 <b>MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI</b> <b>TEACHING AND EXAMINATION SCHEME FOR POST S.S.C. DIPLOMA COURSES</b>																	
<b>COURSE NAME : DIPLOMA IN CHEMICAL ENGINEERING</b>																	
<b>COURSE CODE : CH</b>																	
<b>DURATION OF COURSE : 6 SEMESTERS</b>										<b>WITH EFFECT FROM 2012-13</b>							
<b>SEMESTER : FIFTH</b>										<b>DURATION : 16 WEEKS</b>							
<b>PATTERN : FULL TIME - SEMESTER</b>										<b>SCHEME : G</b>							
SR. NO	SUBJECT TITLE	Abbreviation	SUB CODE	TEACHING SCHEME			EXAMINATION SCHEME										SW (17500)
				TH	TU	PR	PAPER HRS.	TH (1)		PR (4)		OR (8)		TW (9)			
								Max	Min	Max	Min	Max	Min	Max	Min		
1	Plant Safety & Maintenance	PSM	17558	03	--	--	03	100	40	--	--	--	--	--	--		
2	Energy Management	EMA	17559	03	--	02	03	100	40	--	--	--	--	25@	10	<b>50</b>	
3	Heat Transfer Operation	HTO	17560	03	--	04	03	100	40	50#	20	--	--	25@	10		
4	Chemical Process Instrumentation and Control	CPI	17561	03	--	02	03	100	40	50#	20	--	--	25@	10		
5	Chemical Reaction Engineering	CRE	17562	03	01	--	03	100	40	--	--	--	--	--	--		
6	Behavioural Science \$	BSC	17075	01	--	02	--	--	--	--	--	25#	10	25@	10		
7	Entrepreneurship Development and Industrial Project	EDI	17073	01	01	02	--	--	--	--	--	--	--	25@	10		
8	Professional Practices-III	PPT	17074	--	--	03	--	--	--	--	--	--	--	50@	20		
<b>TOTAL</b>				<b>17</b>	<b>02</b>	<b>15</b>	--	<b>500</b>	--	<b>100</b>	--	<b>25</b>	--	<b>175</b>	--		<b>50</b>

Student Contact Hours Per Week: **34 Hrs.**  
**THEORY AND PRACTICAL PERIODS OF 60 MINUTES EACH.**  
Total Marks : **850**  
@ - Internal Assessment, # - External Assessment,   No Theory Examination, \$ - Common to all branches, #\* - Online Theory Examination.

Abbreviations: TH-Theory, TU- Tutorial, PR-Practical, OR-Oral, TW- Term Work, SW- Sessional Work

- Conduct two class tests each of 25 marks for each theory subject. Sum of the total test marks of all subjects is to be converted out of 50 marks as sessional work (SW).
- Progressive evaluation is to be done by subject teacher as per the prevailing curriculum implementation and assessment norms.
- Code number for TH, PR, OR, TW are to be given as suffix 1, 4, 8, 9 respectively to the subject code.

**Course Name : Diploma in Chemical Engineering**

**Course code : CH**

**Semester : Fifth**

**Subject Title : Plant Safety and Maintenance**

**Subject Code : 17558**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS.	TH	PR	OR	TW	TOTAL
03	--	--	03	100	--	--	--	100

**NOTE:**

- Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.
- Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).

**Rationale:**

In the chemical process industry plant safety is important. Knowledge of plant safety is essential to prevent accidents and damages while working in plant. Maintenance of plant and machinery is one of the most important aspects of process industry. This subject deals with safe practices, various types of maintenance and their significance.

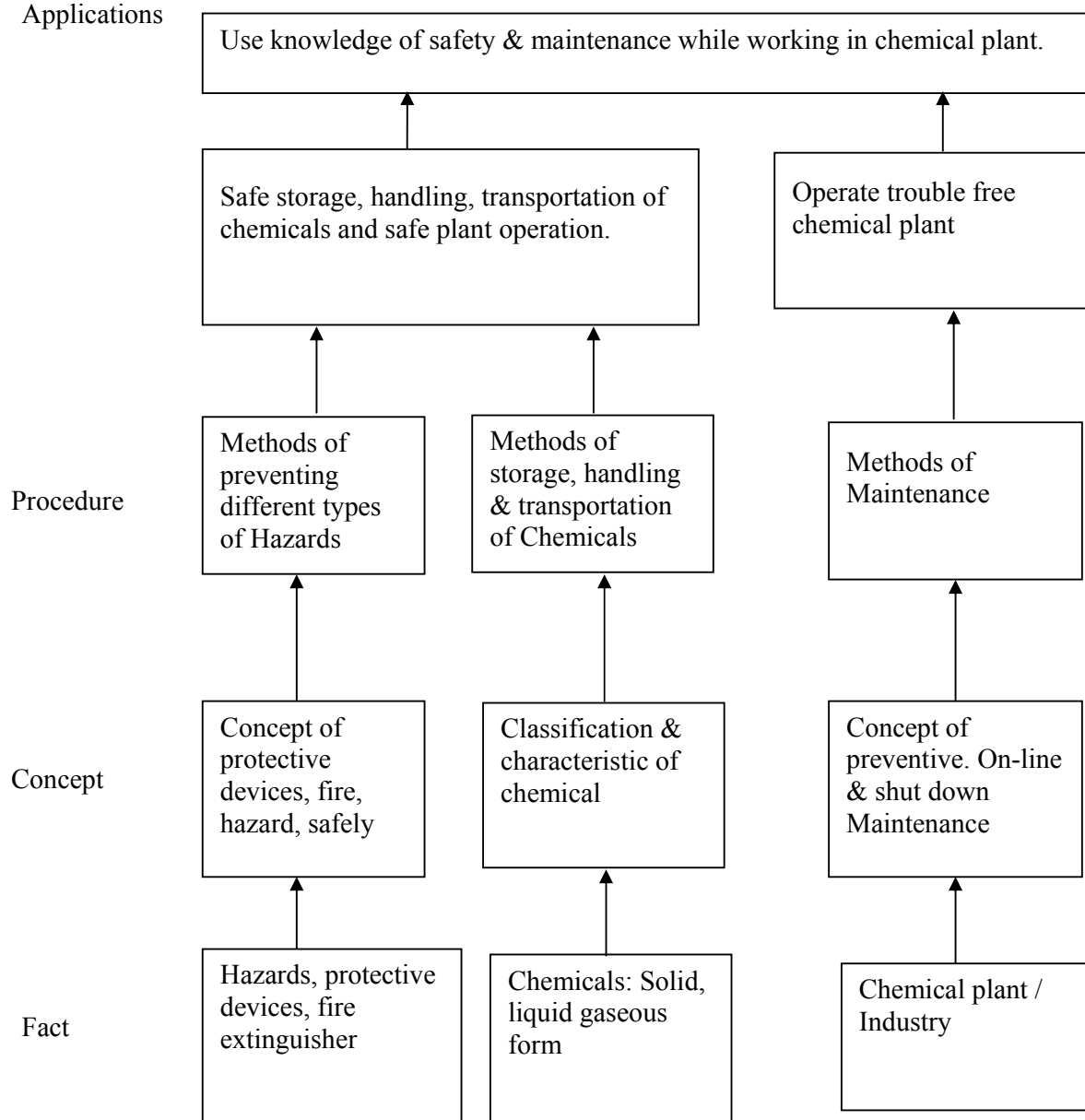
**General Objectives:**

**The students will be able to**

1. Describe the safety procedures to be observed while working in a plant.
2. Identify types of hazards associated in a chemical process industry.
3. Prepare safety audit report & safety report.
4. Explain procedure for preventive maintenance, on-line maintenance, shut down maintenance.

**Learning Structure:**

Applications



## Theory:

Chapter	Topic and Content	Hours	Marks
1	<p><b>Plant Hazards</b>  <b>Specific Objectives :</b></p> <ul style="list-style-type: none"> <li>➤ Study different hazards associated with the Chemical industries and their Control Methods.</li> <li>➤ Study the Preventive Methods for different hazards.</li> <li>➤ Study the hazards associated with Cl<sub>2</sub>, NH<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub></li> </ul> <p><b>Content:</b></p> <p><b>1.1 Industrial hazards 08 Marks</b></p> <ul style="list-style-type: none"> <li>• Industrial hazards due to process &amp; its precautions.</li> <li>• Plant Safety provisions.</li> <li>• Electrical hazards - Common Sources, precautions.</li> <li>• Mechanical hazards.</li> </ul> <p><b>1.2 10 Marks</b></p> <ul style="list-style-type: none"> <li>• Explosion hazards - Classification of explosives, precautions while handling explosives.</li> <li>• Radiation hazards – Health hazards of infrared radiation &amp; X rays.</li> <li>• Noise hazard - Sources, protection.</li> <li>• Chemical hazard - hazards due to NH<sub>3</sub>, Cl<sub>2</sub> H<sub>2</sub>SO<sub>4</sub></li> </ul>	10	18
2	<p><b>Personal Protective equipments</b>  <b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Study the working of different respiratory equipments.</li> <li>➤ Understand the selection of proper respiratory device.</li> <li>➤ Draw and Study various non respiratory personal protective devices.</li> </ul> <p><b>Content:</b></p> <ul style="list-style-type: none"> <li>• Respiratory protective equipment - Air purifier type, supplied air type, Self contained breathing apparatus, Selection of proper devices.</li> <li>• Non respiratory personal protective equipment - Eye &amp; face, ear, head, torso &amp; body, hand, foot &amp; leg protection.</li> </ul>	05	14
3	<p><b>Fire Prevention</b>  <b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ State causes of fire</li> <li>➤ Classify types of fire &amp; suggest suitable type of fire extinguisher</li> </ul> <p><b>Content:</b></p> <ul style="list-style-type: none"> <li>• Types of fire, fire triangle, Principle of extinguish of fire.</li> <li>• Classification of fire and suitable type of extinguisher</li> <li>• Principle, Construction &amp; working of following fire extinguisher – Soda Acid type, Foam type, Dry Chemical powder. Fire buckets and Fire hydrant</li> </ul>	06	16
4	<p><b>Storage &amp; Transportation of Chemicals</b>  <b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ State different methods of storage.</li> </ul>	09	18

	<ul style="list-style-type: none"> <li>➤ Draw various conveyors.</li> <li>➤ State transport requirements of hazardous Chemicals.</li> </ul> <p><b>Content:</b>  4.1 Methods of Storage 08 Marks  Bulk storage, bin storage, underground storage, liquid storage, gas storage;  <ul style="list-style-type: none"> <li>• Storage of flammable &amp; combustible liquid chemicals shock sensitive chemicals.</li> <li>• Packing of solids - bags, boxes, drum, container.</li> <li>• Vibrating hopper, Screw feeder.</li> </ul> 4.2 10Marks  <ul style="list-style-type: none"> <li>• Functions &amp; Principles of material handling.</li> <li>• Construction &amp; working of screw conveyor, belt conveyor, bucket elevator (Spaced bucket positive discharge),</li> <li>• Pneumatic conveyor - (Positive, negative)</li> <li>• Wooden pallets for unit load.</li> <li>• Transportation of hazardous Chemicals - Flammable liquids, corrosives or oxidizing materials, water reactive chemicals, igniting substances, toxic chemicals.</li> </ul> </p>		
5	<p><b>Safety Audit</b>  <b>Specific Objectives:</b>  <ul style="list-style-type: none"> <li>➤ State objective of safety audit.</li> <li>➤ Describe the procedure for safety auditing.</li> </ul> <b>Content:</b>  Objectives of safety audit, procedure for safety auditing.</p>	04	06
6	<p><b>Plant Maintenance</b>  <b>Specific Objectives:</b>  <ul style="list-style-type: none"> <li>➤ State objectives of plant maintenance.</li> <li>➤ Describe functions and responsibilities of plant maintenance department.</li> </ul> <b>Content:</b>  6.1 Objectives of plant maintenance functions &amp; responsibilities of plant maintenance department. 06 Marks  6.2 Types of maintenance 12 Marks  Corrective or breakdown maintenance, Scheduled maintenance, Preventive maintenance, Predictive maintenance,  6.3 Online maintenance 10 Marks  (eg. Rota meter/ Steam trap), Shut down maintenance, Procedure for shutdown &amp; start up of plant.</p>	14	28
	<b>Total</b>	<b>48</b>	<b>100</b>

