortex-shedding meters, turbine meters, positive displacement meters,

magnetic meters, Coriolis meters and thermal meters, Flow through open channel-weirs and notches. Performance and Characteristics of pumps-positive displacement and centrifugal pumps, Fans, compressors, and blowers.

Experiential Learning: Determination of co efficient of discharge of Venturi meter, orifice meter and notches experimentally and graphically. Also working of single and multi-stage centrifugal pump.

Applications: Students will be able to analyze the variations in discharge in various meters and notches like rectangular and v notch also characteristics of centrifugal pump.

Video Links/Any other special information:

https://uta.pressbooks.pub/appliedfluidmechanics/chapter/experiment-10/

Module-5	RBT Level: L1, L2, L3	8 Hours

Flow of fluid past immersed bodies: Drag, drag coefficient, Pressure drop – Kozeny-Carman equation, Blake-Plummer, Ergun equation, Fluidization, conditions for fluidization, Minimum fluidization velocity, Pneumatic conveying, Industrial application of Fluidization. **Dimensional analysis:** Dimensional homogeneity, Rayleigh's and Buckingham ∏- methods, Significance of different dimensionless numbers.

Experiential Learning: Demonstration of flow past packed and Fluidized bed.

Applications: Dimensional analysis helps to find the relationship among various variable in any chemical, mechanical systems. Most chemical engineering system requires flow of fluid pat solid catalyst adsorbent absorbent etc. This learning will help to analyze flow of fluid over such systems.

Video Links/Any other special information:

https://www.youtube.com/watch?v=OdldY3RLw24

Course outcomes:	
CO1	Apply the concepts of fluid statics and dynamics to measure pressure and differentiate various flow phenomena.
CO2	Derive the fundamental equations and apply to solve various fluid flow problems
CO3	Understand the various equations for incompressible and compressible fluids in conduits.
CO4	Demonstrate the knowledge of fluid flow principles in various types of flow measurements, transportation and metering of fluids using experimental

	techniques and applications to industry.
CO5	Develop functional relationships using dimensional analysis and similitude to solve technical problems also to analyze the flow past immersed bodies.

Text Books:	
1	McCabe, W. L., Smith, J. C., &Harriott, P. (1993). *Unit operations of chemical engineering* (Vol. 5, p. 154). New York: McGraw-hill.
2	Bansal, R. K. (2005). *A textbook of fluid mechanics*. Firewall Media.
Reference Books:	
1	Kumar, K. L. (1988). Engineering fluid mechanics 4th edn (New Delhi: Eurasia).
2	Coulson J.H. and Richardson J.F. (1998). Chemical Engineering Vol-I, 5[th]edn.
3	Badger W.L. and Banchero J.T. (1997). Introduction to Chemical Engineering. (Tata McGraw Hill, New York).
4	Web Link and Video Lectures: https://nptel.ac.in/courses/103104043/ https://cosmolearning.org/courses/fluid-mechanics-chemical-engineering/video-lectures/

Scheme of Evaluation:

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e., $\sum$ (Marks Obtained in each test)/3	CIE (50)	30
Quizzes (2 Nos.)		5X2=10
Assignments (2 Nos.)		5X2=10
Semester End Examination	SEE (50)	50
Total		100

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	MECHANICAL OPERATIONS	Semester	III
Course Code	MVJ20CH34	CIE	50
Total No. of Contact Hours	40 L:T:P::20:20:0	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

- Study different properties of particulate solids, handling and mixing of solid particles.
- Study principles of comminution and different types of equipment for size reduction like crushers, grinders etc.
- Understand mechanical separation aspect such as screening, filtration, sedimentation, transportation of solids etc.
- Understand energy requirements in solids handling, agitation and mixing, solid conveying and storage

Module-1	RBT Level: L1, L2, L3	8 Hours

Particle Technology: Particle shape, particle size, Different ways of expression of particle size, Shape factor, sphericity, Particle size analysis, Screens – ideal and actual screens, Tyler series, Differential and Cumulative size analysis, Effectiveness of screen, Specific surface of a mixture of particles, Number of particles in a mixture, Standard screens, Motion of screen, Industrial screening equipment: Grizzly, Gyratory screen, Vibrating screen, Trommels, Sub sieve analysis – Air permeability test, Air elutriation, Beaker decantation.

Experiential learning: Differential and cumulative size analysis method to measure the size distribution of products obtained from vibrating screen, To find out the effectiveness of screen.

Applications: Students can understand the measurement method of size distribution of different sized particles

Video Links/Any other special information:

https://www.russellfinex.in/vibrating-screen/?param1=%2Bvibrating%20%2Bscreen&gclid=EAIaIQobChMInZLMp5_-

6AIV0sEWBR3eMAqREAAYASAAEgJgP_D_BwE		
Module-2	**RBT Level: L1, L2, L3**	**8 Hours**

Size Reduction: Introduction – types of forces used for comminution, Criteria for comminution, Characteristics of comminute products, Laws of size reduction, Work Index, Energy utilization, Methods of operating crushers – Free crushing, Choke feeding, Open circuit grinding, Closed circuit grinding, Wet and Dry grinding, Equipment for size reduction – Classification of size reduction equipment, Equipment – Blake jaw crusher, Gyratory crusher, Smooth roll crusher, Toothed roll crusher, Impactor, Ball mill, Critical speed of ball mill, Cutters – Knife cutter, Ultrafine grinder-Fluid energy mill, Colloid mill.

Experiential learning: To determine the energy required for crushing the given feed and thus obtain the work index for the same. Also determine the reduction ration and critical speed of the mill and to determine the crushing law constants and verify the laws using jaw crusher.

