

**MAHARASHTRA STATE BOARD OF VOCATIONAL EDUCATION EXAMINATION, MUMBAI - 51**

1	Name of Course	Diploma Course in CAD-CAM									
2	Course Code	303416									
3	Max no. of Students	25									
4	Duration	2 Year									
5	Course Type	Full Time									
6	No. of Days per week	6 days									
7	No. of hours per day	7 Hrs									
8	Space require	Theory Class Room – 200 sqft Three Practical Lab – 500 sqft each									
9	Entry qualification	SSC Pass									
10	Objective of syllabus	To get knowledge of cad systems and its uses, Learn the NC machines, their keyboards and operating, create awareness about the concepts and principle of Graphics, To Draft various types of 2D / 3D drawing & Solid Modeling, To create solids & Generate the NC Program, To create Specific programs on CNC Machines.									
11	Employment opportunities	The student can get jobs in industries or with working experience will be in a position to start his own independent Business.									
12	Teachers Qualification	1) For Vocational subject - B.E.Mech. 2) For Non Vocational Subject - Master Degree in Concern subject									
13	Teaching Scheme –										
	Sr.	Subject	Subject Code	Clock Hours / Week				Total			
				Theory	Practical						
	1	English (Communication Skill)	90000001	2 Hrs	1 Hrs			3 Hrs			
	2	Elective – I		2 Hrs	1 Hrs			3 Hrs			
	3	Elective – II		2 Hrs	1 Hrs			3 Hrs			
	4	Mechanical Technology and Material Science	30340001	3 Hrs	8 Hrs			11 Hrs			
	5	Machine Drawing and CAD	30340004	3 Hrs	8 Hrs			11 Hrs			
	6	CAD-CAM Theory & Practice	30340025	3 Hrs	8 Hrs			11 Hrs			
	Total							42 Hrs			
14	Internship	Two Months Summer Internship from 1 <sup>st</sup> May to 30 <sup>th</sup> June is Compulsory.									
15	Examination Scheme – Final Examination will be based on syllabus of both years.										
	Paper	Subject	Subject Code	Theory			Practical		Total		
				Duration	Max	Min	Duration	Max	Min	Max	Min
	1	English (Communication Skill)	90000001	3 Hrs	70	25	3 Hrs	30	15	100	40
	2	Elective – I		3 Hrs	70	25	3 Hrs	30	15	100	40
	3	Elective – II		3 Hrs	70	25	3 Hrs	30	15	100	40
	4	Mechanical Technology and Material Science	30340001	3 Hrs	100	35	3 Hrs	100	50	200	85
	5	Machine Drawing and CAD	30340004	3 Hrs	100	35	3 Hrs	100	50	200	85
	6	CAD-CAM Theory & Practice	30340025	3 Hrs	100	35	3 Hrs	100	50	200	85
										900	375
16	Teachers – Three Teachers per batch for vocational component. For English, Elective-I & II guest faculty on clock hour basis.										
17	a) For Elective I – Student can choose any one subject Code Subject Name 90000011 Applied Mathematics 90000012 Business Economics 90000013 Physical Biology (Botany & Zoology) 90000014 Entrepreneurship 90000015 Psychology						b) For Elective II – Student can choose any one subject Code Subject Name 90000021 Applied Sciences (Physics & Chemistry) 90000022 Computer Application 90000023 Business Mathematics				

Subject Name - **Mechanical Technology and Material Science**

Subject Code - 30340001

Theory – 1 <sup>st</sup> year	Practical – 1 <sup>st</sup> year
<b>1] Fundamental of material</b> <ul style="list-style-type: none"><li><input type="checkbox"/> Introduction of metals and non metals</li><li><input type="checkbox"/> Structure of metal</li><li><input type="checkbox"/> Formation of grain</li><li><input type="checkbox"/> Imperfection in crystals</li><li><input type="checkbox"/> Deformation in metal and change in properties</li><li><input type="checkbox"/> Fracture</li><li><input type="checkbox"/> Equilibrium diagram</li><li><input type="checkbox"/> Iron, carbon equilibrium diagram</li><li><input type="checkbox"/> Time temperature transformation diagrams</li></ul>	1. Take the tensile test of M.S. specimen & Draw stress strain diagram, yield pts.
<b>2 Ferrous metals and alloys</b> <ul style="list-style-type: none"><li><input type="checkbox"/> Pig iron and cast iron</li><li><input type="checkbox"/> Effect of chemical elements on iron</li><li><input type="checkbox"/> Classification of steel and its application</li><li><input type="checkbox"/> Alloy steel and special alloy steel</li></ul> <b>3 Non Ferrous metals and alloys</b> <p>Introduction to non ferrous alloys</p> <ul style="list-style-type: none"><li><input type="checkbox"/> Aluminum and its alloys</li><li><input type="checkbox"/> Copper and its alloys</li><li><input type="checkbox"/> Lead and its alloys</li><li><input type="checkbox"/> Nickel and its alloys</li><li><input type="checkbox"/> Alloys for high temperature service</li><li><input type="checkbox"/> Metal for nuclear energy</li></ul>	2. Study the mechanical properties like Elasticity, ductility, malleability, Brittleness, toughness of Different materials – M.S., C.S. Bronze, Copper, Aluminum Study the Hardness test <ul style="list-style-type: none"><li><input type="checkbox"/> Brinell Hardness test</li><li><input type="checkbox"/> Rockwell hardness test</li></ul>

#### **4 Crystal Structures**

- ☐ Fundamental concept
- ☐ Unit Cells
- ☐ Metallic crystal structures
- ☐ FCC Structure
- ☐ BCC Structure
- ☐ HCP Structure
- ☐ Weld ability

#### **5 Properties of Metal**

##### ☐ **Mechanical properties of Metal**

Elasticity, ductility, malleability, brittleness, Toughness, Stress strain behavior, Elastic limit, hooks Law, UTS, poissons ratio, factor of safety, hardness and hardness tests shear strength, resistance.

