


<div> MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI</div> <div>TEACHING AND EXAMINATION SCHEME FOR POST S.S.C. DIPLOMA COURSES</div>																
COURSE NAME : DIPLOMA IN FABRICATION TECHNOLOGY & ERECTION ENGINEERING																
COURSE CODE : FG																
DURATION OF COURSE : 6 SEMESTERS for FG and 8 SEMESTER for FE										WITH EFFECT FROM 2012-13						
SEMESTER : FIFTH										DURATION : 16 WEEKS						
PATTERN : FULL TIME - SEMESTER										SCHEME : G						
SR. NO	SUBJECT TITLE	Abbreviation	SUB CODE	TEACHING SCHEME			PAPER HRS.	EXAMINATION SCHEME								SW (17500)
				TH	TU	PR		TH (1)		PR (4)		OR (8)		TW (9)		
				Max	Min			Max	Min	Max	Min	Max	Min	Max	Min	
1	Design of Fabricated Structural Element	DFS	17553	04	--	02	04	100	40	--	--	25#	10	25@	10	50
2	Basic Thermodynamics	BTH	17554	03	--	02	03	100	40	--	--	--	--	25@	10	
3	Quality Control & Inspection	QCI	17555	03	--	02	03	100	40	--	--	25#	10	25@	10	
4	Advanced Manufacturing Processes β	AMP	17556	03	--	02	03	100	40	--	--	--	--	50@	20	
5	Estimation & Costing	EAC	17557	03	--	--	03	100	40	--	--	--	--	--	--	
6	Behavioural Science \$	BSC	17075	01	--	02	--	--	--	--	-	25#	10	25@	10	
7	CNC Machines β	CNC	17064	01	--	02	--	--	--	50#	20	--	--	25@	10	
8	Professional Practices-III β	PPT	17065	--	--	03	--	--	--	--	--	--	--	50@	20	
TOTAL				18	--	15	--	500	--	50	--	75	--	225	--	50
Student Contact Hours Per Week: 33 Hrs.																
THEORY AND PRACTICAL PERIODS OF 60 MINUTES EACH.																
Total Marks : 900																
@ - Internal Assessment, # - External Assessment, <div></div> No Theory Examination, \$ - Common to all branches, β - Common to ME / PG / PT/ MH / MI/FG/FE																
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 Fabrication Technology & Erection Engineering****Course Code : FE/FG****Semester : Fifth for FG and Sixth for FE****Subject Title : Design of Fabricated Structural Element****Subject Code : 17553****Teaching and Examination Scheme**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
04	--	02	04	100	--	25#	25@	150

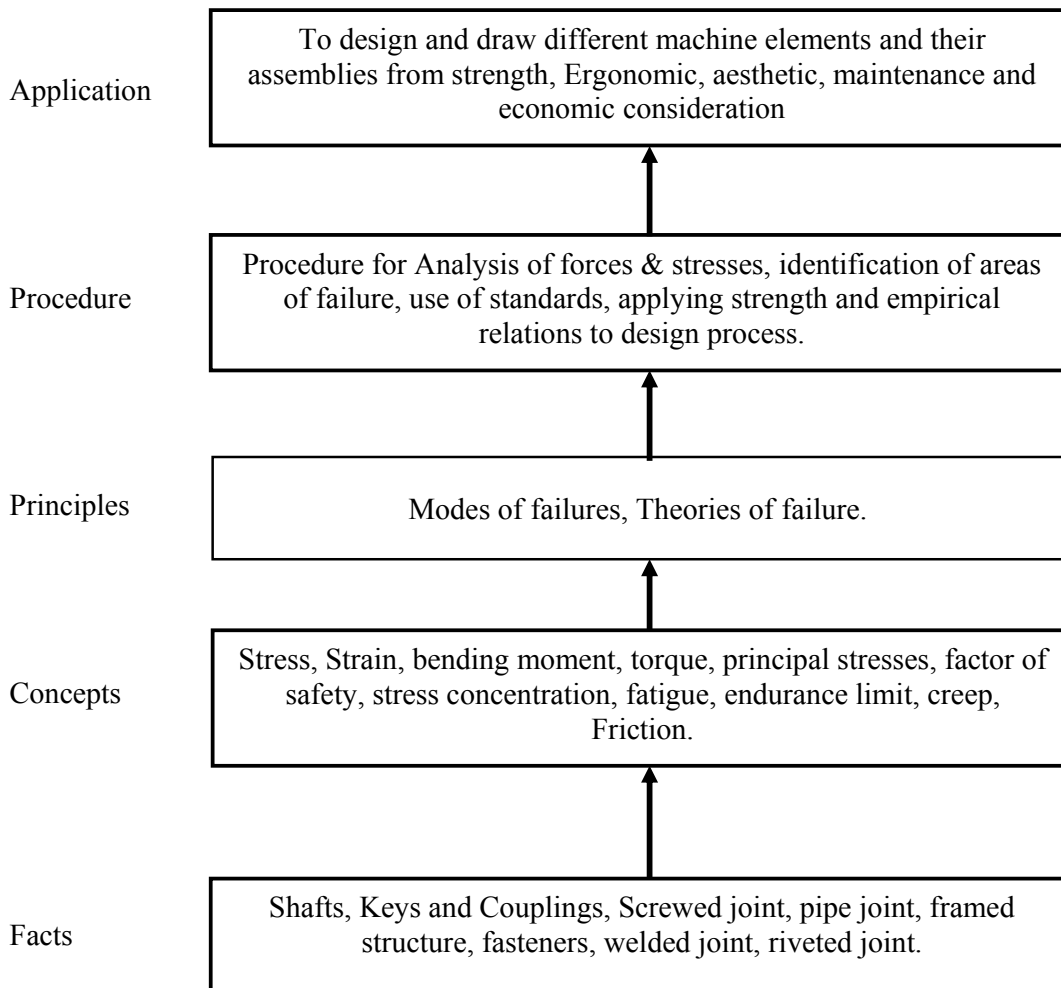
**Rationale:**

It is an Applied Technology subject. A diploma holder is expected to design and draw simple machine components used in small and medium scale industries. Fundamental knowledge of Applied Mechanics, Strength of Materials, Engineering Materials and Theory of Machines is essential. Subject aims at developing analytical abilities & give solutions to engineering design problems.

**Objectives:**

Students should be able to:

1. Analyze the various modes of failure of machine components under different load patterns.
2. Design and prepare part and assembly drawings.
3. Use design data books and different codes of design.
4. Select standard components with their specifications from manufacturer's catalogue.
5. Select the basic manufacturing process for different components to be machined.

**Learning Structure:**

**Contents: Theory**

<b>Topic No.</b>	<b>Name of the Topic</b>	<b>Hours</b>	<b>Marks</b>
01	<b>Introduction to Design</b> Machine Design philosophy and Procedures General Considerations in Machine Design Fundamentals:- Types of loads, concepts of stress, Strain, Stress – Strain Diagram for Ductile and Brittle Materials, Types of Stresses such as Tension, Compression, Shear, Bearing pressure Intensity, Crushing, bending and torsion, Principal Stresses (Simple Numerical) Creep strain and Creep Curve Fatigue, S-N curve, Endurance Limit. Factor of Safety and Factors governing selection of factor of Safety. Stress Concentration – Causes & Remedies Converting actual load or torque into design load or torque using design factors like velocity factor, factor of safety & service factor. Properties of Engineering materials, selection of the material Designation of materials as per IS and introduction to International standards & advantages of standardization, use of design data book, use of standards in design and preferred numbers series.	08	16
02	<b>Design of Shafts, Keys and Couplings.</b> Types of Shafts, Shaft materials, Standard Sizes, Design of Shafts (Hollow and Solid) using strength and rigidity criteria, ASME code of design for line shafts supported between bearings with one or two pulleys in between or one overhung pulley Design of Sunk Keys, Effect of Keyways on strength of shaft. Design of Couplings – Muff Coupling, Protected type Flange Coupling.	10	20
03	<b>Design of Welded Joints.</b> Introduction, Advantages & disadvantages of welded joints; Design of transverse fillet weld; Design of parallel fillet weld; Axially loaded unsymmetrical welded sections	12	16
04	<b>Design of Riveted Joints</b> Methods of riveting, material of rivets, types of rivet heads, types of riveted joints, terms used in riveted joints. Caulking & fullering, failure of riveted joint, efficiency of a riveted joint. Design of longitudinal butt joint for a boiler, design of circumferential lap joint for a boiler.	10	12
05	Design of screwed joints Introduction, advantages & disadvantages of screwed joint, form of screw threads, types of screw fastening, locking devices, stresses in screw fastenings. Bolts of uniform strength, eccentric load acting parallel to the axis of the bolt, eccentric load acting perpendicular to the axis of the bolt. Design of bolts for cylinder cover.	08	12

06	<b>Design of Pipe Joints</b> Stresses in pipes, design of pipes, pipe joints. Design of circular flanged pipe joint, design of oval flanged pipe joint.	08	08
07	<b>Analysis of Framed Structures</b> Perfect frame, reactions at supports, analysis of truss, method of joints, method of sections (no graphical methods)	08	16
<b>Total</b>		<b>64</b>	<b>100</b>

**Skills to be developed:****Intellectual skills:**

1. Understand the basic philosophy and fundamentals of Machine Design
2. Apply and use the basic knowledge of earlier subjects like mechanical Engineering materials, strength of materials and theory of machines
3. Analyse and evaluate the loads, forces, stresses involved in components and subassemblies and decide the dimensions
4. Understand the modes of failures of m/c components and decide the design criteria and equations
5. Understand the concept of standardization and selecting standard components

**Motor skills:**

1. Draw the components assembly as per the designed dimensions.
2. Modify drawings and design as per requirement.
3. Use the different design software.
4. Use different design data books and IS codes.

**List of Assignments:**

1. Assignment on selection of materials & Properties of material.
2. Assignment on shaft , keys & couplings, also problem solving [one drawing sheet]
3. Assignment on welded joints & problem solving.
4. Assignment on riveted joints & problem solving.
5. Assignment on screwed joint & problem solving.
6. Assignment on pipes & pipe joints & problem solving.
7. Assignment on framed structure & problem solving.