Applications: Ball mill and crushers are used in various industries like cement industry, mineral industry and ceramic industry for reducing the size of particles

Video Links/Any other special information(Papers):

https://www.youtube.com/watch?v=TlVxZlGiKyc

https://www.youtube.com/watch?v=1CpjRMICXNM

Module-3	**RBT Level: L1, L2, L3**	**8 Hours**

Filtration: Introduction, Classification of filtration, Cake filtration, Clarification, batch and continuous filtration, Pressure and vacuum filtration, Derivation of Constant rate filtration and Constant Pressure filtration, Characteristics of filter media, Industrial filters: Sand filter, Filter press, Leaf filter, Rotary drum filter, Principles of Centrifugal filtration, Rate of washing – Suspended batch centrifuge, Filter aids, Application of filter aids.

Experiential learning: Demonstrate the working of a leaf filter and Plate & Frame filter.

Applications: Filtration is used to separate particles and fluid in a suspension, where the fluid can be a liquid, a gas or a supercritical fluid. Filtration is major unit operation in edible oil manufacturing, water treatment etc

Video Links/Any other special information:

https://www.youtube.com/watch?v=lRBPQmectLQ

http://uorepc-nitk.vlabs.ac.in/exp6/index.htmlv

Module-4	RBT Level: L1, L2, L3	8 Hours

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, Motion of spherical particles in Stokes's region, Newton's region, and Intermediate region, Criterion for settling regime, Hindered settling, Modification of equation for hindered settling. **Sedimentation:** Batch settling test, Coe and Clevenger theory, Kynch theory, thickener design, Equipment: Gravity Settling Tank, Disk Bowl Centrifuge.

Experiential learning: Batch sedimentation test, To determine the specific cake resistance and filter medium resistance, Rm by Filtration method

Video Links/Any other special information:

https://www.youtube.com/watch?v=M4wBd1_CvNw

https://www.youtube.com/watch?v=gCJ3b8UM4EQ

Module-5	RBT Level: L1, L2, L3	8 Hours

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, mixing index, Types of mixers –, Muller mixers, Mixing index, Ribbon blender, Internal screw mixer. **Sampling, storage and conveying of solids:** Sampling of solids, Storage of solids, Open and closed storage, Bulk and bin storage, Conveyors – Belt conveyers, Chain conveyor, Apron conveyor, Bucket conveyor, Screw conveyor.

Miscellaneous separation: Centrifugal separators: Cyclones and Hydro cyclones, Magnetic separation, Electrostatic separation.

Experiential learning: To separate the iron filings from the sand particles by performing froth floatation experiment.

Applications: There are various industrial application of separation equipment i,e froth floatation, ESP, heavy media separator, magnetic separator which is discussed in this module.

Video Links/Any other special information(Papers):

https://www.youtube.com/watch?v=eu4T080dsG8

https://www.youtube.com/watch?v=nlfJt9rXWto

Course outcomes:	
CO1	Study different properties of particulate solids, handling and mixing of solid particles.
CO2	Study principles of comminution and different types of equipment for size reduction like crushers, grinders etc.
CO3	Derive the expression to find rate of filtration for various types of filtration and to study the working of various filtration equipment's.
CO4	Explain the phenomenon of motion of particles through fluids in various flow fields and regimes, Outline the various theories of Sedimentation in designing industrial thickeners.
CO5	Explain various miscellaneous separation processes and also illustrates the working principle of agitation and mixing and describe the sampling of solid and conveying of it.

Text Books:	
1	McCabe, W. L., Smith, J. C., &Harriott, P. (1993). *Unit operations of chemical engineering* (Vol. 5, p. 154). New York: McGraw-hill.
2	Badger, W. L., &Banchero, J. L. (2010). Introduction to chemical engineering. 25th reprint.
Reference Books:	
1	McCoy, B. J. (1993). CHEMICAL ENGINEERING: Vol. 2. Particle Technology and Separation Processes, by JM Coulson, JF Richardson, JR Backhurst, and JH Harker. *Chemical Engineering Education, 27*(3), 183-199.
2	Montillon, G. H. (1951). Unit Operations. By GG Brown, AS Foust, DL Katz, R. Schneidewind, RR White, WP Wood, JT Banchero, GM Brown, LE Brownell, JJ Martin, GB Williams, and JL York. *The Journal of Physical Chemistry, 55*(4), 614-616.
3	Foust, A. S., Wenzel, L. A., Clump, C. W., Maus, L., & Andersen, L. B. (2008). *Principles of unit operations*. John Wiley & Sons.
4	**Web Link and Video Lectures:** https://nptel.ac.in/courses/103107123/ https://swayam.gov.in/nd1_noc19_ch32/preview

Scheme of Evaluation		
Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e., ∑ (Marks Obtained in each test)/3	CIE (50)	30
Assignments (5 Nos.)		5X4=20
Semester End Examination	SEE (50)	50
Total		100

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	MATERIAL SCIENCE FOR CHEMICAL ENGINEERS	Semester	III
Course Code	MVJ20CH35	CIE	50
Total No. of Contact Hours	40 L : T : P :: 40 : 0 : 0	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

- Understand concepts on properties and selection of metals, ceramics, and polymers for design and Manufacturing.
- Study variety of engineering applications through knowledge of atomic structure, electronic structure, chemical bonding, crystal structure, X-rays and X-ray diffraction, defect structure.
- Study Microstructure and structure-property relationships, Phase diagrams, heat treatment of steels.
- Study detailed information on types of corrosion and its prevention.
- Learn information on selection of materials for design and manufacturing.

Module-1	RBT Level: L1, L2, L3	8 Hours

Introduction: Engineering Materials – Classification – levels of structure, structure property relationships in materials. **Crystal Geometry and Structure Determination:** Geometry of crystals – the Bravais lattices, Crystal directions and planes – the miller indices, Structure determination – X –Ray diffraction- Bragg law, the powder method, Electron diffraction &Neutron diffraction. **Atomic structure and Chemical bonding & Structure of solids:** Periodic table, Ionization potential, Electron affinity and Electro-negativity, Correlation between Bonding and the Properties of Solids (Ionic, molecular, covalent, metallic solids)

Experiential Learning: (1) To find the ionization potential of mercury using a gas-filled diode.

