4.1 CHEMICAL ENGINEERING THERMODYNAMICS

L	T	P
5	-	-

RATIONALE

It is a core subject of chemical engineering and is essential for understanding basic concepts, thermodynamic properties of fluids and performance of thermal used in industry.

DETAILED CONTENTS

1. **Introduction:** **(10** Periods**)**
   Scope of Thermodynamics, Macroscopic and Microscopic view-point. Thermodynamic systems: open, closed & isolated System. Thermodynamic Properties- temperature. State of a substance: Change of state,path function Process- reversible & irreversible cycle.
   Intensive & Extensive properties. Equality of temperature.
   Zeroth law of thermodynamics. Kinds of processes: Isobaric (constant-pressure process), Isochoric process (Constant Volume process), Isothermal process (Constant temperature process), Isentropic process, Isenthalpic process, Polytropic process. Pure substance.

2. **Work and Heat Transfer:** **(10** Periods**)**
   Work, Sign of work transfer, p-dv work or displacement work; Quasi-static processes, Calculation of work done in various Quasi-static Processes-Isobaric process (constant pressure process), Isochoric process (Constant Volume process), Isothermal process (Constant temperature process), Adiabatic process. Non-flow and Flow processes.
   Heat: Heat (Q), Sign of heat transfer, Heat transfer a path function.
   Specific heat& latent heat. Difference between heat and work.

3. **First law of thermodynamics:** **(10** Periods**)**
   Various forms of energy: Kinetic Energy, Potential Energy, Molecular Internal Energy, First law of thermodynamics, First law of thermodynamics applied for a closed system undergoing a cycle and a change of state,
   Joule Thomson coefficient J. Energy a property of the system.
   Specific heat at constant volume and pressure, Enthalpy, Calculation of U, ΔH, KE, PE, Q, W for reversible Non Flow processes Isobaric change(constant pressure process), Isochoric change (Constant Volume process), Isothermal change (Constant temperature process), Adiabatic change and Polytropic change.

4. **Second Law of Thermodynamics:** **(10** Periods**)**
   Second law of thermodynamics. Cyclic Heat Engine, Energy reservoirs, Kelvin Plank's statement of the second law, Reversibility & Irreversibility, Factors that render process of irreversibility, Carnot cycle, Two propositions regarding the efficiency of a Carnot cycle, Thermodynamic temperature scale and ideal gas temperature scale. Simple numerical problems.

5. Thermodynamic Relations: **(10** Periods**)**

Significance of Thermodynamic Relations. Theorem of Exact Differentials, for a functional relationship among three coordinates x,y,z of the type f(x,y,z) = 0 , Show that:

$(\partial x/\partial y)_z = (\partial y/\partial x)_z^{-1}$ and $(\partial x/\partial y)_z\ (\partial y/\partial z)_x\ (\partial z/\partial x)_y = -1$

Maxwell Relations from first principle. Derive

(i) $dS = c_p(\ dT/T) - (\partial V/\partial T)_p\ dP$

(ii) $dS = c_v(\ dT/T) + (\partial P/\partial T)_v\ dV$

(iii) (a) $(\partial E/\partial V)_v = C_v$ and $(\partial H/\partial T)_p = C_p$

(b) $(\partial E/\partial V)_T = 0$ and $(\partial H/\partial P)_T = 0$

6. Entropy : **(8** Periods**)**

Entropy- a property of a system. Inequality of Claussius, Temperature entropy plot, Entropy change in an irreversible process. Entropy principle: Entropy change for an open system, principle of change of entropy. Reversibility and availability, simple numerical problem for calculation of entropy change.

7. Third law of thermodynamics and its statement **(2** Periods**)**

8. Refrigeration and Liquifaction: **(10** Periods**)**

Refrigeration: Methods of achieving low temperature. Refrigeration cycle, Types of refrigeration cycles- Carnot-Air refrigeration and Vapour compression cycles. Capacity of refrigeration or Tons of refrigeration. Coefficient of Performance (COP), Characteristics of ideal refrigerants, Latest refrigerants and their qualities and application.

9. Phase Equilibria **(10** Periods**)**

Raoult's law,' Gibbs phase rule, vapour liquid equilibrium, dew point and bubble point calculations for binary system, Partial molar properties, definition of partial molar properties, Gibbs Deuhem equation, concept of fugacity and fugacity coefficient, activity and activity coefficient

INSTRUCTIONAL STRATEGY

Lot of stress should be given to numerical aspect/problem solving to give indepth knowledge of the subject. This will make the subject interesting and improve students involvement in the subject.