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

<b>Sr. No</b>	<b>Author</b>	<b>Title</b>	<b>Publication</b>
01	V.B.Bhandari	Introduction to Machine Design	Tata Mc- Graw Hill
02	R.K.Jain	Machine Design	Khanna Publication
03	Pandya & Shah	Machine Design	Dhanpat Rai & Son
04	Joseph Edward Shigley	Mechanical Engg. Design	McGraw Hill
05	PSG Coimbtore	Design Data Book	PSG Coimbtore
06	Abdulla Shariff	Hand Book of Properties of Engineering Materials & Design Data for Machine Elements	Dhanpat Rai & Sons
07	Hall, Holowenko, Laughlin	Theory and Problems of Machine Design	Mc-Graw Hill
08	R. S. Khurmi	Machine Design	S. Chand
09	S. Ramamurthan	Engg. Mechanics	Dhanpat Rai

**Course Name : Diploma in Fabrication Technology & Erection Engineering****Course Code : FE/FG****Semester : Fifth for FG and Sixth for FE****Subject Title : Basic Thermodynamics****Subject Code : 17554****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:**

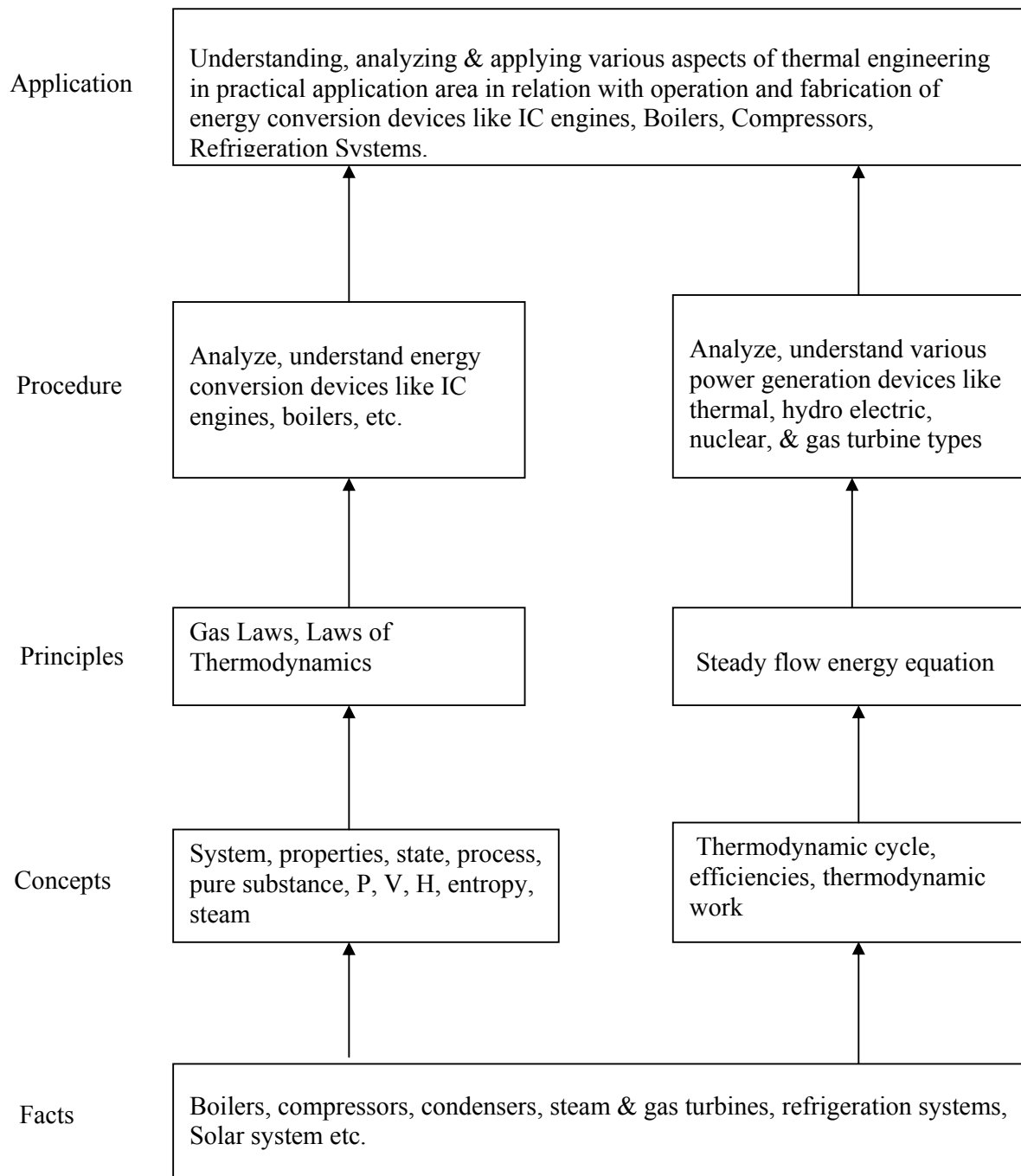
- Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.
- Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).

**Rationale:**

Fabrication engineers have to work with various power producing & power absorbing devices like boilers, turbines, compressors, pumps etc. In order to understand the principles, construction & working of these devices, it is essential to understand the concept of energy, work, heat & conversion between them. Hence it is important to study the subject of Thermodynamics which is a core subject. It includes the study of various sources of energy, basic laws & concept of thermodynamics, gas laws, properties of steam & generation. Heat transfer forms the basis for different power engineering application. Boilers find application in different process industries. Steam turbines and condensers are the major component of any steam power plant. Fabrication engineer should understand working and application of these devices.

**Objectives:****The Students should be able to:**

1. Know various sources of energy & their applications.
2. Apply fundamental concepts of thermodynamics to thermodynamic systems.
3. Understand various laws of thermodynamics.
4. Apply various Gas laws & ideal gas processes to various thermodynamic systems.
5. Calculate properties of two phase system by using steam tables/ Mollier charts.
6. Explain construction & working of boilers, mountings & accessories.
7. Explain construction & working of heat exchangers.
8. Explain use of different types of steam condensers and compare various steam condensers.
9. Describe internal combustion engine.

**Learning Structure:**



**Contents: Theory**

Topic No.	Name of the Topic	Hours	Marks
1.	<b>Sources of energy</b> 1.1 Brief description of energy sources - <b>Classification of energy sources</b> - <b>Renewable, Non-Renewable</b> 1.2 Fossil fuels, including CNG, LPG. 1.3 Solar - Flat plate and concentrating collectors & its application. - Solar Water Heater - Photovoltaic Cell, Solar Distillation. 1.4 Wind, Tidal, Geothermal 1.5 Biogas, Biomass, Bio-diesel 1.6 Hydraulic, Nuclear 1.7 Fuel cell – list of fuel cells	06	08
2.	<b>Fundamentals of Thermodynamics</b> 2.1 Concepts of pure substance, types of systems, properties of systems, Extensive and Intensive properties with units and conversion like P, V, $\rho$ And temperature. Point function and path function. 2.2 Work and Energy - Thermodynamic definition of work, heat, difference between heat and work, P.E., K.E, Internal Energy, Flow work, concepts of enthalpy, entropy. 2.3 Laws of Thermodynamic - Zeroth Law, Temperature Measurement, principle of energy conservation, irreversibility, Second Law of Thermodynamics, Kelvin Plank, Clausius statements and their equivalence, Concept of perpetual motion machine 1 and 2. 2.4 Application of Thermodynamic laws - Steady Flow Energy equation and its application to open system like boiler, engine, nozzle, turbine, compressor & condenser. 2.5 Application of Second law to Heat Engine, Heat Pump and Refrigerator.	10	22
3.	<b>Steam and Steam Boiler</b> 3.1 Generation of steam at constant pressure with representation on various charts such as T-H, T-S, H-S, P-H. Properties of steam and use of steam table, Quality of steam and its determination with Separating, throttling and combined Separating and throttling calorimeter (no numerical). 3.2 Vapour process : - - constant pressure, constant volume, constant enthalpy, constant entropy (numerical using steam table and Mollier chart), Rankine Cycle 3.3 Steam Boilers: - - Classification of boilers. - Construction and working of - Cochran, Babcock and Wilcox, La-mont and Loeffler boiler.	10	22

	Boiler draught natural and Mechanical. 3.4 Boiler mounting and accessories [to be covered in practical].		
4.	<b>Steam Turbines and Condensers</b> 4.1 Steam nozzle: - - Types of nozzles, Application of steam nozzles. 4.2 Steam turbine: - - Classification of turbines, Construction and working of Impulse and Reaction turbine (no numerical). 4.3 Steam condenser: - - Dalton's law of partial pressure, function and classification of condensers, construction and working of surface condensers & jet condenser. 4.4 Sources of air leakage, concept of condenser efficiency, vacuum efficiency (no numerical). 4.5 Cooling Towers. - Force draught, natural draught and induced draught.	09	20
5.	<b>I.C. Engine</b> 5.1 Power Cycles - Carnot, Otto, Diesel, Dual, Brayton Cycle, representation on P-V, T-S diagram and Simple numerical on Otto cycle only. 5.2 Classification of I.C. Engines 5.3 Two stroke and four stroke Engines - Construction and working, comparison, valve timing Diagram. 5.4 List of fuel, lubricant additives and their advantages. 5.5 Scavenging, pre-ignition, detonation, Supercharging, turbo charging	09	20
6.	<b>Heat Exchangers</b> Parallel, counter, cross-flow heat exchangers. Material used & application of different types such as concentric tubes, Shell and tube, plate type, multiple tube & compact heat exchangers (no numerical).	04	08
<b>Total</b>		<b>48</b>	<b>100</b>

**Practical:****Skills to be Developed:****Intellectual Skill:**

1. Understand different sources of energy and their applications
2. Understand various concepts and fundamentals of thermodynamics
3. Understand concepts and laws of ideal gasses
4. Understand vapour processes, steam boilers and different mountings and accessories
5. Understand modes of heat transfer and concept of heat exchangers
6. Interpret steam tables , mollier chart and relationship between different thermodynamic properties

**Motor Skills:**

1. Draw proportionate sketches
2. Draw Block diagrams

## 3. Draw process Charts

**List of practical:**

1. Study of different types of energy sources & their application.
2. Study of different types of boilers, identification of components and their functions.
3. Study of boiler mountings and accessories.
4. Study of working of four stroke diesel engine
5. Study of working of two stroke petrol engine
6. Study of working of different types of steam turbines.
7. Study of different types of condensers & cooling towers.
8. Study of different types of heat exchangers.

**Note:** Students should be able to identify the components, draw sketches and state their functions and importance in the operation.