(2) To measure the absorbance of the sample at different wavelengths & to find out the unknown concentration of the sample by using spectrophotometer.

Applications: (1) Ionization potential can predict the strength of chemical bond

(2) directly used to measure light intensity at different wavelength & used to determine unknown concentration of solution.

Video Links:		
http://apniphysics.com/viva/ionization-experiment-physics/		
https://vlab.amrita.edu/?sub=2&brch=190&sim=338&cnt=1		
Module-2	RBT Level: L1, L2, L3	8 Hours

Crystal Imperfection: Point Imperfections, Line imperfections – edge and screw dislocations, the Burgers vector, line energy of dislocations, Surface imperfections. **Basic thermodynamic functions:** phase diagrams and phase transformation: Single component systems, Binary phase diagrams, Lever rule, typical phase diagrams for Magnesia-Alumina, Copper – Zinc, iron – carbon systems, Nucleation and growth. Solidification, Allotropic transformation

Experiential Learning: Heat treatment processes can be adopted to study the phase transformation

Applications: Phase transformation can be adopted to predict the various crystal structure of metals

Video Links:

http://www.cittumkur.org/mech2019/MTLab.pdf

Module-3	RBT Level: L1, L2, L3	8 Hours

Deformation of Materials and Fracture: Elastic deformation, Plastic deformation, Visco-elastic deformation, Stress and strain curve for ductile & brittle material, creep, Different types of fracture. **Heat Treatment:** Annealing, Normalizing Hardening, Martempering, Austempering, Hardenability, Quenching, Tempering, Furnace types.

Experiential Learning:

(1) To determine Young's modulus of elasticity of the material of a given wire. (2) To study the heat treatment process (Annealing)

Applications: (1) Young's modulus of elasticity defines the relationship between stress (force per unit area) and strain (proportional deformation) in a material. (2) Annealing reduces internal stress, softens the metal & improve the ductility of metals

Video Links:

https://byjus.com/physics/to-determine-youngs-modulus-of-elasticity-of-the-material-of-a-given-wire/

http://www.cittumkur.org/mech2019/MTLab.pdf

Module-4	RBT Level: L1, L2, L3	8 Hours

Corrosion and its Prevention: corrosion and its manifestations, consequences, direct corrosion, Electro-chemical corrosion, Galvanic cells, High temperature corrosion, Passivity, factors influencing corrosion rate, control and prevention of corrosion-modification of corrosive environment, inhibitors, protective coatings, Specific types of corrosion.

Experiential Learning: Construction & working of galvanic cell

Applications: Galvanic cells and batteries are typically used as a source of electrical power.

Video Links:

https://www.uccs.edu/Documents/chemistry/nsf/106%20Expt9V-GalvanicCell.pdf

Module-5	RBT Level: L1, L2, L3	8 Hours

Typical engineering materials: Ferrous metals, non-ferrous metals and alloys, Aluminium and its alloys, Copper and its alloy, Lead and its alloy, Tin, Zinc and its alloy, silicon and its alloys, Alloys for high temperature service, Ceramic materials- structure of ceramics, polymorphism, Mechanical, electrical and thermal properties of ceramics phases, Refractories, Glasses, abrasives, plastics, fibres, and elastomers, Organic protective coating.

Experiential Learning: To determine the shear stress & hardness of engineering materials

Applications: To select the material of construction in automotive, structural, failure analysis, quality control, aerospace & other types of industries

Video Links:

http://www.cittumkur.org/mech2019/MTLab.pdf

Course outcomes:	
CO1	Classify different types of engineering materials depending on structure property, crystal geometry and X-Ray diffraction, atomic structures, types of bonding.
CO2	Explain crystal imperfections and. Draw phase diagrams of different metals, TTT curves.
CO3	Enumerate deformation of materials and Suggest different type of heat treatment techniques depending on the type of the material.
CO4	Interpret different types of corrosions and suggest preventive methods
CO5	Select materials depending on type of application.
Text Books:	

1	Raghavan, V. (2006). *Materials Science and Engineering: A First Course*, 468 s.
2	HajraChoudhury S.K. (1982). *Materials Science and Processes*. Indian book distributing Co.

Reference Books:

1	Van Vlack H.L. (2002). *Elements of Material Science.* Addison – Wesly Publish Company, New York.
2	Chanda, M. (1981). *Science of Engineering Materials*, McMillan Company of India Ltd
3	**Web Link and Video Lectures:** https://nptel.ac.in/courses/113107078/ https://freevideolectures.com/course/2266/material-science

Scheme of Evaluation:

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e., Σ (Marks Obtained in each test)/3	CIE (50)	30
Quizzes - 2 Nos.		2X2=4
Activities/ Experimentations related to course/ Assignment -2 Nos. /Presentation - 1 Nos		3X2=6
Mini Projects/ Case studies - 2 Nos.		2X5=10
Semester End Examination	SEE (50)	50
Total		100

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	TECHNICAL CHEMISTRY	Semester	III
Course Code	MVJ20CH36	CIE	50
Total No. of Contact Hours	40 L : T : P :: 30 : 10 : 00	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	3	Exam. Duration	3hrs

Course objective is to:

- To familiarize the students with the principles of some important topics in physical Chemistry, Inorganic Chemistry and Organic Chemistry.