##### ☐ **Electrical properties of Metal**

Electrical conductivity, resistivity, electrical Characteristic of commercial alloys

Theory – 1 <sup>st</sup> year	Practical – 1 <sup>st</sup> year
<p><input type="checkbox"/> <b>Thermal properties of metal</b></p> <p>Heat capacity, thermal expansion, thermal Conductivity, thermal stress</p> <p><b>6 <input type="checkbox"/> Magnetic Properties of metal</b></p> <p>Basic concepts, diamagnetism and Para magnetism, ferromagnetism, influence of temperature on magnetic behavior, domain and hysteresis, soft and hard magnetic material.</p> <p><b>7 Heat Treatment of material</b></p> <p><input type="checkbox"/> Normalizing</p> <p><input type="checkbox"/> Hardening</p> <p><input type="checkbox"/> Quenching and tempering</p> <p><input type="checkbox"/> Annealing</p> <p><input type="checkbox"/> Stress Relieving</p> <p><input type="checkbox"/> Case carburizing and case hardening.</p> <p><input type="checkbox"/> Toughening</p> <p>Weld ability of Metal definition and concept Effect of alloying elements on weld ability Purpose and types of weld ability tests</p>	<p>3. Study the Electrical Properties of some conductors (conductivity, Resistivity) Aluminum,  Copper, Brass, Tungsten</p>
<p><b>8 Cracking phenomena in steel</b></p> <p><input type="checkbox"/> Cold crack due to hydrogen</p> <p><input type="checkbox"/> Hydrogen cracking</p> <p><input type="checkbox"/> Measurement and control of hydrogen in the deposited weld metal</p> <p><input type="checkbox"/> Cracking mechanism in the weld metal and HAZ</p> <p><input type="checkbox"/> Weld decay</p> <p><input type="checkbox"/> Lamellar tearing</p> <p><input type="checkbox"/> Hot cracking</p> <p><input type="checkbox"/> Reheat cracking</p>	<p>4. Study the effect on materials with heat treatment Normalizing, Hardening, Quenching &amp;  Tempering Annealing, Stress Relieving, Case Hardening, Toughening For Different Material's M.S., C.S., Nickel, Copper</p>

Theory – 2 <sup>nd</sup> year	Practical – 2 <sup>nd</sup> year
<p><b>1 Bench work and fitting</b></p> <p>Introduction- Vices – Hammers- Chisels-</p> <p>Chipping- Files- Filing- Scraper-Scraping- Grinding and Polishing- Hacksaw sawing- Marking tools – Surface plate- Scriber – Punch- V block- Angle plate- Try square – Marking out –</p> <p>Drill- Drilling- Reamer- Reaming- Taps- Tap drill size-Tapping – Dies and stock- Dieing.</p> <p><b>2 Sheet Metal Work</b></p> <p>Introduction – Metal used in sheet metal work-</p> <p>Sheet metal hand tools- Sheet metal operation-Sheet metal joint- Hems and Sems – Sheet metal allowance- Sheet Metal working</p> <p>machine-Laying out a pattern</p> <p><b>3 Plumbing, Threading, Fasteners &amp; joints</b></p> <p>Plumbing- Specifications of pipes- Material used</p> <p>for pipes-Pipe fitting &amp; Joints-Taps &amp; valves – Plumber tools – Threaded fasteners- screw threads and their uses- Indian standard</p> <p>threads-Cap screw and machine screw-Set screw- Methods of producing screw threads- Bolts- Studs- Forms of nuts- Riveting joints.</p> <p><b>4 Smithy and Forging</b></p> <p>Maintenance and application of smith health- Anvil- Swage block-Tongs-Hammer-Flatters- Measuring tools e.g.-Try square- Steel rules- Calipers-Operations e.g. up setting- drawing down- bending setting- forge welding.</p>	<p><b>Fitting</b></p> <p>1. Filing Flat surfaces:</p> <p>Checking flatness and square ness using a try square –</p> <p>Types of filing – Cleaning files.</p> <p>2. Chipping: Hints on chipping</p> <p>3. Hack sawing: Selection of blades for different metal sections - Fix hack</p> <p>sawing the material for the job blades maintaining. Correct tension and</p> <p>direction – Hack sawing. Filing ‘V groove and complex profile by file &amp;</p> <p>check with profile gauge.</p> <p>4. Filing radius –check with radius gauge</p> <p>5. Check profile with profile gauges.</p> <p>6. Drill plate, Drilling, counter sinking, counter boring. Operations on job</p> <p>7. Drilling and Tapping: Internal threading of holes by using hand taps –</p> <p>determine the tap drill size, drilling, counter-sinking and tapping –</p> <p>precautions with tapping a blind hole.</p> <p>8. External thread cutting using die.</p>

## **5 Welding Technology**

Welding Welding introduction to different welding processes, like gas Welding, ARC welding TIG, MIG, submerged arc welding, spot Welding, electrodes etc. Brazing methods & application, Knowledge of welding skills.