Refrigeration and liquefaction cycles can be taught in a better way by field visits to industries having such units

RECOMMENDED BOOKS

1. Thermal Engineering by Ballaney, Prentice Hall Publications
2. Chemical Engineering Thermodynamics by YVC Rao

3. Engineering Thermodynamics by PK Nag
4. Introduction to Chemical Engineering Thermodynamics by JL Smith and Vanners, McGraw Hill Publication

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	10	10
2	10	10
3	10	15
4	10	15
5	10	15
6	08	10
7	02	05
8	10	10
9	10	10
Total	**80**	**100**

4.2 PLASTIC AND ENGINEERING MATERIALS

L	T	P
5	-	-

RATIONALE

The knowledge of plastic and engineering materials is essential for the students. Mechanical, Electrical, Thermal and Chemical properties of thermoplastics, thermosetting and elastomers help the student to acquire knowledge on the selection of right type of material for processing to make the product.

DETAILED CONTENTS

1. **Introduction to Plastic Materials:** **(12 Hrs)**
   Concept of plastic material, sources, grades (nomenclature of grades). The characteristics of:
   (i) Thermoplastic, thermosetting, elastomers
   (ii) Crystalline, amorphous and their relation to chemical structure, and applications.

2. **Thermoplastics:** **(27 Hrs)**
   History, methods of manufacturing, general properties, additives, processing behaviour and its applications. –
   (i)Commodity Plastics
   polyethlene , styrene, vinyl plastics,
   polyproplene

3. **Synthesis and application -(25 Hrs)**
   (a) Polyolefin- LDPE, HDPE, LLDPE PP, polyethylene co-polymer, PP co-polymers.
   (b) Styrene and styrene co-polymer : GPPS, HIPS, ABS, SAN
   (c) Vinyl plastics: PVC, PVA
   (d) Cellulosic: Cellulose nitrate, cellulose acetate

   (ii) Synthesis ,and application of Engineering Plastics

   (a) Polyamides: Nylon 6, Nylon 66.
   (b) Acrylic plastics : polymethyl methacrylate (PMMA) .
   (c) Polyesters : Polyethylene terepthalate (PET).
   (d) Polycarbonate : PC
   (e) Polyurethane
   (f) Speciality polymer : PTFE

4. **Thermosets (Thermosetting)** **(16 hrs)**

   History, general properties, processing behaviour. PF, UF, MF, FRP, Alkyd resin. Epoxy resin, Amino resin, phenol formaldehyde Urea formaldehyde, Melamine formaldehyde.

INSTRUCTIONAL STRATEGY

Small and simple models can be made to explain the crystal structure of plastics and metals.

RECOMMENDED BOOKS

1. Introduction to Engineering Materials by Raghvan
2. Introduction to Engineering Materials by Askland Donald R.
3. Introduction to material science for Engineers by Shatketlord, Jaiv, F.
4. Plastic Materials by Brydson
5. Organic Chemistry of Polymers by sourders
6. Polymer Science and Technology by P Ghosh
7. Polymer Material – I, Ed. Polymer Research Centre, Banglore
8. Application of Polymer; CIPET
9. Plastic materials - I and II By A.S. Athlay, Colour Age Pub. Mumbai

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	12	10
2	27	35
3	25	35
4	16	20
Total	**80**	**100**

4.3 HEAT TRANSFER OPERATIONS

L	T	P
4	2	4

RATIONALE

The subject enables the students to apply the understanding of heat transfer mechanisms such as conduction, convection and radiation for understanding the performance of various heat transfer equipment such as heat exchangers, condensers, boilers, evaporators etc. used in almost all chemical and related industries.

DETAILED CONTENTS

1. **Modes of Heat transfer** **(04** Periods**)**
   Conduction, convection & radiation

2. **Conduction** **(08** Periods**)**
   Fourier's law, Thermal conductivity, Conductance, flat Wall, Multilayer flat wall, Hollow cylinder, Multilayer cylinder, log mean area, geometric mean area and Arithmetic mean area, Introduction to unsteady state conduction, Simple numerical problems in S.I. Units.

