Semester: V		
TECHNICAL MANAGEMENT & ENTREPRENEURSHIP (Theory)		
Course Code: MVJ21CH51		CIE Marks: 50
Credits: L:T:P: 3:0:0		SEE Marks: 50
Hours: 40L		SEE Duration: 3 Hrs.

Course Learning Objectives: The students will be able to	
1	Introduce the field of management, task of the manager, importance of planning and types of planning, staff recruitment and selection process.
2	Explain need of coordination between the manager and staff, the social responsibility of business and leadership.
3	Explain the role and importance of the entrepreneur in economic development and the concepts of entrepreneurship.
4	Discuss the importance of Small-Scale Industries and the related terms and problems involved.
5	Explain project feasibility study and project appraisal and discuss project financing.

UNIT-I	
Management: Definition, Importance – Nature and Characteristics of Management, Management Functions, Roles of Manager, Levels of Management, Managerial Skills, Management & Administration, Management as a Science, Art &Profession. Planning: Nature, Importance and Purpose of Planning, Types of Plans, Steps in Planning, Limitations of Planning, Decision Making – Meaning, Types of Decisions- Steps in Decision Making.	8 Hrs
UNIT-II	
Organizing and Staffing: Meaning, Nature and Characteristics of Organization – Process of Organization, Principles of Organization, Departmentalization, Committees – meaning, Types of Committees, Centralization Vs Decentralization of Authority and Responsibility, Span of Control, Nature and Importance of Staffing, Process of Selection and Recruitment. **Directing and Controlling**: Meaning and Nature of Directing-Leadership Styles, Motivation Theories, Communication – Meaning and Importance, Coordination- Meaning and Importance, Techniques of Coordination. Controlling – Meaning, Steps in Controlling.	8 Hrs
UNIT-III	
Social Responsibilities of Business: Meaning of Social Responsibility, Social Responsibilities of Business towards Different Groups, Social Audit, Business Ethics and Corporate Governance. **Entrepreneurship**: Definition of Entrepreneur, Importance of Entrepreneurship, concepts of Entrepreneurship, Characteristics of successful Entrepreneur, Classification of Entrepreneurs, Intrapreneur – An Emerging Class,	8 Hrs

Comparison between Entrepreneur and Intrapreneur, Myths of Entrepreneurship, Entrepreneurial Development models, Entrepreneurial development cycle, Problems faced by Entrepreneurs and capacity building for Entrepreneurship.	
UNIT-IV	
Modern Small Business Enterprises: Role of Small Scale Industries, Concepts and definitions of SSI Enterprises, Government policy and development of the Small Scale sector in India, Growth and Performance of Small Scale Industries in India, Sickness in SSI sector, Problems for Small Scale Industries, Impact of Globalization on SSI, Impact of WTO/GATT on SSIs, Ancillary Industry and Tiny Industry (Definition only). **Institutional Support for Business Enterprises:** Introduction, Policies & Schemes of Central– Level Institutions, State-Level Institutions.	8 Hrs
UNIT-V	
Project Management: Meaning of Project, Project Objectives & Characteristics, Project Identification- Meaning & Importance; Project Life Cycle, Project Scheduling, Capital Budgeting, Generating an Investment Project Proposal, Project Report-Need and Significance of Report, Contents, Formulation, Project Analysis-Market, Technical, Financial, Economic, Ecological, Project Evaluation and Selection, Project Financing, Project Implementation Phase, Human & Administrative aspects of Project Management, Prerequisites for Successful Project Implementation. New Control Techniques- PERT and CPM, Steps involved in developing the network, Uses and Limitations of PERT and CPM.	8 Hrs

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the concept of Management.
CO2	Understand the staffing process.
CO3	Explain the social responsibilities of business towards different groups.
CO4	Explain the role of small scale industries.
CO5	Interpret the project objective.

Reference Books	
1.	Management‖, Stephen P. Robbins & Mary Coulter,2009, Prentice Hall (India) Pvt. Ltd., 10th Edition,
2.	Management‖, JAF Stoner, Freeman R.E and Daniel R Gilbert,2004,Pearson Education, 6 th Edition.
3.	Essentials of management, Harold Koontz & Heinz Weihrich ,1998, Tata McGraw Hill.
4.	Principles of Management,Tripathy PC & Reddy PN,1999, , Tata McGraw Hill.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 Marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three sub divisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	2	3	3	2	--	--	--	1	1	--	1	1
CO2	2	2	1	2	2	--	1	1	1	1	1	1
CO3	2	2	1	2	2	--	--	--	--	--	1	1
CO4	2	2	1	1	--	2	--	1	1	--	1	1
CO5	3	3	1	2	2	--	--	1	1	--	1	1