**Learning Resources:****Books:**

Sr. No.	Name of Book	Name of Author	Name of Publisher
1	Safe Handling of Hazardous Chemicals	A. K. Rohatgi	J. K. Entrprises
2	Safety & Accident Prevention in Chemical	H. H. Foucet & W. S. wood	Inter Science Publication, John Willey & Sons

	operation		
3	Safety in Process Plant Design	G. L. Wells	John Willey & Sons
4	Plant Maintenance	S. S. Apte	Delhi Productivity Council
5	Maintenance Engineer Handbook	C. L. Morrow	McGraw Hill Publication

**Course Name : Diploma in Chemical Engineering**

**Course Code : CH**

**Semester : Fifth**

**Subject Title : Energy Management**

**Subject Code : 17559**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	--	02	03	100	--	--	25@	125

**NOTE:**

- Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.
- Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).

**Rationale:**

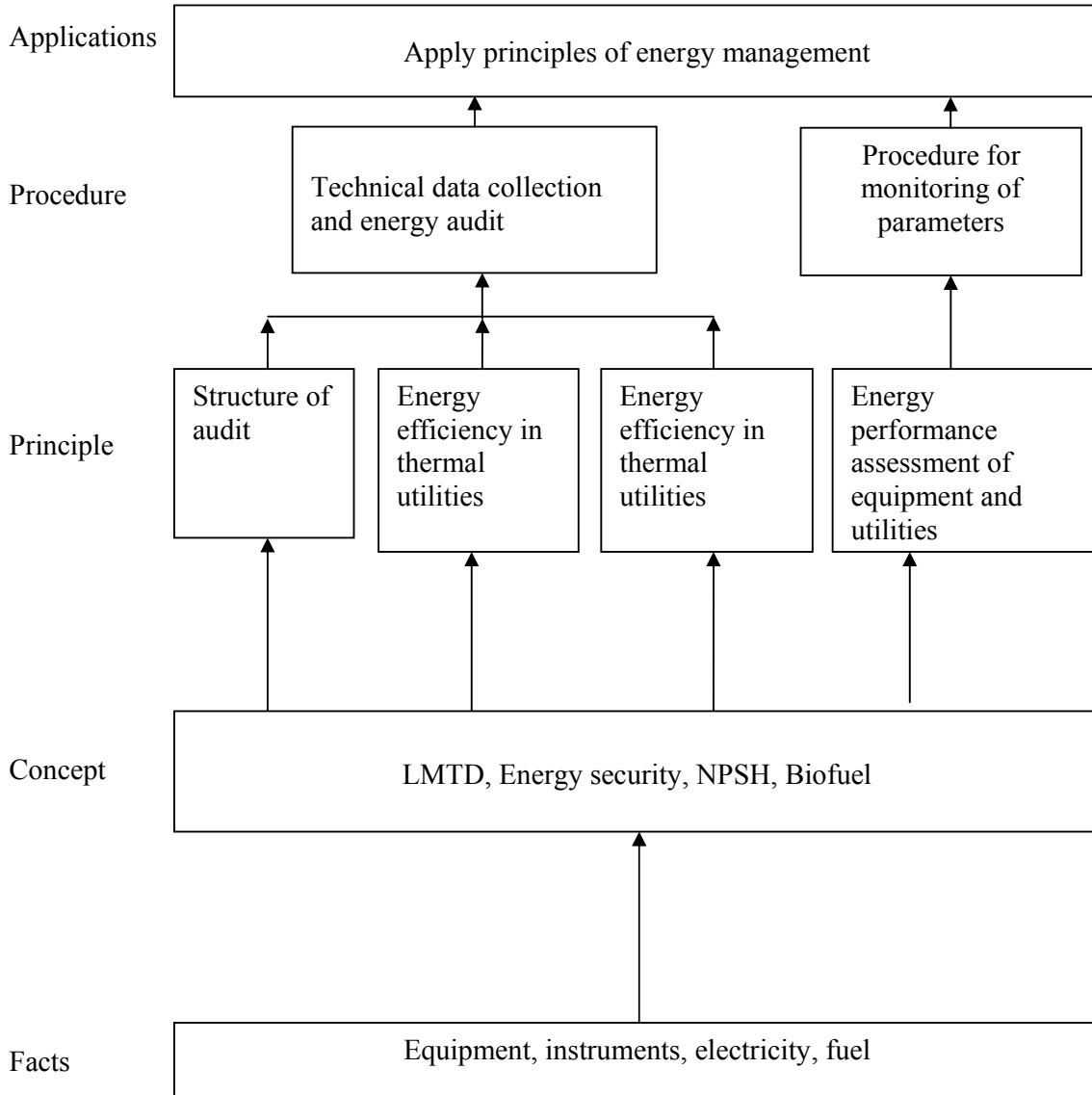
Today commercial energy sources are limited and putting great burden on nation and industries. Energy management is important industrial and commercial activity which will help to reduce this burden. This subject will equip the students with knowledge of energy types and its use. Energy conservation method and energy audit methodology are also studied.

**General Objectives:**

**The students will be able to:**

1. Know various forms of energy
2. Understand various types of energy conservation methods
3. Apply method of energy auditing.
4. Understand the use of energy in various equipment
5. Know different types of renewable energy sources.

**Learning Structure:**





## Theory:

Chapter	Topics and Contents	Hours	Marks
1	<p><b>Energy Scenario</b></p> <p><b><u>Specific Objectives :</u></b></p> <ul style="list-style-type: none"> <li>➤ Classify sources of energy</li> <li>➤ Describe energy security measures</li> <li>➤ State salient features of EC act 2001</li> </ul> <p><b><u>Content:</u></b></p> <ul style="list-style-type: none"> <li>• Primary and Secondary Energy Sources</li> <li>• Commercial and Noncommercial energy sources</li> <li>• Global Primary Energy Reserves</li> <li>• Indian energy scenario</li> <li>• Energy Security</li> <li>• Energy Conservation and its Importance</li> <li>• Features of Perform Achieve &amp; Trade- PAT scheme</li> <li>• Salient features of EC act 2001</li> </ul>	06	12
2	<p><b>Basic of Energy</b></p> <p><b><u>Specific Objectives:</u></b></p> <ul style="list-style-type: none"> <li>➤ Give examples of modes of heat transfer</li> <li>➤ Calculate energy content in fuel</li> <li>➤ Calculate power factor</li> </ul> <p><b><u>Content:</u></b></p> <ul style="list-style-type: none"> <li>• Concept of Calorific value, Specific heat, Modes of heat transfer,</li> <li>• Combustion (concept and calculations)- Basics of combustion, 3 T's of combustion, Stoichiometry of combustion, Excess air in combustion</li> <li>• Fuels- Types and examples of fuel, Properties of fuel, Storage of fuel</li> <li>• Electrical Energy ( Concept and calculations )- DC and AC, Power factor, Energy demand</li> <li>• Electricity generation from thermal power plant (concept and block diagram)</li> </ul>	08	16
3	<p><b>Energy Audit</b></p> <p><b><u>Specific Objectives:</u></b></p> <ul style="list-style-type: none"> <li>➤ State necessity of energy audit</li> <li>➤ Compare energy utilization for given product</li> <li>➤ Suggest ENCON recommendation</li> </ul> <p><b><u>Content:</u></b></p> <ul style="list-style-type: none"> <li>• Concept of energy audit</li> <li>• Need for energy audit</li> <li>• Types of energy audit-Preliminary &amp; Detailed</li> <li>• Energy audit instruments</li> <li>• Structure of Audit report</li> <li>• Energy benchmarking</li> </ul>	10	20

	<ul style="list-style-type: none"> <li>• ENCON recommendation</li> <li>• Simple payback period (definition and calculation)</li> </ul>		
4	<p><b>Energy Efficiency in Thermal and Electrical Utilities</b></p> <p><b><u>Specific Objectives:</u></b></p> <ul style="list-style-type: none"> <li>➤ Calculate efficiency of boiler by direct method</li> <li>➤ Describe steps for efficiency calculation</li> <li>➤ State steps for performance assessment of heat exchanger</li> <li>➤ Calculate specified power for pump</li> </ul> <p><b><u>Content:</u></b></p> <p><b>Boilers</b></p> <ul style="list-style-type: none"> <li>• Types of boiler – salient features of fire tube, water tube, package , FCB</li> <li>• Boiler evaporation ratio</li> <li>• Efficiency calculation by direct method</li> <li>• Advantages and disadvantages of direct method</li> <li>• Steps to check performance assessment of boiler</li> <li>• Energy conservation measures in boiler</li> </ul> <p><b>Heat Exchangers</b></p> <ul style="list-style-type: none"> <li>• Concept of heat exchanger</li> <li>• Types of heat exchangers - by construction and flow</li> <li>• LMTD</li> <li>• Overall heat transfer coefficient</li> <li>• Steps to check performance assessment of heat exchanger</li> </ul> <p><b>Pumps</b></p> <ul style="list-style-type: none"> <li>• Working of centrifugal Pump</li> <li>• Pump performance</li> <li>• Hydraulic, shaft and electrical input power</li> <li>• Pump operating point</li> <li>• Effect of oversizing pump</li> <li>• Energy loss in throttling</li> <li>• NPSH</li> <li>• Effect of speed variation, impeller trimming</li> <li>• Performance assessment of pump (only method)</li> <li>• Energy conservation opportunities in pump</li> </ul> <p><b>Cooling tower</b></p> <ul style="list-style-type: none"> <li>• Types of cooling tower</li> <li>• Components of cooling tower</li> <li>• Cooling tower performance</li> <li>• Efficient system operation</li> <li>• Energy saving opportunities</li> </ul>	14	32
5	<p><b>Non-Conventional Energy Sources</b></p> <p><b><u>Specific Objectives:</u></b></p> <ul style="list-style-type: none"> <li>➤ Describe method of generating electricity by solar thermal energy</li> <li>➤ Calculate power available in wind</li> <li>➤ Compare conventional and non-conventional energy on given point</li> </ul>	10	20

	<p><b>Content:</b></p> <p>Solar energy</p> <ul style="list-style-type: none"> <li>• Solar constant</li> <li>• Solar insolation</li> <li>• Solar water heater – construction and working flat plate collector</li> <li>• Solar thermal energy</li> <li>• Solar photovoltaic energy</li> <li>• Construction and working of box type and parabolic solar cooker</li> </ul> <p>Wind Energy</p> <ul style="list-style-type: none"> <li>• Wind Generation</li> <li>• Power available in wind</li> <li>• Components of wind mill</li> <li>• Capacity factor</li> </ul> <p>Biomass energy</p> <ul style="list-style-type: none"> <li>• Types of biomass</li> <li>• Direct combustion of biomass</li> <li>• Gasification of biomass</li> <li>• Construction and working of Biogas plant</li> <li>• Biofuels- types , raw material and use</li> </ul> <p>Concept of fuel cell</p> <p>Concept of wave and tidal energy</p> <p>Concept of geothermal energy</p> <p>Comparison of conventional and non-conventional energy</p>		
<b>Total</b>		<b>48</b>	<b>100</b>

**Practical:****Intellectual Skills**

- 1) Follow standard method of energy audit.
- 2) Select proper instrument and its location for measuring the parameter.