3. **Convection.** **(08** Periods**)**
   Natural and forced convection, dimensional analysis, Pi-theorem, physical significance of dimension less number, Reynolds No, Prandlt No., Nusselt No., Stanton No., PecletNo., Grashoff No., Dittus-Boelter's equation, simple numerical problems using Dittus-Boelter equation, Fouling factor, Individual heat transfer coefficient and over all heat transfer coefficient.

4. **Radiation** **(08** Periods**)**
   Reflection, absorption and transmission of radiation, Kirchoff law, Emissive power, Wein's displacement law, Stefen Boltman law, heat transfered by radiation exchange of energy between two parallel planes of different emissivity, Radiant heat transfer coefficient, Solar radiation, grey surfaces or grey body.

5. **Heat Exchanger** **(10**Periods**)**
   Log.-Mean-Temperature Difference (L.M.T.D.) for parallel or concurrent -flow, counter-current-flow, cross -flow, Construction and description of-
   (i) Double pipe heat exchangers (ii) Shell & Tube heat exchanger (iii) Finned tube heat exchangers. Scale formulation and cleaning devices, Wilson's plot. (Simple Numerical Problems for heat exchangers).

6. **Condenser.** **(08** Periods**)**
   Film-wise and Drop-wise condensation, Construction and description of contact condenser.

7. **Evaporators** **(10** Periods**)**
   Construction and description of- (i) Kettle type boilers (ii) Horizontal tube types (iii) Standard vertical type or calendria type (iv) Natural and forced circulation type evaporators. Entrainment and foam formation, Method of feeding evaporators –Forward feed, Backward feed and Mixed feed, Multi effect evaporation, Boiling : Nucleate boiling, Film boiling, Transition boiling, Maximum flux and critical

temperature drop, Boiling Point rise (B.P.R) and its effect, steam economy for single effect evaporator (Simple Numerical Problem).

8. Crystallizers **(08** Periods**)**

Classification of crystallizers; construction and description of-
(i) Swensen Walker (ii)Vacuum crystallizer

9. Insulation **(06** Periods**)**

Purpose of insulation, common insulators, critical thickness of insulation for cylinder and spheres, optimum thickness of insulation, Heat loss from a pipe.

LIST OF PRACTICALS

1. To determine the overall heat transfer coefficient for an open pan evaporator in steady and unsteady state conditions.
2. To determine the amount of steam required in evaporating the solution in open pan evaporator.
3. To determine overall heat transfer coefficient for a double pipe heat exchanger in steady state conditions and also to determine efficiency of heat utilization for parallel current.
4. To determine overall heat transfer coefficient for a double pipe heat exchanger in steady state conditions and also to determine efficiency of heat utilization for counter current.
5. To determine overall heat transfer coefficient for a shell and tube heat exchanger in steady state conditions and also to determine efficiency of heat utilization for parallel current.
6. To determine overall heat transfer coefficient for a shell and tube heat exchanger in steady state conditions and also to determine efficiency of heat utilization for counter current.
7. To determine steam economy of a single and double effect evaporator.
8. Measurement of emissivity of test surfaces.
9. To determine the rate of evaporation for a given sample.
10. To determine thermal conductivity of metal.
11. To determine the rate of evaporation in a jacket bottled (open pan evaporation).
12. Study a sketch of oil fired boiler.

INSTRUCTIONAL STRATEGY

Since this is an important subject, it is very essential for the teacher to make the students very clear about the fundamentals of heat transfer, numerical problems and various heat transfer equipment.

RECOMMENDED BOOKS

1. Unit Operation of Chemical Engineering by McCabe and Smith, McGraw Hill Publication
2. Heat Transfer by Chapman, McMillan Publication
3. Heat Transfer by NC Adams, McGraw Hill Publication

4. Process Heat Transfer by Kern, McGraw Hill Publication
5. Principles of Heat Transfer by Kreith, Harper and Raw Publication

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted Theory(Hrs)	Time Allotted Tutorials(Hrs)	Marks Allotted (%)
1	04	02	05
2	08	02	10
3	08	04	15
4	08	04	15
5	08	04	15
6	08	04	15
7	10	04	15
8	05	04	05
9	05	04	05
Total	**64**	**32**	**100**

4.4 MATERIAL AND ENERGY BALANCE

L	T	P
4	2	-

RATIONALE

The subject provides the knowledge of materials and energy requirements for a process and with this knowledge raw material requirements for a given process can be calculated.