## **6 Metal Turning (Lathe)**

6.1 Function of lathe, Types of lathe, the size of lathe, Descriptions & function of lathe parts,

6.2 Lathe accessories and attachments.

6.3 Operation on Lathe

6.4 Cutting Tools, Classification , Influence of tool angles.

6.5 Types of tools, cutting speed, Feed, Depth of cut,

6.6 Machining time. Cutting tool signature.

Theory – 2 <sup>nd</sup> year	Practical – 2 <sup>nd</sup> year
<p><b>7 DRILLING</b></p> <p>Introduction Types of drilling machine, Portable drilling machine, Sensitive drilling machine. Upright drilling machine, Radial Drilling Machine; Gang drilling machine, Multiple spindle drilling machine Automatic drilling machine, Deep hole drilling machine; The size of a drilling machine, Upright drilling machine parts. Radial drilling machine parts, Work holding devices, Tool holding devices, Drilling machine operation, Drilling machine tools.</p> <p>Twist drill nomenclature. Drill size Designation of drill material Reamer, reamer nomenclatures. Counter bore, Countersinks and spot face, Taps. Tap nomenclatures. Cutting speed Feed, Depth of cut, Machining time in drilling</p>	<p><b>Basic Workshop Practice</b></p> <p>1. Step turning and Radius forming: Free hand form turning – by using form tool.</p> <p>2. Drilling and Boring-Use of inside caliper and outside Micrometer for bore measurement.</p> <p>3. Drilling and reaming: by hand-Method of checking the bore With a plug gauge.</p> <p>4. Drilling and step Boring: Boring blind hole with a boring tool.</p>
<p><b>8 SHAPER</b></p> <p>Introduction. Types of shapers. Principal parts. Shaper size; Shaper mechanism; Work holding devices. Shaper operations. Shaper tools; Cutting speed, feed and depth of cut; Machining time.</p> <p><b>9 SLOTTING</b></p> <p>Introduction. Types of slotting machine; Slotter size; Slotting machine parts; Work holding devices; Slotter operation; Slotter tools; Cutting speed, feed and depth of cut.</p>	<p>5. Drilling, Boring and Recessing: Internal recessing to a size broader than the width tool – Form a recess.</p> <p>6. Shaping blind &amp; open keyways on shaping machine</p> <p>7. Shaping irregular surfaces.(Concave / Convex)</p>
<p><b>Powder Metallurgy</b></p> <p>Introduction- Process Description- Manufacture of metal powder- Blending of powders- competing profiteering- Sintering- Secondary operation –ISO Static pressing – Product of</p> <p>powder metallurgy-Advantages of process – Disadvantages and limitation-Design considerations Introduction to CNC</p>	<p>8. Slotting internal grooves on slotting machine</p> <p>9. Welding Practical-fusion run with/without filler rod on MS Sheet – squire butt joint on MS sheet LAP,T&amp; Edge joint on M.S. Sheet</p>

**List of Books**

- 1 M. N. Uppal A Text - book of engineering Chemistry
- 2 V. P. Mehta A Text - book of polytechnic Chemistry
- 3 Banswal, Mahajan and Mehta A Text - book of, Applied Chemistry
- 4 Hazra Choudhary Elements, of workshop technology
- 5 S.K.Hajra Choudhary Elements of workshop technology Vol-I First 1964 Media promoters & Publisher pvt. Ltd.
- 6 Mahajan Mechanical Technology Third 1989 Vrinda publication

**Sr. No. Name of the equipment/ machinery NOS.**

1	TRAINEES TOOL KIT	5
2	Try Square 10 cm Blade	5
3	Calipers outside 15 cm spring	5
4	Caliper inside 15 cm spring	5
5	Dividers 15 cm Spring	5
6	Calipers 15 cm Hermaphrodite	5
7	Scriber 15 cm	5
8	Punch center 10 cm	5
9	Screw driver 15 cm	5
10	Chisel cold 20 cm	5
11	Trammel 30 cm	5
12	Hammer ball peen 0.5 kg with handle	5
13	Hammer Mallet	5
14	Hammer Plastic	5
15	Hammer ball peen 0.5 kg with handle	5
16	File flat 25 cm second cut	5
17	File flat 25 cm second cut	5
18	Hacksaw frame adjustable 20-30 cm	5
19	Dot slot punch	5



20	Steel rule 15 cm English and metric	5
21	Steel rule 30 cm English and metric	5
22	Try square 20 cm Blade	5
23	Steel tool box	5
24	Scriber	5
25	Lock and keys	5
26	Combination plier	5
27	Jenny calipers	5
28	Aluminum tray 15 cm X 10 cm	5
29	Fellow polish cloth standard size	5

	<b>SHOP OUTFIT &amp; MEASURING INSTRUMENTS</b>	
30	Straight edge 45 cm X 45 cm	1
31	Marking table 90X90 cm	1
32	Surface plate 45 cm X 45 cm	1
33	Vee Block pair 7 cm and 15 cm with clamps	1
34	Angle plate 10 X 20cm	1
35	Number Punch 3 mm set	2
36	letter Punch 3 mm set	2
37	Round punch 3 mm X 4 mm set of 2	2
38	File flat 20 cm bastard	2
39	Oil Stone 15 X 5 cm X 2.5 cm	
40	Spanner adjustable 10 cm	1
41	Chisel cold 20 cm cross cut	2
42	Chisel 10 cm flat	2
43	Drill twist 1.5 mm to 15mm (various sizes) by 0.5	2
44	Files assorted sizes and type including safe edge	10
45	Micrometer inside 50-150 mm with screen	2
46	Bench Vice 12 cm jaw	5
47	Work Bench 240 X 120 60 mm with screen	3
48	Drill point angle gauge	1
49	Vernier Calipers 20 cm	2
50	Vernier height gauge 30 cm	1
51	Huntington and diamond dresser	1
52	Taps and dies complete set (metric)	2 set
53	Hacksaw frame	5
54	Fire buckets with stand	1
55	Thread pitch gauge metric, BSX, BSF, MC, MF & SAE	1 each
56	D.E. spanner ser of 12 metric 6 mm to 32 mm	1 set
57	Ring spanner set at 12 metric 6 mm to 32	1 set

