RV COLLEGE OF ENGINEERING®

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

Scheme and Syllabus of III & IV Semesters

(Autonomous System of 2018 Scheme)

Master of Technology (M.Tech)

in

CHEMICAL ENGINEERING

DEPARTMENT OF

CHEMICAL ENGINEERING

RV COLLEGE OF ENGINEERNG®, BENGALURU-560 059
(Autonomous Institution Affiliated to VTU, Belagavi)

DEPARTMENT OF CHEMICAL ENGINEERING
M.Tech in CHEMICAL ENGINEERING

THIRD SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			
				L	**T**	**P**	**Total Credits**
1	18MCH31	Transport Phenomena	CH	4	1	0	5
2	18 MCH32X	Elective G	CH	4	0	0	4
3	18 MCH33	Internship	CH	0	0	5	5
4	18 MCH34	Dissertation Phase I	CH	0	0	5	5
Total number of Credits				**8**	**1**	**10**	**19**
Total Number of Hours / Week							

FOURTH SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			
				L	**T**	**P**	**Total Credits**
1	18MCH41	Dissertation Phase II	CH	0	0	20	20
2	18MCH42	Technical Seminar	CH	0	0	2	2
Total number of Credits				**0**	**0**	**22**	**22**
Total Number of Hours / Week							

III Sem		
GROUP E: PROFESSIONAL CORE ELECITVE		
Sl. No.	**Course code**	**Course Title**
1	18MCH321	Computational Fluid Dynamics
2	18MCH322	Solar Photovoltaic Systems and Technology
3	18MCH323	Food Process Engineering and Technology

TRANSPORT PHENOMENA (Theory)						
Course Code	**:**	**18MCH31**		**CIE**	**:**	**100 Marks**
Credits	**:**	**L:T:P:4:1:0**		**SEE**	**:**	**100 Marks**
Hours	**:**	**48**		**SEE Duration**	**:**	**3 Hours**

Unit – I	**10 Hrs**

Velocity profile, Average Velocity, Shear Stress Distribution and Forces in Laminar Flow: Development of models to describe laminar flow over flat inclined plate, flow through a circular tube, flow through annulus, flow between parallel plate and through a slit, flow as wetted wall column, annular flow with inner cylinder

Velocity Distributions in Turbulent Flow: Comparison of laminar and turbulent flows, time-smoothed equations of change, Reynolds rules of averaging, Reynolds stresses, turbulence models moving.

Unit – II	**10 Hrs**

Thermal Conductivity and Mechanism of Energy Transport: Fourier law of heat conduction. Effect of Temperature and pressure on thermal conductivity, heat transfer through composite plane wall, composite cylindrical wall, composite spherical wall, Over-all heat transfer co-efficient.

Temperature Distribution in Solids and Laminar Flow: Heat conduction problems of Chemical Engineering for heat conduction with internal generation by electrical, nuclear, viscous sources, heat transfer in annular flow, conduction through walls of varying thermal conductivity as function of temperature.

Unit – III	**10 Hrs**

Diffusivity and Mechanism of Mass Transport: Fick's law of diffusion, Effect of temperature and pressure on diffusivity of liquids and gases

Concentration Distributions in Solids and in Laminar Flow: Steady state shell mass balance, Diffusion through stagnant gas and liquid film, Equi-molar counter diffusion, Diffusion with homogeneous and heterogeneous reaction, diffusion and reaction inside a porous catalyst..

Unit – IV	**10 Hrs**

Equations of Change for Isothermal Systems: Equation of continuity, equation of motion, Navier-Stokes equation in Cartesian coordinates, Modifications of all these equations to spherical and cylindrical coordinates, Application of these equations to solve simple flow problems, Couette flow and rotating cylinder.

Unit – V	**8 Hrs**

The equations of change for non-isothermal systems: Energy Equation, special forms, Use of equation to solve steady state problems. Tangential flow in annulus with viscous heat, Transportation cooling

Course Outcomes: After completion of the course student will be able to:
CO1: Recall fundamentals of heat, mass and momentum transfer
CO2: Explain geometry, domain and flux distribution for transfer operations
CO3: Apply laws of conservation to carry out shell balance for transfer operations
CO4: Develop steady state models involving momentum, heat and mass transfer