Module-1		RBT Level: L1, L2, L3	8 Hours

Bonding: Atomic and Molecular orbital theory: Theory of bonding, Types of bonds, Hydrogen bond with discussion on interaction between two atoms such as exchange of electron, screen effect of electrons. Anti-bonding, Bond theory of metals, Theory of resonance, Structural stability, structure of carbonate ion and benzene, Importance of resonance compounds

Module-2		RBT Level: L1, L2, L3	8 Hours

Phase rule: Definition of terms, derivation and application of phase rule consisting of two component system.

Surface chemistry: Introduction, adsorption and absorption, types of adsorption, physical and chemical adsorption, adsorption isotherms, Freundlich, Langmuir and BET and applications of adsorption-industrial, general, analytical.

Module-3		RBT Level: L1, L2, L3	8 Hours

Isomerism: Definition, Types, Conformational isomerism in alkanes, free rotation about carbon- carbon single bond, conformation of ethane, propane n, butane, relative stability of different conformations. Optical isomers – Isomer number & tetrahedral carbon atom chirality, optical isomerism with one asymmetric carbon atom, Polarimeter, Specific rotation, Enantiomerism R & S Nomenclature. Geometrical isomerism – Definition, conditions for geometrical isomerism, cis-trans & E-Z nomenclature, physical & chemical properties of geometrical isomerism.

Coordination chemistry: Werner's theory, Nomenclature, properties effective atomic number, stability of complex ions, factors affecting the stability, Bonding in coordination compounds, Crystal field theory, stereochemistry of co-ordination compounds. Isomerism

of co-ordination compounds. Importance of coordination compounds.		
Module-4	RBT Level: L1, L2, L3	8 Hours

Heterocyclic compounds: Nomenclature, Classification, Structure, Preparation, Properties & Reactions of Heterocyclic, Analogues of Cyclopropane, Cyclo butane Cyclopentadiene, Heterocyclic's one or more hetero atoms, Azetidenes, Furans, Pyratidine, Pyroles, diazines, Fused heterocyclics, Heterocyclics in Dyes, Medicines, Natural products.

Module-5	RBT Level: L1, L2, L3	8 Hours

Reactions & mechanisms: Concept of Steady states, reactive intermediates, Carbanions, Carbocations, Inductive and resonance effects. Mechanism of nucleophilic substitution (SN1 and SN2) in alkyl halides. Mechanism of elimination reactions (E1 and E2). Mechanism of electrophilic substitution in benzene, nitration, sulphonation, halogenation. Friedel-crafts alkyl and acylation reactions. Electronic interpretation of orienting influence of substituents in aromatic electrophilic of toluene, chlorobenzene, phenol, Benzonitrile, aniline and nitrobenzene. Solvents effects.

Laboratory Sessions

Activity:

1. Model making of Different geometrical isomers.

2. Preparation of adsorbents for the treatment of colored waste water.

Break up of CIE marks: CIE: 50

    (i)   Average of three internal Assessment (IA) Tests :30

    (ii)   Remaining 20 Marks allocated for Two Assignment and One Innovative Activity:

    Average of Three Assignments : 10 marks

Assignment 1 are to be given from Module 1 and 2; Assignment 2 are to be given from Module 3 and 4; Assignment 3 are to be given from Module -5 and 1

Allocation of marks for Assignment:

Neat presentation / submission time	2 marks
content/concept	5 marks
References Bibliography / webliography	3 marks

At least Three **Bibliography** and **Two webliography** are to be included in each assignment by the students.

(a) Innovative Activity: 10 marks:

Allocation of marks for Innovative Activity:

Relevance of the topic	2 marks
Print Preview / Presentation (seminar)	5 marks
References Bibliography / webliography	3 marks

This innovative work can be taken by a 4 set of students. Innovative work should be related to their respective syllabus. **SEE: 50**

Course outcomes:

On successful completion of this course students will be able to

CO1	Explain the bond theory Resonance theory H-O-H Bonds
CO2	Understand the techniques of Surface chemistry and phase rule and their application in industry.
CO3	Explain the structure and bonding of coordination compounds with proper reason of deviation, isomerism prevailing
CO4	Write reaction mechanisms in various types of reactions.

Text Books:	
1.	Puri L.R. and Sharma B.R., **"Physical Chemistry"**, 14th edn., Chand S. and Company, New Delhi, 1998.

Reference Books:	
1.	James Huheey, **"Inorganic Chemistry"**, 19[th]edn. Wiley Publishers, New Delhi, 1997.
2.	Dhone D. B., A Text Book of Plant Utilities, Nirali Publications.

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

High-3, Medium-2, Low-1

Course Title	MOMENTUM TRANSFER LAB	Semester	III
Course Code	MVJ20CHL37	CIE	50
Total No. of Contact Hours	20 L:T:P::0:10:10	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	2	Exam. Duration	3 Hours

Course objective is to:

- This course aims to familiarize students with the principles of Fluid mechanics.

S. No.	Experiment Name	RBT Level	Hours
1.	Friction in circular pipes.	L1, L2, L3	3
2.	Friction in non-circular pipes.	L1, L2, L3	3
3.	Friction in helical/spiral coils.	L1, L2, L3	3
4.	Flow measurement using venturi (incompressible fluid).	L1, L2, L3	3
5.	Flow measurement using orifice meters (incompressible fluid).	L1, L2, L3	3
6.	Flow over notches- find the coefficient of discharge through various notches.	L1, L2, L3	3
7.	Flow through open orifice-Hydraulic coefficients.	L1, L2, L3	3
8.	Flow through Packed bed-Verify ERGUN'S Equation	L1, L2, L3	3
9.	Flow through Fluidized bed- to calculate the minimum fluidization velocity	L1, L2, L3	3
10	Study of characteristics for centrifugal, Positive displacement pump	L1, L2, L3	3
11.	Study of various pipe fittings and their equivalent lengths.	L1, L2, L3	3
12.	Unsteady flows - Emptying of Tank	L1, L2, L3	3

Course outcomes:

CO1	Identify, name, and characterize flow patterns and regimes.
CO2	Measure fluid pressure and relate it to flow velocity.
CO3	Demonstrate practical understanding of friction losses, coefficient of discharge in various notches and pipes.
CO4	Explain fluid flow in channels and application of flow meters and notches.