High-3, Medium-2, Low-1

Semester: V		
MASS TRANSFER – I (Theory)		
Course Code:MVJ21CH52		CIE Marks: 50
Credits: L:T:P: 2:2:0		SEE Marks: 50
Hours: 40L		SEE Duration: 3 Hrs.
Course Learning Objectives: The students will be able to		
1	Formulate equations for estimation of diffusivities in fluids & solids using first principles of engineering sciences.	
2	Apply mass transfer fundamentals to calculate mass transfer rates and design the mass transfer equipment	

UNIT-I	
Types of diffusion in fluids and solids. Measurement and calculations of diffusivities. Multi component diffusion. Mass transfer coefficients and their correlations. Theories of mass transfer. Inter phase mass transfer. material balance for co-current, cross-current and counter-current operations. concept of stages, cascades operation, NTU and HTU concepts	8 Hrs
UNIT-II	
Humidification: General theory, Psychometric chart. Adiabatic saturation temperature, Wet bulb temperature, Concepts in humidification dehumidification. Design of cooling towers.	8 Hrs
UNIT-III	
Drying: Introduction, Equilibria, drying rate curves. Mechanism of drying, types of dryers. Design of batch and continuous dryers.	8 Hrs
UNIT-IV	
Adsorption: Theories of adsorption. Isotherms, industrial adsorbents. equipment, batch & continuous multistage adsorption	8 Hrs
UNIT-V	
Crystallization: Factors governing nucleation and crystal growth rates. Controlled growth of crystals. Incorporation of principles into design of equipment. Different types of crystallizer equipment. **Introduction to Separation Techniques:** Ion exchange, Membrane Processes-Reverse Osmosis, Dialysis, Ultra and Micro-filtrations, Super-critical fluid extraction. (Working principle and operations only)	8 Hrs

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the principles of diffusion in solids and fluids and interpret the behavior the mass transfer coefficients using various theories and HTU and NTU concepts.
CO2	Explain concepts, application of humidification, dehumidification and design of cooling towers.
CO3	Comprehend operation, concepts and types of dryers.

CO4	Explain various isotherms, modes of adsorption operations, types of adsorber and design of packed bed adsorber.
CO5	Apply principles of crystallization in design of crystallizer and illustrate the working principle of various novel separation techniques.

Reference Books	
1.	Mass transfer operations. Treybal, R. E., 1980 New York, 466.
2.	Unit Operations in Chemical Engineering, McCabe & Smith, 2001, 6th edn, McGraw Hill.
3.	Transport processes and separation principles (include unit operation), Geankoplis, C. J. 2003.
4.	Chemical Engineering Vol I, II, III, IV and V, Coulson and Richardson, 1988, 4th edn, Pergamon Press.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 Marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three sub divisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	1	-	-	-	-	-
CO2	3	3	-	-	-	-	1	-	-	-	-	-
CO3	3	3	2	-	-	-	1	-	-	-	-	-
CO4	3	3	2	-	-	-	1	-	-	-	-	-
CO5	3	3	2	-	-	-	1	-	-	-	-	-

High-3, Medium-2, Low-1

Semester: V		
INSTRUMENTAL METHODS OF ANALYSIS (Theory and Practice)		
Course Code:MVJ21CH53		CIE Marks:50+50
Credits: L:T:P: 3:0:2		SEE Marks: 50 +50
Hours:40 L+26P		SEE Duration: 03+03 Hours
Course Learning Objectives: The students will be able to		
1	The course is designed to impart the knowledge in the field of Instrumental Analysis. The various modern analytical techniques like UV-Visible, IR, NMR, Mass, GC, HPLC, different chromatographic methods and other important topics are taught to enable the students.	
2	To understand and apply the principles involved in the determination of different bulk drugs and their formulation. In addition to the theoretical aspects, the basic practical knowledge relevant to the analysis is also imparted.	

UNIT-I	
Chromatography: Introduction, classification of chromatographic methods based on the mechanism of separation. Column Chromatography: Adsorption and partition, theory, preparation, procedure and methods of detection. **Thin Layer Chromatography**: Theory, preparation, procedures, detection of compounds. **Paper Chromatography**: Theory, different techniques employed, filter papers used, qualitative and quantitative detection. Counter – current extraction, solid phase extraction techniques, gel filtration.	8 Hrs
UNIT-II	
Gas chromatography: introduction, fundamentals, instrumentation, columns: preparation and operation, detection, dramatization. **Liquid chromatography**: HPLC- Principles and instrumentation, solvents and columns, detection and applications.	8 Hrs
UNIT-III	
Spectroscopy: Introduction, electromagnetic spectrum. **UV-Visible spectroscopy**: absorbance laws and limitations, instrumentation-design and working principle, chromophore and auxochromes concept, Wood-Fisher rules for calculating absorption maximum, applications of UV-Visible spectroscopy. **IR spectroscopy**: Basic principles-Molecular vibrations, vibrational frequency, factors influencing vibrational frequencies, sampling techniques, instrumentation, interpretation of spectra, FT-IR, theory and applications.	8 Hrs
UNIT-IV	
Mass spectroscopy: Theory, ionization techniques: electron impact ionization, chemical ionization, field ionization, fast atom bombardment, plasma desorption, fragmentation process: types of	8 Hrs