Reference Books:	
1	Transport Phenomena, Bird R.B., W.E. Stewart and E.N. Lightfoot, 2nd Edition, 2002, John Wiley and Sons, ISBN 81-2654-0808-6
2	Fundamental of Momentum, Heat and Mass Transfer, Welty, J.R., C.E. Wicks and R.E. Wilson, 5th Edition, 2008, John Wiley and Sons, ISBN 13 978-0470128688
3	Advanced Transport Phenomena, John C Slattery, Cambridge University Press, 2005, ISBN 978-0-521-63565-3
4	Brodkey R.S. and H.C.Hershey, Transport Phenomena, A United Approach, Vol 2, McGraw Hill, 1988, ISBN 0-9726635-8-4

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

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) solving innovative problems 2) seminar/new developments in the related course 3) Laboratory/field work 4) mini project.

Total CIE is 20+50+30=100 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:

The question paper will have FIVE questions with internal choice from each Unit. Each question will carry 20 marks. Student will have to answer one question from each Unit.

COMPUTATIONAL FLUID DYNAMICS (Elective group-G)						
Course Code	**:**	**18 MCH321**		**CIE**	**:**	**100 Marks**
Credits	**:**	**L:T:P:4:0:0**		**SEE**	**:**	**100 Marks**
Hours	**:**	**48**		**SEE Duration**	**:**	**3 Hrs**

Unit – I **10Hrs**

Introduction to CFD

Introduction to CFD, CFD Applications, Numerical vs Analytical vs Experimental analysis, Modeling vs Experimentation.

Fundamental principles of conservation, Reynolds transport theorem, Conservation of mass, Conservation of linear momentum: Navier-Stokes equation, Conservation of Energy, General scalar transport equation.

Unit – II **10Hrs**

Differential Equations and Physical Behavior

Mathematical classification of Partial Differential Equation, , Physical examples of elliptic, parabolic and hyperbolic partial differential equations, Error Minimization Principles, Approximate solution of differential equations through variational formulation, Boundary conditions in the variational form: Primary and secondary variables, Essential and natural boundary conditions, Properties of variational form, Weighted residual approach: trial function and weighting function, Requirement of trial function and weighting function, Least square method, Point Collocation method, Galerkin's method, Rayleigh-Ritz method

Unit – III **10Hrs**

D**iscretization**

Discretization principles: Pre-processing, Solution, Post-processing, Finite Element Method, Finite difference method, Well posed boundary value problem, Possible types of boundary conditions, Conservativeness, Boundedness, Transportiveness, Finite volume method (FVM), Illustrative examples: 1-D steady state heat conduction without and with constant source term , Discretization of Unsteady State Problems, Discretization of Time Dependent Problems.

Discretization of the Momentum Equation: Stream Function-Vorticity approach and Primitive variable approach, Staggered grid and Collocated grid, SIMPLE Algorithm, SIMPLER Algorithm

Unit – IV **10Hrs**

Introduction to Turbulence Modeling

Important features of turbulent flow, Vorticity transport equation, Statistical representation of turbulent flows: Homogeneous turbulence and isotropic turbulence, General Properties of turbulent quantities, Reynolds average Navier stokes (RANS) equation, Closure problem in turbulence: Necessity of turbulence modeling, Different types of turbulence model: Eddy viscosity models, Mixing length model, Turbulent kinetic energy and dissipation, The κ-ε model, Advantages and disadvantages of κ-ε model, More two-equation models: RNG κ-ε model and κ-ω model, Reynolds stress model (RSM),Large eddy Simulation (LES),Direct numerical simulation (DNS)

Unit – V **08Hrs**

Numerical grid generation; basic ideas; transformation and mapping.

About the CFD softwares for different applications and construction of geometry and Discretions using available commercial CFD solvers. Creating and meshing a basic geometry. Any 5 Basic problems (eg. Basic flow studies in pipe Modeling a mixing elbow (2-D). Modeling a three-pipe intersection (3-D).Modeling flow in a tank,Modeling a combustion

chamber (3-D).	
Course outcomes: After completion of the course student will be able to	
CO1: Understand basic concepts and use of tools of computational fluid dynamics	
CO2:Apply engineering approximation to obtain discretized fluid dynamics equations	
CO3: Explain characteristics of regimes covered by various discretized schemes	
CO4: Develop computer code to solve the discretized equations.	
Reference books:	
1	Computational Fluid Dynamics: The Basics with Application, Anderson, J.D., 2010 McGraw-Hill Co. Inc., ISBN: 9788131720486, 8131720489
2	Numerical Heat Transfer and Fluid Flow, Patankar, S.V.,2017, Hemisphere Publishing Corporation, ISBN: 9781138564695, 1138564699
3	Computational Methods for Fluid Dynamics, Ferziger, J.H. and Peric, M., 2014, Springer, ISBN 978-3-540-42074-3
4	An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Versteeg, H.K. and Malalasekera, W, Prentice-Hall Inc., ISBN 978-0-13-127498-3

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

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) solving innovative problems 2) seminar/new developments in the related course 3) Laboratory/field work 4) mini project.