CO5	Study of characteristics & efficiency of centrifugal, Positive displacement pump

Scheme of Evaluation:

Details		Marks
Regular lab work	CIE (50)	30
Record writing		10
Viva-voce		10
Semester End Examinations	SEE (50)	20
Total		100

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

High-3, Medium-2, Low-1

Course Title	TECHNICAL CHEMISTRY LAB	Semester	III
Course Code	MVJ20CHL38	CIE	50
Total No. of Contact Hours	40 L : T : P :: 0 : 10 : 30	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	2	Exam. Duration	3hrs

Course objective is to: This course aims to familiarize students with the principles of technical chemistry and basic analytical techniques including volumetric analysis.

Laboratory Experiments:

1. Critical Solution Temperature-Water–Phenol System.

2. Estimation of dissolved oxygen in given sample of water by Winkler's method.

3. Estimation of Iodine & Saponification number of vegetable oil.

4. Analysis of Bleaching Powder-Available chlorine.

5. Heats of mixing-Water–HCl system.

6. Conductometric estimation-Water hardness estimation.

7. Colorimetric Estimation–Potassium dichromate Estimation.

8. Analysis of coal-Moisture Volatile matter & Ash content.

9. Study of kinetics of reaction between $K_2S_2O_8$ and KI.

10. Conductometric determination of equivalent conductance of acetic acid at infinite.

11. Estimation of phenol by iodometric method.

12. Preparation of p-bromo acetanilide from acetanilide.

13. Colorimetric estimation of fluoride in water using SPADNS reagent

Minimum of 10 experiments are to be performed

Course outcomes: Through this course students should be able to

CO1	Explain and perform analytics of quantitative estimation by volumetric method of metal and alloys, oil and proximate analysis of coal.
CO2	Determine disinfectant and water quality parameter analysis to assess the quality of water.
CO3	Analyse kinetics, partition co-efficient, transition temperature, percentage composition of binary mixture, critical solution temperature

	and molecular weight of chemical components.
CO4	Predicttheorganicreactionmechanismandtoestimatefunctionalgroupsempl oyingdifferenttechniques.
CO5	Have knowledge of handling instruments for precise analysis.

CIE: 50

SEE:50

Reference Books:	
1.	ESSENTIALS OF EXPERIMENTAL ENGINEERING CHEMISTRY b y SHASHICHAWLA, DHANPATRAI PUBLICATIONS.
2.	VOGEL'S QUANTITATIVE CHEMICAL ANALYSIS by J. MENDHAM,R.C. DENNEY, J.D.BARNES, M.J.K.THOMAS,PEARSON.

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

High-3, Medium-2, Low-1

Course Title	SAMSKRUTHIKA KANNADA	Semester	III
Course Code	MVJ20SK39	CIE	50
Total No. of Contact Hours	20 L: T: P 20:0:0	SEE	50
No. of Contact Hours/week	1	Total	100
Credits	1	Exam. Duration	3Hrs

Course objective:

- Samskruthika Kannada –Parichaya (Introduction to Adalithakannada)
- Kannada Kavyagalaparichaya (Kannada D Ra Bendre, Siddalingaiha)
- Adalithdalli Kannada Padagalu (Kannada KagunithaBalake, Patra Lekhana, Prabhandha)
- Kannada Computer Gnyana (Kannada ShabdhaSangraha, Computer Paribashikapadagalu)
- Activities in Kannada.

ಅಧ್ಯಾಯ –೧
ಕನ್ನಡ ಭಾಷೆ–ಸಂಕ್ಷಿಪ್ತ ವಿವರಣೆ.

ಅಧ್ಯಾಯ –೨
ಭಾಷಾ ಪ್ರಯೋಗಗಳ್ಲಾಗುವ ಲೋಪದೋಷಗಳು ಮತ್ತು ಅವುಗಳ ನಿವಾರಣೆ.

ಅಧ್ಯಾಯ –೩
ಲೇಖನ ಚಿಹ್ನೆಗಳು ಮತ್ತು ಅವುಗಳ ಉಪಯೋಗ

ಅಧ್ಯಾಯ –೪
ಪತ್ರ ವ್ಯವಹಾರ.

ಅಧ್ಯಾಯ –೫
ಆಡಳಿತ ಪತ್ರಗಳು.

ಅಧ್ಯಾಯ –೬
ಸರ್ಕಾರದಆದೇಶ ಪತ್ರಗಳು

ಅಧ್ಯಾಯ –೭
ಸಂಕೀಪ್ತ ಪ್ರಬಂಧರಚನೆ, ಪ್ರಬಂಧ ಮತ್ತು ಭಾಷಾಂತರ

ಅಧ್ಯಾಯ –೮
ಕನ್ನಡ ಶಬ್ದಸಂಗ್ರಹ

ಅಧ್ಯಾಯ –೯
ಕಂಪ್ಯೂಟರ್ ಹಾಗೂ ಮಾಹಿತಿತಂತ್ರಜ್ಞಾನ

అధ్యాయ –౧౦		
ಪಾರಿಭಾಷಿಕ ಆಡಳಿತ ಕನ್ನಡ ಪದಗಳು ಮತ್ತುತಾಂತ್ರಿಕ/ಕಂಪ್ಯೂಟರ್ ಪಾರಿಭಾಷಿಕ ಪದಗಳು.		
Scheme of Evaluation:		
Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e.Σ (Marks Obtained in each test) / 3	CIE(50)	30
ASSIGNMENT		20
Semester End Examination	SEE (50)	50
Total		100