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

Sr. No.	Author	Title	Publication
01	Domkundwar V. M.	A Course in Thermal Engineering	Dhanpat Rai & Co.
02	P. L. Ballaney	A Course in Thermal Engineering	Khanna Publishers
03	R. S. Khurmi	A text book of Thermal Engineering.	S. Chand & co. Ltd.
04	R. K. Rajput	A Course in Thermal Engineering	Laxmi Publication, Delhi
05	Patel and Karmchandani	Heat Engine Vol. - I & II	Acharya Publication
06	P. K. Nag	Engineering Thermodynamics	Tata McGraw Hill
07	B. K. Sarkar	Thermal Engineering	Tata McGraw Hill

**Course Name : Diploma in Fabrication Technology & Erection Engineering****Course Code : FE/FG****Semester : Fifth****Subject Title : Quality Control & Inspection****Subject Code : 17555****Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	--	02	03	100	---	25#	25@	150

**NOTE:**

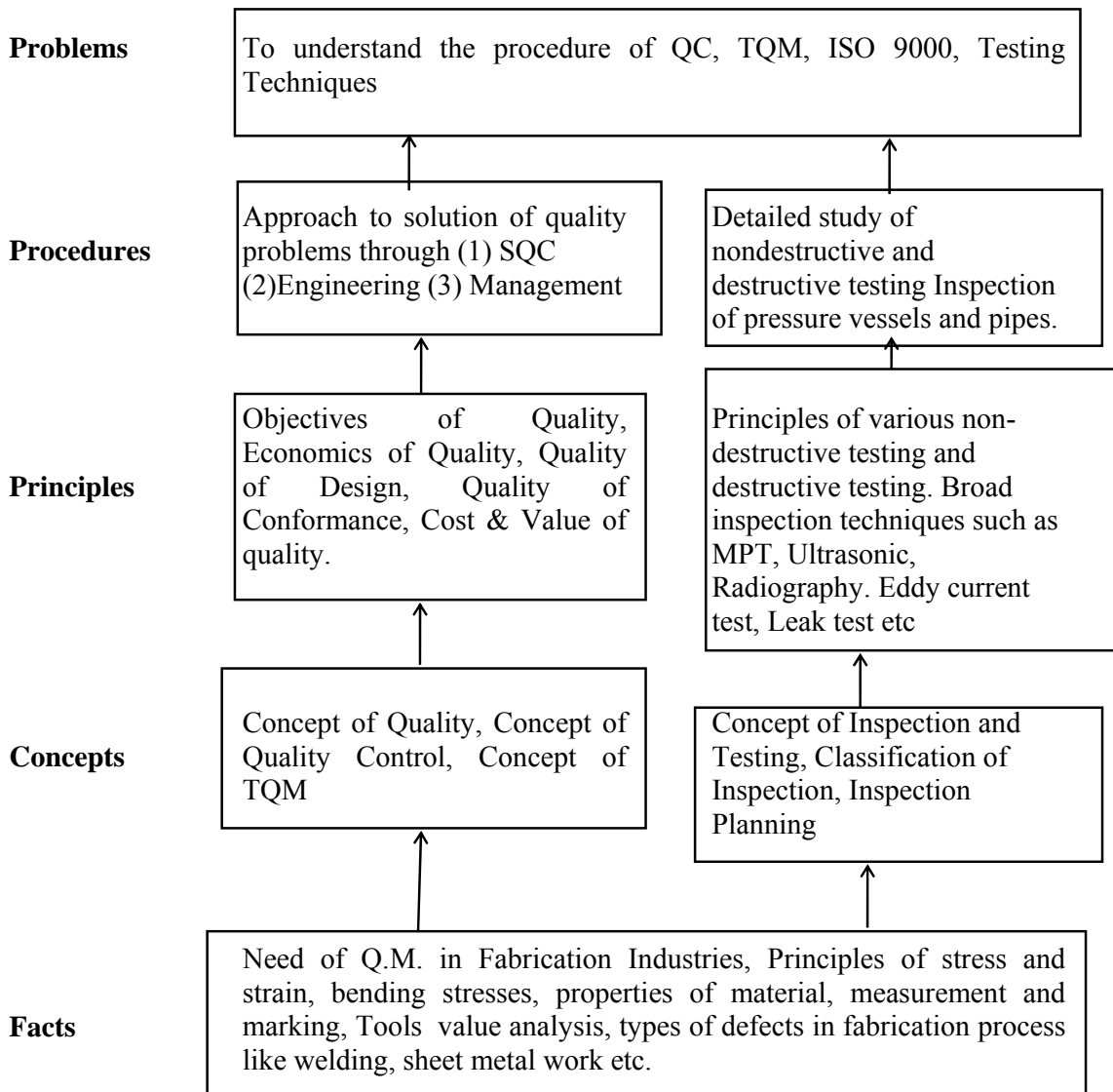
- Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.
- Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).

**Rationale:**

To make student understand total quality management, quality control, commitment to quality and Testing of quality.

**Objectives:**

1. To know the various non-destructive & destructive testing Techniques
2. To know the various codes which are used for inspection of pressure vessels & pipe.
3. To know the basic concept of metrology & quality inspection.
4. To know about various series of quality standards.

**Learning Structure:**

**DETAILED CONTENTS**

<b>Chapter</b>	<b>Description</b>	<b>Marks</b>	<b>Hours</b>
<b>1</b>	<b>1.1 Standards and Comparators-</b> <ul style="list-style-type: none"> <li>• Definition and introduction to line standard, end standard, Wavelength standard, Slip gauge and its accessories, Length bars.</li> <li>• Definition, Requirement of good comparator, Classification, use of comparators, Working principle of comparators, Dial indicator, Sigma comparator, Pneumatic comparator, Electrical, Electronic, Relative advantages and disadvantages.</li> </ul>	10	05
	<b>1.2 Limits, Fits ,Tolerances and Gauges –</b> <ul style="list-style-type: none"> <li>• Concept Of Limits, Fits, And Tolerances, (IS 3477-1973.)</li> <li>• Selective Assembly, Interchangeability, Hole And Shaft Basis System, Taylor's Principle,</li> <li>• Design Of Plug, Ring Gauges,( IS919-1993)</li> </ul>	08	04
<b>2</b>	<b>Basic Concepts Of Quality Control: -</b> <ul style="list-style-type: none"> <li>• Definition of quality as fitness for use</li> <li>• Parameters of fitness for use (quality characteristics) <ul style="list-style-type: none"> <li>➤ Quality of Design</li> <li>➤ Quality of conformance</li> </ul> </li> <li>➤ Abilities: <ul style="list-style-type: none"> <li>❖ Availability</li> <li>❖ Reliability</li> <li>❖ Maintainability</li> <li>❖ Field service</li> </ul> </li> <li>• Factors affecting quality of a product :</li> <li>• Control <ul style="list-style-type: none"> <li>➤ Definition</li> <li>➤ Regulatory process of control</li> </ul> </li> <li>• Quality control : <ul style="list-style-type: none"> <li>➤ Definition</li> <li>➤ Basic objectives</li> <li>➤ Advantages of Quality Control</li> <li>➤ Role of technician in quality control</li> <li>➤ Promoting quality mindedness amongst workers and operators.</li> <li>➤ Introduction to TQM &amp; ISO-9000</li> </ul> </li> </ul>	08	04

3	<p><b>Inspection, Testing &amp; Inspection Tools</b></p> <ul style="list-style-type: none"> <li>• <b>Inspection &amp; Testing</b> <ul style="list-style-type: none"> <li>➤ Definition and meaning</li> <li>➤ Difference between inspection and quality control</li> <li>➤ Classification of inspection (Based on location) <ul style="list-style-type: none"> <li>❖ Process inspection</li> <li>❖ Final inspection</li> <li>❖ Receiving inspection</li> <li>❖ Tool and Gauge inspection</li> </ul> </li> </ul> </li> </ul> <p><b>Duties of Inspector :</b></p> <ul style="list-style-type: none"> <li>• Interpretation of specifications</li> <li>• Measurement of product</li> <li>• Comparison with standards</li> <li>• Judging conformity</li> <li>• Disposition of the product.</li> <li>• Recording data</li> </ul> <p><b>Inspection planning</b></p> <ul style="list-style-type: none"> <li>• Necessity for planned inspection</li> <li>• What to inspect</li> <li>• How to inspect</li> <li>• Where to inspect</li> <li>• When to inspect</li> <li>• How much to inspect</li> </ul>	08	04
4	<p><b>Non Destructive &amp; Leak Testing</b></p> <ul style="list-style-type: none"> <li>• <b>Non Destructive Testing</b></li> <li>• Visual Inspection</li> <li>• Acoustic Test</li> <li>• Radiography Testing <ul style="list-style-type: none"> <li>➤ Introduction</li> <li>➤ Principle</li> <li>➤ X-rays and Gamma rays</li> <li>➤ X-ray radiographic procedure</li> <li>➤ Gamma ray radiography</li> <li>➤ Penetrameters</li> <li>➤ Interpretation of penetrameters</li> <li>➤ Interpretation of radiographs</li> <li>➤ Safety precautions</li> <li>➤ Advantages and disadvantages of x-ray radiography</li> <li>➤ Advantages and disadvantages of gamma radiography</li> <li>➤ Applications</li> </ul> </li> <li>• Magnetic Particle Inspection <ul style="list-style-type: none"> <li>➤ Basic Principles</li> <li>➤ Brief description of equipment</li> <li>➤ Flaws detected</li> <li>➤ Scope and Limitations</li> <li>➤ Sensitivity</li> <li>➤ Dry and wet methods</li> </ul> </li> </ul>	32	16

	<ul style="list-style-type: none"> <li>➤ Sequence of operation</li> <li>➤ Common applications</li> <li>➤ Inspection of light weldments</li> </ul> <p>Plate and repair/rework inspection.</p> <ul style="list-style-type: none"> <li>• Penetrant Inspection               <ul style="list-style-type: none"> <li>➤ Fluorescent Penetrant Inspection</li> <li>➤ Basic Principles</li> <li>➤ Systems</li> <li>➤ Test procedure</li> <li>➤ Inspection</li> </ul> </li> <li>• Common applications Ultrasonic Inspection               <ul style="list-style-type: none"> <li>➤ Introduction</li> <li>➤ Principles of operation</li> <li>➤ Technique selection</li> <li>➤ Testing techniques</li> <li>➤ Testing standard</li> <li>➤ Evaluation</li> <li>➤ Basic factors in ultrasonic testing</li> <li>➤ Advantages and limitations</li> <li>➤ Applications</li> </ul> </li> <li>• Eddy Current testing               <ul style="list-style-type: none"> <li>➤ Principles of operation</li> <li>➤ Flaws detected</li> <li>➤ Testing of non-magnetic materials</li> <li>➤ Testing of magnetic materials</li> <li>➤ Advantages and limitations</li> <li>➤ Applications</li> </ul> </li> <li>• <b>Leak testing</b> <ul style="list-style-type: none"> <li>➤ Introduction</li> <li>➤ Measurement of leakage</li> <li>➤ Types of leaks</li> <li>➤ Types of tests</li> <li>➤ Visual test</li> <li>➤ Testing under fluid pressure</li> <li>➤ Leak detecting by gas</li> <li>➤ Water-soluble paper with aluminum foil.</li> </ul> </li> </ul>		
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5	<b>Destructive Testing</b> <ul style="list-style-type: none"> <li>• Tensile testing : <ul style="list-style-type: none"> <li>➤ Preparation of specimen</li> <li>➤ Test procedure</li> <li>➤ Test report</li> <li>➤ Longitudinal Tensile test</li> <li>➤ All weld metal test.</li> </ul> </li> <li>• Compression <ul style="list-style-type: none"> <li>➤ Principle of compression test</li> <li>➤ Information gained</li> <li>➤ practical reasons for test</li> <li>➤ Test Piece</li> <li>➤ Practical aspect of test.</li> </ul> </li> <li>• Bend Test <ul style="list-style-type: none"> <li>➤ Introduction and purpose</li> <li>➤ types of bend test</li> <li>➤ free bend test</li> <li>➤ guided bend test</li> <li>➤ longitudinal bend test</li> <li>➤ side bend test</li> </ul> </li> <li>• Impact testing <ul style="list-style-type: none"> <li>➤ Principles of test</li> <li>➤ Types of test</li> <li>➤ Charpy test</li> <li>➤ Izod test</li> <li>➤ Test procedures</li> <li>➤ Reporting of result</li> </ul> </li> <li>• The Etch test <ul style="list-style-type: none"> <li>➤ Introduction</li> <li>➤ Types of test</li> <li>➤ Macro-etch test</li> <li>➤ Micro etch test</li> <li>➤ Concept and purpose</li> <li>➤ Preparation of test specimen</li> <li>➤ Etching reagents</li> <li>➤ Faults detector</li> </ul> </li> <li>• Hardness Test <ul style="list-style-type: none"> <li>➤ Purpose of test</li> <li>➤ Types of test</li> <li>➤ Procedure of testing</li> </ul> </li> <li>• <b>Nick Break Test</b> <ul style="list-style-type: none"> <li>➤ Purpose</li> <li>➤ Preparation of specimen</li> <li>➤ Test procedure</li> </ul> </li> </ul>	24	10
6	<b>Inspection Codes</b> <b>Theory:-</b>	10	05