Total CIE is 20+50+30=100 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:

The question paper will have FIVE questions with internal choice from each Unit. Each question will carry 20 marks. Student will have to answer one question from each Unit.

SOLAR PHOTOVOLTAIC SYSTEMS AND TECHNOLOGY (Elective group-G)						
Course Code	**:**	**18 MCH322**		**CIE**	**:**	**100 Marks**
Credits	**:**	**L:T:P:4:0:0**		**SEE**	**:**	**100 Marks**
Hours	**:**	**48**		**SEE Duration**	**:**	**3 Hrs**

Unit – I	**08Hrs**

Introduction

Types of material- classification of semiconductor-Crystals structures, atomic bonding, energy band diagram – direct & indirect band gap semiconductors. Doping and carrier concentration - Hall effect in semiconductors – diffusion and drift of carriers, continuity equation – optical absorption – carrier recombination-Effect of temperature. P-N junctions-I-V characteristics-Types of junctions-homo junction-hetero junctions-Rectifying-Schottky barriers, MIS, and its characteristics.

Unit – II	**10Hrs**

Photovoltaic Fundamentals

Photovoltaic effect - Choice of semiconductor materials for fabrication of homojunction solar cells - equivalent circuit of a solar cell. Solar cell output parameters -Fill-factor, conversion efficiency, quantum efficiency. Effect of series and shunt resistance on the efficiency of solar cells. Variation of Open-circuit voltage and short circuit current with intensity of incident light. Effect of temperature on I-V characteristics. p-n heterojunction solar cells - criteria for choosing absorber and window layers.

Unit – III	**10Hrs**

Silicon Photovoltaics

Single crystal silicon (c-Si) ingot growth – Float Zone and Czochrolski methods – silicon wafer fabrication – wafer to cell formation - I-V characteristics and spectral response of c-Si solar cells. Factors limiting the efficiency - Polysilicon wafer fabrication methods – EFG and SRG methods. Amorphous Silicon - differences in properties between crystalline silicon and amorphous (a-Si) silicon. a-Si deposition by glow discharge method – Electrical and optical properties of a-Si. Outline of a-Si solar module processing steps. Heterojunction Intrinsic Thin film solar cell –fabrication by PECVD - I-V characteristics

Unit – IV	**10Hrs**

Thin Film Solar Cells

Principle of multi-junction cells– Structure and fabrication of GaInP/GaAs/Ge triple junction solar cell –Metamorphic solar cells. CdTe/CdS and CuInGaSe/CdS (CIGS) solar cells - Cell configuration – techniques used for the deposition of each layer- cell characteristics. Organic solar cells – Configuration and principle – Types of organic solar cells, Dye-sensitized (DS) solar cells – Principle – Configuration and performance, Basic

concept of quantum dot, nano wire (NW), hot carrier and plasmonic solar cells		
Unit – V		**10Hrs**
Solar Photovoltaic Systems Photovotaic Module Assembly: Description of steps involved in the fabrication of Silicon Photovoltaic Module - Performance of Photovoltaic Module - Module Protection - Modules in series and in parallel - Use of Bypass and Blocking Diodes, Solar photovoltaic system - components – PV Array, battery, invertor and load. Applications of solar photovoltaic systems. Stand alone, Hybrid and Grid connected PV systems		
Course outcomes: After completion of the course student will be able to:		
CO1: Understand basic concepts and use of tools of computational fluid dynamics.		
CO2:Apply engineering approximation to obtain discretized fluid dynamics equations		
CO3: Explain characteristics of regimes covered by various discretized schemes.		
CO4: Develop computer code to solve the discretized equations		
Reference Books		
1	Introduction to semiconductor materials and devices, M. S. Tyagi, 2008, John Wiley & Sons, ISBN: 978-812-6518-678	
2	Fundamentals of solar cells, A.L. Farenbruch, R.H. Bube, 1983, Elsevier, ISBN 978032314538	
3	Solar photovoltaics: Fundamentals, technologies and applications C.S. Solanki, 2015, Prentice Hall India, ISBN: 978-812-0343-863	
4	Terrestrial solar photovoltaics, T. Bhattacharya,1998, Narosa, ISBN 978-8173192067	

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

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1)solving innovative problems 2) seminar/new developments in the related course 3) Laboratory/field work 4) mini project.