**Motor Skill:**

- 1) Handle instrument properly.
- 2) Measure parameters accurately.

**List of Practicals:**

**Note: Following practicals can be conducted in group of 4 students**

- 1) Compare intensity of light using lux meter in given rooms with standard values
- 2) Use of contact/ non-contact tachometer to measure rpm of given motor
- 3) Find out energy consumption of given appliances (computer, heater, microwave, refrigerator, etc.) using wattmeter and compare it with rated values
- 4) Compare heat loss from insulated and non-insulated furnace or oven or equipment or pipe.
- 5) Compare efficiency of box and parabolic solar cooker in terms of temp attained.
- 6) Calculate energy efficiency of shell and tube heat exchanger
- 7) Calculate energy efficiency of double pipe heat exchanger
- 8) Calculate energy efficiency of finned tube heat exchanger
- 9) Calculate losses when transfer of heat takes place from steam or hot water to cold water.
- 10) Calculate range and approach in cooling tower.

**Learning Resources:****1. Books:**

<b>Sr. No.</b>	<b>Name of Book</b>	<b>Name of Author</b>	<b>Name of Publisher</b>
1	Guide book for Nation Certification Examination for Energy Managers & Energy Auditors Book 1 to 4	BEE	available at <a href="http://www.energymanagertraining.com">www.energymanagertraining.com</a>
2	Energy Management Handbook	W.C. Turner	The Fairmont Press

**2. Web Source**

- (i) [www.bp.com/centres/energy](http://www.bp.com/centres/energy).
- (ii) [www.epa.org](http://www.epa.org)
- (iii) [www.calculator.org/properties.html](http://www.calculator.org/properties.html)
- (iv) [www.eeca.govt.nz](http://www.eeca.govt.nz)
- (v) [www.energyusernews.com/](http://www.energyusernews.com/)
- (vi) [www.bce-india.nic.in](http://www.bce-india.nic.in)
- (vii) [www.bp.com/statisticalreview](http://www.bp.com/statisticalreview)

**Course Name : Diploma in Chemical Engineering****Course Code : CH****Semester : Fifth****Subject Title : Heat Transfer Operation****Subject Code : 17560****Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	--	04	03	100	50#	--	25@	175

**NOTE:**

- Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.
- Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).

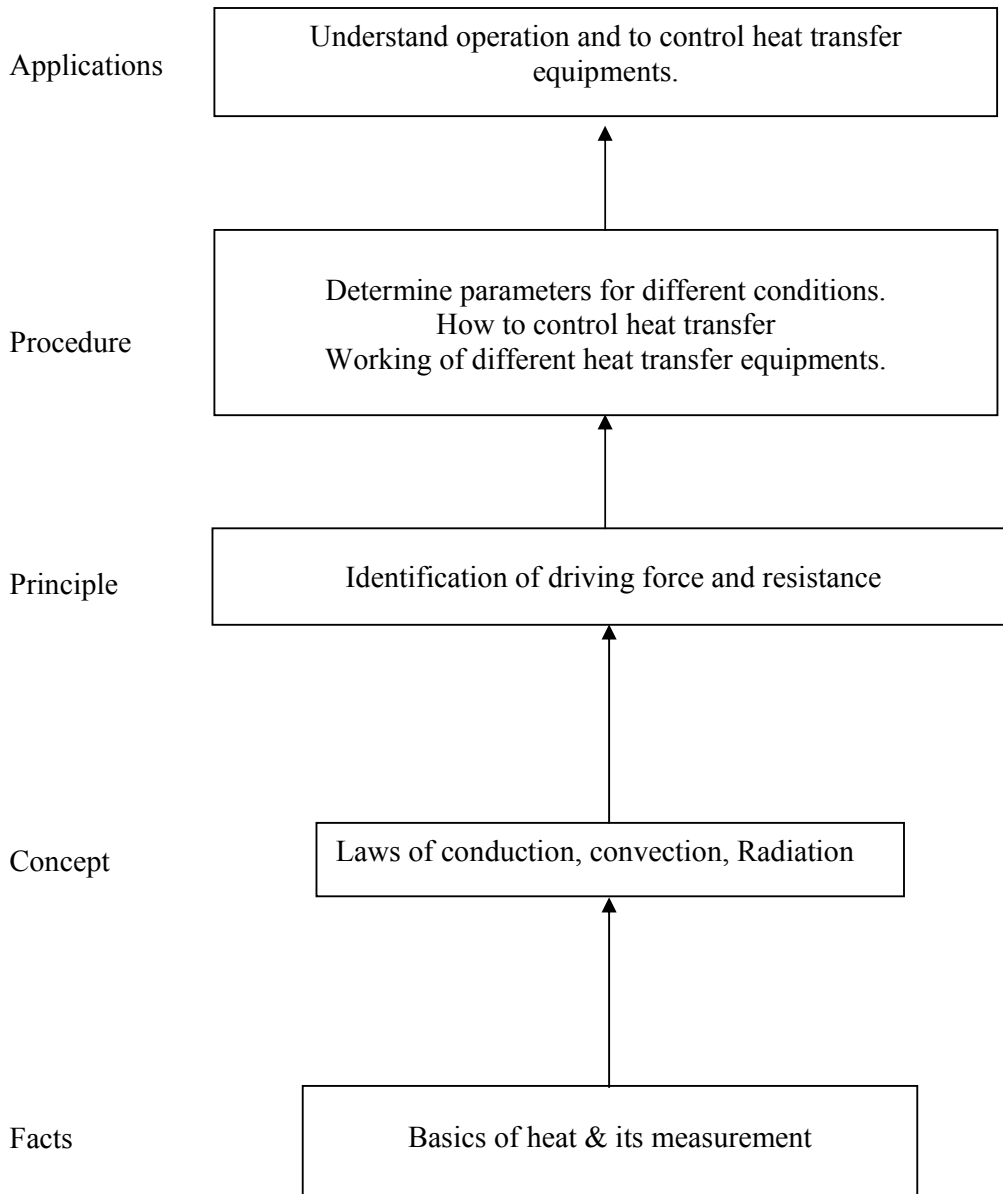
**Rationale:**

This subject intends to equip the students with the concept and principles of heat transfer operations, which are of prime importance in any chemical industry. It will develop the skills of logical thinking of control of various parameters, which affect the operations by which an overall control of the equipment can be achieved.

**General Objectives:****The students will be able to**

1. Understand basic modes , mechanism and laws of heat transfer
2. Understand concept of overall and individual heat transfer coefficient.
3. Apply basic equations to calculate rate of heat transfer.
4. Know working of different heat transfer equipments.
5. Know working of different evaporators.

**Learning Structure:**



**Content: Theory**

Chapter	Topic	Hours	Marks
1	<p><b>Conduction</b>  <b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Derive equations to calculate rate of heat transfer through flat wall, cylinder &amp; sphere</li> <li>➤ Calculate rate of heat transfer through flat wall, cylinder &amp; sphere</li> </ul> <p><b>Content:</b></p> <p>1.1 <span style="float: right;">08 Marks</span></p> <ul style="list-style-type: none"> <li>• Modes of heat transfer - definition with examples</li> <li>• Fourier's law - statement, mathematical expression</li> <li>• Thermal conductivity - definition, relation with temperature</li> <li>• Description of steady state conduction</li> <li>• Derivation of rate of heat flow by conduction through rectangular block, composite wall &amp; numericals</li> </ul> <p>1.2 <span style="float: right;">10 Marks</span></p> <ul style="list-style-type: none"> <li>• Derivation of rate of heat flow through cylinder, sphere &amp; numericals</li> <li>• Study of variation of thermal conductivity with temperature</li> <li>• optimum thickness of insulation - concept &amp; definition</li> </ul>	10	18
2	<p><b>Convection</b>  <b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Derive relation between film coefficient &amp; overall heat transfer coefficient</li> <li>➤ Calculate overall heat transfer coefficient &amp; area of heat transfer</li> <li>➤ Describe heat transfer coefficient in boiling liquid &amp; condensing vapour</li> </ul> <p><b>Content:</b></p> <p>2.1 <span style="float: right;">18 Marks</span></p> <ul style="list-style-type: none"> <li>• Natural &amp; forced convection – definition &amp; example</li> <li>• Film coefficient – concept, definition and unit</li> <li>• Derivation of overall heat transfer coefficient from hot fluid to cold fluid through metal wall. Effect of surface coefficient on overall heat transfer coefficient</li> <li>• Dimensional analysis for heat transfer for understanding the use of Reynold's number, prandtl number, Nusselt number and Grashoff number in calculating film coefficient</li> <li>• Calculating heat transfer coefficient in laminar &amp; turbulent flow by Dittus –Bolter &amp; Sider Tate equation</li> </ul> <p>2.2 <span style="float: right;">18 Marks</span></p> <ul style="list-style-type: none"> <li>• Co-current &amp; counter current heat flow- concept, schematic representation &amp; comparison</li> <li>• Concept of Log Mean Temp. Difference, derivation &amp; numericals based on this</li> <li>• Boiling – definition of saturated pool boiling, boiling curve, study of film boiling, nucleate boiling &amp; transition boiling</li> <li>• Condensation – definition,</li> </ul>	14	36

	Dropwise & filmwise condensation – definition & relative merits & demerits, effect of vertical & horizontal heat transfer surface on heat transfer coefficient		
3	<p><b>Radiation</b>  <b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Describe basic laws of radiation</li> <li>➤ Calculate rate of heat radiated between two surfaces</li> </ul> <p><b>Content:</b></p> <ul style="list-style-type: none"> <li>• Radiation- Definition &amp; examples</li> <li>• Definition of absorptivity, reflectivity and transmissivity</li> <li>• Laws of radiation- statement &amp; mathematical expression of Plank's Law, Wien's displacement law, Stefan Boltzman law</li> <li>• Definition, mathematical expression &amp; description of Kirchoff's law</li> <li>• Mathematical expression for rate of radiation between two surfaces, numericals based on that</li> <li>• Definition of black body, Gray body, emissivity, Emissive power</li> </ul>	03	08
4	<p><b>Heat Transfer Equipment</b>  <b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Draw different types of heat exchanger</li> <li>➤ Compare single &amp; multipass heat exchangers</li> <li>➤ calculate area of heat exchangers</li> </ul> <p><b>Content:</b></p> <ul style="list-style-type: none"> <li>• Different heat transfer equipment in chemical industry- names &amp; uses</li> <li>• Double pipe Heat Exchangers- Diagram, construction, working</li> <li>• Shell &amp; Tube Heat Exchanger- Diagram, construction, working of different types</li> <li>• Single pass &amp; multipass heat exchangers- Working &amp; comparison</li> <li>• Diagram of 1-2 &amp; 2-4 heat exchanger</li> <li>• Graphite Block heat exchanger - Diagram, construction, working</li> <li>• Extended Surface heat exchanger - Diagram, construction, working</li> <li>• Scrapped Surface heat exchanger - Diagram, construction, working</li> <li>• Plate type heat exchanger - Diagram, construction, working</li> </ul>	10	16
5	<p><b>Evaporation</b>  <b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Describe working of different evaporators</li> <li>➤ Distinguish between single effect &amp; multiple effect evaporator</li> <li>➤ Calculate area of heat transfer in single effect evaporator</li> </ul> <p><b>Content:</b></p> <p>5.1 12 Marks</p> <ul style="list-style-type: none"> <li>• Definition of evaporation, comparison of Evaporation &amp; Drying</li> <li>• Statement &amp; effects of properties that influences evaporation</li> </ul>	11	22