58	Stud extractor set of 3	1 set
59	Universal puller for removing pulleys, bearings	1 set
60	Unserviceable engine/gear box rear axle	1
61	Stud remover with socket handle	1
62	Combination pliers 15 cm	5
63	Depth guage (inch and metric	1
64	Screw pinch gauge (inch and metric)	1 set
65	Feeler gauge 20 blades (inch and metric)	1
66	Aluminum tray 45 X 30 mm	5
67	Oil can 0.5 liter capacity	1
68	Surface gauge	1
69	Cylinder bore gauge (mercer)	1
70	Telescopic gauge	1
71	Steel measuring tape 10 meter in a case	2
72	Sets of Morse socket MT 0-1,1-2,and 2-3	1 set
73	Blow lamp	1
74	Torque wrenches 5-35 Nm,12-68 Nm&50-225 Nm.	1 each
75	Outside micrometer English 0-1,1-2,2-3,3-4,4-5,And 5-6 inches	1 each

76	Micrometer outside 1 to 25 mm,25mmto 50mm ,50 to75 mm,75 to100mm,100 to 125mm,125 to 150mm.	1
77	Surface gauge with dial test indicator plunger type i.e. 0.01 mm	1
78	Printed wall chart framed for display showing measuring instruments.	10
79	Inside micrometer English 2" to 6" with extension road	1
80	Vernier bevel protractor (metric and inch )	1
81	Vernier calipers (inch and metric) 6"x12"	1
82	Vernier micrometers(inch and metric)	1
83	Vernier height gauge 150 mm height (inch and metric)	1
84	Dial micrometer (inch and metric)	1
85	Small bore gauge (standard )	1
86	Dial test indicator to read (inch an metric)0.02mm	1
	<b>GENERAL INSTALLATOIN /MACHINERIES</b>	
87	Radial Drilling Machine 25mm capacity	1
88	Power Hacksaw	1
89	Rotary Cut off Machine	1
90	Shaping machine	1
91	Hydraulic Press 2 ton capacity	1
92	Surface plate (small)	1
93	Surface plate (big)	1
94	Standard Arc Welding machine	1
95	Horizontal milling machine	1
96	Bench Drilling machine 6-12mm cap Motorized with chuck and key	1
97	Grinding machine (general purpose )D.E. pedestal with 300mm dia wheels rough and smooth	1
98	Hydraulic Trainer with Power pack	1
99	Pneumatic Trainer	1
	<b>Workshop furniture</b>	
100	Suitable Work Tables with vices As required	1
101	Stools 25 Nos	25

102	Tool Cabinet 2 nos	2
103	Trainees locker 2 nos	2
104	Fire fighting equipment , first aid box etc As required	1
105	Book shelf (glass panel) 1 nos	1
106	Storage Rack As required	2
107	Storage shelf As required	2

Subject Name - Machine Drawing and CAD

Subject Code - 30340004

Theory – 1 <sup>st</sup> year	Practical – 1 <sup>st</sup> year
<p><b>1 INTRODUCTION OF DRAWING</b></p> <p>Use of different drawing instruments, equipments &amp; Drafting Techniques, Types of letters, conventions of line, Scales; plane scale and diagonal scales.</p> <p><b>2 CURVES &amp; TANGENTIAL EXERCISES</b></p> <p>To draw an ellipse by</p> <ol style="list-style-type: none"><li>1. Arcs of circle method</li><li>2. Concentric circle Method</li><li>3. Rectangle / oblong method;</li></ol> <p>To draw a parabola by</p> <ol style="list-style-type: none"><li>1. Director focus method</li><li>2. Rectangle method;</li></ol> <p>To draw hyperbola</p> <ol style="list-style-type: none"><li>1. Transverse axis and focus Method</li><li>2. Passing Through a given point;</li></ol> <p>To draw an Involute of</p> <ol style="list-style-type: none"><li>1. A polygon (up to Hexagon)</li><li>2. A circle. To draw a cycloid, epicycloid &amp; hypocycloid.</li></ol> <p><b>3 ORTHOGRAPHIC PROJECTIONS</b></p> <p>Introduction to orthographic projections, first and third angle Method of projection, conversion of simple pictorial view into Orthographic view Dimensioning technique</p>	<p><b>PRACTICAL</b></p> <p>1. Practice: Layout of drawing sheet</p> <p>Types of lines – Thickness, shade of lines and its General applications. Practice: Draw type of lines as per IS-70714-1983</p> <p>Type of Angle, Triangles and their types.</p> <p>Dimensioning- Types of dimension, elements of dimensions, Methods of indicating</p> <p>Values, Arrangement and indication of dimensions.</p> <p>Place dimensions in the drawing by aligned system and unidirectional system, Give dimension to the given drawing by following dimensioning principles as per BIS Method of dimension common features</p> <p>Geometrical construction using drawing instruments-Lines, Angles, patterns, Circle, Arc, Tangents, Triangles, Quadrilaterals, Regular Polygons. Different type of Tapers, Related Exercise on this topic.</p> <p>1. Practice: Construct square, rectangle, parallelogram, rhombus, trapezium and quadrilateral</p> <p>2. Practice: Draw a regular pentagon by circumscribing &amp; inscribing</p> <p>3. Practice: Draw a regular hexagon by arc method</p> <p>4. Practice: Draw a regular pentagon, octagon and various types of tapers</p> <p>5. Free hand sketching of straight lines, rectangular, circles, squares, Polygons,</p>