fission, resolution, GC/MS, interpretation of spectra and applications for identification and structure determination. **X-ray diffraction (XRD):** Bragg's law, basic powder diffraction, generation of X-rays, Instrumentation, Scherer equation, BCC and FCC Bravis lattice, phase identification using XRD.	
UNIT-V	
NMR: theory, instrumentation, chemical shift, shielding and de-shielding effects, splitting of signals, spin-spin coupling, proton exchange reactions, coupling constant (J), Nuclear OverHauser effect (NOE), ^{1}HNMR, ^{13}C-NMR spectra and its applications	**8 Hrs**
LABORATORY EXPERIMENTS	
1. Analysis of effluents for pH and alkalinity 2. Determination of BOD 3. Volatile, Fixed, Filterable and Dissolved solid analysis 4. Analysis by ion selective electrode (any two anions) 5. Measurement of particulate matter in Air 6. Measurement of SO2 in air 7. Analysis of exhaust by ORSAT apparatus 8. Determination of COD 9. UV Spectrophotometer 10. UV Spectrophotometer 11. Flame photometer 12. Dissolved Oxygen measurement 13. Bomb calorimeter 14. Viscometer 15. Potentiometer titration 16. Jar test apparatus **Any 12 experiments to be conducted**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Analyze various parameters to assess pollution in water and air.
CO2	Interpret qualitative composition of a solution using instruments like Bomb calorimeter, Viscometer.
CO3	Interpret quantitative composition of a solution using instruments like turbid meter, KF Auto titrator.
CO4	Analysis of Volatile, Fixed, Filterable and Dissolved solids.
CO5	Measurement of particulate matter and SO2 in air.

Reference Books	
1.	Air pollution engineering manual, Davis, W. T., & Buonicore, A. J., (2000). New York: McGraw-Hill.
2.	Standard methods for the examination of water and wastewater, Baird, R. B. (2017).

3.	Practical waste treatment and disposal. Edited by Denis Dickinson. Compiled in collaboration with the Institute for Industrial Research and Standards, Dickinson, D. (1974)
4.	Pollution control in process industries., Mahajan, S. P. (1985).Tata McGraw-Hill Education

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each).The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Laboratory- 50 Marks

The laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average of the marks over number of weeks is considered for 30 marks. At the end of the semester a test is conducted for10 marks. The students are encouraged to implement additional innovative experiments in the lab and are awarded 10 marks. Total marks for the laboratory is 50.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks are executed by means of an examination.

The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three sub divisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

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

High-3, Medium-2, Low-1

Semester: V		
PROCESS CONTROL & IIOT (Theory and Practice)		
Course Code: MVJ21CH54		CIE Marks:50+50
Credits: L:T:P:2:2:2		SEE Marks: 50 +50
Hours:40 L+26P		SEE Duration: 03+03 Hours

Course Learning Objectives: The students will be able to	
1	To determine possible control objectives, input variables (manipulated variables and disturbances) and, to model the dynamic behavior of a process.
2	To deal with control equipment and various controllers and their functions and applications.
3	To understand the frequency response and analyze stability of closed loop and open loop systems.
4	To study about the various industrial revolutions and role of IOT & IIOT in industry.

UNIT-I	
Introduction to process control and modeling consideration: Introduction to chemical process control, process modeling and an example, linearization of a non-linear model, linearization and its application in process control, Laplace Transforms - Standard functions. **First Order Systems:** Development of transfer functions, open loop systems, thermometer, level, mixing tank, STR, I order systems in series. Response for various input forcing functions, first order systems and their transient response for standard input functions, first order systems in series.	8 Hrs
UNIT-II	
Second Order Systems: Characteristics of manometer and damped vibrator. Transfer functions. Response for various input forcing functions, response for step input for under damped case – Terms associated with it. Transportation lag. **Closed Loop System:** Development of block diagram for feed-back control systems, servo and regulatory problems, transfer function for controllers and final control element, principles of pneumatic controllers	8 Hrs
UNIT-III	
Stability: Stability of linear control systems. Routh Test. **Frequency response:** Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, Bode diagram, Principle of Nyquist diagram, stability criterion. **Control System Design By Frequency Response:** Bode criterion. Gain and Phase margins, Tuning of controller settings, Ziegler – Nichols controller tuning, Cohen-Coon controller tuning.	8 Hrs
UNIT-IV	