	<ul style="list-style-type: none"> <li>• Definition &amp; description of capacity &amp; economy of evaporator, methods to improve economy</li> <li>• Feeding of multiple effect evaporator – description &amp; diagram</li> <li>• Mechanical &amp; thermal recompression description &amp; diagram</li> </ul>		
5.2	10 Marks		
	<ul style="list-style-type: none"> <li>• Material &amp; enthalpy balance for single effect evaporator, numericals based on this topic to calculate area of evaporator</li> <li>• Detailed study of construction, working, diagram &amp; application of open pan evaporator, Horizontal tube evaporator, Vertical tube evaporator, Long tube vertical evaporator, forced circulation evaporator</li> </ul>		
<b>Total</b>		<b>48</b>	<b>100</b>

**Practicals:**

Skills to be developed:

**Intellectual Skills:**

- To calculate the Physical property (thermal conductivity) of material.
- To calculate the rate of heat flow through different materials.
- To calculate the overall heat transfer coefficient.

**Motor Skill:**

- To operate different types of heat exchange.
- To control the operating parameters of heat exchange.

**List of Practicals:**

- To find the thermal conductivity of material at different temperatures.
- To calculate the rate of heat loss through composite wall.
- To calculate the overall heat transfer coefficient for finned tube heat exchanges.
- To calculate the overall heat transfer coefficient for shell and tube heat exchanges.
- To calculate the overall heat transfer coefficient for double pipe heat exchanges for co-current flow.
- To calculate the overall heat transfer coefficient for double pipe heat exchanges for counter current flow.
- To calculate the emissivity of a material.
- To calculate heat transfer coefficient for natural convection.
- Measures various parameters controlled in a heat exchanger using process simulator.
- To calculate Heat Transfer coefficient for forced convection.

**Learning Resources:****Books:**

Sr. No.	Name of Book	Name of Author	Name of Publisher
1	Introduction to Chemical Engg.	Mr. Walter L. Badger & Mr. Julius T. Bachero	Mc Graw Hill International.
2	Unit Operations of Chemical Engineering	McCabe, W. L. Smith & Harriot.	Mc Graw Hill International.
3	Process Heat Transfer	Kern D. Q.	Mc Graw Hill International.
4	Solved problems in mass and heat transfer	G. K. Roy	Khanna Publication

**Course Name : Diploma in Chemical Engineering****Course Code : CH****Semester : Fifth****Subject Title : Chemical Process Instrumentation and Control****Subject Code : 17561****Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	--	02	03	100	50#	--	25@	175

**NOTE:**

- Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.
- Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).

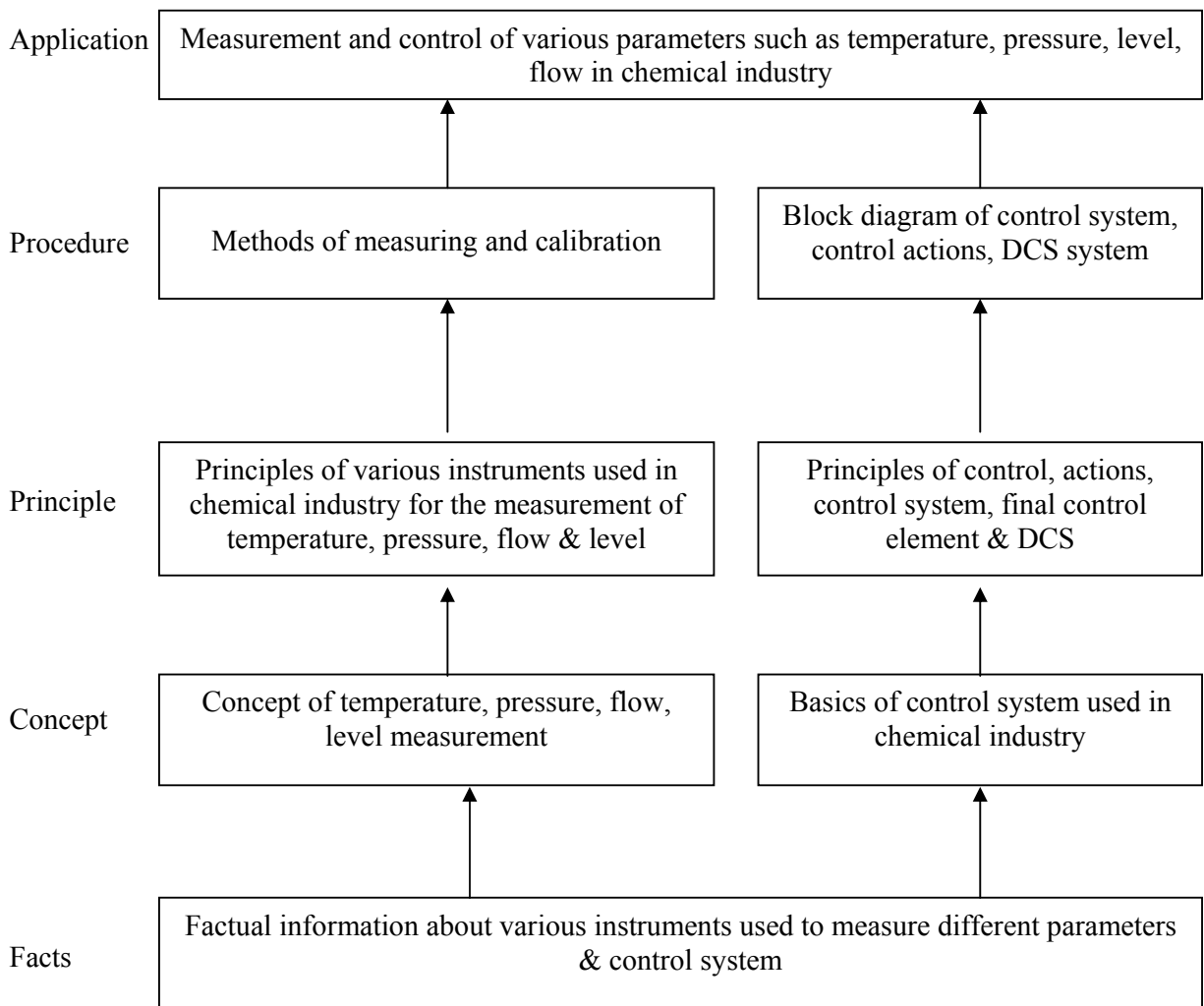
**Rationale:**

Monitoring and control of processes is an important activity of Chemical Engineer. The subject deals with measurement principles of process parameters like temperature, pressure, level, flow, etc. With knowledge of this subject student will be able to control the process parameter as per the desired value for the optimization of the process. The subject also gives exposure to the PID control action and control system like DCS, PLC.

**General Objectives:****The students will be able to -**

1. Understand the principles & working of different measuring instrument.
2. Select proper instrument for measuring desired parameters.
3. Calibrate and Maintain process control elements.
4. Use Controllers, PLC & DCS in process Industry.

**Learning Structure:**



**Theory:**

Topic and Contents	Hours	Marks
<p><b>Chapter 1: Basic Concepts</b>            Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ State static and dynamic characteristics of instrument</li> <li>➤ State elements of instruments</li> </ul> <p>Contents:</p> <ul style="list-style-type: none"> <li>• Measurement and its aim</li> <li>• Functional elements - Primary, Secondary, Manipulating, data transferring</li> <li>• Static characteristics - definition of Calibration, Accuracy, Precision, Repeatability, Drift, Sensitivity, Resolution, Dead zone, Static error.</li> <li>• Dynamic Characteristics - definition of Speed of response, fidelity, lag, Dynamic error.</li> </ul>	04	04
<p><b>Chapter 2: Temperature Measurement</b>            Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ State various temperature measuring instruments</li> <li>➤ State methods of measuring temperature by using sensor</li> </ul> <p>Contents:</p> <ul style="list-style-type: none"> <li>• Temperature Scales;- Centigrade, Kelvin, Fahrenheit, Rankine Methods of Temperature Measurement.</li> <li>• Expansion Thermometer- Bimetallic thermometer, Glass thermometer</li> <li>• Electrical temperature measuring instruments- RTD, thermocouple &amp; Thermistor</li> <li>• Pyrometer- Optical &amp; Radiation</li> </ul>	06	12
<p><b>Chapter 3: Pressure Measurement</b>            Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Determine pressure in different units.</li> <li>➤ State various pressure measuring instrument</li> <li>➤ Measure pressure using pressure measuring device</li> </ul> <p>Contents:</p> <ul style="list-style-type: none"> <li>• Units of Pressure</li> <li>• Methods of Pressure Measurement</li> </ul> <p>Elastic Pressure Transducer - Bourdon tube, Bellows, Diaphragm            Force-balance Pressure Gauges - Dead weight tester,            Electrical Pressure Transduce - Strain gauge, , LVDT            Measurement of Vacuum - McLeod gauge</p>	08	14
<p><b>Chapter 4: Level Measurement</b>            Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Know various level measuring instrument</li> <li>➤ Measure level using level measuring instruments</li> </ul> <p>Contents:</p> <ul style="list-style-type: none"> <li>• Methods of Liquid level Measurement</li> </ul> <p>Direct Methods: Sight Glass, Float            Indirect Methods: Pressure gauge, Air purge, Radioactive, Ultrasonic, Capacitive.</p> <ul style="list-style-type: none"> <li>• Solid level Measurement.</li> </ul>	06	12
<p><b>Chapter 5: Flow Measurement</b>            Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ State various flow measuring instrument</li> <li>➤ Measure flow using flow measuring device</li> </ul>	06	16

<p>Contents: Method of flow measurement</p> <ul style="list-style-type: none"> <li>• Inferential Flow Measurement</li> </ul> <p>Variable head- flow nozzles, Variable area- Piston type, Magnetic meter, Turbine meter Ultrasonic flow meter</p> <p>Quantity Flow meter:</p> <ul style="list-style-type: none"> <li>• Positive displacement meters- Rotating vane meter,</li> <li>• Mass Flow meters: Thermal flow meter.</li> </ul>		
<p><b>Chapter 6: Process Control System &amp; Controller</b> Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ State concepts of control system</li> <li>➤ State effect of control action on parameter such as temperature, pressure, level, flow etc.</li> </ul> <p>Contents: Open, closed loop system, cascade control system. Servo &amp; Regulatory operation. Definition of system - input step, ramp, sinusoidal, pulse. Selection of Control Action -On-Off, proportional, integral, derivative. Construction and working of Pneumatic Controllers - P, PI, PD, PID</p>	08	14
<p><b>Chapter 7: Control Valve</b> Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ State control valves &amp; understand control valve</li> <li>➤ Select control valve for particular application</li> </ul> <p>Contents :</p> <ul style="list-style-type: none"> <li>• Types of control valve – air to open, air to close</li> <li>• Valve characteristics.- Linear, Equal %, Quick opening</li> <li>• Valve types- single seated, Double seated</li> <li>• Valve actuators.</li> <li>• Valve selection and sizing.</li> </ul>	06	14
<p><b>Chapter 8: Computer-Aided Measurement &amp; Control System</b> Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ State concepts of computer aided control system</li> <li>➤ State applications of PLC, DCS</li> </ul> <p>Contents: Elements of computer-aided measurement and control. Computer aided process control Architecture - Distributed Digital Control Architecture. Computer- aided process control hardware. Programmable Logic controller (PLC) Architecture. Distributed Control System (DCS) Architecture.</p>	04	14
<b>Total</b>	<b>48</b>	<b>100</b>

**Practical:****Skills to be developed:****Intellectual Skills:**

To verify the principles, laws, using given measuring instruments under different conditions.