DETAILED CONTENTS

1. **Introduction:** **(5** Periods**)**
   - 1.1 Use of gravitational conversion factor. Problems relating conversion of one set of units in a function of equation into another equivalent set for mass, length, time, temperature, area, volume, pressure, energy and force of an expression for heat capacity from one set of units to another.
   - 1.2 Conventions of Methods of Analysis and Measurement: Density & specific gravity, Transform a material from one measure of concentration to another, including mass/volume, moles/volume, PPM.

2. **Material Balance without Chemical Reactions:** **(15** Periods**)**
   Significance of material balance, General methods for solving material balance problems involving no chemical Reaction, Outlines of a procedure for material Balance calculations. Various Important unit operations carried out in the chemical Industries. Tie substance. Bypass stream. Simple numerical problems.

3. **Material Balance with Chemical Reactions:** **(15** Periods**)**
   Definition of terms involved: Stoichiometry, Stoichiometric equation, Stoichiometric coefficient, Stoichiometric ratio, Stoichiometric proportions. Limiting reactant, Excess reactant, Percent Excess. Conversion, Percent Conversion. Yield & Selectivity. Simple numerical problems.

4. **Recycling Operations:** **(09** Periods**)**
   Importance of recycling operation. Recycle stream, Recycle ratio. Material balance for recycling operation. Purge, Purge stream, purge ratio. Simple problems relating various chemical reactions.

5. **Energy Balance:** **(10** Periods**)**
   General balance procedure, Sensible heat & Heat capacities, Heat capacities of gases at constant volume and pressure. Empirical equation for Heat capacities. Mean molal heat capacities of gases. Heat capacity of gaseous mixtures. Enthalpy Changes accompanying chemical reaction: Heat of reaction, Heat of formation, Standard heat of formation, Heat of combustion, Hess law of constant heat summation. Standard heat of reaction from heats of formation, Standard heat of reaction from heats of combustion. Phase change operation: Latent heat of phase change, Latent heat of vaporization, Latent heat of fusion, Latent heat of

sublimation. Energy balance during phase change operation. Heat of solution & mixing.

6. Combustion Processes: (10 Periods)

Complete & incomplete combustion, Significance of combustion. Calorific values of fuels, Gross Calorific Value (GCV), Net Calorific Values (NCV). Air requirement, theoretical air, actual air, excess air, percent excess air. Oxygen requirement, theoretical Oxygen, actual Oxygen, excess Oxygen, percent excess Oxygen. Analysis of products of combustion, Proximate and Ultimate analysis. Oxidation of sulphur and its component. Problem on fuel gas analysis (i.e. calculation of net hydrogen carbon atomic ratio H/C).

INSTRUCTIONAL STRATEGY

Emphasis should be laid on problem solving in all the area of material and energy balance.

Simple practical relating to wet bulb temperature, dry bulb temperature and humidification chart, should be done

Students should be encouraged to make flow sheets for various processes. This will help the students to understand the subject better and solve intricate problems in various areas.

RECOMMENDED BOOKS

1 Stoichiometry by Bhatt and Vohra, Tata McGraw Hill Publications

2 Chemical Process Principles by Hougen and Watson, Wiley International Edition

3 Industrial Stoichiometry by Lewis and Lewis, McGraw Hill Publications

4 Solved Examples in Chemical Engineering by GK Ray, Khanna Publications

5 Basic Principles and calculations in Chemical Engineering by Himmelblau, Prentice Hall Publication International Series.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs.)	Time Allotted for Tutorials (Hrs.)	Marks Allotted %
1	05	01	5
2	05	01	5
3	15	08	20
4	15	08	20
5	05	08	25
6	10	03	15
7	09	03	10
Total	**64**	**32**	100

4.5 PROCESS CONTROL

L	T	P
4	-	4

RATIONALE

The subject gives the knowledge of various process controls used to measure process parameters.

DETAILED CONTENTS

1 Introduction: **(07** Periods**)**

1.0. Block diagram of a general open and closed loop process
1.1. Control System & Application
1.2. Automatic Control

2 Control System Components: **(3** Periods**)**

.Definition-Input means, controlling means, actuating means, measuring means, final control elements, feed forward and backward system .