<p><b>4 SECTIONAL VIEWS</b></p> <p>Conversion of given pictorial view into sectional orthographic views.</p> <p><b>5 ORTHOGRAPHIC VIEWS</b></p> <p>Isometric scale and views of simple objects; isometric views of Rectangular, cylindrical objects and Representations of slots on Sloping faces.</p> <p><b>6 PROJECTIONS OF LINES</b></p> <p>Projections of solids- prism, prism, cone, cylinder, Tetrahedron; axis Inclined to one reference plane only.</p> <p><b>7 SECTION OF SOLIDS</b></p> <p>Sections of the solids-prism, pyramid, cone, cylinder, Solids resting on their bases on the Ground Section plane is inclined to one Reference plane and perpendicular to other</p>	<p>ellipse.</p> <p>6. Practice: Prepare proportionate free hand sketches of plane figures</p> <p>7. Practice: Sketch horizontal, vertical and inclined line by free hand, Draw circles by free hand using square and radial line method, Draw arcs and ellipse by free hand</p> <p>Orthographic projection I and III angle – Simple machine elements, Procedure for preparing a scale drawing.</p> <p>8. Practice: Draw a plan, elevation and side view of prism and cylinder, cone and pyramids</p> <p>9. Practice: Draw 1<sup>st</sup> angle and 3<sup>rd</sup> angle projection (i) Front View (ii) Top view and (iii) side view of object having stepped blocks with curved surfaces – simple machine elements. Drawing Isometric views out of orthographic views – Simple Machine Elements</p> <p>10. Practice: Construct an isometric scales to a given length</p>
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<p><b>8 CONVENTIONAL REPRESENTATION</b></p> <p>Introduction; Conventional Representation of Material; Conventional breaks, Machine components such as splinted shaft; bearings, slotted heads, raced &amp; pinion, Internal &amp; External Threading, Springs, Gears, Pipe fitting &amp; pipe joint, Welded joint; Practice Drawing of all type of Conventions in the sketch book.</p> <p><b>9 LIMIT FITS &amp; TOLERANCES</b></p> <p>Process Tolerance, Machining symbol, Induction of machining Symbol, Indication of surface roughness characteristics, symbol for direction of lay; Induction of machine allowance, position of Specification of surface roughness, Indication of drawing, Introduction of dimensional; Tolerances Element of Interchangeable system, Tolerance; Fundamental tolerance, Calculation of limit size, Method of specifying dimensions of fit, limit &amp; Tolerance, Geometrical Tolerance, form tolerance, Position Tolerance, Indication of Geometrical Tolerance; types of geometrical Tolerance.</p>	<p>11. Practice: Draw the isometric projection of cube, hexagonal prism, cylinder and cone</p> <p>12. Practice: Draw the isometric view of the objects/blocks/solids with curved surfaces</p> <p>Missing lines and views.</p> <p>13. Practice: Visualize the shape of the object from the given two views and add the third</p> <p>views – simple machine elements</p> <p>14. Practice: Identify the lines missed in multi views and supply them. Identify at least five shapes satisfying a given view.</p> <p>One problem on each projection of lines and plane are to be drawn in A-3 size sketch book.</p> <p>15. Identify the third view for the given two views of similar in shapes and size.</p> <p>Development of regular objects bounded by plane surfaces-cube, prisms, cylinder and cones.</p> <p>16. Practice: Draw the development of surfaces of a cube and prism</p> <p>17. Practice: Draw the development of surfaces of a cylinder and cones</p> <p>Explanations of full – sectional view, half-sectional view, aligned sections.</p>
<p>10</p> <p><b>PRODUCTION DRAWING</b></p> <p>Introduction, need, scope; Production drawing procedure,</p> <p>Production drawing for, Nut &amp; Bolt, Spur gear, Fly – cotter joint Wheel, V belt pulley.</p>	<p>18. Practice: Draw full and half sectional view of simple machine elements. Conventions and symbols used in drawing, Abbreviations used in engineering drawing, surface finish symbols, Welding symbols and Annotations.</p> <p>19. Practice: Draw surface finish symbols, Welding symbols and Annotations.</p> <p>Machining symbol, Induction of machining Symbol, Indication of surface roughness characteristics,</p> <p>symbol for direction of lay; Induction of machine allowance, position of Specification</p>



	<p>of</p> <p>surface roughness, Indication of drawing, Blue print reading of various Engineering drawing and Machine drawing.</p> <p>20. Practice: Blue print reading of Engineering Drawings and Machine drawing.</p> <p>Introduction to free hand sketching of machine parts. Tracing and printing of drawing.</p> <p>Introduction to Auto CAD, 3D modeling concept.</p> <p>21. Practice: Draw the elevation, plan and the side view of Nut &amp; Bolt, Spur gear, and Fly cotter joint Wheel, V belt pulley.</p>
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## Machine Drawing and CAD – 2<sup>nd</sup> Year