- To read and interpret the graph.
- To interpret the results from observations and calculations.

**Motor Skills:**

- Proper handling of measuring devices.
- Measuring physical quantities accurately.
- To observe the phenomenon and to list the observations in proper tabular form.
- To adopt proper procedure while performing the experiment.
- To plot the graphs.

**List of Practicals:**

- 1) Measurement of temperature using thermocouple or RTD or thermistor and to find their characteristics.
- 2) Measurement of high temperature using radiation or optical pyrometer
- 3) Measurement of pressure using LVDT
- 4) Calibrate pressure gauge using Dead Weight Tester
- 5) Measurement of flow using magnetic flow meter or ultrasonic flow meter or rotating vane flow meter or turbine wheel flow meter.
- 6) Determine the characteristics of ON- OFF or proportional or proportional integral or proportional derivative or proportional integral derivative controller.
- 7) Determine the characteristics of control valve.
- 8) Industrial visit to study DCS/ PLC.
- 9) To measure liquid level by using air purge method or capacitance method.
- 10) Measurement of pressure using strain gauge transducer.

**Learning Resources:****Books:**

Sr. No.	Author	Title	Publisher
1.	Industrial Instrumentation and control	S. K. Singh	Tata McGraw Hill Publishing Company Ltd.
2.	Instrumentation	Franklyn Kirk & Nicholas Rimboi	D. B. Taraporevala Sons & Co Private Ltd
3.	Industrial control and Instrumentation	W. Bolten	Universities Press (India) Ltd
4.	Process control	Coughner	McGraw Hill Publishing Company Ltd
5.	Fundamentals of Industrial Instrumentation	Barua	Wiley India Pvt. Ltd.

**Course Name : Diploma in Chemical Engineering**

**Course Code : CH**

**Semester : Fifth**

**Subject Title : Chemical Reaction Engineering**

**Subject Code : 17562**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	01	--	03	100	--	--	--	100

**NOTE:**

- Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.
- Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).

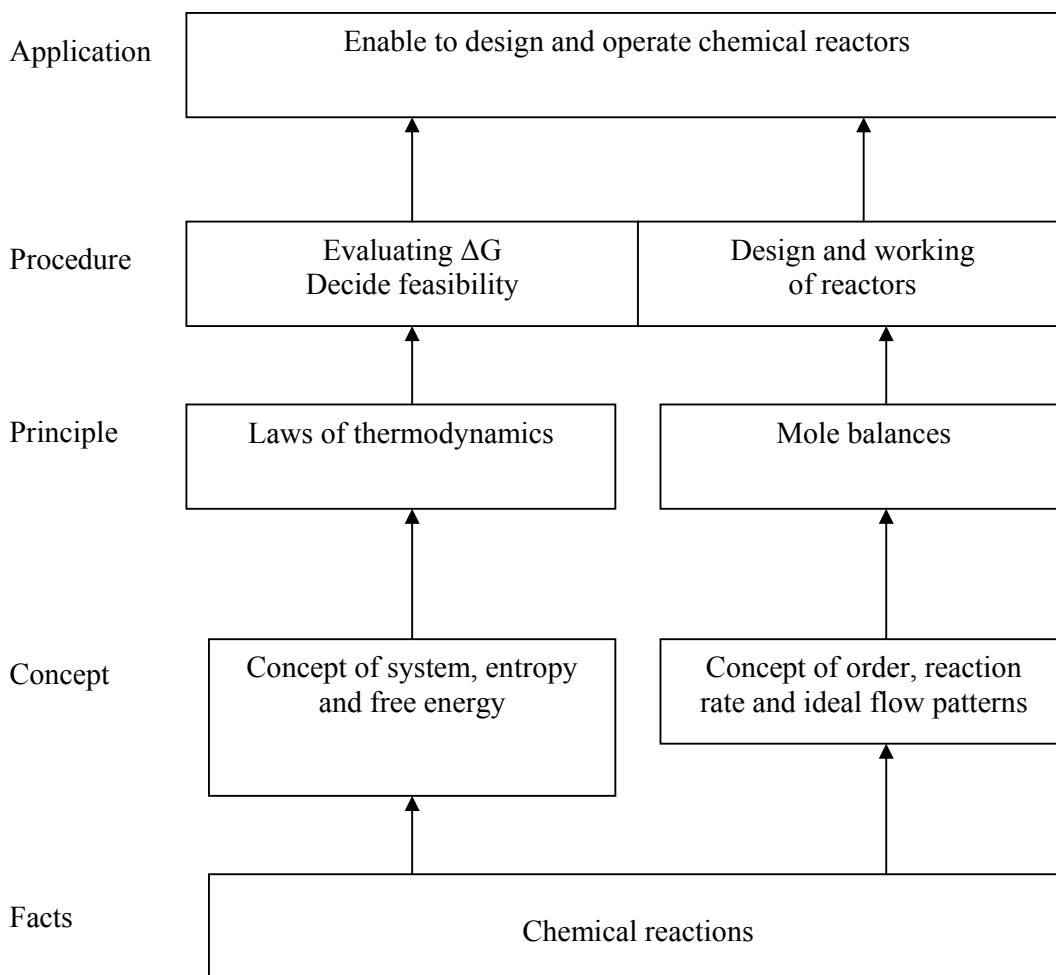
**Rationale:**

This subject outlines the basic principles of kinetics, reactor design and its selection. These principles are useful in operating the reactors in the industries. This subject enables students to have an idea about various types of reactors and catalyst used in the process industry.

**General Objectives:**

Students will be able to

1. Decide the feasibility of a chemical reaction.
2. Understand the fundamentals of reactor design and specific applications of different types of chemical reactors.

**Learning Structure:**



**Theory Content:**

Chapter No.	Topic and Contents	Hours	Marks
01	<p><b>Topic 1 : Thermodynamics</b></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Understand effect of process parameters on extent of reaction.</li> <li>➤ Decide the feasibility of a chemical reaction</li> </ul> <p>Contents:</p> <p>1.1 (12 Marks)</p> <ul style="list-style-type: none"> <li>• Internal energy, enthalpy, entropy, Gibbs free energy chemical potential and fugacity – definitions and notation.</li> <li>• Entropy changes for ideal gas processes and phase change.</li> <li>• Gibbs free energy change and the feasibility of a chemical reaction from free energy change.</li> <li>• Relationship between <math>\Delta G</math> and <math>K</math> and its derivation.</li> <li>• Chemical equilibrium, its characteristics <math>K_f</math>, <math>K_p</math>, <math>K_c</math> and <math>K_y</math> and the relationship among them.</li> <li>• Vant Hoff equation and variation of equilibrium constant with temperature.</li> <li>• To obtain the relationship between conversion and thermodynamic equilibrium constant for first order and second order reversible reaction.</li> </ul> <p>1.2 Numericals on entropy change for ideal gas processes, <math>K_p</math>, <math>K_c</math> and <math>K_y</math>. (06 Marks)</p>	14	18
02	<p><b>Topic 2 : Kinetics of Homogeneous Reactions</b></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ State Arrhenius law</li> <li>➤ Calculate the rate constant and activation energy</li> </ul> <p>Contents:</p> <p>2.1 (08 Marks)</p> <ul style="list-style-type: none"> <li>• Rate of reaction, rate equation/law, factors affecting the rate of reaction, classification of reactions, reaction rate, rate constant.</li> <li>• Concentration dependent term of a rate equation, elementary and non-elementary reactions, molecularity and order of reaction, chain and non-chain reactions.</li> <li>• Types of intermediate in non-chain reactions.</li> </ul> <p>2.2 Temperature dependency of rate constant based on</p> <ul style="list-style-type: none"> <li>• Arrhenius theory</li> <li>• Collision state theory</li> <li>• Transition state theory</li> </ul> <p>Comparison of different theories (06 Marks)</p> <p>2.3 Problem based on Arrhenius' law – calculation of <math>k</math> and <math>E</math> and rate of reaction. (08 Marks)</p>	08	22
03	<p><b>Topic 3 : Interpretation of Batch reactor data</b></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Analyse the kinetic data</li> <li>➤ Derive the integrated rate expressions for different order</li> </ul>	12	24

	<p>reactions.</p> <ul style="list-style-type: none"> <li>➤ Find the rate expression for a given reaction</li> </ul> <p>Contents:</p> <p>3.1 (10 Marks)</p> <ul style="list-style-type: none"> <li>• Method of interpretation of kinetic data, constant-volume batch reactor, analysis of total pressure data. Differential and integral methods of analyzing kinetic data.</li> <li>• Integral method of analysis of data, integrated rate equations for zero order, first order and second order irreversible reactions and first order reversible reaction in term of concentration and conversion.(constant volume)</li> <li>• Overall order of irreversible reactions from half-life, <math>n^{\text{th}}</math> order reaction.</li> <li>• Differential method of analysis of data</li> </ul> <p>3.2 (14Marks)</p> <p>Concept of Variable volume batch reactor, fractional change in volume, integrated rate equations for zero order and first order reactions</p> <p>3.3 Concepts of autocatalytic, parallel &amp; series reactions</p>		
04	<p><b>Topic 4 : Introduction to Reactor design</b></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ State concept of ideal reactors</li> <li>➤ Derive performance equations for ideal reactors</li> <li>➤ Calculate the reactor volume for a specified conversion</li> </ul> <p>Contents:</p> <p>4.1 Types of reactors, material balance equation, relationship between <math>C_A</math> and <math>X_A</math> for constant density and changing density batch and flow systems. (04 Marks)</p> <p>4.2 Definition of Space time, Space velocity, and holding time (04 Marks)</p> <ul style="list-style-type: none"> <li>• Performance/design equations for ideal batch reactor, mixed flow reactor and plug flow reactor in terms of concentration and conversion and graphical representations</li> <li>• Size comparison of reactors, advantages and disadvantages of batch reactor, mixed flow reactor v/s plug flow reactor.</li> </ul> <p>4.3 Numericals based on the above subtopics. (12 Marks)</p> <p>4.4 Multiple reactors (04 Marks)</p>	10	24
05	<p><b>Topic 5 : Catalysis</b></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ State characteristics of catalysed reaction</li> <li>➤ Distinguish between fixed bed reactor and fluidized bed reactor</li> </ul> <p>Contents:</p> <p>5.1</p> <ul style="list-style-type: none"> <li>• Concept of Catalysis, catalyst, classification of catalytic reactions catalytic reactions/catalysis,</li> <li>• Characteristics of catalytic reactions, desired properties of catalyst</li> <li>• Methods of catalyst preparation, promoters, inhibitors and accelerators.</li> </ul>	04	12