3 Process Characteristics **(18** Periods**)**

3.1. Process variables, process degree of freedom, forcing function, step fn., ramp, impulse, sinusoidal function, Laplace transformation, introduction to first order and second order system.
3.2. Elements of process dynamics: - Proportional, Capacitance.
3.3. Time constant and oscillatory element, determination of system function or transfer function of the following: (Sketch physical diagram and block diagram)
3.4. (a) First order system or time constant element:-
(i) Naked bulb thermometer.
(ii) Stirred tank heater.
(iii) Mixing process.
(iv) R.C. Circuit.
(v) Liquid levels.
(vi) Two time constant type liquid vessel cascaded i.e. non interacting and non cascaded, i.e. interacting.
(vii) Continuous stirred tank chemical reactor with first order chemical reaction.

4. Second order system or oscillatory type element. **(15** Periods**)**

Bulb in thermo well. Mechanical damper. Fluid manometer or U tubes.
Response of first order system to step, ramp, impulse and sinusoidal inputs,
Response of second order system to step change (Transient response).

5 Controller & Control Techniques: (12 Periods)

ON-OFF Control, Proportional, Integral, Derivative, PI, PD, PID, Block diagram.

6 Closed Loop in Automatic Control (09 Periods)

6.1. Overall transfer function for a single loop system,
6.2. Overall transfer function for change in set point and for change in load,
6.3. Overall transfer function for multi loop control system,
6.4. Unit step response.

LIST OF PRACTICAL

1. Experiment of ON-OFF Controller
2. Experiment of PID Controller
3. Experiment of Electronics Controller
   a. Heating Control
   b. Welding Control
   c. Level Control
   d. Pressure Control
4. To calibrate & install a pneumatic control valve.
5. To study the response of two tank non interacting, liquid, level system and two tanks interacting liquid system.
6. Experiment of solenoid valve.
7. To measure time constant of a single capacity thermal process (water bath & heater).
8. To study the transient response of first order system (thermo couple) and find out time constant.
9. To study the transient response of a simple R-C network plot Bodey's diagram.
10. To study the frequency response of a second order electrical circuit equipment. to a physical system (R-L-C network)

INSTRUCTIONAL STRATEGY

Field visits to new and developing industries with automatic controls will give in-depth knowledge of different types of controllers used in chemical industry. If possible small simple experiments can be designed to give practical information about first order and second order systems.

RECOMMENDED BOOKS

1. Instrumentation Devices & Systems by S Ranjan (Tata McGraw-Hill Publishing)
2. Electrical & Electronics Measurement by A.K. Sawhney (Danpat Rai & Co.)
3. Process Instrumentation by Donald P. Echman
4. Process Control by Donald P. Echman
5. Instrumentation by Cirk & Rimboi
6. Instrumentation Measurement and Analysis by B.C. Nakra and KK Chaudhary (McGraw Hill Publication)
7. Process System Analysis and Control by Cough Snowr D.R. & Koppel L.B.
8. Chemical Process Control by Stephanopolous
9. Chemical Process Control by Kulkarni

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	07	10
2	03	05
3	18	25
4	15	25
5	12	20
6	09	15
Total	**64**	**100**

4.6 RUBBER TECHNOLOGY

L	T	P
4	-	-

RATIONALE

The subject is designed to enable the students to acquire basic knowledge of rubbers, their advantages, applications, classification and recycling The elementary acquired knowledge will help them in understanding different processes in detail in the later part of the course.

DETAILED CONTENTS

1. Sources and history of natural and synthetic rubber, chemical nature of natural rubber. Hydrogenated rubber, cyclised rubber, chlorinated rubber, powdered rubber **(07 hrs)**

2. Manufacturing process, properties and application like Styrene Butadiene Rubber (SBR), nitrile rubber. Ethylene propylene-structure of EDPM, the non conjugated straight chain diolefin . cyclic and bycyclic structure of Ethylene propylene rubber. application of ethylene propylene rubber. **(10 hrs)**

3. Synthesis and vulcanization of silicon rubber. Application and types of neoprene rubber. thermoplastic elastomers. produce poly vinyl chloride by chemical reactions. **(14 hrs)**

4. Modified rubber, types of modified rubber-(1)-anti crytalling rubber . (2)-Grafted rubber. **(10 hrs)**

5. Compounding of rubber with ingredients like fibres, fillers, softness,accelerators, activators, peptisors etc. Miscellellaneous ingradient. **(13 hrs)**

6. Industrial fabrication of rubber article such as transmission belt, hoses, tyres, footwear, their compounding and processing techniques. **(13 hrs)**

INSTRUCTIONAL STRATEGY

As this subject involves study of rubber products, field visit is must to give details about the various processes involved in rubber industry.