Course Title	BALIKE KANNADA	Semester	III
Course Code	MVJ20BK39	CIE	50
Total No. of Contact Hours	14	SEE	50
No. of Contact Hours/week	1 Hour/week	Total	100
Credits	1	Exam. Duration	Hours

Course objective is to: The course will enable,
- The students to understand Kannada and communicate in Kannada language.
- Vyavharika Kannada –Parichaya (Introduction to Vyavharikakannada)
- Kannada Aksharamaalehaaguuchcharane(Kannada Alphabets and Pronounciation.
- Sambhashanegaagi Kannada Padagalu (Kannada Vocubulary for Communication).
- Kannada Grammer in Conversations(Sambhasaneyalli Kannada Vyakarana)
- Activities in Kannada

	Module-I	L1 & L2	1Hour

Vyavharika Kannada: Necessity of learning a local language, Tips to learn the language with easy methods, Hints for correct and polite conversation, About Kannada language (Kannada Bhase).

Experiential Learning:

1. Listen to Kannada news and watch Kannada movies

2. Use online applications (apps) for faster learning.

Video Links: https://youtu.be/fd966GC8Yko

	Module-2	L1&L2	5Hours

Kannada Alphabets And Pronounciation: Kannada Aksharamaale (Vowels, consonants & Unstructured consonants), Kannada stress letters, Kannada Khagunitha, Pronounciation (SwaragalaUchcharane, Vyanjangala Ucharane) ,Exercises.

Experiential Learning:

1.Based on the above topics Exercises

Video Links: https://youtu.be/RuRmq7VyCaQ

	Module-3	L1 & L2	5Hours

Sambhasanegaagi Kannada Padagalu: Introduction ,Ekaavachana Mattu Bhavuvachana, Linga (Gender),Prashnartha kapadagalu (Interrogative words), Viruddha Padagalu (Antonyms), Asamanjasa Ucharane (Inappropriate Pronunciations), Sankyavyavasthe (Numbers System) , List of Vegetables, Bhinnamshagalu (Fractions) ,Menu of famous food items in Karnataka , aahara Padarthgalahesaragalu (Names of the Food Items),

Samay/KalakkeSambhandhisidapadagalu (Words Relating to Time) ,Dikkugaligesambhasidhisidapadagalu (words Related to Directions),ManushyanaBhavanegaligesambhadhisidaPadagalu (Words Related to Humen's Feelings and Emotions),Manushyanashareeradabhagagalu (Parts of the Human Body),Sambhandhisidasambhandhakkepadagalu (Words Related to Relationship), Vasadstalakkesambhandhisidapadagalu (Words Related to Place of Living), SaamanyaSambhasaneyallibhalasuvanthaPadagala Patti (List of Words used in the general communication) & Colors in Kannada

Experiential Learning: 1.Based on the above topics Exercises

Video Links: https://youtu.be/PoQ9m16d7QA

	Module-4	L1&L2	8 Hours

Kannada Grammer in Conversations (Sambhasaneyalli Kannada Vyakarna):Introduction , Nouns (Naampadagalu), Pronoun (Sarvanaampadagalu) , Use of Pronouns in Kannada Sentences , Adjectives (Kannada namaVishenegalu) , Kannada Verbs (Kriya Padagalu) , Adverbs in Kannada (Kriya Vishenegalu) , Conjuctions in Kannada (Sanyaga) , Preposition in Kannada (Poorvabhavi).

Experiential Learning: Questions constructing words in Kannada (PrashnarthakaPadagalu), Simple Communicative Sentences in Kannada, Exercise for Practice, Enquiry Questions

Video Links: https://youtu.be/fd966GC8Yko

	Module-5	L1 &L2	1Hour

Activies in Kannada (KannadadalliChatuvatikegalu): Activites –Vocubulry (Shabdakosh), Conversation (Shambhasane)

Experiential Learning: Try to communicate with each other in Kannada

Video Links: https://youtu.be/fd966GC8Yko

Course outcomes:	
CO1	Understanding the advantage of learning a local language
CO2	Understanding the difference between pronunciation of English and Kannada
CO3	Understanding the word meaning in Kannada and frame the simple sentences if any difficulty can use any other language words to complete the conversation
CO4	Understanding the word meaning and frame the sentences and try to translate Kannada to English vise versa

CO5	Understanding the Kannada grammar and how to implement in Kannada sentences for communication

Text Books:	
1	Sankispta Kannada Nighantu (Parishkratha), Kannada sahitya Parishatha,Bangalore
2	Mysore vishwavidyalayada English –Kannada Nighantu (Parishkratha) samputa –(A inda Z varage)
3	Kacheri Kaipidi –Dr .Ha .Ma. Nayak, Kannada Adhyanasamsthe . Mysorevishwavidyalayada ,1974

Reference Books:	
1.	Vyavharika Kannada PatyaPusthaka by L.Thimmesha

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)

- Mini Project / Case Studies (8 Marks)

- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

iv. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

v. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

vi. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

High-3, Medium-2, Low-1

Course Title	CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND CYBER LAW	Semester	III
Course Code	MVJ20CPH39	CIE	50
Total No. of Contact Hours	20 L : T : P :: 20:0 : 0	SEE	50
No. of Contact Hours/week	01	Total	100
Credits	01	Exam. Duration	2 hrs

Course objective is to:

- To know the fundamental political codes, structure, procedures, powers, and duties of Indian constitution, Indian government institutions, fundamental rights, directive principles and the duties of the citizens.

- To provide overall legal literacy to the young technocrats to manage complex societal issues in the present scenario.

- To understand engineering ethics & their responsibilities, identify their individual roles and ethical responsibilities towards society.