	<ul style="list-style-type: none"> <li>• Inspection of pressure vessels and pipes</li> <li>➤ Various codes for pressure vessels &amp; pipes.</li> <li>➤ A.S.M.E.</li> <li>➤ A.S.T.M.</li> <li>➤ D.I.N.</li> <li>➤ I.B.R.</li> </ul>		
<b>Total</b>		<b>100</b>	<b>48</b>

**Skill to be developed****Intellectual skill:**

1. Identify the use of various DT & NDT techniques.
2. Identify the use of Metrology in industry.
3. Identify the use of various codes used in industry.

**Motor skill:**

1. To detect the defects by Magnetic Particle Testing.
2. To detect the defects by Ultrasonic Testing.
3. To apply Taylor's principle for gauge design.

**Practice:**

1. Gauge Design (2 Exercises)
2. Study of Radiography Tests
3. Performance on Liquid Penetrant Test.
4. Performance on Magnetic particle Testing
5. Study of Ultrasonic Testing
6. Study of Leak Testing
7. Study of Eddy Current Testing
8. Study of Acoustic Emission
9. Study of Visual Inspection

**References:**

Author	Title	Edition	Year of Publication	Publisher & Address
Higgins B.A.	Engineering Metallurgy Part-I	6th	1993	The English Language Book Societies ELBS
Dr. O.P. Khanna,	A.T.B. of Welding Technology	Ist	1994	Dhanpatrai & sons.
Baldev Raj T. Jayakumar M. Thavasimuthu	Practical Non-Destructive Testing	Ist	197	Narosa Pub. House, New Delhi
R. K. Jain	Metrology	--	--	Khanna Publications

**Course Name : Mechanical Engineering Group****Course Code : ME/MH/MI/PG/PT/FE/FG****Semester : Fifth for ME/PG/PT/FG and Sixth for MH/MI/FE****Subject Title : Advanced Manufacturing Processes****Subject Code : 17556****Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	--	02	03	100	--	--	50@	150

**NOTE:**

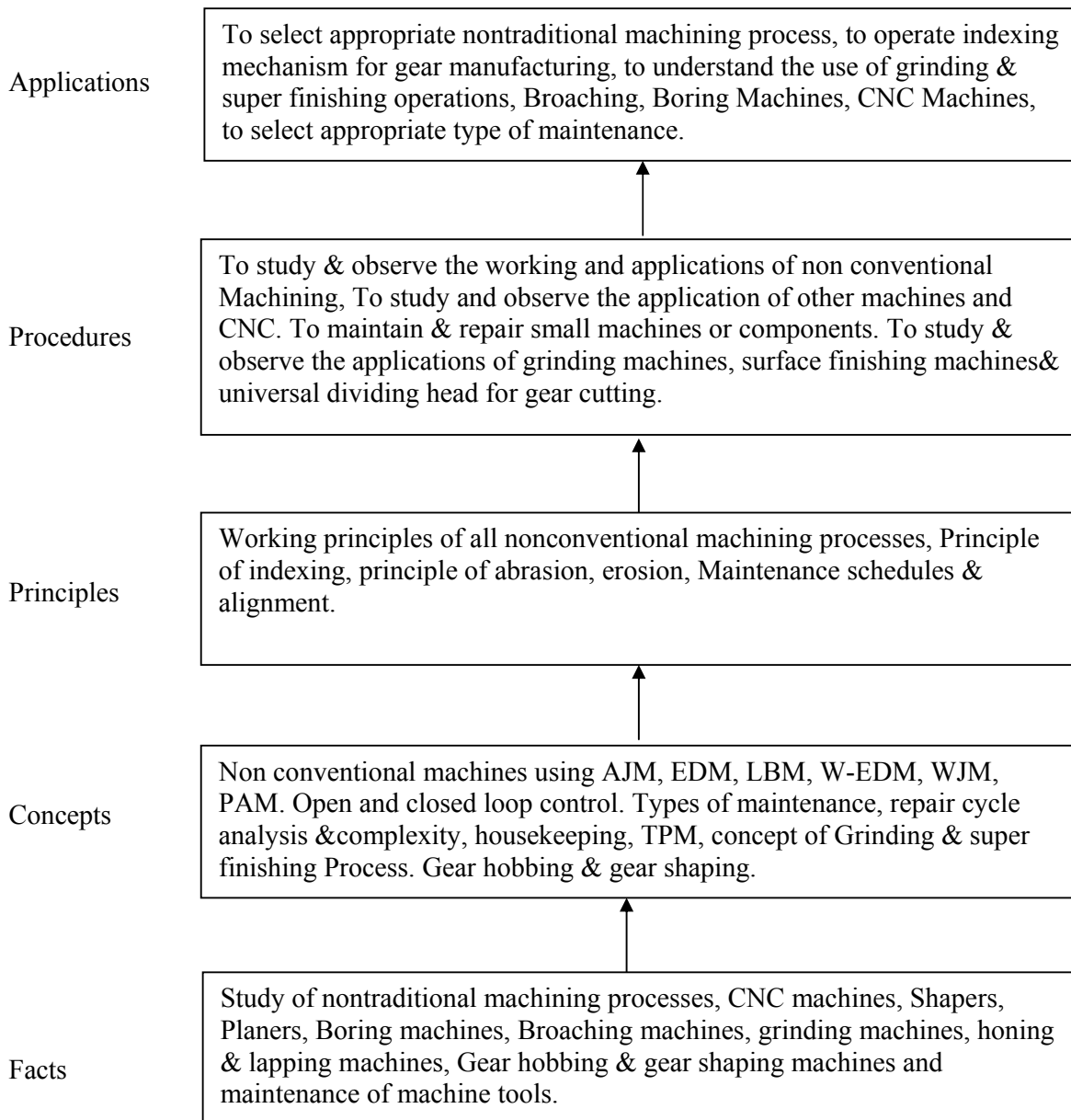
- Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.
- Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).

**Rationale:**

This is a advanced technology subject which is to be taught, after getting conversant with the basic manufacturing processes. It is necessary for a diploma engineer to know about the advancements in the area of manufacturing processes. This subject will impart knowledge & skills necessary for working in modern manufacturing environment. This subject will help the student to get familiarize with working principles and operations performed on non conventional machines, CNC Machines, milling machines, grinding machines, surface finishing machines and maintenance of machine tools.

**Objectives:****The student will be able to:**

- 1) Know different Nontraditional machining processes.
- 2) Understand the working of Broaching Machine, Milling Machine, Gear Cutting machines, Grinding Machines, Surface finishing machines.
- 3) Work as a maintenance engineer.
- 4) Know the Operation and control of different CNC machine tools.
- 5) Produce jobs as per specified requirements by selecting the specific machining process.
- 6) Adopt safety practices while working on various machines.
- 7) Develop the mindset for modern trends in manufacturing and automation.

**Learning Structure:**

**Theory:**

Topic & Content	Hours	Marks
<b>Topic 1. Non Traditional Machining</b> <b>Specific Objectives</b> ➤ Understand different Nontraditional machining processes. <b>Content</b> <b>1.1</b> Need and importance, classification 04 Marks <b>1.2</b> AJM, WJM, EDM, W-EDM - setup, working, process parameters, advantages, disadvantages and applications. 08 Marks <b>1.3</b> PAM, LBM - setup, working, process parameters, advantages, disadvantages and applications. 08 Marks	10	20
<b>Topic 2: Introduction to CNC</b> <b>Specific Objectives</b> ➤ Know the Operation and control of CNC machine tools. <b>Content</b> <b>2.1</b> Introduction, advantages of CNC, open loop and closed loop control, axis identification, absolute & incremental coordinate system- G codes and M codes 08Marks <b>2.2</b> Fundamental part programming - simple lathe and milling programmes. Dry run, Jog Mode, Block by Block execution, Safety Procedures, Adaptive controls, Displays and indicators. 08 Marks	08	16
<b>Topic 3: Other Machining Methods</b> <b>Specific Objectives</b> ➤ Understand the working of different Machines. <b>Content</b> <b>3.1</b> Introduction, classification of Broaching machines, basic parts of horizontal broaching machine & their functions, applications, advantages and limitations of Broaching machine. 08 Marks <b>3.2</b> Capstan, turret lathe & automats, Planer and planomiller - function of parts & operations. 04 Marks <b>3.3</b> Boring Machines – types, tools and operations. 04Marks	08	16
<b>Topic 4: Milling &amp; Gear Cutting</b> <b>Specific Objectives</b> ➤ Understand the working of Milling & Gear Cutting machines. <b>Content</b> <b>4.1 Milling:</b> 10 Marks Introduction, classification ,basic parts of column & knee type milling machine & their functions, standard milling cutters, milling operations like plain milling, side milling, straddle milling, gang milling, face milling - slot milling, slitting. Up milling & down milling, cutting parameters. <b>4.2 Gear Cutting:</b> 12 Marks Introduction, gear manufacturing methods, universal dividing head & indexing methods, gear shaping & gear hobbing - setup, working, advantages, disadvantages, applications, gear finishing methods-grinding, shaving, burnishing.	10	22
<b>Topic 5. Surface Finishing</b> <b>Specific Objectives</b> ➤ Understand the working of Grinding Machines & Surface finishing machines. <b>Content</b>	06	14

<b>5.1 Grinding Machines</b> 08 Marks Classification and working of grinding machine – surface, cylindrical, centreless, grinding wheel specifications, grinding wheel dressing & truing. Selection criteria for grinding wheel. Balancing of grinding wheels, safety precautions.		
<b>5.2 Super Finishing</b> 06 Marks Methods of surface finishing like honing, lapping, burnishing, polishing and buffing - setup, working, advantages, limitations and applications.		
<b>Topic 6. Maintenance of Machine Tools:</b> <b>Specific Objectives</b> ➤ Know the maintenance methods and procedures. <b>Content</b> Need and importance of maintenance activity, Types of maintenance, Basic maintenance practices for simple machine elements, viz Bearing, Coupling, Shaft and pulley, gears, chains, machine belts. Repair cycle analysis, Repair complexity, Maintenance manual, Maintenance records.	06	12
<b>Total</b>	<b>48</b>	<b>100</b>

**Practical:**

Skills to be developed:

**Intellectual skills:**

- 1) Compare an appropriate non conventional machining process for required component.
- 2) Write part programming for a component.
- 3) Know the significance of various super finishing methods.
- 4) Calculations for indexing for a spur gear cutting, helical gear cutting.
- 5) Select the grinding machine parameters.
- 6) Identify the maintenance procedure for a machine.