Total CIE is 20+50+30=100 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:

The question paper will have FIVE questions with internal choice from each Unit. Each question will carry 20 marks. Student will have to answer one question from each Unit.

FOOD PROCESS ENGINEERING AND TECHNOLOGY (Elective group-6)						
Course Code	**:**	**18 MCH323**		**CIE**	**:**	**100 Marks**
Credits	**:**	**L:T:P:4:0:0**		**SEE**	**:**	**100 Marks**
Hours	**:**	**48**		**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives: The students will be able to	
1	Gain the knowledge about the chemistry and quality attributes of food
2	Apply Unit operations for food processing
3	Learn about various food additives, food contamination/adulteration
4	Know various methods of food processing, packaging and preservation

Unit-I	**9 Hrs**
Formation and chemistry of food: Properties and significance of constituents of food - Carbohydrates, Lipids, Proteins, Vitamins, Minerals and Moisture. Nutritive aspects of food constituents.	
Unit-II	**9 Hrs**
Quality attributes of food: Appearance factors, Textural factors, Flavor factors. Visual and objectively measurable attributes. Additional quality; quality standards, quality control. Food laws and standards. Introduction to sensory evaluation of foods. **Food contamination and adulteration**: Types of adulterants and contaminants, Intentional adulterants, incidental adulterants and its effects	
Unit-III	**10 Hrs**

Food preservation: Causes for food deterioration. Aims and objectives of preservation and processing. Unit operations in processing. Different methods of food preservation –low temperature, high temperature, preservatives, food irradiation.

Food Processing: Milk and dairy products, vegetables and fruits, cereals, meat and meat products, fats and oils, beverages.

Unit-IV	**10Hrs**

Food additives: Introduction and need for food additives. Types of additives – antioxidants, chelating agents, coloring agents, curing agents, emulsions, flavors and flavor enhancers, flavor improvers, humecants and anti-caking agents, leavening agents, nutrient supplements, non - nutritive sweeteners, pH control agents,stabilizers and thickeners, other additives. Additives and food safety

Unit-V	**10Hrs**

Enzymatic and non-enzymatic reactions during storage: Introduction to enzymes. Nature and function of enzymes. Classification of enzymes. Hydrolases
–Esterase, amylases, pectic enzymes. Proteases. Oxidoreductases –phenolases, glucose oxidase, catalos, peroxidase, lipoxygenase, oxidase. Immobilized enzymes. Uses of enzymes in food processing. Non-enzymatic reactions.

Modern trends in food science: Biotechnology in food, Biofortification, Nutraceuticals, Organic foods, Packaging of foods and nutrition labeling.

Course Outcomes: After completing the course, the students will be able to	
CO 1	Comprehend the chemistry and the quality attributes of food.
CO 2	Apply biocompatible additives and packaging for food products
CO 3	Identify sources of contaminants, adulterants with its prevention for safe and healthy food.
CO 4	Evaluate different food processing and preservation technologies
CO 5	Design and develop new technologies involved in food processing

Reference Books

1.	Food Science, Norman N. Potter and Joseph HHotchkin Avi Publishing Co., 5th Ed., 1995, ISBN: 0-8342-1265-X
2.	Foods, Facts and Principles, N. ShakuntalaManay and M. Sadaksharamurthy, 2nd Ed, 2005, New Age Publishers, , ISBN: 81-224-1325-0
3.	Food Science, B. Srilakshmi, 6th Ed., 2015, New Age International, ISBN: 978-81-224-3809-3
4.	Romeo T. Toledo; Fundamentals of Food Process Engineering; 2nd Ed, 2007, Springer, ISBN:978-0-387-29019-5

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

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1)solving innovative problems 2) seminar/new developments in the related course 3) Laboratory/field work 4) mini project.

Total CIE is 20+50+30=100 Marks.

Scheme of Semester End Examination (SEE) for 100 marks

The question paper will have FIVE questions with internal choice from each Unit. Each question will carry 20 marks. Student will have to answer one question from each Unit.