Module-1	RBT Level: L1, L2, L3	4 Hours

Introduction to Indian Constitution: The Necessity of the Constitution, The Societies before and after the Constitution adoption. Introduction to the Indian Constitution, The Making of the Constitution, The role of the Constituent Assembly – Preamble and Salient features of the Constitution of India. Fundamental Rights and its Restriction and Limitations in different Complex Situations. Directive Principles of State Policy (DPSP) and its present relevance in our society with examples. Fundamental Duties and its Scope and Significance in Nation Building.

Module – 2	RBT Level: L1, L2, L3	4 Hours

Union Executive and State Executive

Parliamentary System, Federal System, Centre-State Relations. Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism. State Executives – Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts, Special Provisions (Article 370, 371, 371J) for some States.

Module – 3	RBT Level: L1, L2, L3	4 Hours

Elections, Amendments and Emergency Provisions: Elections, Electoral Process, and Election Commission of India, Election Laws. Amendments - Methods in Constitutional Amendments (How and Why) and Important Constitutional Amendments. Amendments – 7,9,10,12,42,44,61,73,74,75,86, and 91,94,95,100,101,118 and some important Case Studies. Recent Amendments with explanation. Important Judgements with Explanation and its impact on society (from the list of Supreme Court Judgements). Emergency Provisions, types of Emergencies and it's consequences. **Constitutional Special Provisions:** Special Constitutional Provisions for SC & ST, OBC, Special Provision for Women, Children & Backward Classes.		
Module – 4	RBT Level: L1, L2, L3	4 Hours
Professional / Engineering Ethics: Scope & Aims of Engineering & Professional Ethics - Business Ethics, Corporate Ethics, Personal Ethics. Engineering and Professionalism, Positive and Negative Faces of Engineering Ethics, Code of Ethics as defined in the website of Institution of Engineers (India): Profession, Professionalism, Professional Responsibility. Clash of Ethics, Conflicts of Interest. **Responsibilities in Engineering** - Responsibilities in Engineering and Engineering Standards, the impediments to Responsibility. Trust and Reliability in Engineering, IPRs (Intellectual Property Rights), Risks, Safety and liability in Engineering.		
Module – 5	RBT Level: L1, L2, L3	4 Hours
Internet Laws, Cyber Crimes and Cyber Laws: Internet and Need for Cyber Laws, Modes of Regulation of Internet, Types of cyber terror capability, Net neutrality, Types of Cyber Crimes, India and cyber law, Cyber Crimes and the information Technology Act 2000, Internet Censorship, Cybercrimes and enforcement agencies.		

Scheme of valuation:		
Details		
Average of three Internal Assessment (IA) tests of 40 Marks each i.e., Σ(Marks obtained in each test)/3	CIE (50)	40
Assignment		10
Semester End Examination	SEE (50)	50
	Total	100

Course Outcomes: On completion of this course, students will be able to	
CO1	Have constitutional knowledge and legal literacy
CO2	Understand Engineering and Professional ethics and responsibilities of Engineers.

CO3	Understand the cyber crimes and cyber laws for cyber safety measure.

Text Books:	
1.	Constitution of India and Professional Ethics, T.S. Anupama, Sunstar Publisher
Reference Books:	
1.	Durga Das Basu (DD Basu): "Introduction to the Constitution on India", (Students Edition.)Prentice –Hall EEE, 19th/20thEdn., (Latest Edition) or 2008.
2.	Shubham Singles, Charles E. Haries, and Et al : "Constitution of India and Professional Ethics" by Cengage Learning India Private Limited, Latest Edition – 2018.
3	M.Govindarajan, S.Natarajan, V.S.Senthilkumar, "Engineering Ethics", Prentice –Hall of India Pvt. Ltd. New Delhi, 2004.
4.	M.V.Pylee, "An Introduction to Constitution of India", Vikas Publishing, 2002.
5.	Latest Publications of NHRC - Indian Institute of Human Rights, New Delhi.

Course Title	ADDITIONAL MATHEMATICS-I (COMMON TO ALL BRANCHES)	Semester	III
Course Code	MVJ20MATDIP31	CIE	50
Total No. of Contact Hours	40 L:T:P 30:10:00	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	-	Exam. Duration	3hrs

Course objective is to: This course viz., aims to prepare the students:

To familiarize the important and basic concepts of Differential calculus and Differential Equation, ordinary/partial differential equations and Vector calculus and analyse the engineering problems.

Module-1	RBT Level: L1, L2	8 Hours

Differential calculus: Recapitulations of successive differentiations -n^{th} derivative - Leibnitz theorem and Problems, Mean value theorem -Rolle's theorem, Lagrange's Mean value theorem , Cauchy's theorem and Taylor's theorem for function of one variables.

Video Link:

https://users.math.msu.edu/users/gnagy/teaching/ode.pdf

Module-2	RBT Level: L1, L2	8 Hours

Integral Calculus: Review of elementary Integral calculus, Reduction formula $\int_0^{\frac{\pi}{2}} sin^m x\, dx$, $\int_0^{\frac{\pi}{2}} cos^m x\, dx$, $\int_0^{\frac{\pi}{2}} sin^m cos^n x\, dx$ and problems. Evaluation of double and triple integrals and Simples Problems.

Video Link:

https://www.youtube.com/watch?v=rCWOdfQ3cwQ

https://nptel.ac.in/courses/111/105/111105122/

Module-3	RBT Level: L1, L2	8 Hours

Vector Calculus: Derivative of vector valued functions, Velocity, Acceleration and related problems, Scalar and Vector point functions, Gradient, Divergence, Curl, Solenoidal and Irrotational vector fields. Vector identities - div (φA), curl (φA), curl (grad φ), div (curl A).