**Motor Skills:**

- 1) Use the indexing mechanism.
- 2) Operate CNC Lathe & CNC milling machine.
- 3) Operate grinding machine
- 4) Carry out maintenance of machines.
- 5) Use and operate different hand tools required for repair and maintenance.
- 6) Identify and rectify the faults in the given sub assembly.

**List of Practical:**

- 1) Industrial visit to observe at least one nontraditional machining process and write a report individually on visit.
- 2) One simple Job on CNC Lathe Machine and Verification on simulation software (One job /max. four students).
- 3) One simple Job on CNC Milling Machine and Verification on simulation software (One job /max. four students)
- 4) Industrial visit to observe Broaching machine, Boring machine, Planer machine and report on the same.
- 5) One job of gear cutting (spur gear /helical gear) by using simple indexing method (max. four students per job).
- 6) One job containing surface grinding / cylindrical grinding operation. (max. four students per job).
- 7) Industrial visit to observe at least one super finishing process.

- 8) Maintenance procedure for any two machines/machine elements with reference to type of faults, causes & remedies. (In a group of 4-5 students)
- 9) Teacher can suggest topics (ind. visit/non conv. man. process etc.) for ppt files and students (4 students) should present in practical batch.

**Notes:**

1. The workshop instructor should prepare the specimen job in each shop as demonstration/ before the students (as per the drawing given by subject teacher / workshop superintendent)
2. Theory behind practical is to be covered by the concerned subject teacher / workshop superintendent.
3. Workshop diary should be maintained by each student duly signed by respective shop instructors

Sr. No.	Equipment /Software	Group Size	Remark
1	Simulation software for Turning on 20 PCs	One student	Institute can establish a separate simulation, CAD, CAM, CAE, computational facility lab. Internet facility is must. Teacher can download good videos and help students to understand the principles. Students can observe various videos on machining, calibration, maintenance of machine tools.
2	Simulation software for Milling on 20 PCs		
3	Videos demonstrating Non Conventional machining and other machines on 20 PCs		
4	Simulation software for Grinding on 20 PCs		
5	Videos on maintenance of machine tools		

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

Sr.No.	Author	Title	Publisher
01	S. K. Hajra Chaudary, Bose, Roy	Elements of workshop Technology-Volume II	Media Promoters and Publishers Limited
02	O. P. Khanna & Lal	Production Technology Volume- II	Dhanpat Rai Publications.
03	P.K.Mishra	Nonconventional Machining	Narosa Publishing Houswe
04	H.P.Garg	Industrial Maintenance	S.Chand& Co.
05	L.R.Higgins	Maintenance Engg. Handbook	McGraw Hill
06	B. L. Juneja, G.S.Sekhon, Nitin Seth	Fundamental of metal cutting and machine tools	New age international ltd.
07	P.C.Sharma	Production Engg.	Dhanpat Rai Publications.
08	S.F.Krar,A.R.Gill,P.Smid	Technology of Machine Tools	Tata-McGraw Hill
09	HMT	Production Technology	Tata-McGraw Hill
10	B.S.Pabla &M.Adithan	CNC Machines	New Age International Ltd.

**Course Name : Diploma in Fabrication Technology & Erection Engineering****Course Code : FE/FG****Semester : Fifth for FG and Sixth for FE****Subject Title : Estimation & Costing****Subject Code : 17557****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).

**Rational:**

This subject is classified under Technology subject. Fabrication Engineering Diploma holders have to work as Technicians & Supervisors for Fabrication and Installations of various companies, commercial and Industrial schemes and prepare estimates for these schemes. They also work as Independent fabricators and erection engineers and execute various types of installations. Knowledge of Principles of costing, elements of costing and cost control are important aspects of costing. Costing for various types of jobs and assignments is important component of the business of Erection and Fabrication.

Similarly understanding of the methods and procedure of estimating the material required; development of the skills of preparing schedule of material; detailed estimates; costing of different types of Installation which leads to preparing of the tender documents, procedure for tendering, evaluation and billing of executed work of different types of is essential.

**Objectives:****The student will able to:**

- 1) Define different types of Installations
- 2) Interpret the Fabrication and installation drawings
- 3) State and describe the basic terms, general rules, design procedure and design considerations of Fabrication and Erection work in Installations.
- 4) Explain the sequence to be followed in carrying out the estimate of fabrication and Installations.
- 5) Prepare detail estimate and costing of Installations.
- 6) Understand the concept of contracts, contractors, tender and tender document and its related procedures.



**Theory:**

Topic and Contents	Hours	Marks
<b>Topic 1: Principles of Costing</b> <ul style="list-style-type: none"> <li>• Definition of costing &amp; objectives of costing.</li> <li>• Introduction to elements of costing</li> <li>• Definition of different types of costs like direct labour cost, material cost, indirect material cost, overhead charges like factory overheads, administrative overhead, selling overheads, distributing overheads, fixed overheads, floating overheads etc. prime cost, factory cost, manufacturing cost, total cost, selling price.</li> <li>• Difference between costing &amp; estimating</li> <li>• Cost control</li> <li>• Pricing policy.</li> </ul>	04	10
<b>Topic 2: Material and Labour Costing</b> <ul style="list-style-type: none"> <li>• Introduction to material costing</li> <li>• Material costing and its elements</li> <li>• Control over material cost</li> <li>• waste control (scrap, surplus, absolute)</li> <li>• Valuation of materials issued from the store: <ul style="list-style-type: none"> <li>➤ First-in-first out, last in first out,</li> <li>➤ Average price method, fixed price method,</li> <li>➤ Actual cost method, current value method</li> <li>➤ Inflated price method.</li> </ul> </li> <li>• Simple problem on estimation of material cost</li> <li>• Introduction to wages &amp; incentive</li> </ul>	07	12
<b>Topic 3 : Overhead Costing and Depreciations</b> <ul style="list-style-type: none"> <li>• Introduction &amp; study of different types of overheads</li> <li>• Depreciation &amp; obsolescence</li> <li>• Causes of depreciation</li> <li>• Method of calculating depreciation : straight line method, diminishing balance method, sinking fund method, annuity charging method, the insurance policy method, revaluation method, machine hour basis method, the sum of the years digit method.</li> </ul>	05	10
<b>Topic 4 : Estimating</b> <ul style="list-style-type: none"> <li>• Introduction, importance &amp; use of estimating</li> <li>• Function of estimator, quality of estimator &amp; qualification of estimator</li> <li>• Estimating procedure</li> <li>• Divisions of estimating <ul style="list-style-type: none"> <li>➤ Material quality &amp; cost</li> <li>➤ Labour cost</li> <li>➤ Tool cost</li> </ul> </li> </ul>	04	08
<b>Topic5 : Estimation of Work Material</b> <ul style="list-style-type: none"> <li>• Fundamental of mensuration</li> <li>• Simple problems</li> </ul>	04	08
<b>Topic 6 : Machine Shop Estimations</b> <ul style="list-style-type: none"> <li>• Machine time for various operations like turning operation, drilling, milling, shaping &amp; planning, grinding operation.</li> <li>• Simple problems on machine shop estimation</li> </ul>	05	10
<b>Topic 7: Welding and Riveting Estimates</b>	05	10

<ul style="list-style-type: none"> <li>Types of welding joints</li> <li>Factors affecting welding costs and welding cost estimation</li> <li>Gas welding and cutting, arc welding costs</li> <li>Simple problems on Welding Riveting Estimations.</li> </ul>		
<b>Topic 8 : Sheet Metal Shop Estimations</b> <ul style="list-style-type: none"> <li>Introduction to sheet metal shop estimation</li> <li>Blank layouts</li> <li>Estimation of time</li> <li>Capacity of power presses</li> <li>sheet metal shop cost estimates</li> </ul>	04	10
<b>Topic 9 : Erection Costing</b> <ul style="list-style-type: none"> <li>Cost elements</li> <li>Estimation of erection costs</li> <li>Simple problems</li> </ul>	03	06
<b>Topic 10 : Estimation of Forging Shop</b> <ul style="list-style-type: none"> <li>Forging-Hand forging &amp; machine forging</li> <li>Forging operations &amp; Procedure of forging shop</li> <li>Estimation of time &amp; estimation of losses</li> <li>Simple problems</li> </ul>	04	08
<b>Topic 11 : Jobs and Process Order Costing</b> <ul style="list-style-type: none"> <li>Job orders costing: Job cost sheet, costing procedure, cost flow in job orders, cost accounting.</li> <li>Process cost accounting : Material &amp; overhead costing, cost flow chart in process costing, characteristics of process cost accounting</li> </ul>	03	08
<b>Total</b>	<b>48</b>	<b>100</b>

**Assignments:**

1. Calculation of selling price of the complex product produced in mass production industry(2 case studies)
2. Estimation of material cost (3 exercises)
3. Study of Waste control (1 Exercise)
4. Study of Depreciation & obsolescence (1 Exercise)
5. Machine shop estimation (2 Exercise)
6. Welding shop Estimation (2 Exercise)

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

Sr. No.	Name of Book	Author
1.	Mechanical Estimating & Costing	Banga & Sharma
2.	Mechanical Estimating & Costing	Singh & Khan
3.	Mechanical Estimating & Costing	K. Lal & Hari Bershad