Theory	Practical
<b>A] Computer Fundamental</b>	
<b>1] Fundamentals Of Computer</b>  Introduction  Components of PC  The system Unit  Front part of system Unit  Back part of system Unit  CPU  Memory of computer  Monitor  Mouse, Keyboard Disk, Printer, Scanner, Modem,  Video, Sound cards, Speakers	<b>List of Practical</b>  1. Working with Windows 2000 desktop ,start icon, taskbar, Recycle Bin, My Computer icon ,The Recycle Bin and deleted files Creating shortcuts on the desktop  2. The Windows 2000 accessories, WordPad – editing an existing document, Use of Paint – drawing tools  The Calculator, Clock  3. The Windows Explorer window, concept of drives, folders and files? Folder selection techniques, Switching drives, Folder creation, Moving or copying files, Renaming, Deleting files ,and folders  4. Printing, Installing a printer driver, Setting up a printer, Default and installed printers, Controlling print queues, Viewing installed fonts, The clipboard and 'drag and drop', Basic clipboard concepts  Linking vs. embedding,
<b>2] Introduction To Windows 2000/Xp</b>  Working with window Desktop  Components of window Menu bar option  Starting window Getting familiar with desktop  Moving from one window to another  Reverting windows to its previous size  Opening task bar buttons into a windows  Creating shortcut of program  Quitting windows	5. Moving through a Word document menu bar and drop down menus toolbars  6. Entering text into a Word 2000 document, selection techniques Deleting text  7. Font formatting keyboard shortcuts  8. Paragraph formatting Bullets and numbering  9. Page formatting What is page formatting? Page margins Page size and orientation Page breaks, Headers and footers  10. Introducing tables and columns
<b>3] GUI Based Editing, Spreadsheets, Tables &amp; Presentation</b>  Application Using MS Office 2000 & Open Office.Org Menus Opening, menus, Toolbars, standard toolbars, formatting toolbars & closing Quitting Document , Editing & designing your document Spreadsheets  Working & Manipulating data with Excel  Changing the layout Working with simple graphs	11. Printing within Word 2000 Print setup Printing options Print preview  12. Development of application using mail merge  Mail merging addresses for envelopes Printing an addressed envelope and letter  13. Creating and using macros in a document  14. Creating and opening workbooks Entering data  15. Navigating in the worksheet Selecting items

Presentation Working With PowerPoint and Presentation	within Excel 2000 Inserting and deleting cells, rows and column Moving between worksheets, saving worksheet, workbook
<b>4] Introduction To Internet</b>  What is Internet  Equipment Required for Internet connection  Sending &receiving Emails  Browsing the WWW  Creating own Email Account  Internet chatting	16. Formatting and customizing data  17. Formulas, functions and named ranges  18. Creating, manipulating & changing the chart type  19. Printing, Page setup, Margins  Sheet printing options, Printing a worksheet  20. * Preparing presentations with Microsoft Power Point. Slides and presentations, Opening an existing presentation , Saving a presentation
<b>5] Usage of Computer System in various Domains</b>  Computer application in Offices, books publication data analysis ,accounting , investment, inventory control, graphics, database management, Instrumentation, Airline and railway ticket reservation, robotics, artificial intelligence, military, banks, design and research work, real-time, point of sale terminals, financial transaction terminals.	21. Using the AutoContent wizard ,Starting the AutoContent wizard, Selecting a presentation type within the AutoContent wizard Presentation type  Presentation titles, footers and slide number  22. Creating a simple text slide, Selecting a slide layout  Manipulating slide information within normal and outline view, Formatting and proofing text, Pictures and backgrounds, drawing toolbar, AutoShapes, Using clipart, Selecting objects, Grouping and un-grouping objects, The format painter

## Machine Drawing and CAD – 2<sup>nd</sup> Year

Theory	Practical
	<p>23. Creating and running a slide show, Navigating through a slide show, Slide show transitions, Slide show timings. Animation effects</p> <p>24. Microsoft Internet Explorer 5 &amp; the Internet</p> <p>Connecting to the Internet The Internet Explorer program window, The on-line web tutorial Using hyper links, Responding to an email link on a web page</p> <p>25. Searching the Internet, Searching the web via Microsoft Internet Explorer, Searching the Internet using Web Crawler, Searching the Internet using Yahoo, Commonly used search engines</p>
<p><b>6] Information technology for benefits of community</b></p> <p>Impact of computer on society</p> <p>Social responsibilities</p> <p>Applications of IT</p> <p>Impact of IT</p> <p>Ethics and information technology</p> <p>Future with information technology</p>	<p>26. Favorites, security &amp; customizing Explorer Organizing Favorite web sites Customizing options – general, security, contents, connection, programs, advanced</p> <p>27. * Using the Address Book Adding a new contact</p> <p>Creating a mailing group, Addressing a message, Finding an e-mail address</p> <p>28. Using electronic mail, Starting Outlook Express</p> <p>Using the Outlook Express window, Changing the window layout, Reading file attachment, Taking action on message-deleting, forwarding, replying</p> <p>29. Email &amp; newsgroups, Creating and sending emails</p> <p>Attached files, Receiving emails, Locating and subscribing to newsgroups, Posting a message to a newsgroup</p> <p>30. Chatting on internet, Understating Microsoft chat environment, Chat toolbar</p>
<p><b>Minimum system requirement for AutoCAD</b></p> <p><b>Starting AutoCAD</b> – Use a Wizard, Use a Template, Start from Scratch, Open a Drawing, Quick Setup method, Advanced Setup method, Types of Units, <b>AutoCAD Window Details</b> – Menus, Toolbars, Command line area, Drawing area, WCS icon etc, Use of Function keys,</p> <p><b>Modes in AutoCAD</b> – Snap, Grid, Ortho, Osnap, Polar, Otrack, Model</p> <p><b>Using various Toolbars</b>, Creating new drawing, Saving</p>	<p>Practical related Creating New file, Closing Drawing, Saving Drawing, Startup Methods, Modes in AutoCAD,</p> <p>Use of Function Keys, Use of Keyboard and Mouse in AutoCAD Practice.</p> <p>CAD Command Practice on small objects</p>

<p>a drawing, Closing a drawing, Opening a drawing, Use of mouse in AutoCAD, Use of Keyboard,</p> <p><b>Coordinate system</b> – Types of Coordinate, Absolute, relative, polar coordinate</p> <p><b>Draw commands</b> – Line, Ray, Construction line, Spline, rectangle, Polygon, circle, ellipse, Arc, Donut, Polyline, Multiline, Multiline Style, Point, Point Style, Divide, measure</p> <p><b>Zoom commands</b> – Real-time zoom, pan real-time, zoom window, zoom all, zoom in, zoom out, zoom center, zoom dynamic. Zoom scale, zoom previous.</p>	
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## Machine Drawing and CAD – 2<sup>nd</sup> Year