INTERNSHIP						
Course Code	**:**	**18MCH 33**		**CIE Marks**	**:**	**100**
Credits	**:**	**L:T:P:0:0:5**		**SEE Marks**	**:**	**100**
Hours/week	**:**	**10Hrs**		**SEE Duration**	**:**	**3 Hrs**

GUIDELINES FOR INTERNSHIP

Course Learning Objectives (CLO):

The students shall be able to:

(1) Understand the process of applying engineering knowledge to produce product and provide services.

(2) Explain the importance of management and resource utilization

(3) Comprehend the importance of team work, protection of environment and sustainable solutions.

(4) Imbibe values, professional ethics for lifelong learning.

1) The duration of the internship shall be for a period of 8 weeks on full time basis between II semester final exams and beginning of III semester.
2) The student must submit letters from the industry clearly specifying his / her name and the duration of the internship on the company letter head with authorized signature.
3) Internship must be related to the field of specialization or the M.Tech program in which the student has enrolled.
4) Students undergoing internship training are advised to report their progress and submit periodic progress reports to their respective guides.
5) Students have to make a presentation on their internship activities in front of the departmental committee and only upon approval of the presentation should the student proceed to prepare and submit the hard copy of the internship final report. However interim or periodic reports and reports as required by the industry / organization can be submitted as per the format acceptable to the respective industry /organizations.
6) The reports shall be printed on bond paper – 80GSM, back to back print, with soft binding – A4 size with 1.5 spacing and times new roman font size 12.
7) The broad format of the internship final report shall be as follows
    - Cover Page
    - Certificate from College
    - Certificate from Industry / Organization
    - Acknowledgement
    - Synopsis
    - Table of Contents

- Chapter 1 - Profile of the Organization – Organizational structure, Products, Services, Business Partners, Financials, Manpower, Societal Concerns, Professional Practices,
- Chapter 2 - Activities of the Department -
- Chapter 3 – Tasks Performed – summaries the tasks performed during 8 week period
- Chapter 4 – Reflections – Highlight specific technical and soft skills that you acquired during internship
- References & Annexure

Course Outcomes:

After going through the internship the student will be able to:

CO1: Apply engineering and management principles
CO2: Analyse real-time problems and suggest alternate solutions
CO3: Communicate effectively and work in teams
CO4: Imbibe the practice of professional ethics and need for lifelong learning.

1. Scheme of Continuous Internal Evaluation (CIE):

A committee comprising of the Head of the Department / Associate Dean, Associate Professor, Assistant Professor and Guide would review the presentation and the progress reports in two phases. The evaluation criteria shall be as per the rubrics given below:

Scheme for Semester End Evaluation (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

(1) Explanation of the application of engineering knowledge in industries 35%

(2) Ability to comprehend the functioning of the organization/ departments 20%

(3) Importance of resource management, environment and sustainability 25%

(4) Presentation Skills and Report 20%

Dissertation Phase 1						
Course Code	**:**	**18MCH34**		**CIE Marks**	**:**	**100**
Credits	**:**	**L:T:P: 0:0:5**		**SEE Marks**	**:**	**100**
Hours	**:**	**10**		**SEE Duration**	**:**	**3 Hours**

Course Learning Objectives:

The students shall be able to

1. Understand the method of applying engineering knowledge to solve specific problems.
2. Apply engineering and management principles while executing the project
3. Demonstrate good verbal presentation and technical report writing skills.
4. Identify and solve complex engineering problems using professionally prescribed standards.

GUIDELINES

1. Major project will have to be carried out by only one student in his/her area of interest.
2. Each student has to select a contemporary topic that will use the technical knowledge of their program of specialization.
3. Allocation of the guides preferably in accordance with the expertise of the faculty.
4. The project can be carried out on-campus or in an industry or an organization with prior approval from the Head of the Department.
5. The standard duration of the project is for 16 weeks, however if the guide and the evaluation committee of the department, after the assessment feel that the work is insufficient and it has to be extended, then the student will have to continue as per the directions of the guide and the committee.
6. It is mandatory for the student to present his/her work in one of the international conferences or publish the research finding in a reputed unpaid journal with impact factor.

Course Outcomes:

After going through this course the students will be able to

CO1: Conceptualize, design and implement solutions for specific problems.

CO2: Communicate the solutions through presentations and technical reports.