**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.

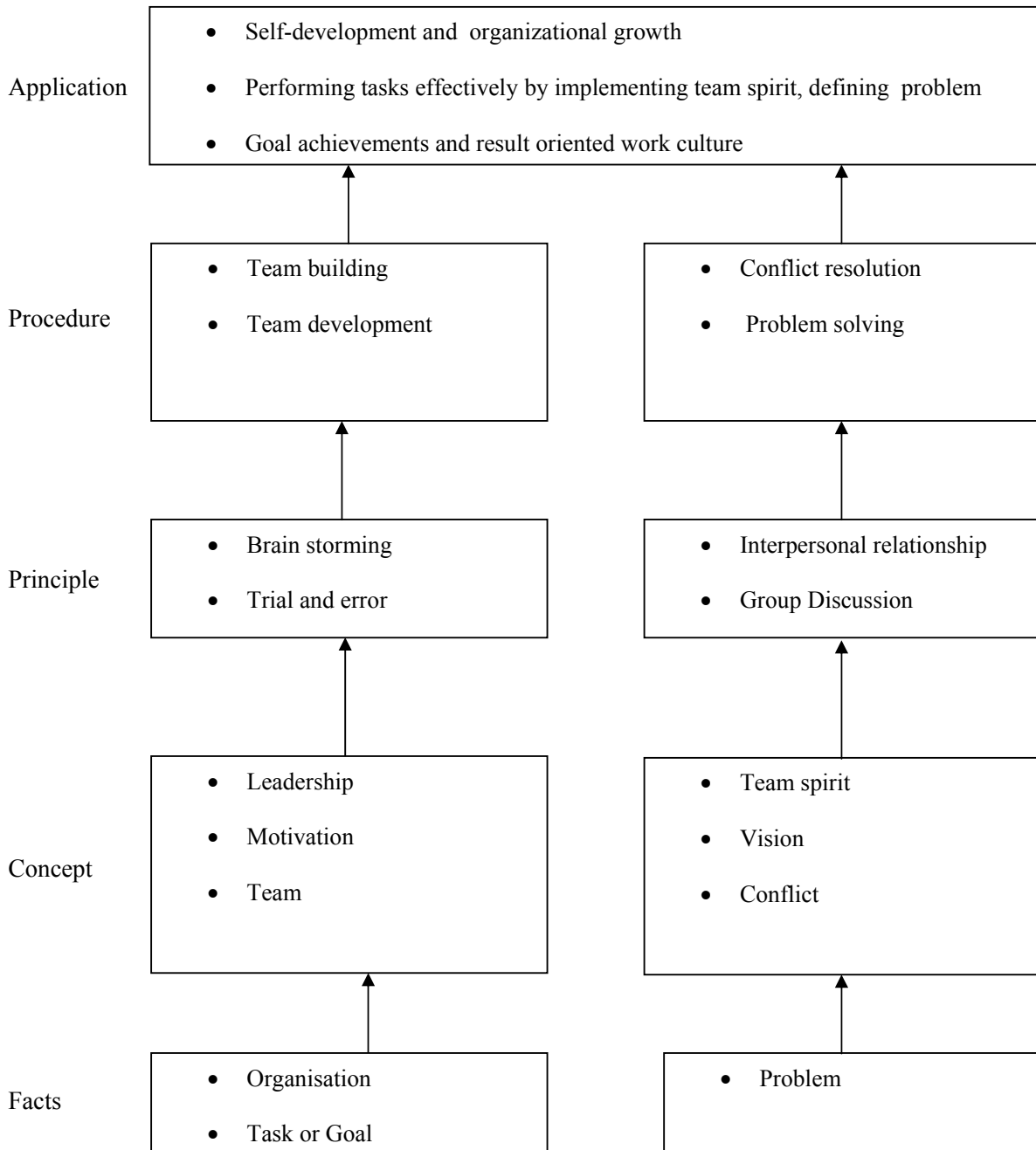
Addition of behavioural science in curriculum is intended to enhance the efficiency of a person so that he can contribute to overall growth of organisation. It aims at developing insight into leadership, team building, motivation, interpersonal relationship, problem solving, decision making and aspects 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:**

Topic and Contents	Hours
<b>Topic 1: LEADERSHIP</b> Contents: 1.1 Introduction – Importance, examples of different types of leaders. 1.2 Meaning and Definition of Leadership. 1.3 Leadership qualities – Confidence, Vision, Communication Skills, influencing people etc. 1.4 Types of Leadership styles, their advantages and disadvantages – Autocratic, Democratic, Delegative, Bureaucratic and Laissez Fairie.	02
<b>Topic 2: MOTIVATION</b> Contents: 2.1 Meaning and Definition of motivation. 2.2 Types of motivation. 2.3 Maslow's Motivation theory. 2.4 Job characteristic model to enhance motivation.	03
<b>Topic 3: TEAM BUILDING</b> Contents: 3.1 Definition of Team. 3.2 Difference between Group and Team. 3.3 Need for formation of good team (vision, trust, cooperation, initiative, etc.) 3.4 Approach to Team building (Personality based, activity based, skill based, problem solving based, etc.)	02
<b>Topic 4: CONFLICT RESOLUTION</b> Contents: 4.1 Definition of Conflict. 4.2 Types of Conflict – Functional and Dysfunctional 4.3 Sources of Conflict – Ego, Authority, Frustration etc. 4.4 Positive and Negative effects of conflicts. 4.5 Methods of Conflict resolution – Compromising, withdrawal, forcing.	04
<b>Topic 5: PROBLEM SOLVING AND DECISION MAKING</b> Contents: 5.1 Steps in Problem Solving. 5.2 Methods used for solving problems – trial and error method, brain storming, lateral thinking method. 5.3 Techniques used for Decision making- Decision tree, Decision Matrix, Mind Mapping etc.	03
<b>Topic 6: GROUP DISCUSSION AND INTERVIEW TECHNIQUES</b> Contents: 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>	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:**

<b>Sr. No.</b>	<b>Author</b>	<b>Name of Book</b>	<b>Publication</b>
1	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 : Mechanical Engineering Group****Course Code : ME/PG/PT/MH/MI/FG/FE****Semester : Fifth for ME/PG/PT/FG and Sixth for MH/MI/FE****Subject Title : CNC Machines****Subject Code : 17064****Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
01	--	02	--	--	50#	--	25@	75

**Rationale:**

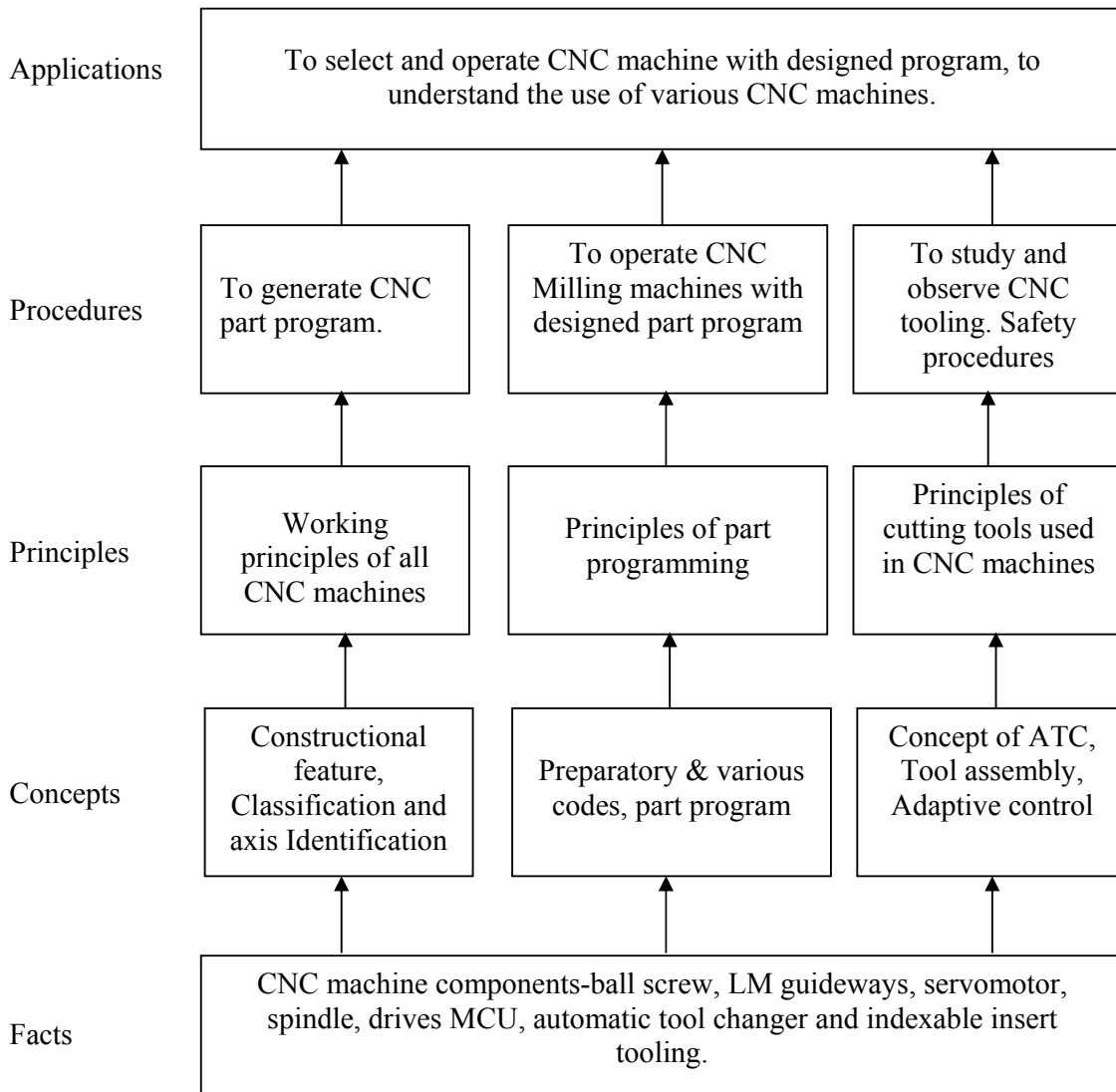
This is Technology subject which has relevance with the subjects taught earlier namely Manufacturing Processes and advanced manufacturing processes. After getting conversant with the basic manufacturing processes and production processes, it is necessary for a technician to know about the advancements in the area of manufacturing and production processes. The subject will impart knowledge & skills necessary for working in modern manufacturing demands and environment. This subject will help the student to get familiarized with working principles and operations performed on CNC machining centers, generation of part program and study tooling of CNC machine.

**Objectives:**

The student will be able to

- 1) Know different types of CNC machines,
- 2) Understand the different codes used in CNC programming.
- 3) Know the Operation and control of different CNC machine and equipments.
- 4) Adopt different tooling while working on various CNC machines.