Theory	Practical
<p><b>Object Snapping</b> – Dialog box, Toolbar, Tracking, snap p from, end point, mid point, center, intersection, apparent intersection, insertion, quadrant, tangent, perpendicular, node etc.</p> <p><b>Editing commands</b> – Setting drawing limit, setting units, drawing area parameter, Copy, move, erases, opps, scale, rotate, stretch, lengthen, break, trim, extend, chamfer, fillet, mirror, offset, align, explode, array – rectangular &amp; polar, editing using grips, edit Polly line, edit multiline, using property dialog box., Match property, using single line text, using multiline text, editing text, creating text style.</p> <p><b>Dimensioning technique</b> – Linear, Aligned, Radius, Diameter, Angular, Baseline, Continuous, Leader, Center mark, creating dimensioning style.</p> <p><b>Block, Wblock, Attribute.</b></p> <p><b>Hatch, Boundary, Region.</b></p> <p><b>Object property toolbar</b> – layer control, color control, Line type control, line weight control, working with layers, (freeze, thaw, lock, unlock, plot etc.)</p> <p><b>Printing and using scale in the drawing.</b></p>	<p>Practice on Small Drawing Objects using Commands in</p> <p>Draw Menu Practice of Editing command on above drawing objects, Dimensioning Drawing</p> <p>Creating Title block, Creating Part List, Material List using Text in AutoCAD,</p> <p>Drawing Plan, Elevation, Section, in AutoCAD for various mechanical objects, machine part etc.</p>
<p><b>Viewing</b> Orthographic projections, Viewing Isometric projections, Plan View, Aerial View Window, Using Named Views, Using multiple Tiled View ports – New view ports, Polygonal View ports, object viewports, named view ports, joining viewports, Floating viewports in paper space, Region, Redraw, Regen all command.</p> <p><b>Shading</b> the model – 2D wireframe, 3D wireframe, Flat shaded, Gauged shaded, hidden view Region, Redraw, Regen all command.</p> <p><b>Interacting Viewing in 3D</b> – 3D orbit command, panning, zooming, adjusting the view, Adjusting the camera distance, swiveling the camera, Continuous orbit, using Visual aids – Compass, Grid, UCS icon etc Concept of Wire frame modeling, Surface modeling, Solid modeling, Concept of Thickness &amp; Elevation</p>	<p>Suitable CAD Practical ( Command Practice) based on the Theory.</p> <p>Creating Simple 3D Model of Machine assemblies required 3D view from all sides.</p> <p>Practice of using AutoCAD Mechanical Desktop package for creating various 3D Machine Elements.</p>
<p><b>Surface modeling</b> – Ruled surface, Edge surface, Revolve surface, Tabulated surface, 2D solid, 3D face, Using Predefined 3D surface objects – Box, pyramid, Wedge, dome, sphere, cone, tours, dish, mesh.</p> <p><b>Solid modeling</b> – Extruding solid, Revolving solid, Slicing &amp; Interfering solid, using predefined 3D solid objects - Box, pyramid, Wedge, Cylinder, Cone, Torus</p> <p><b>Modifying 3D Solid object</b> – 3D array, 3D mirror, 3D Rotate, Trim, Extend, Fillet, Chamfer etc.</p> <p><b>Boolean operation</b> – Union, Subtract, intersect.</p>	<p>Creating, Rendering, and Viewing Various Machine parts and assemblies Elements like different types of</p> <p>Screws, bolt, nut, nail, rivet, keys, cotter, locking devices, stud, plates, angle, channel, sockets, cover, packings, gasket, belt, wheels, gear, grooved parts, casting, supports base plates, pipe joints, I section joints etc.</p>

## Machine Drawing and CAD – 2<sup>nd</sup> Year

Theory	Practical
<p><b>Solid Editing</b> – Extrude face, move face, offset face, delete face, rotate face, taper face, color face, copy face, color edge, copy edge, imprinting the object, Cleaning, separating objects, shelling the solid Checking validity of solid object.</p> <p><b>Rendering 3D solid</b> – Rendering options / Rendering procedure – query, crop window, skip dialog box method, Rendering, using light effects in rendering – Distance light, point light, spot light, using Sun angle calculator for shaded model, modifying lights parameter, using lights in scene.</p> <p><b>Applying material</b> effect to solid object. Using material library. Mapping background. Using background images <b>Printing the 3D rendered view / drawing.</b></p>	<p>Creating, Rendering, Viewing, Generating JPEG images for Complete assembly model, Printing Photo with various View of machine assemblies,</p> <p>Creating Slide show presentation of such views of assembly model including All four side view, 3D view from four corner, Isometric View, Perspective View etc.</p> <p>Introduction to 3DS Max Software Package for animation Purpose.</p> <p>Introduction to Pro-Engineer, CATIA Software.</p>

### List of Books

#### **Machine Drawing**

- 1] N.D.Bhatt Elements of Engineering Drawing 49<sup>TH</sup> 2005 Charotar publishing house,opposite Amuldairy, court road Anand India
- 2] N.D.Bhatt Machine Drawing 40<sup>TH</sup> 2005 Charotar publishing house,opposite Amul dairy, courtroad Anand India

#### **Computer Fundamental**

- 1] Vikas Gupta Comdex Computer Course Kit First Dreamtech
- 2] Henry Lucas Information Technology for management 7<sup>Th</sup> Tata Mc-Graw Hills
- 3] B.Ram Computer Fundamentals Architecture and Organisation Revised 3<sup>rd</sup> New Age International Publisher