Advanced Control System: Introduction to advanced control systems, cascade control, feed forward control. Introduction to computer control of chemical processes: Digital Computer control loops	8 Hrs

UNIT-V

Introduction to Industrial IoT (IIoT) Systems: The Various Industrial Revolutions, Role of Internet of Things (IoT) & Industrial Internet of Things (IIoT) in Industry, Industry 4.0 revolutions, Support System for Industry 4.0, Smart Factories.	8 Hrs

LABORATORY EXPERIMENTS

1. Determination of time constant of thermocouple
2. Step response of a single tank system
3. Step response of non-interacting Tanks
4. Step Response of interacting tanks
5. Transient behaviour of pressure vessel system
6. Dynamics of a 2nd order under damped process- U Tube Manometer
7. Impulse Response of a single tank system
8. Impulse Response of non-interacting Tanks
9. Impulse Response of Interacting Tanks
10. Level/Flow/Pressure/pH/Temperature control – P controller
11. Level/Flow/Pressure/pH/Temperature control – PI controller
12. Level/Flow/Pressure/pH/Temperature control – PD controller
13. Level/Flow/Pressure/pH/Temperature control – PID controller
14. Determination of valve characteristics
15. Characteristics of flapper nozzle system

Any 12 experiments to be conducted

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the process control and modelling considerations and model the dynamics of a first order process.
CO2	Develop the transfer functions for a second system and derive the transient response of servo and regulator control with various control modes.
CO3	Analyze the stability for a given linear control systems using Routh Hurwitz criteria and the frequency response using Bode and Nyquist diagrams, Analyze the control system design by frequency response and plot root locus diagram for different process.
CO4	Discuss cascade control, feed forward control and the digital digital computer control loops.
CO5	Study about the role of Internet of Things (IOT) and Industrial Internet of Things (IIOT) in industry.

Reference Books	
1.	Process systems analysis and control, Coughanowr, D. R., & Koppel, L. B., (1965). New York: McGraw-Hill.

2.	Chemical process control (Vol. 2), Stephanopoulos, G. (1984), New Jersey: Prentice Hall.
3.	Industry 4.0: The Industrial Internet of Things, Alasdair Gilchrist Publications: A press
4.	Process modeling, simulation and control for chemical engineers, Benenati, R. F., (1973). William L. Luyben, McGraw-Hill, New York.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each).The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Laboratory- 50 Marks

The laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average of the marks over number of weeks is considered for 30 marks. At the end of the semester a test is conducted for10 marks. The students are encouraged to implement additional innovative experiments in the lab and are awarded 10 marks. Total marks for the laboratory is 50.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks are executed by means of an examination.

The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three sub divisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

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

High-3, Medium-2, Low-1

Semester: V		
CHEMICAL PROCESS INSTRUMENTATION (Theory)		
Course Code: MVJ21CH551		CIE Marks:50
Credits: L:T:P:3:0:0		SEE Marks: 50
Hours: 40L		SEE Duration: 3 Hrs

Course Learning Objectives: The students will be able to	
1	Understand basic principles of various measuring instruments and its static, dynamic response.
2	Understand the various instruments utilized to measure the temperature and calculate the temperature using thermometer, thermistor, radiation, and pyrometer.
3	Understand to calculate the pressure using manometer and the fundamentals of pressure measuring devices.
4	Study the fundamentals of variable head meter, area flow meter, direct, inertial type level meter, and density measurement devices.
5	Understand to select suitable measuring device for gas mixture analysis, thermal, electrical conductivity, and viscosity and construct piping and instrumentation diagram.

UNIT-I	
Principles of measurement: analysis- measurement of force, strain and torque- use of strain gauges, transducers - resistive, capacitive, inductive and piezoelectric pickups, static and dynamic response of instruments. Errors in measurements.	8 Hrs
UNIT-II	
Temperature measurement: liquid filled, gas filled and vapour pressure thermometers. Bimetallic and resistance thermometers. Thermocouples and thermistors. Optical and radiation pyrometers.	8 Hrs
UNIT-III	
Pressure measurement: manometers, bourdon gauge, and bellow gauge. Measurement of pressure and vacuum. Use of transducers.	8 Hrs
UNIT-IV	
Flow, density and level measurements: variable head flow meters. Area flow meters, positive displacement meters, pressure probes, level measurements - direct and inertial types. Measurement of density and specific gravity. Instruments for weighing and feeding.	8 Hrs
UNIT-V	
Miscellaneous measurements: Analysis of gas mixtures, thermal conductivity, viscosity and electrical conductivity. Supporting instrumentation - standard cells, balancing circuits and terminating devices. Principles of telemetering. P and I diagrams.	8 Hrs