	<ul style="list-style-type: none"> <li>Catalyst poisoning and types of catalyst poisons, deactivation and regeneration</li> <li>Steps involved in solid catalyzed gas phase reactions</li> </ul> 5.2 Fluidized bed reactors, fixed bed reactors and difference between them, their merits and demerits.		
<b>Total</b>		<b>48</b>	<b>100</b>

**List of Assignments:**

Sr. No.	Topic	No. of Hrs.
1	Introduction to chemical kinetics Numericals on Arrhenius law and activation energy	02
2	a) Numericals on unimolecular first order reaction b) Numericals on bimolecular second order reaction c) Numericals on half life d) Numericals on zero order reaction for constant volume reaction systems.	01 02 02 01
3	Introduction to reactor design (Find volume & conversion) a) Numericals on batch reactor b) Numericals on Plug flow reactor c) Numericals on mixed flow reactor	02 02 03
<b>Total</b>		<b>16</b>

**Learning Resources:****Books:**

Sr. No.	Name of Books	Name of Author	Publication
01	Chemical Reaction Engg.	Octave Levenspiel	Wiley Eastern Ltd. New Delhi
02	Elements of Chemical Engg.	H. Scott Fogler	Printice Hall of India Pvt. Ltd., New Delhi
03	Chemical Engg. Thermodynamics	Smith and Van Ness	McGraw Hill, New York
04	Chemical Engg. Thermodynamics	K.V. Narayanan	Printice Hall of India Pvt. Ltd., New Delhi
05	Chemical Engg. Kinetics	Smith J M	McGraw Hill, New York

**Course Name : All Branches of Diploma in Engineering & Technology**

**Course Code : EJ/EN/ET/EX/EV/IC/IE/IS/MU/DE/ME/PG/PT/AE/CE/CS/CR/ CO/CM/IF/  
EE/EP/CH/PS/CD/ED/EI/CV/FE/FG/IU/MH/MI/TX/TC/DC/AU**

**Semester : Fifth for EJ/EN/ET/EX/EV/IC/IE/IS/MU/DE/ME/PG/PT/AE/CE/CS/CR/  
CO/CM/IF/EE/EP/CH/PS/AU and Sixth for CD/MH/IU/CV/FE/FG/MI/  
ED/EI/DC/TC/TX**

**Subject Title : Behavioural Science**

**Subject Code : 17075**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
01	--	02	--	--	--	25 #	25 @	50

**Rationale:**

With increased globalization and rapid changing business expectations, employers are looking for wide cluster of skills to cater to the changing demand. Personality traits and soft skills are playing a key role in a student's career in this changing scenario. Corporate houses look for soft skills that supplement hard skills.

Addition of behavioural science in curriculum is intended to enhance the efficiency of a person so that he can contribute to overall growth of organisation. It aims at developing insight into leadership, team building, motivation, interpersonal relationship, problem solving, decision making and aspects of personality in a technician's profile. Addition of the topic of organizational culture will further mould him/ her in the organisational role.

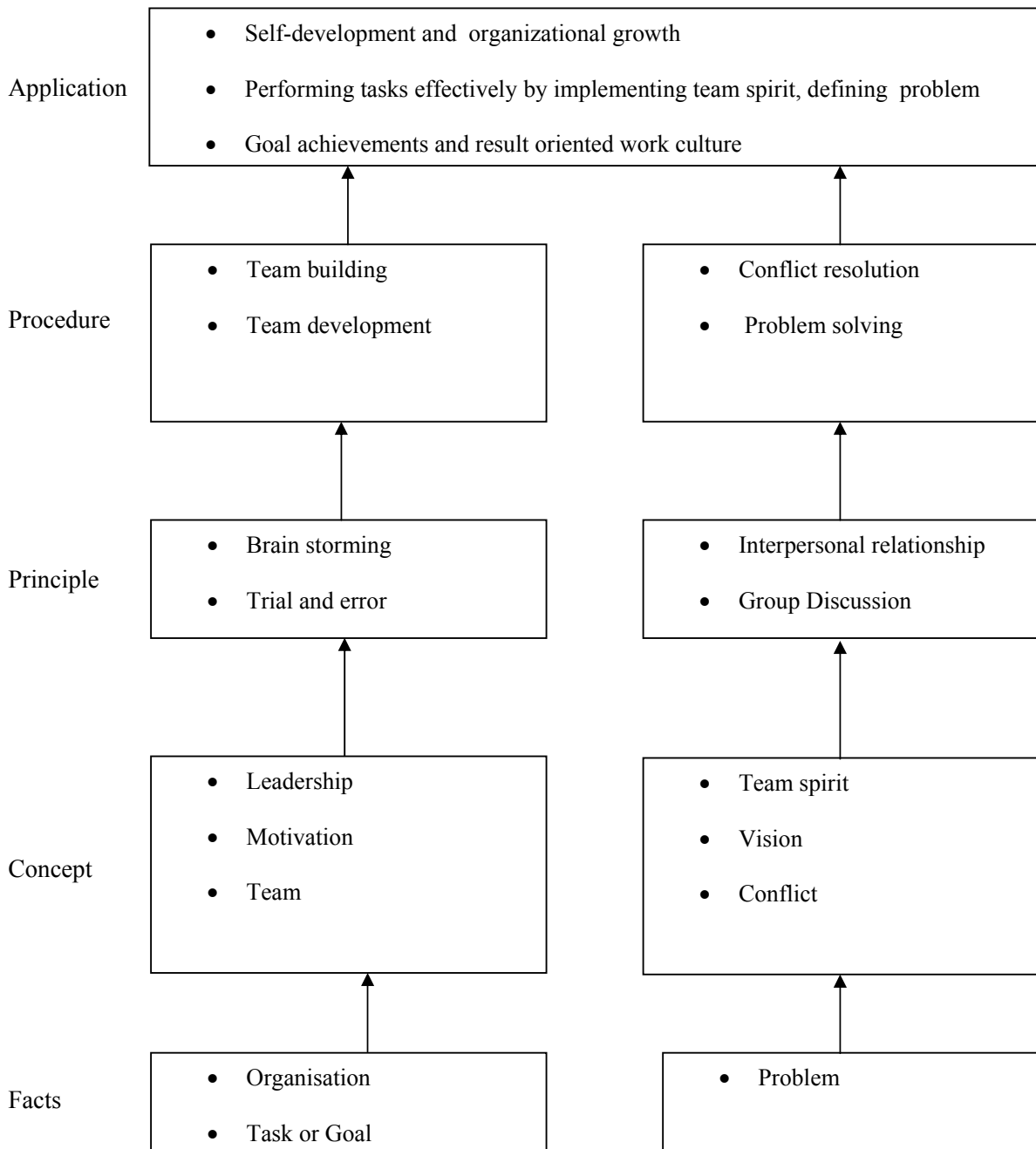
This subject of 'Behavioural Science' provides a broad base in which a technician can develop a successful career in the world of work.

**General Objectives:**

After studying this subject, the students will be able to:

1. Develop him/her as Team leader.
2. Use self-motivation and motivate others.
3. Build a team and develop team spirit among the team members.
4. Improve the interpersonal relationship skills.
5. Learn Problem solving and decision making skills.
6. Discuss a particular topic in a group and face the interview.

**Learning Structure:**



**Theory:**

<b>Topic and Contents</b>	<b>Hours</b>
<p><b>TOPIC 1: LEADERSHIP</b></p> <p>Contents:</p> <ol style="list-style-type: none"> <li>1.1 Introduction – Importance, examples of different types of leaders.</li> <li>1.2 Meaning and Definition of Leadership.</li> <li>1.3 Leadership qualities – Confidence, Vision, Communication Skills, influencing people etc.</li> <li>1.4 Types of Leadership styles, their advantages and disadvantages – Autocratic, Democratic, Delegative, Bureaucratic and Laissez Fairie.</li> </ol>	02
<p><b>TOPIC 2: MOTIVATION</b></p> <p>Contents:</p> <ol style="list-style-type: none"> <li>2.1 Meaning and Definition of motivation.</li> <li>2.2 Types of motivation.</li> <li>2.3 Maslow’s Motivation theory.</li> <li>2.4 Job characteristic model to enhance motivation.</li> </ol>	03
<p><b>TOPIC 3: TEAM BUILDING</b></p> <p>Contents:</p> <ol style="list-style-type: none"> <li>3.1 Definition of Team.</li> <li>3.2 Difference between Group and Team.</li> <li>3.3 Need for formation of good team (vision, trust, cooperation, initiative, etc.)</li> <li>3.4 Approach to Team building (Personality based, activity based, skill based, problem solving based, etc.)</li> </ol>	02
<p><b>TOPIC 4: CONFLICT RESOLUTION</b></p> <p>Contents:</p> <ol style="list-style-type: none"> <li>4.1 Definition of Conflict.</li> <li>4.2 Types of Conflict – Functional and Dysfunctional</li> <li>4.3 Sources of Conflict – Ego, Authority, Frustration etc.</li> <li>4.4 Positive and Negative effects of conflicts.</li> <li>4.5 Methods of Conflict resolution – Compromising, withdrawal, forcing.</li> </ol>	04
<p><b>TOPIC 5: PROBLEM SOLVING AND DECISION MAKING</b></p> <p>Contents:</p> <ol style="list-style-type: none"> <li>5.1 Steps in Problem Solving.</li> <li>5.2 Methods used for solving problems – trial and error method, brain storming, lateral thinking method.</li> <li>5.3 Techniques used for Decision making- Decision tree, Decision Matrix, Mind Mapping etc.</li> </ol>	03
<p><b>TOPIC 6: GROUP DISCUSSION AND INTERVIEW TECHNIQUES</b></p> <p>Contents:</p> <ol style="list-style-type: none"> <li>6.1 GROUP DISCUSSION <ul style="list-style-type: none"> <li>• Objectives of Group Discussion (ability to work in team, speaking and listening skills, leadership, creativity)</li> <li>• Does and Don’ts of Group Discussion.</li> <li>• How to conclude Group Discussion.</li> </ul> </li> </ol>	02

6.2 INTERVIEW TECHNIQUES <ul style="list-style-type: none"> <li>• Types of Interviews. (patterned, stress, behavioural)</li> <li>• Dress Code, Body Language and Communication Skill.</li> <li>• Probable questions for Interview.</li> <li>• Telephonic or Video Interview.</li> </ul>	
<b>Total</b>	<b>16</b>

**Practical:****Skills to be developed:****Intellectual Skills:**

- Develop ability to find his strengths.
- Select proper source of information.
- Follow the technique of time and stress management.
- Set the goal.

**Motor Skills:**

- Follow the presentation of body language.
- Work on internet and search for information.
- Prepare slides / transparencies for presentation.