**Learning structure:**

**Theory:**

Topic and Content	Hours
<b>1. Introduction to CNC machines</b> <b>Specific objectives:</b> <ul style="list-style-type: none"> <li>➤ State different types and advancements in CNC machines</li> <li>➤ Describe Construction and working of CNC turn-mill center</li> </ul> <b>Content:</b> <ul style="list-style-type: none"> <li>1.1 Classification of CNC machines</li> <li>1.2 Axis standards and its identification.</li> <li>1.3 Construction and working of CNC turning centre, VMC and HMC</li> <li>1.4 Construction and working of CNC turn mill centre</li> <li>1.5 Construction and working of Multi- axis CNC machines</li> <li>1.6 Construction and working of Pallet type CNC machine</li> <li>1.7 Construction and working of CNC based Coordinate Measuring Machine.</li> </ul>	4
<b>2. Constructional features and working of CNC machines</b> <b>Specific objectives:</b> <ul style="list-style-type: none"> <li>➤ Describe construction and working of the different components, subassemblies, assemblies and peripherals of CNC machines</li> </ul> <b>Content:</b> <ul style="list-style-type: none"> <li>2.1 Bed and machine frame construction.</li> <li>2.2 Spindle constructional details</li> <li>2.3 Constructional details and working of ball screw and L.M. guideways.</li> <li>2.4 Various Spindle drives used in CNC machines.</li> <li>2.5 Working of Machine control unit.</li> <li>2.5 Types of lubrication systems used for CNC machines.</li> <li>2.6 Working of swarf removal arrangement.</li> <li>2.7 Working of hydraulic and pneumatic systems used for chuck, tool and pallet changing in CNC machines.</li> </ul>	4
<b>3. CNC Part programming</b> <b>Specific objectives:</b> <ul style="list-style-type: none"> <li>➤ Describe CNC part programming according to the drawing of the component</li> </ul> <b>Content:</b> <ul style="list-style-type: none"> <li>3.1 NC words, G codes, M codes.</li> <li>3.2 Programming format, word statement, block format.</li> <li>3.3 Tool offsets and tool wear compensation.</li> <li>3.4 Part programming containing Subroutines, Do- loops and Canned cycles.</li> <li>3.5 Introduction to Macro programming.</li> </ul>	4
<b>4. Tooling for CNC machines</b> <b>Specific objectives:</b> <ul style="list-style-type: none"> <li>➤ State types of CNC cutting tools</li> <li>➤ Describe tool presetting procedure</li> </ul> <b>Content:</b> <ul style="list-style-type: none"> <li>4.1 Introduction</li> <li>4.2 Types of CNC Cutting tools</li> <li>4.3 Types of indexable inserts with its geometry</li> <li>4.4 Construction of tool holding assembly</li> <li>4.5 Tool presetting procedure</li> <li>4.6 Working of Automatic Tool Changing (ATC) device and types of tool magazine</li> <li>4.7 Safety Procedures, alarms, fool-proof procedures.</li> <li>4.8 Online measurement of dimensions, cutting forces, Adaptive controls, communication with servers.</li> </ul>	4

4.9 Fixtures used in CNC machines.	
<b>Total</b>	<b>16</b>

**Practicals:**

Skills to be developed.

**Intellectual Skills:**

- 1) To select the appropriate CNC machine for the given component.
- 2) To select the appropriate tools for the given component.
- 3) To generate programme for the given component.
- 4) To calculate the cycle time for the given component.

**Motor Skills:**

- 1) To feed the programme to CNC machine.
- 2) To conduct the programme in single block mode and dry run.
- 3) To carry out job production on CNC machine.
- 4) To carry out changes in job and carry out compensation.

**Notes:**

- 1) The College/Institute should purchase at least one CNC production machine.
- 2) The requisite time of practical mentioned in the scheme should be allotted to the students. A group of 4-5 students can handle machine for 30mins in 2 hrs. practical. Whenever students are free they can approach the lab in charge to work on machines.
- 3) Students can model components required for their project (6<sup>th</sup> sem) on 3D modeling software, thereafter if students manufacture these components on CNC machines, it is highly appreciable.
- 4) The Workshop Superintendent/ HOD should personally see that the CNC Practicals are conducted in his Institute.

**Guidelines for Practical Examination**

An examiner must prepare 6 assignments on turning and 6 assignments on milling. See that the task can be completed in 1 hr. A group of 4 students can pick up **one** assignment randomly. The group should write part programme, enter into machine, dry run and manufacture the component. Evaluation of students based on their contribution in activities shall be done by the internal as well as external examiner.

**List of practical**

1. One practical on single block mode & dry run on CNC turning center for production job part programme (Batch of 4-5 students) and verification using any simulation software.
2. One practical on single block mode & dry run on CNC milling for production job part programme (Batch of 4-5 students) and verification using any simulation software.
3. One job on CNC lathe having plain turning, taper turning, step turning, threading, boring and grooving (Batch of 4-5 students).
4. One job on CNC milling having following operations – face milling, slotting, contour machining (Batch of 4-5 students)
5. One assignment on indexable inserts used in CNC tooling with its geometrical details and ISO codes, nomenclature.
6. Conduct a practical on presetting of a milling cutter or one assignment on tool presetting procedure.
7. Visit to CNC machine (Production) shop having turning and machining centre to observe construction and working of CNC turning and vertical machining centre, write visit report and draw plant layout.

8. One assignment on CNC programming containing subroutines, do-loop and canned cycle
9. Visit to industry having CNC-CMM machine and inspect various dimensions and geometry of production component.

**List of Books:**

Sr. No.	Author	Title	Publisher
1	HMT, Bangalore	CNC Machines	New age International Limited
2	P. N. Rao	CAD/CAM Principles Applications	Tata McGraw Hill
3	Pabla B. S. & M. Adithan	CNC Machines	New age International Limited
4	Groover , Zimmers	CAD/CAM Computer Aided Design & Manufacturing	Pearson
5	HMT, Bangalore	Mechatronics	Tata McGraw Hill
6	Chougule N. K.	CAD/CAM/CAE	Scitech Publication Pvt. Ltd.
7	Binit Kumar Jha	CNC Programming Made Easy	Vikas Publishing House Pvt. Ltd. New Delhi. Revised Edition 2010.

**Note:** Practice of Programming is required for students using Simulation Software

**Course Name : Mechanical Engineering Group****Course Code : AE/ME/PG/PT/MH/MI****Semester : Fifth for AE/ME/PG/PT/FG and Sixth for MH/MI/FE****Subject Title : Professional Practices-III****Subject Code : 17065****Teaching and Examination Scheme:**

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

**Rational:**

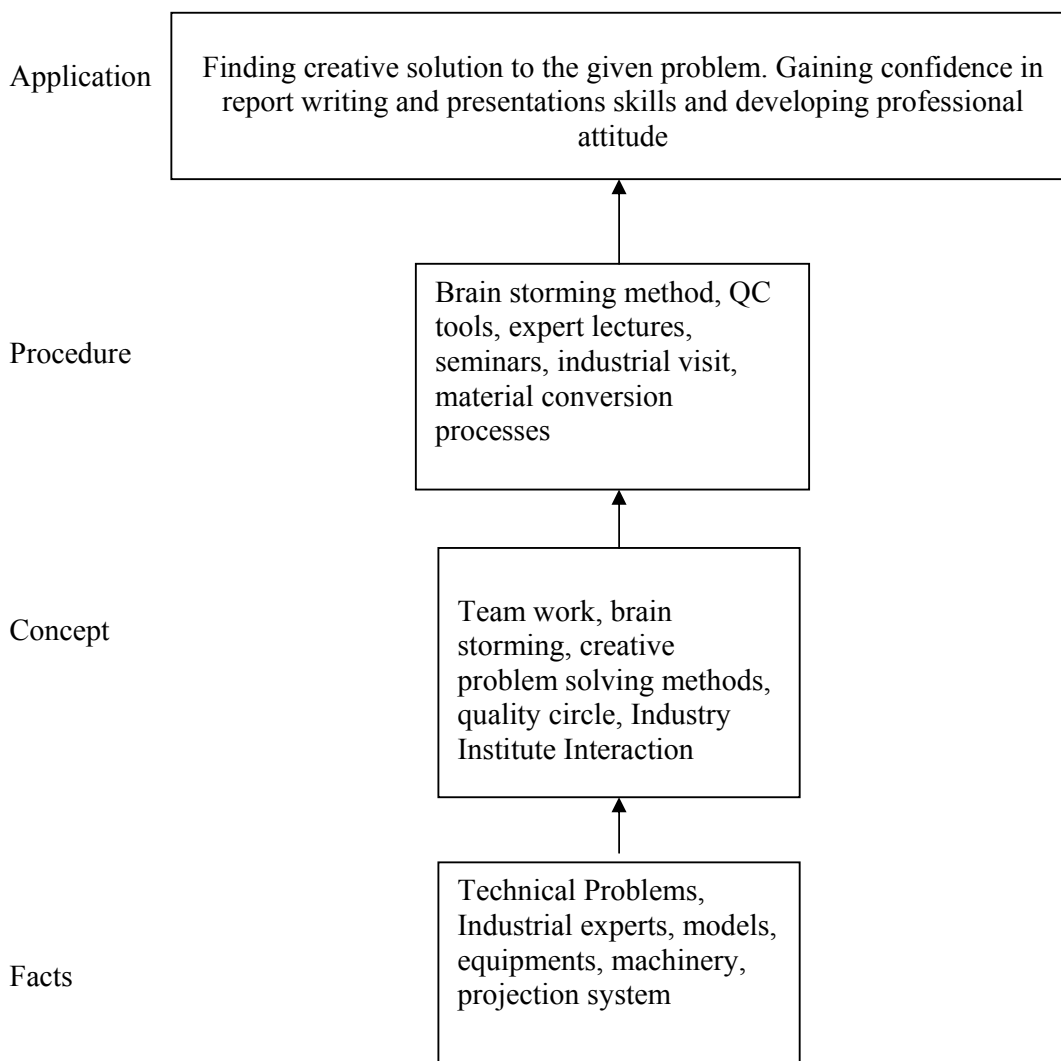
Overall professional development of diploma mechanical engineers is the need of the day for enabling them to sustain in competitive global environment.

Professional development of Diploma engineering students is to be done by exposing them to various simulative situations in the industries. This can be achieved by inculcating attitude to face the problems, get alternative solutions and validation of the selected alternatives. This is achieved by involving students in activities such as inviting experts from various industries for sharing their experiences, arranging industrial visits, quality circles, seminars and mini projects activities etc.

**General Objectives:**

Student will be able to:

1. Identify, select and solve the problems.
2. Acquire information from different sources.
3. Prepare technical report and present seminar using power projection system.
4. Interact with peers to share thoughts.
5. Make them work with their own hands.
6. Work in a team and develop team spirit.