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the basic principles of various measuring instruments and its static,

	dynamic response. Errors in the measurements.
CO2	Demonstrate the various instruments utilized to measure the temperature and calculate the temperature using thermometer, thermistor, radiation, pyrometer.
CO3	Calculate the pressure using manometer and demonstrate the basic fundamentals of pressure measuring devices.
CO4	Demonstrate the fundamentals of variable head meter, area flow meter, direct, inertial type level meter, and density measurement devices.
CO5	Select suitable measuring device for gas mixture analysis, thermal, electrical conductivity, viscosity and construct piping and instrumentation diagram.

Reference Books	
1.	Automatic process control, Eckman, D. P., 1967, Wiley.
2.	Mechanical and industrial Measurements, Jain, R. K., 1988, Khanna Publishers.
3.	Fundamentals of temperature, pressure, and flow measurements, Benedict, R. P., 1991, John Wiley & Sons.
4.	Perry's chemical engineers' handbook, Perry, R. H., & DW, G., 2007, 8th illustrated ed. New York: McGraw-Hill.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 Marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three sub divisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
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CO2	2	2	1	--	2	--	--	--	--	--	2	3
CO3	2	2	1	--	2	--	--	--	--	--	2	3
CO4	2	2	1	--	2	--	--	--	--	--	2	3
CO5	2	2	1	--	2	--	--	--	--	--	2	3

High-3, Medium-2, Low-1

Semester: V		
COMPUTATIONAL FLUID DYNAMICS (Theory)		
Course Code: MVJ21CH552		CIE Marks:50
Credits: L:T:P:3:0:0		SEE Marks: 50
Hours: 40L		SEE Duration: 3 Hrs
Course Learning Objectives: The students will be able to		
1	To introduce Governing Equations of viscous fluid flows.	
2	To introduce numerical modeling and its role in the field of fluid flow and heat transfer.	
3	To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.	
4	To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.	

UNIT-I	
Introduction: Illustration of the CFD approach, CFD as an engineering analysis tool, Review of governing equations, Modelling in engineering, Partial differential equations- Parabolic, Hyperbolic and Elliptic equation, CFD application in Chemical Engineering, CFD software packages and tools.	8 Hrs
UNIT-II	
Finite difference and finite volume methods: Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – Finite volume formulation for steady state One, Two and Three -dimensional diffusion problems –Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations – Use of Finite Difference and Finite Volume methods	8 Hrs
UNIT-III	
Solution algorithms: Steady one-dimensional convection and diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes.	8 Hrs
UNIT-IV	
Flow field analysis: Finite volume methods -Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms.	8 Hrs
UNIT-V	
Turbulence models, mixing length model, Two equation (k-ε) models – High and low Reynolds number models – Structured Grid generation – Unstructured Grid generation – Mesh refinement – Adaptive mesh –	8 Hrs

Software tools	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the concept of computational fluid dynamics and its application
CO2	Analyze the consistency, stability and convergence of various discretization schemes for parabolic, elliptic and hyperbolic partial differential equations.
CO3	Apply finite difference and finite volume methods to various chemical engineering problems.
CO4	Analyze variations of SIMPLE schemes for incompressible flows and variations of Flux Splitting algorithms for compressible flows.
CO5	Evaluate the grid sensitivity and analyse the accuracy of a numerical solution.

Reference Books	
1.	An introduction to computational fluid dynamics: the finite volume method, Versteeg, H. K., & Malalasekera, W., 2007, Pearson education.
2.	Computational Fluid Flow and Heat Transfer, Muralidhar, K. and Sundararajan (Narosa), T., 2nd Edition, 2011.
3.	Numerical Heat Transfer and Fluid Flow, Patankar, S.V., 2004, Hemisphere Publishing Corporation.
4.	Computational fluid dynamics, Chung, T. J., 2002, Cambridge university press.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 Marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three sub divisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	3	--	--	2	--	--	--	--	--	--	--
CO2	3	3	--	--	2	--	--	--	--	--	--	--
CO3	3	3	2	--	2	--	--	--	--	--	--	--
CO4	3	3	2	--	2	--	--	--	--	--	--	--
CO5	3	3	--	--	2	--	--	--	--	--	--	--

High-3, Medium-2, Low-1

Semester: V		
PETROLEUM REFINING & PETROCHEMICALS (Theory)		
Course Code: MVJ21CH553		CIE Marks:50
Credits: L:T:P:3:0:0		SEE Marks: 50
Hours: 40L		SEE Duration: 3 Hrs
Course Learning Objectives: The students will be able to		
1	Understand history.	
2	Understand the extraction and production of oil and gas to meet energy needs.	