RECOMMENDED BOOKS

1. Rubber Technology and Manufacture by SBP Board of Consultants and Engineers.
2. Rubber Technology- A Basic Course by Alexandar S. Craig
3. Rubber & Modern Rubber goods industries by Small Industry Research Institute.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	07	10
2	07	10
3	14	25
4	10	15
5	13	20
6	13	20
Total	**64**	**100**

4.7 MINOR PROJECT WORK

L	T	P
-	-	6

Minor project work aims at developing skills in the students whereby they apply technical knowledge and skills gained through the course in the solution of particular problem or undertaking a project. The students have various aptitudes and strengths. Project work, therefore should match the strengths. The faculty of the department may have a brainstorming to identify suitable project assignments. Students during middle of the course, are required to be sent for a period of 4 weeks at different work sites. Some of the good industries are suggested by the expert group as follows:

List of Industries

1. India Glycols Ltd., Kashipur
2. DSM Sugar Mills Ltd. Kashipur
3. Pashupati Acrylon, Thakurdwara
4. Naini Paper Mills, Kashipur
5. Cheema Paper Mills, Kashipur
6. Siddharth Paper Mill, Kashipur
7. Banwari Paper Mills, Kashipur
8. Bazpur Distillary, Bazpur
9. SRF, Kashipur
10. Bazpur Cooperative Sugar Mills, Bazpur
11. PEPSI Holdings, Bazpur
12. Mahindra and Mahindra, Rudrapur
13. Honda Siel Ltd, Rudrapur
14. Polyplex Ltd, Khatima
15. Ester Industries, Khatima
16. Surya Roshni Ltd., Kashipur
17. Jindal Solvent Extraction, Kashipur
18. Himgiri Oils, Kashipur
19. Century Pulp and Paper,Lalkuan
20. Dabur Ltd, Rudrapur
21. Parle Industries Ltd., Rudrapur
22. Nestle, Rudrapur
23. Cooperative Milk Plant, Haldwani

24. Jindal Cold Store, Bazpur
25. BHEL, Hardwar
26. Doiwala Distillary, Doiwala, Dehradun
27. Shivalik Rasayan, Dehradun
28. Air Liquid Ltd, Roorkee

As a minor project activity, each student is supposed to study the material and technology used at site and prepare a detailed project report of the observation of process seen by him/her. These students should be supervised and guided by respective subject teachers. Each teacher may guide a group of four to five students.

The teacher along with field supervisors will conduct performance assessment of students. This minor project work will carry 200 marks. 100 marks will be given by Industrial/field supervisors and 100 marks by the teacher supervising this training. The components of evaluation will include the following:

a)	Punctuality and regularity	15%
b)	Initiative in learning new things	15%
c)	Relationship with workers	15%
d)	Industrial training report	55%

4.8 INDUSTRIAL TRAINING

Industrial training provides an opportunity to students to experience the environment and culture of industrial production units and commercial activities undertaken in field organizations. It prepares student for their future role as diploma engineers in the world of work and enables them to integrate theory with practice.

For this purpose, students at the end of fourth semester need to be sent for industrial training for a minimum of 4 weeks duration to be organised during the semester break starting after IV Semester examinations. The concerned HODs along with other teachers will guide and help students in arranging appropriate training places relevant to their specific branch. It is suggested that a training schedule may be drawn for each student before starting of the training in consultation with the training providers. Students should also be briefed in advance about the organizational setup, product range, manufacturing process, important machines and materials used in the training organization.

Equally important with the guidance is supervision of students training in the industry/organization by the teachers. A teacher may guide a group of 4-5 students. A minimum of one visit by the teacher is recommended. Students should be encouraged to write daily report in their diary to enable them to write final report and its presentation later on.

Internal assessment and external assessment have been provided in the study and evaluation scheme of V Semester. Evaluation of professional industrial training report through viva-voce/presentation aims at assessing students understanding of materials, industrial process, practices in industry/field organization and their ability to engage in activities related to problem solving in industrial setup as well as understanding of application of knowledge and skills learnt in real life situations. The formative and summative evaluation may comprise of weightage to performance in testing, general behaviour, quality of report and presentation during viva-voce examination. It is recommended that such evaluations may be carried out by a team comprising of concerned HOD, teachers and representative from industry, if any. The components of evaluation will include the following.

a) Punctuality and regularity	15%
b) Initiative in learning new things	15%
c) Relationship with workers	15%
d) Industrial training report	55%