**Learning Structure**

**Contents:**

Activity	Practical Hours
<p><b>1. Idea Generation for final semester Project selection:</b></p> <p>The student should use innovation principles for Idea generation .These ideas should lead to selection of Project. Head of Department should allot the project guides for the activity and form groups of four students per project.</p> <p>Following are some of the guidelines for projects selection.</p> <ul style="list-style-type: none"> <li>• Development of working models.</li> <li>• Development of attachments to machine tools.</li> <li>• Reconditioning of existing equipments, machines in the Institute.</li> <li>• Industrial Problem Solving.</li> <li>• Interdisciplinary Projects.</li> <li>• Use of Non conventional Energy sources.</li> <li>• Use of appropriate technology.</li> <li>• Agro based projects to reduce drudgery of farmers.</li> <li>• Ergonomic equipments</li> <li>• Jig, fixtures, dies, special purpose tools</li> <li>• Any project on Low Cost Automation</li> <li>• Automation Problems in industries</li> <li>• Experimental setups required in laboratories for measurement of parameters and component performance.</li> <li>• Any other project suitable for Industry and Institute.</li> </ul> <p><b>Note:</b> The project group should submit their progress report, activity planning, any preliminary calculations to evaluate the project to be submitted at the end of the semester.</p> <p>The student should submit a report for the project which will have proportional weightage in the term work</p>	06

<p><b>2. Industrial Visits</b></p> <p>Structured industrial visits be arranged and report of the same shall be submitted by the individual student, to form a part of the term work.</p> <p>Following are the suggested types of Industries/ Fields. The subject teacher(s) have liberty to select nearby organization/industry</p> <ul style="list-style-type: none"> <li>• Automobile manufacturing / press component / auto component manufacturing units to observe the working of SPM / Non Conventional Manf process / CNC / FMS / Robots</li> <li>• Refrigeration and air conditioning manufacturing / servicing units / industries / workshops</li> <li>• Automobile service stations for four wheelers/Wheel Balancing unit for light and/or heavy motor vehicles/exhaust gas analysis and vehicle testing / PWD / ST workshop.</li> <li>• Co-ordinate measuring machine to observe its construction working specifications and applications.</li> <li>• Engine Testing unit to gather details regarding the testing procedures/parameters etc.</li> <li>• Food processing/ Dal mill/ Oil Mill/ Automated bakery unit.</li> <li>• Textile industry / Textile machinery manufacturing / garment manufacturing / embroidery / textile printing and dyeing units.</li> <li>• Hydro electric and Thermal power plants.</li> <li>• Automotive Research Association of India, Pune, Central Institute of Road Transport, Pune, Vehicle Research and Development establishment, Ahmednagar.</li> <li>• Safety museum at Central Labour Institute, Sion, Mumbai</li> <li>• Common Facility Center by MSME, GOI.</li> <li>• Auto Cluster projects of MSME, GOI.</li> <li>• CIPET and IGTR Aurangabad</li> <li>• Tyre retreading, paint manufacturing, foundries, forging unit, heavy fabrication unit, steel and wooden furniture manufacturing</li> <li>• Agricultural equipments manufacturing units.</li> <li>• Hardware and Machinery stores selling agro equipments</li> <li>• Plastic injection molding, extrusion, blow molding.</li> <li>• Stone crushers / hot mix plant/ service stations of JCBs and other earthmoving equipments</li> </ul> <p><b>Note:</b> One Industrial visits be arranged per practical batch of students.</p>	06
<p><b>3. The Professionals/ Industrial Expert Lecture/s</b></p> <p>Experts / Professionals from different field/industries are invited to deliver lectures of 2 Hrs. duration at least TWO occasions. The topics may be selected by the teacher / industry expert to develop required skills .The following topics may serve guidelines.</p> <ul style="list-style-type: none"> <li>• Vehicle testing. Vehicle aerodynamics &amp; design.</li> <li>• Modern automobiles systems, Hybrid motor vehicles, electric vehicles, MPFI, ABS etc.</li> <li>• Environmental pollution &amp; control, Automobile pollution, norms, act.</li> <li>• Earth moving machines.</li> <li>• Biotechnology</li> <li>• Nanotechnology</li> <li>• CAD, CAM, Computer Integrated Manufacturing, Material resources</li> </ul>	06



<p>planning, Enterprise resources planning</p> <ul style="list-style-type: none"> <li>• Product design and modeling, Rapid prototyping</li> <li>• Programmable logic controllers, Automation, Robotics, Automated Guided Vehicles, Non industrial robots,</li> <li>• TQM, 5S, JIT, KAIZEN, Lean Manufacturing., World class Manufacturing, Pokayoke, Total Productive Maintenance, Six Sigma.</li> <li>• Packaging technology</li> <li>• Appropriate technology</li> <li>• LPG / CNG conversion kit.</li> <li>• Current HR Policies, Labor Act.</li> <li>• ISO implementation,</li> <li>• Import – Export policies and procedures, Taxation.</li> <li>• IPO, Mutual Fund, FPO, Share- Commodity trading and Investment.</li> <li>• Role of Insurance, Value Assessors in industry and society, Vehicle valuers,</li> <li>• Trends in modern agriculture engineering</li> <li>• Sustainable development, Green Environment, Solar and alternative fuels, Rain water harvesting, Disaster management.</li> <li>• Innovation Principles.</li> <li>• Opportunities in software industries.</li> <li>• Supply chain management. E-commerce.</li> <li>• Energy Audit.</li> <li>• Road Safety, Road Signs, Prevention of accidents on Roads, First aid.</li> </ul> <p>Note: The brief report to be submitted on these lectures by each student as a part of Term work</p>	
<p><b>Topic 4. Students Quality Circles:</b> The students should form Quality Circles consisting of group of six to eight students and brain storm on various problems faced by students, use QC tools to find root causes and alternative solutions.</p> <p>Following are some of the problems undertaken by students Quality Circle - Poor vocabulary of Diploma Engineering students Poor practical skills of Diploma Engineering students Poor Journal preparation of Diploma Engineering students Poor Entrepreneurial abilities of Diploma Engineering students Students and teacher can select different problems according to their priorities. The students should prepare QC register and Case Study presentation. Present this case study in the class.</p> <p>Such Quality Circles can participate in State level and National Level Conventions organized by Quality Circle Forum of India. For additional information visit website <a href="http://www.qcfihq.com">www.qcfihq.com</a></p>	12
<p><b>5. Seminar:</b> Seminar topic may be related to the subjects of fifth semester / topics from guest lectures. Students shall submit a report of at least 5 typed pages (font size 12 all Margins 1" A4 size) (Presentation time – 10 minutes per student)</p>	06
<p><b>6. Mini Projects: (in a group of 4-5 students)</b></p> <p>Students can choose any mini project of their interest. Mini Projects means a short term project which may be completed in 2 to 3 months and with a limited scope. Suggestive topics for guidance are as follows : CNC Programming and manufacturing, Advanced mechanism, Model making--</p>	12

conveyors, agro equipments, wax/ thermocol prototypes, factory layouts, string diagrams,. Standard Operating Procedures for various machines Students and teachers are free to select any techno-viable mini project.  Students shall arrange exhibition of all mini projects in the class/hall and present the task to the audience/ experts/examiners. The student shall submit a brief report (Max. 5 pages) of the mini project.	
<b>Total</b>	<b>48</b>

### Note for Industrial In-plant Training

#### **PART A - Term Work / Assignments mentioned in the curriculum of Professional Practices III**

#### **PART B - In plant Training (Minimum Two Weeks)**

The students who are willing to undergo In Plant Training should complete minimum two weeks training in summer vacation at the end of IVth Semester examination in following types of organizations

1. Small scale industry
2. Private Ltd organization / industry
3. Public Ltd organization
4. Machine shop / Work shop
5. Tool room
6. Press shop
7. Die manufacturing unit
8. CNC shop/Center
9. Fabrication shop
10. Foundry
11. Heat treatment shop
12. Surface plating shop
13. Rubber components manufacturing unit
14. Plastic manufacturing unit
15. Tyre retreading shop
16. Four wheeler/two wheeler service station
17. Earth moving machinery
18. Rice mill / Sugar mill / Food industry
19. Farm equipment manufacturing unit
20. CAD / CAM design unit
21. Any other relevant industry/shop in the field of Mechanical / Automobile / Production Engineering

Student should complete his report (Duly typed and bound) and submit along with Term Work in **PART - A**

**Note – Student should attach the certificate along with training report duly certified by the competent authority (Ex. Engineer/Manager/Director/Owner etc.) from the concerned industry for the validity of in plant training**

#### **Guidelines for contents in the report**

- Name and type of industry
- Plant layout (Actual)
- No of departments / employees
- Nature of product / manufacturing process/service etc.
- Types of machines / equipments used and their maintenance.
- Machine specifications/make/capacity/efficiency etc.
- Measuring instruments used, their types and applications.
- Name of components/items/subcomponents/assemblies/subassemblies produced.
- Raw materials used / inventory control.
- Quality systems employed - TQM/Kaizen / 5S / Quality circle.
- Information about customer and competitor
- Conclusion - knowledge gained by the student, skills developed / learned / enhanced.
- Opinion / view of student about in plant training.
- Any other relevant information.

Guidelines for assessment of Term Work and in plant training report

The assessment of Term Work and in plant training report shall be done on following basis

Assignments completed as per PART A (converted from D4 format)	In plant training	Total Term Work Marks
40	10	50

#### Learning Resources:

##### 1. Books:

Sr. No.	Author	Title	Publisher
01	NRDC, Publication Bi Monthly Journal	Invention Intelligence Journal	National Research Development Corporation, GOI.
02	DK Publishing	How things works encyclopedia	DK Publishing
03	QCFI Publication, Secunderabad	Quality Circle Concepts and Implementation, 5S, KAIZEN 6 SIGMA TRIZ TQM SPC TPM SMED ERP	QCFI Publication, Secunderabad Visit website <a href="http://www.qcfihq.com">www.qcfihq.com</a> for details
04	Paul Trott	Innovation Management and New Product Development 4 <sup>th</sup> Ed.(2008)	Pearson Education
05	Joe Tidd	Managing Innovation,3rd Ed.	Wiley India

##### 2. CD-ROM:

Federation of Indian Chambers of Commerce and Industries (FICCI) has developed 7 internationally acclaimed CD-ROM titles on various aspects of Quality Management & Business Excellence, which enable the organizations in achieving their ‘mission critical objectives’ in a cost-effective manner.

- Developing continuous improvement as an organizational strategy.
- Strategies for becoming a customer driven organization.
- Six Sigma - A breakthrough strategy.
- Seven steps to World Class Manufacturing.
- Maximizing business results and competitive advantages.
- Concise Encyclopedia of Business Excellence.
- Developing a passion to excel.

For more details log on to: [www.ficci.com/fqf03/index.htm](http://www.ficci.com/fqf03/index.htm)

### 3. Web Sites:

[www.start2think.com](http://www.start2think.com)  
[www.Innovationgoldmine.com](http://www.Innovationgoldmine.com)  
[www.engineeringforchange.org](http://www.engineeringforchange.org)  
[www.qcfihq.com](http://www.qcfihq.com)  
[www.wikipedia.com](http://www.wikipedia.com)  
[www.slideshare.com](http://www.slideshare.com)  
[www.teachertube.com](http://www.teachertube.com)