**List of Practicals / activities:**

1. Form a group of 4 or 5 students and discuss the topic 'Qualities of an effective leader'. Each group will prepare its list with justification to the entire class and write an assignment under the guidance of subject teacher.
2. Form a pair of student and each one from pair will ask each other questionnaire on motivation, self-motivation, experiences that motivated him or other which him for success in the past and write an assignment under the guidance of subject teacher based on discussion.
3. Form a group of 4 or 5 students and assign them a group activity such as 'making a shape from match stick (50 to 100 match sticks) without guidance and without group discussion.
4. The group as in activity 3 will now perform the same activity. After group discussion and under guidance of subject teacher, each student from a group will write an assignment for both the activities and write their inferences with reference to group discussion, team development, team building, etc.
5. Form a group of 8 to 10 student and arrange a group activity such as;
  - Industrial visit.
  - Visit to any historical place/fort/museum, etc
  - Housekeeping and cleaning of any laboratory/seminar hall for any function.

After the execution of activity student will write an assignment under guidance of teacher keeping in mind individual role, purpose of activity, inter dependency of work or task, coordination of person and task involved and final performance.
6. Write an assignment on interpersonal relationship and conflict management with student's personal experience of solving conflicts.
7. Form a group of 20 students and ask them to prepare a list of 8 to 10 problems affecting the institute. Subject teacher should analyze one such problem on black board using 'Fish bone technique' with the participation of students. Students will write an assignment consisting;
  - Apparent problem statement.
  - Analysis of the causes.

- Definition of real problem.
8. The subject teacher starts the session with 'Statement of the problem' written on the black board. After ensuring that all the participants are at the same level of understanding the statement of problem, he initiates NGT (Normal Group Technique) to arrive at maximum possible number of creative solutions.  
Based on ranking matrix the group will arrive at feasible solutions and students will write an assignment consisting of;
    - Problem Statement.
    - Model of problem solving.
    - List of creative solution suggested by participants.
    - Write the most feasible solution based on given criteria.
  9. Form a group of 4 to 5 students and give them a topic for GD for 10 to 15 minutes. Teacher should analyse GD on certain parameters and students will write an assignment on aspects of GD and prepare a format (suggested or designed by teacher) which gives details of GD carried out.
  10. Arrange a guest lecture of H.R. Person from industry/expert in interview technique and conduct mock interview of each student. Student should write a report on this activity.
  11. Arrange a visit to industry and gather information about organisation, product, turnover, work culture, vision/mission statement, quality policy, Corporate social responsibility etc and write a report on it.

**Note - Subject teacher shall guide the students in completing the assignments based on above practicals.**

#### Learning Resources:

##### Books:

Sr. No.	Author	Name of Book	Publication
1	Subject Experts-MSBTE	Handbook and assignment book on Development of Life Skills-II	MSBTE
2	Dr. Kumkum Mukherjee	Principles of management and organizational behaviour	Tata McGraw Hill Education Pvt Ltd.
3	Dr.T.Kalyana Chakravarti Dr.T.Latha Chakravarti	Soft Skills for Managers	Biztantra
4	Barun K Mitra	Personality Development and soft skills	Oxford University Press
5	Priyadarshini Patnaik	Group discussion and interview skills	Foundation Books



**Course Name : Diploma in Chemical Engineering****Course Code : CH****Semester : Fifth****Subject Title : Entrepreneurship Development and Industrial Project****Subject Code : 17073****Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
01	01	02	--	--	--	--	25@	25

**Rationale:**

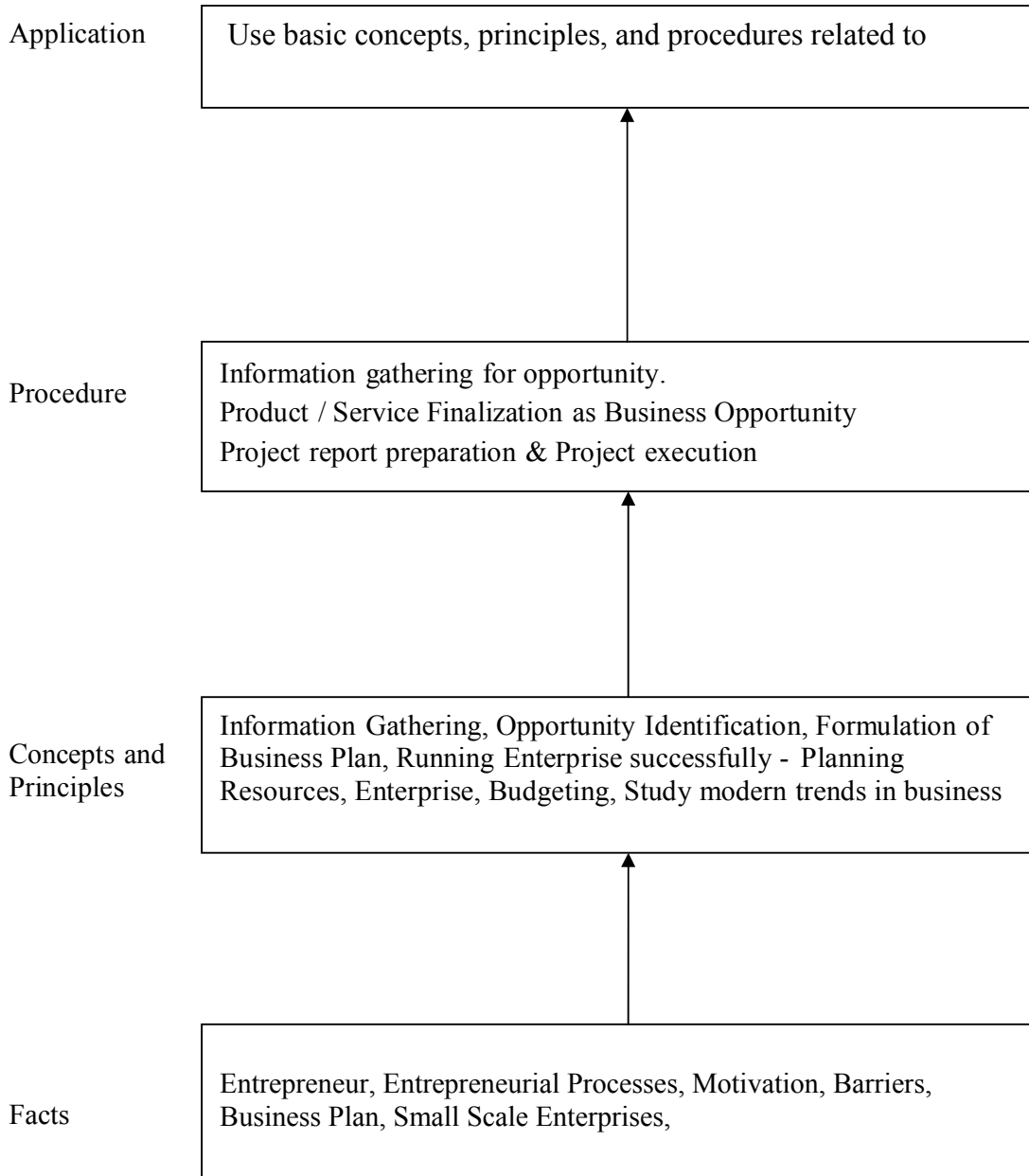
Globalization, liberalization & privatization along with revolution in Information Technology, have thrown up new opportunities that are transforming lives of the masses. Talented and enterprising personalities are exploring such opportunities & translating opportunities into business ventures such as- BPO, Contract Manufacturing, Trading, Service sectors etc. The student community also needs to explore the emerging opportunities. It is therefore necessary to inculcate the entrepreneurial values during their educational tenure. This will help the younger generation in changing their attitude and take the challenging growth oriented tasks instead of waiting for white-collar jobs. This subject will help in developing the awareness and interest in entrepreneurship and create employment for others.

**Objectives:**

Students will be able to

- 1) Identify entrepreneurship opportunity.
- 2) Acquire entrepreneurial values and attitude.
- 3) Use the information to prepare project report for business venture.
- 4) Develop awareness about enterprise management.

**Learning Structure:**



**Topics:**

<b>Topic</b>	<b>Name of Topic</b>	<b>Hours</b>
01	<b>Entrepreneurship, Creativity &amp; Opportunities</b> <ul style="list-style-type: none"> <li>• Concept, Classification &amp; Characteristics of Entrepreneur</li> <li>• Creativity and Risk taking, Risk Situation, Types of risk &amp; risk takers.</li> <li>• Business Reforms.</li> <li>• Process of Liberalization.</li> <li>• Reform Policies.</li> <li>• Impact of Liberalization.</li> <li>• Emerging high growth areas.</li> <li>• Business Idea Methods and techniques to generate business idea.</li> <li>• Transforming Ideas in to opportunities transformation involves</li> <li>• Assessment of idea &amp; Feasibility of opportunity</li> <li>• SWOT Analysis</li> </ul>	03
02	<b>Information and Support Systems</b> <ul style="list-style-type: none"> <li>• Information Needed and Their Sources:</li> <li>• Information related to project, Information related to support system, Information related to procedures and formalities</li> <li>• Support Systems</li> <li>• Small Scale Business Planning, Requirements.</li> <li>• Govt. &amp; Institutional Agencies, Formalities</li> <li>• Statutory Requirements and Agencies.</li> </ul>	02
03	<b>Market Assessment</b> <ul style="list-style-type: none"> <li>• Marketing -Concept and Importance</li> <li>• Market Identification, Survey Key components</li> <li>• Market Assessment</li> </ul>	02
04	<b>Business Finance &amp; Accounts</b> <ul style="list-style-type: none"> <li>➤ Business Finance <ul style="list-style-type: none"> <li>• Cost of Project</li> <li>• Sources of Finance</li> <li>• Assessment of working capital</li> <li>• Product costing</li> <li>• Profitability</li> <li>• Break Even Analysis</li> <li>• Financial Ratios and Significance</li> </ul> </li> <li>➤ Business Account <ul style="list-style-type: none"> <li>• Accounting Principles, Methodology</li> <li>• Book Keeping</li> <li>• Financial Statements</li> <li>• Concept of Audit</li> </ul> </li> </ul>	03

05	<p><b>Business Plan &amp; Project Report</b></p> <ul style="list-style-type: none"> <li>• Business plan steps involved from concept to commissioning Activity Recourses, Time, Cost</li> <li>• Project Report</li> <li>• Meaning and Importance</li> <li>• Components of project report/profile (Give list)</li> </ul> <p><b>5.3) Project Appraisal</b></p> <ol style="list-style-type: none"> <li>1) Meaning and definition</li> <li>2) Technical, Economic feasibility</li> <li>3) Cost benefit Analysis</li> </ol>	03
06	<p><b>Enterprise Management And Modern Trends</b></p> <ul style="list-style-type: none"> <li>➤ Enterprise Management: <ul style="list-style-type: none"> <li>• Essential roles of Entrepreneur in managing enterprise</li> <li>• Product Cycle: Concept and importance</li> <li>• Probable Causes Of Sickness</li> <li>• Quality Assurance: Importance of Quality, Importance of testing</li> <li>• E-Commerce: Concept and Process</li> </ul> </li> <li>➤ <b>Global Entrepreneur</b> <ul style="list-style-type: none"> <li>• Assess yourself-are you an entrepreneur?</li> <li>• Prepare project report and study its feasibility</li> </ul> </li> </ul>	03

**List of Assignments:**

1. Write the SWOT Analysis required for an successful entrepreneur.
2. Collect the required information, formalities and supporting systems for starting a small scale business.
3. Collect information regarding key parameters required for market analysis of an electrical industry.
4. Search for current available sources of finance to start a new business and write a report.
5. Write a report on different accounting methods, financial statements and audit.
6. Write a report on preparing a good business plan.
7. Collect information on E-commerce system and write a report on how it is useful for entrepreneurs.
8. Prepare a report on how to become a successful entrepreneur?