Video Link:

https://www.whitman.edu/mathematics/calculus_online/chapter16.html

https://www.math.ust.hk/~machas/vector-calculus-for-engineers.pdf		
Module-4	**RBT Level: L1, L2, L3**	**8 Hours**
Probability: Introduction-Conditional Probability, Multiplication theorem, Independent events, Baye's theorem and Problems. **Video Link:** https://www.khanacademy.org/math/statistics-probability/probability-library https://nptel.ac.in/courses/111/105/111105041/		
Module-5	**RBT Level: L1, L2, L3**	**8 Hours**
Differential equation: Homogenous differential equation, Linear differential equation, Bernoulli's differential equation and Exact differential equation. Video Link: https://www.mathsisfun.com/calculus/differential-equations.html		
Course outcomes:		
CO1	Apply the knowledge of Differential calculus in the modeling of various physical and engineering phenomena	
CO2	Apply the concept of change of order of integration and variables to evaluate multiple integrals and their usage in computing the area and volumes.	
CO3	Study on Vector calculus to understand the various solution to Application to Engineering problems.	
CO4	Understand the basic Concepts of Probability	
CO5	Solve first order linear differential equation analytically using standard methods.	

Text Books:	
1.	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition 2013.
2.	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.
Reference Books:	
1	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers,

	10thedition,2014.
2	G. B. Gururajachar: Calculus and Linear Algebra, Academic Excellent Series Publication, 2018-19

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (10 marks)
- Assignment (10 marks)

SEE Assessment:

vii.　Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

viii.　Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

ix.　One question must be set from each unit.　The duration of examination is 3 hours.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	0	3	0	0	0	0	0	0	1	1
CO2	2	3	0	3	0	0	0	0	0	0	1	1
CO3	2	2	0	2	0	0	0	0	0	0	1	0
CO4	3	2	0	3	0	0	0	0	0	0	0	1
CO5	3	3	0	2	0	0	0	0	0	0	0	0

High-3, Medium-2, Low-1

Course Title	UNIVERSAL HUMAN VALUES I	Semester	III
Course Code	MVJ20UHV310	CIE	50
Total No. of Contact Hours	15 L: T : P :15 : 0 :0	SEE	50
No. of Contact Hours/week	1	Total	100
Credits	1	Exam. Duration	3 Hrs.

Course objective is to: This course will enable the students to

- Perceive the need for developing a holistic perspective of life
- Sensitise the scope of life – individual, family (inter-personal relationship), society and nature/existence, Strengthening self-reflection
- Develop more confidence and commitment to understand, learn and act accordingly

Module-1	RBT Level: L1, L2	3 Hours

Welcome and Introductions: Getting to know each other (Self-exploration). **Aspirations and Concerns:** Individual academic, career, Expectations of family, peers, society, nation, Fixing one's goals (Basic human aspirations Need for a holistic perspective Role of UHV). **Self-Management:** Self-confidence, peer pressure, time management, anger, stress, Personality development, self-improvement (Harmony in the human Being)

Health: Health issues, healthy diet, healthy lifestyle, Hostel life (Harmony of the Self and Body Mental and physical health). **Relationships:** Home sickness, gratitude, towards parents, teachers and, others Ragging and interaction, Competition and cooperation, Peer pressure (Harmony in relationship Feelings of trust, respect, gratitude, glory, love). **Society:** Participation in society (Harmony in the society). **Natural Environment:** Participation in nature (Harmony in nature/existence)

Video link:

- https://youtube.com/playlist?list=PLYwzG2fd7hzc4HerTNkc3pS_IvcCfKznV
- https://youtube.com/playlist?list=PLYwzG2fd7hzcZz1DkrAegkKF4TseekPFv

Presentation: https://fdp-si.aicte-india.org/AicteSipUHV_download.php

Module-2	RBT Level: L1, L2	3 Hours

Introduction to Value Education: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Self-exploration as the Process for Value Education, Happiness and Prosperity – Current Scenario.

Video link:

- https://www.youtube.com/watch?v=85XCw8SU084

- https://www.youtube.com/watch?v=E1STJoXCXUU&list=PLWDeKF97v9SP_Kt6jqzA3p Z3yA7g_OAQz
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

Module-3	RBT Level: L1, L2	3 Hours

Introduction to Harmony in the Human Being: Understanding Human being as the Co-existence of the Self and the Body, The Body as an Instrument of the Self, Harmony of the Self with the Body.

Video link:

- https://www.youtube.com/watch?v=GpuZo495F24
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

Module-4	RBT Level: L1, L2	3 Hours

Introduction to Harmony in the Family and Society: Harmony in the Family – the Basic Unit of Human Interaction, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society.

Video link:

- https://www.youtube.com/watch?v=F2KVW4WNnS8
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

Module-5	RBT Level: L1, L2	3 Hours

Introduction to Implications of the Holistic Understanding: Natural Acceptance of Human Values, Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Holistic Technologies, Production Systems and Management Models-Typical Case Studies.

Video link:

- https://www.youtube.com/watch?v=BikdYub6RY0
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

Course outcomes: On completion of the course, students would be able to	
CO1	Develop a holistic perspective about life
CO2	Explore his/her role (value) in all aspects of living – as an individual, as a member of a family, as a part of the society as an unit in nature
CO3	Become more responsible in life, and in handling problems with sustainable solutions
CO4	Have better critical ability
CO5	Become sensitive to their commitment

Scheme of Evaluation			
Details		Marks	
Assessment by Faculty mentor (Class Room Evaluation)	CIE(50)	10	
Self-Assessment + Assessment by peers		20	
Activities / Experimentations related to courses/Assignment		10	
Mini Projects / Case Studies		10	
Semester End Examination	SEE (50)	50	
	Total	100	

Text Books:	
1.	AICTE SIP UHV-I Teaching Material, https://fdp-si.aicte india.org/ AicteSipUHV_download.php
2.	A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
3.	Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books:	
1.	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
2.	Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
3.	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
4.	The Story of Stuff (Book).
5.	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

CO-PO Mapping

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

High-3, Medium-2, Low-1