UNIT-I	
Introduction: Origin and occurrence of petroleum crude, status of petroleum refining industry in india, classification and physical properties of petroleum testing, uses and blending of petroleum products. petroleum refining processes, atmospheric and vacuum distillation, thermal and catalytic cracking, vapor, liquid and mixing phases, hydro cracking.	8 Hrs
UNIT-II	
Catalyst reforming: Catalytic reforming, polymerization, isomerization, hydrogenation, production of aviation gasoline, motor fuel, kerosene, diesel oil and jet fuel.	8 Hrs
UNIT-III	
Treatment of Petroleum Products: Vacuum distillation, solvent extraction, uses of lubricating oils and petroleum waxes, chemical and clay treatment of petroleum products, desulfurization process for petroleum product, catalyst delayed coking, hydro treating & visbreaking.	8 Hrs
UNIT-IV	
Petroleum and Petrochemical Industries: Introduction to petrochemical industries in India, structure of petrochemical complexes, product profile of petrochemicals units. Olefin production (naptha & gas cracking), separation of aromatics (benzene, xylene and toluene), aromatic conversion processes (depropanization, isomerisation, dealkylation).	8 Hrs
UNIT-V	
Manufacture of major petrochemical, methanol and formaldehyde, ethylene oxide and ethylene glycol, acetaldehyde, butadiene, linear alkyl benzene.	8 Hrs

Course Outcomes: After completing the course, the students will be able to	
CO1	Outline the overview of the modern, integrated petroleum refinery, its feedstocks, product state and the processes employed to convert crude oil and intermediate streams into finished products.
CO2	Classify the various treatment techniques employed in petroleum refining for the Production of wide spectrum of useful products.
CO3	Discuss the thermal and catalytic cracking methods employed in petroleum refining.
CO4	Identify suitable refining technology for maximizing the product yield.
CO5	Interpret the coking and the hydrocracking process employed and the environmental issues and new trends in petroleum refining.

Reference Books	
1.	Modern Petroleum Refining Processes, Rao, B., 2002, Oxford & IBH Publishing.
2.	A textbook on petrochemicals, Rao, B., 2004, Khanna.
3.	Petroleum refining technology, Prasad, R., 2000, Khanna.
4.	Petroleum processing handbook [Book chapter], Bland, W. F., & Davidson, R. L.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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Semester End Examination (SEE):

Total marks: 50+50=100

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CO-PO Mapping												
CO/P	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1

O	1	2	3	4	5	6	7	8	9	0	1	2
CO1	3	2	--	--	--	--	--	--	--	--	--	--
CO2	3	3	--	--	--	--	--	--	--	--	--	--
CO3	3	3	3	3	--	--	--	--	--	--	--	--
CO4	3	3	--	--	--	--	--	--	--	--	--	--
CO5	3	3	--	--	--	--	--	--	--	--	--	--

High-3, Medium-2, Low-1

Semester: V		
HETEROGENEOUS REACTION SYSTEMS (Theory)		
Course Code: MVJ21CH554		CIE Marks:50
Credits: L:T:P:3:0:0		SEE Marks: 50
Hours: 40L		SEE Duration: 3 Hrs
Course Learning Objectives: The students will be able to		
To impart knowledge on different types of catalysis and heterogeneous reactions, Transport processes and industrial catalytic process under isothermal and non-isothermal conditions.		

UNIT-I	
Introduction to catalysis and heterogeneous reactions: general definition of catalysts, solid catalysts, components of catalyst, industrial catalysts, preparation of solid catalysts, precipitation and co-precipitation methods, sol gel method, supported catalysts, impregnation and ion exchange method, catalyst drying calcinations and formulations, catalyst characterization techniques, structural analysis, chemisorption technique, thermal analysis, spectroscopic techniques, microscopic technique.	8 Hrs
UNIT-II	
Kinetics of heterogeneous catalytic reactions: reaction mechanism and rate equations, power law model, Langmuir-Hinshelwood – Hougen- Watson (lhhw) model, Eeyrideal model, rate controlling step, estimation of model parameters, reactor types- fixed bed reactor, fluidised bed reactor, berty reactor, multiphase reactors- slurry reactor, trickle bed reactor, bioreactors, catalysts tests.	8 Hrs
UNIT-III	
Transport processes with reactions catalyzed by solids: effect of external transport on catalytic reaction rate, effect of external mass transfer resistance on order of reaction, effect of external transport on selectivity, effect of internal mass transport on catalytic reaction rate, bulk diffusion, knudsen diffusion, surface diffusion, effectiveness factor at isothermal conditions, significance of intrapellet diffusion, effect of intrapellet mass transfer on activation energy.	8 Hrs
UNIT-IV	
Catalyst deactivation: types of catalyst deactivation, the kinetics of catalyst poisoning, kinetics of catalyst deactivation by coke formation.	8 Hrs
UNIT-V	
Industrial catalytic processes: steam reforming, catalytic cracking, three lumped kinetic model for catalytic cracking of gas oil hydrocracking, hydrogenation, and dehydrogenation catalytic reactions.	8 Hrs