**Learning Resources:****1) Books:**

Sr. No	Author	Title	Publisher
1	J.S. Saini B.S.Rathore	Entrepreneurship Theory and Practice	Wheeler Publisher, New Delhi
2	Prepared by Colombo plan staff college for Technician Education.	Entrepreneurship Development	Tata McGraw Hill Publishing Co. Ltd. New Delhi.

3	J. B. Patel D. G. Allampally	A Manual on How to Prepare a Project Report	EDI STUDY MATERIAL Near Village Bhat, Via Ahmadabad Airport & Indira Bridge, P.O. Bhat 382428, Gujrat, India P.H. (079) 3969163, 3969153
4	Gautam Jain Debmuni Gupta	New Initiatives in Entrepreneurship Education & Training	E-mail : <a href="mailto:ediindia@sancharnet.in">ediindia@sancharnet.in</a> <a href="mailto:olpe@ediindia.org">olpe@ediindia.org</a> Website : <a href="http://www.ediindia.org">http://www.ediindia.org</a>
5	Schaper, Michael Volery	Entrepreneurship- Small Business	Wiley India,2011
6	Alpana, Trehan	Entrepreneurship	Dreamtech, 2011

## 2) Video Cassettes:

No	Subject	Source
1	Five success Stories of First Generation Entrepreneurs	EDI STUDY MATERIAL Ahmadabad (Near Village Bhat , Via Ahmadabad Airport & Indira Bridge), P.O. Bhat 382428 , Gujrat,India P.H. (079) 3969163, 3969153 E-mail : <a href="mailto:ediindia@sancharnet.in">ediindia@sancharnet.in</a> <a href="mailto:olpe@ediindia.org">olpe@ediindia.org</a> Website : <a href="http://www.ediindia.org">http://www.ediindia.org</a>
2	Assessing Entrepreneurial Competencies	
3	Business Opportunity Selection and Guidance	
4	Planning for Completion & Growth	
5	Problem Solving-An Entrepreneur Skill	

## PART B) Industrial Project

Following activities related to project are required to be dealt with, during this semester

1. Form project batches & allot project guide to each batch. (Max. 4 students per batch)
2. Each project batch should select topic / problem / work by consulting the guide & / or industry. Topic / Problem / work should be approved by Head of department.
3. Each project batch should prepare action plan of project activities & submit the same to respective guide.
4. At the end of semester, each project batch should submit the action plan and abstract of the project along with list of materials required if project involves fabrication or other facilities required in other kinds of project.
5. Action Plan should be part of the project report.
6. Each group member shall write assignments on the action plan prepared for the project for this semester (half of the project work). The assessment of the assignments will be considered for next semester as a total term work.

Group	Project
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**Course Name : Diploma in Chemical Engineering****Course Code : CH****Semester : Fifth****Subject Title : Professional Practices-III****Subject Code : 17074****Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
--	--	03	--	--	--	--	50@	50

**Rationale:**

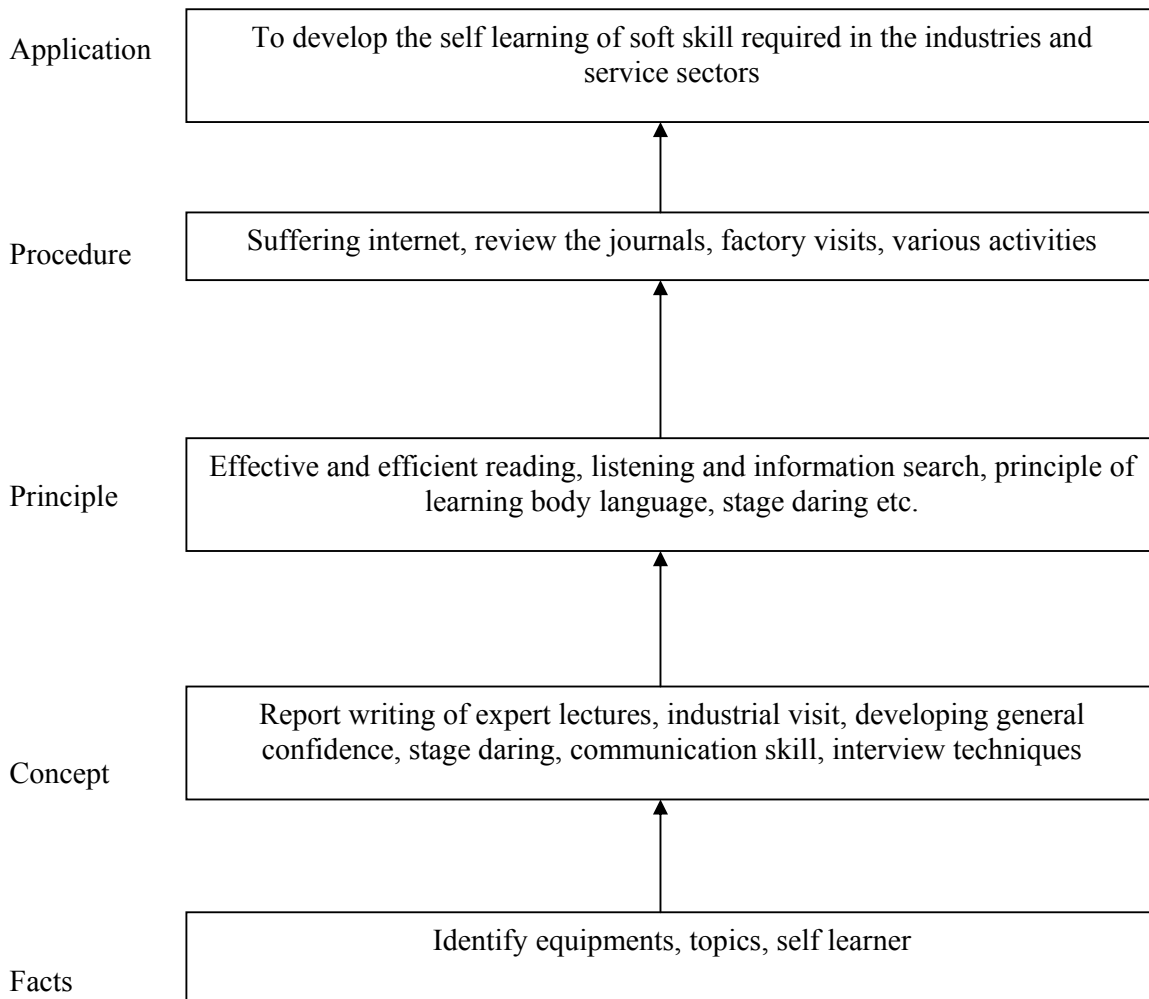
Due to globalization and competition in industrial services, sectors, selection of candidates for job is based on campus interview and competitive test.

While selecting the candidates in general confidence, ability to communicate attitudes are the basic concepts.

The purpose of introducing subject of professional practice is to provide the opportunity for student to undergo various objectives so as to develop his confidence and communication skills. Industrial visits, group discussions, seminar presentations, expert lectures are introduced in the subject to provide maximum participation of students in learning process.

**General Objectives:****Students will be able to:**

1. Acquire information and data of different industries
2. Deliver the information and knowledge required to develop awareness about latest trends in chemical industries.
3. Present seminar on selected topic.
4. Prepare report on industrial visit.

**Learning Structure:****Guidelines for implementing professional practices**

- In order to implement contents of professional practice effectively it is necessary for the department to plan the activities for full semester. Minor modifications may be done if required. Following are guidelines for the same.
- Activities to be guided and monitored by the faculty of the concerned department only.
- Involve students in related activities to a great extent to develop learning to learn skills.
- Arrange industrial visits and expert lectures on convenient days. Periods of PP may be allocated to concerned faculty members whose periods may be lost.
- Ensure to carry out all activities suggested.

**Practical:**

<b>Contents</b>	<b>Hours</b>
<p><b>1. Industrial Visits</b>            Industrial visits to be arrange and report of same should be submitted by individual student as a part of term work.            Visit any two chemical industries available such as</p> <ol style="list-style-type: none"> <li>a. Dairy industry</li> <li>b. Sugar industry</li> <li>c. Starch industry</li> <li>d. paper industry</li> <li>e. Petro chemical industry</li> <li>f. Solvent – Extraction plant</li> </ol> <p>Revalent content of report            Manufacturing process, it's flow diagram, various instruments used for measurement of temperature, pressure, flow, level. Their types and ranges.            Type of equipments used in manufacturing processes such as heat exchanger, reactor, dryer, distillation column, extractor, absorber, boiler, cooling tower and effluent treatment arrangement in industries.</p>	16
<p><b>2. Seminar Presentation</b>            Student should present a seminar on a topic given below or any other topic given by lecturer or topic related to industrial visit.</p> <ol style="list-style-type: none"> <li>a. Dairy industry – Pastuerasation of milk, drying process of milk powder.</li> <li>b. Sugar industry – crystallization of sugar, alcohol from molasses</li> <li>c. Starch industry – Dextrose, glucose, corn oil manufacturing</li> <li>d. Petrochemical industry – Fractional distillation process, Automatic controls in distillation column, storage of petrochemical chemicals, safety procedure used in petrochemical industries.</li> <li>e. Solvent extraction plant – Extraction process, recovery of solvent</li> </ol> <p>The report should be written and submitted individually in advance in a specific format before seminar and it should be presented in 10 min.</p>	12
<p><b>3. Group Discussion</b>            Students should discuss in a group of 8 – 10 to be monitored by faculty member. The student should have to write a brief report on the same and submit it as a term work.            Topics such as given below or topic selected by concern teacher</p> <ol style="list-style-type: none"> <li>a. Effect of chemical industries waste on global warming</li> <li>b. Benefits of energy audit of industries</li> <li>c. Effect of global warming and recent effort to control global warming</li> <li>d. Renewable energy sources</li> </ol>	14
<p><b>4. Expert Lecturers</b>            Minimum two expert lectures based on chemical engg. field to be arranged. Report prepared by individual student and submitted to the concern teacher as a part of term work. Topics selected by expert lecturer or topic such as given below</p> <ol style="list-style-type: none"> <li>a. Safety in Petrochemical industry</li> <li>b. Waste water management</li> <li>c. Recovery of energy in thermal power station</li> <li>d. Fermentation industry – It's scope and application</li> </ol>	06
<b>Total</b>	<b>48</b>



**Industrial Training (Optional)**

- Students who have completed industrial training in summer vacation after 4<sup>th</sup> Semester will be granted exemption for activities related to topic 1 to 4.
- These students shall submit report of Industrial training signed and certified by authorities from Industry. Student will give seminar on industry training attended by him.
- Evaluation will be done on seminar and report submitted by student.