CO3: Apply project and resource managements skills, professional ethics, societal concerns

CO4: Synthesize self-learning, sustainable solutions and demonstrate life-long learning

Dissertation Phase II						
Course Code	**:**	**18MCH41**		**CIE Marks**	**:**	**100**
Credits	**:**	**L:T:P: 0:0:20**		**SEE Marks**	**:**	**100**
Hours/Week	**:**	**40**		**SEE Duration**	**:**	**3 Hours**

Course Learning Objectives:

The students shall be able to

1. Understand the method of applying engineering knowledge to solve specific problems.
2. Apply engineering and management principles while executing the project
3. Demonstrate good verbal presentation and technical report writing skills.
4. Identify and solve complex engineering problems using professionally prescribed standards.

GUIDELINES

1. Major project will have to be done by only one student in his/her area of interest.
2. Each student has to select a contemporary topic that will use the technical knowledge of their program of specialization.
3. Allocation of the guides preferably in accordance with the expertise of the faculty.
4. The project can be carried out on-campus or in an industry or an organization with prior approval from the Head of the Department.
5. The standard duration of the project is for 16 weeks, however if the guide and the evaluation committee of the department, after the assessment feel that the work is insufficient and it has to be extended, then the student will have to continue as per the directions of the guide and the committee.
6. It is mandatory for the student to present his/her work in one of the international conferences or publish the research finding in a reputed unpaid journal with impact factor.

Course Outcomes:

After going through this course the students will be able to

CO1: Conceptualize, design and implement solutions for specific problems.
CO2: Communicate the solutions through presentations and technical reports.
CO3: Apply project and resource managements skills, professional ethics, societal concerns
CO4: Synthesize self-learning, sustainable solutions and demonstrate life long learning

Scheme of Continuous Internal Examination (CIE)

Evaluation will be carried out in THREE Phases. The evaluation committee will comprise of: guide, two senior faculty members, one industry member and Head of the Department.

Phase II	Activity	Weightage
5th week	Review and refinement of Objectives and methodology.	20%
10th week	Mid-term progress review shall check the compliance with the objectives and methodology presented in Phase I, review the work performed.	40%
15th week	Oral presentation, demonstration and submission of project report. Outcome and publication	40%

CIE Evaluation shall be done with marks distribution as follows:

- Review of formulation of objectives and methodology 10%
- Design and simulation/ algorithm development/experimental setup 25%
- Conducting experiments / implementation / testing / analysis 25%

- Demonstration & Presentation 20%
- Report writing 20%

Scheme for Semester End Evaluation (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

1. Brief write-up about the project 5%
2. Formulation of Project Objectives & Methodology 20%
3. Experiments / Analysis Performed; Results & Discussion 25%
4. Report 20%
5. Viva Voce 30%

TECHNICAL SEMINAR						
Course Code	**:**	**18MCH42**		**CIE Marks**	**:**	**50**
Credits	**:**	**L:T:P:0:0:2**		**SEE Marks**		**50**
Hours/Week	**:**	**4**		**SEE Duration**		**30 min**

Course Learning Objectives (CLO):

The students shall be able to:

(1) Understand the technological developments in their chosen field of interest
(2) Explain the scope of work and challenges in the domain area
(3) Analyze these engineering developments in the context of sustainability and societal concerns.
(4) Improve his/her presentation skills and technical report writing skills

GUIDELINES

1) The presentation will have to be done by individual students.
2) The topic of the seminar must be in one of the thrust areas with in-depth review and analysis on a current topic that is relevant to industry or on-going research.
3) The topic could be an extension or complementary to the project
4) The student must be able to highlight or relate these technological developments with sustainability and societal relevance.
5) Each student must submit both hard and soft copies of the presentation.

Course Outcomes:

After going through this course the student will be able to:

CO1: Identify topics that are relevant to the present context of the world
CO2: Perform survey and review relevant information to the field of study.
CO3: Enhance presentation skills and report writing skills.
CO4: Develop alternative solutions which are sustainable

2.

Scheme of Continuous Internal Evaluation (CIE):

3. Evaluation would be carried out in TWO phases. The evaluation committee shall comprise of Head of the Department / Associate Dean, Associate Professor, Assistant Professor and Guide. The evaluation criteria shall be as per the rubrics given below:

Scheme for Semester End Evaluation (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

Rubrics for Evaluation:

1)	Topic – Technical Relevance, Sustainability and Societal Concerns	15%
2)	Review of literature	25%
3)	Presentation Skills	35%
4)	Report	25%