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

CO1	Derive the rate expressions for heterogeneous catalytic reactions and Catalytic deactivation.
CO2	Develop the rate equations for heterogeneous fluid particle systems and the fluid-fluid noncatalytic reactions to solve problems.
CO3	Analyze different steps in reaction mechanisms on solid catalytic surfaces and identify the factors affecting the rate.
CO4	Derive the Kinetics of Catalyst Deactivation for different industrial applications.
CO5	Derive the performance equation of solid catalysed reaction in various reactors with industrial application of green catalysis.

Reference Books	
1.	Chemical reactor analysis and design, Froment, G. F., Bischoff, K. B., & De Wilde, J., 1990, New York: Wiley.
2.	Elements of chemical reaction engineering, Fogler, H. S., & Fogler, S. H., 1999, Pearson Education.
3.	Chemical reaction engineering, Levenspiel, O., 1998, John wiley & sons.
4.	Fundamentals of chemical reaction engineering, Davis, M. E., & Davis, R. J., 2012, Courier Corporation.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 Marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three sub divisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	3	2	3	--	--	--	--	--	--	--	--

CO2	3	3	2	--	1	--	--	--	--	--	--	--
CO3	3	2	--	--	1	--	--	--	--	--	--	--
CO4	3	3	--	--	1	--	--	--	--	--	--	--
CO5	3	3	2	--	--	--	--	--	--	--	--	--

High-3, Medium-2, Low-1

Semester: V		
ENVIRONMENTAL STUDIES		
Course Code: MVJ21CH56		CIE Marks: 50
Credits: L:T:P: 1:0:0		SEE Marks: 50
Hours: 15 L		SEE Duration: 3 Hrs.
Course Learning Objectives: The students will be able to		
1	Relate interdisciplinary approach to complex environmental problems using basic tools of the natural and social sciences including geo-systems, biology, chemistry, economics, political science and international processes.	
2	Study drinking water quality standards and to illustrate qualitative analysis of water.	
3	Critically evaluate the science and policy ramifications of diverse energy portfolios on air and water quality, climate, weapons proliferation and societal stability.	

UNIT-I	
Introduction to environmental studies, Multidisciplinary nature of environmental studies; Scope and importance; Concept of sustainability and sustainable development. **Ecosystems (Structure and Function)**: Forest, Desert, Rivers, Ocean **Biodiversity**: Types, Hot spots; Threats and Conservation of biodiversity, Deforestation.	3 Hrs
UNIT-II	
Advances in Energy Systems (Merits, Demerits, Global Status and Applications): Hydrogen, Solar, Tidal and Wind. **Natural Resource Management (Concept and case-study)**: Disaster Management, Sustainable Mining and Carbon Trading.	3 Hrs
UNIT-III	
Environmental Pollution: Surface and Ground Water Pollution, Noise pollution, Soil Pollution and Air Pollution. **Waste Management & Public Health Aspects**: Bio-medical Waste, Solid waste, Hazardous waste and E-waste.	3 Hrs
UNIT-IV	
Global Environmental Concerns (Concept, policies, and case-studies): Global Warming, Climate Change, Acid Rain, Ozone Depletion and Fluoride problem in drinking water.	3 Hrs
UNIT-V	
Latest Developments in Environmental Pollution Mitigation Tools (Concept and Applications): G.I.S. & Remote Sensing, Environment Impact Assessment, Environmental Management Systems.	3 Hrs

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale.
CO2	Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.
CO3	Demonstrate ecology knowledge of a complex relationship between biotic and Abiotic components.
CO4	Apply their ecological knowledge to illustrate and graph a problem.

Reference Books	
1.	Principals of Environmental Science and Engineering, Raman Siva kumar, 2005, 2nd Edition, Cengage learning, Singapur.
2.	Environmental Science – working with the Earth G.Tyler Miller Jr. Thomson Brooks /Cole, 2006, 11th Edition.
3.	Textbook of Environmental and Ecology, Pratiba Singh, Anoop Singh & Piyush Malaviya, 1st Edition, ACME Learning Pvt. Ltd. New Delhi.

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Theory for 50 Marks

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Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 Marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three sub divisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	3	3	1	--	2	2	1	1	--	2	1

CO2	3	3	2	1	--	1	2	--	1	1	2	1
CO3	3	3	2	1	--	2	2	--	1	1	2	1
CO4	3	3	2	2	--	2	2	--	1	1	2	1
CO5	3	3	2	2	--	2	2	--	1	1	2	1

High-3, Medium-2, Low-1

Semester: V		
AEC5: RESEARCH METHODOLOGY &IPR		
Course Code: MVJ21CH57		CIE Marks: 50
Credits: L:T:P: 1:2:0		SEE Marks: 50
Hours: 10L+20P		SEE Duration: 3 Hrs.

Course Learning Objectives: The students will be able to	
1	Identify an appropriate research problem in their interesting domain
2	Understand ethical issues understand the preparation of a research project thesis report
3	Understand the Preparation of a research project thesis report
4	Understand the law of patent and copyrights
5	Understand the Adequate knowledge on IPR

UNIT-I	
Meaning of research problem: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.	6 Hrs
UNIT-II	
Literature studies: Effective literature studies approaches, Meaning of Research Design, Need for Research Design, Features of a Good Design and analysis, Plagiarism, Research ethics	6 Hrs
UNIT-III	
Technical writing: Effective technical writing, how to write report, Paper Developing a Research Proposal. Format of research proposal, a presentation and assessment by a review committee.	6 Hrs
UNIT-IV	
Research proposal: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	6 Hrs
UNIT-V	
Patent rights and new developments in IPR: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	6 Hrs

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the research problem and research process
CO2	Understand research ethics
CO3	Prepare a well-structured research paper and scientific presentations
CO4	Explore on various IPR components and process of filing
CO5	Understand the adequate knowledge on patent and rights

Reference Books	
1.	Research Methodology, Kothari, C.R,Gaurav Garg, 2018New Age International
2.	Research Methodology a step-by- step guide for beginners,Ranjit Kumar, 2011) (3rded.). SAGE Publications Ltd
3.	Research Methods: the concise knowledge base, Trochim. (2005). Atomic Dog Publishing
4.	Conducting Research Literature Reviews: From the Internet to Paper, Fink A. (2009). Sage Publications

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Theory for 50 Marks

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Semester End Examination (SEE):

Total marks: 50+50=100

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

High-3, Medium-2, Low-1

Semester: V		
UNIVERSAL HUMAN VALUES (Theory)		
Course Code: MVJ21UHV58		CIE Marks:50
Credits: L:T:P: 2:0:0		SEE Marks: 50
Hours: 30L		SEE Duration: 3 Hrs

Course Learning Objectives: The students will be able to	
1	Appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2	Facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3	Highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

UNIT-I	
Introduction to Value Education: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfill the Basic Human Aspirations. **Practical Sessions**: (1) Sharing about Oneself (2) Exploring Human Consciousness (3) Exploring Natural Acceptance	6 Hrs
UNIT-II	
Harmony in the Human Being: Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health. **Practical Sessions**: (4) Exploring the difference of Needs of Self and Body (5) Exploring Sources of Imagination in the Self (6) Exploring Harmony of Self with the Body	6 Hrs
UNIT-III	
Harmony in the Family and Society: Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order.	6 Hrs

Practical Sessions: (7) Exploring the Feeling of Trust (8) Exploring the Feeling of Respect (9) Exploring Systems to fulfill Human Goal.	
UNIT-IV	
Harmony in the Nature/Existence: Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence. **Practical Sessions**: (10) Exploring the Four Orders of Nature (11) Exploring Co-existence in Existence	6 Hrs
UNIT-V	
Implications of the Holistic Understanding – a Look at Professional Ethics: Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession **Practical Sessions**: (12) Exploring Ethical Human Conduct (13) Exploring Humanistic Models in Education (14) Exploring Steps of Transition towards Universal Human Order	6 Hrs

Course Outcomes: After completing the course, the students will be able to	
CO1	Explore themselves, get comfortable with each other and with the teacher.
CO2	Enlist their desires and the desires are not vague.
CO3	Restate that the natural acceptance (intention) is always for living in harmony, only competence is lacking.
CO4	Differentiate between the characteristics and activities of different orders and study the mutual fulfillment among them.
CO5	Present sustainable solutions to the problems in society and nature.

Reference 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
4.	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

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Theory for 50 Marks

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Semester End Examination (SEE):

Total marks: 50+50=100

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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