#### **CAD Books**

- 1] Reference Manual of AutoCAD AutoDesk
- 2] Reference Manual of Felix cad Felix CAD
- 3] Reference Manual of Intel CAD
- 4] Reference Manual of Auto Civil
- 5] Reference Manual of 3D-Max

### **List of Tools and Equipment**

#### **A] General Class room**

<b>Sr</b>	<b>Name of Item</b>	<b>No.</b>
1	Steel lockers 8 compartments with individual lockers (1980 x 910 x 480 mm)	4
2	Chair with writing pad	25
3	Steel almari with self 6.5' x 3' (18 gauge)	2
4	Steel table 4' x 3'	2
5	Teacher chair	2

#### **B] For Computer Fundamental and CAD Practical**

<b>Sr</b>	<b>Name of Item</b>	<b>No.</b>
1	Computer System P4 with accessories Complete with license OS. Compatible for- to run AutoCAD 2010 and Windows 7 OS.	5+1
2	Plotter- HP Design Jet 500 latest model	1
3	Scanner	1
4	Computer table	5+2
5	Chair for computer	10+2
6	Laser Printer	1
7	AutoCAD 2010 or above Software	1
8	M. S. Office Software	1
9	Pro- Engineering –V-4 Student Version	1
10	CATIA R-17 – Evolution Student Version	1





**Subject Name - CAD-CAM – Theory and Practice****Subject Code - 30340025**

<b>Theory – 1<sup>st</sup> year</b>	<b>Practical – 1<sup>st</sup> year</b>
<b>1] CAD System</b>  2] Types of manufacturing systems i) Continuous process industries. ii) Mass production iii) Batch  3] Evaluation of computer Aided Design (CAD) i) Types of Computers ii) Classification of Computers iii) Computer Codes. iv) Computer Hardware  4] Product development through CAD i) Integration role of CAD Database. ii) Benefits and cost of CAD. v) Introduction to latest CAD version.  5 CAD – Soft and Hard prototyping. i) Solid Modeling – Boolean operations. ii) CAD Files. iii) AutoCAD  6] Design and development Environment i) Graphic workstations. ii) Description of Hardware of a workstation. iii) Major workstations. a) Sun Microsystems 01 b) HP 01 c) Silicon Graphics 01	<b>Practical</b>  Create AutoCAD shortcut at desktop, open AutoCAD, close AutoCAD, create user folder for AutoCAD files,  Draw a point using absolute co ordinate system, relative coordinate system, polar coordinate system, Set limits, zoom all, zoom window, zoom previous, zoom real-time. Use snap for drawing a line.  Draw a rectangle, pentagon, hexagon, star using line command with polar coordinate system and relative coordinate system. Draw circles of various dimensions by center radius, tangent method, 3point,  SCE, SER, SEA, SCA, SCL methods, Draw ellipse with major and minor axis length method, rotation method. Draw a tapered rod using polyline command.  Convert line and arcs into ploy lines. Create spline and fit Curves using polyline edit options, Explode Ploylines.  Practice exercises on OSNAP snapping modes like endpoint, mid point, center of circle, and tangent, perpendicular quadrant of a circle with many example exercises.  Erase the entities created in the previous examples, using different types of selection like window, and single entity methods. Move the drawings created from one place to other with reference to a base point. Copy the entities using different reference and by a value.  2.1 Rotate the items at a point at different angles.  2.2 Create composite solids using Boolean addition, Subtraction And Intersection by Joining the primitives. Sketch revolved Solids like bottle, Cylinder, Pullies.  2.3 Create 3D wire frames, 3D surface meshes

<p>d) IBM 02</p> <p>7] Digital Equipment Corporations Modeling techniques General Specification of a Graphic workstation. Cad process planning</p> <p>8] <b>CAM</b> CAM Hardware</p> <p>a) CNC Machine tools.</p> <p>b) Robots</p> <p>c) Co-ordinate Measuring Machine.</p> <p>Principle of NC and Historical development.</p> <p>Types of CNC Machine tools.</p> <p>Programming of CNC Machine tools.</p> <p>i) Manual Programming</p> <p>ii) Computer aided part programming.</p> <p>iii) Geometrical Statement in APT.</p> <p>iv) Point-to-Point Programming.</p> <p>v) Programming a tool path.</p> <p>Flexible Manufacturing Systems.</p>	<p>like box, cone, Dishes, Domes, Pyramids, Spheres, Domnuts, and wedges. Use D view, Points for different viewing enhancements. Use surf Tab. Taper a face, Remove a face. Take printouts of Solid Models, cad files etc.</p> <p>3.1 Study of CNC machine, keyboard &amp; specifications.</p> <p>3.2 Machine starting &amp; operating in Reference Point, JOG.</p> <p>3.4 Co-ordinate system points, assignments and simulations.</p> <p>3.5. Absolute and incremental programming assignments and Simulations.</p>
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## CAD-CAM – Theory and Practice

Theory – 2 <sup>nd</sup> year	Practical – 2 <sup>nd</sup> year
<p>1.0 Graphic Standards</p> <p>1.1 Standards For Graphics Programming</p> <p>1.2 Features Of GKS ( Graphic Kernel Systems)</p> <p>1.3 Other Graphics Standards</p> <p>1.4 PHIGS ( Programming Hierarchical Interactive Graphics Standard )</p> <p>1.5 Difference Between GKS And PHIGS.</p> <p>1.6 Evaluation Of Data Exchange Formats.</p> <p>1.7 DXF Files.</p> <p>1.8 IGES (Initial Graphics Exchange Specification )</p> <p>1.9 Short coming Of IGES</p> <p>1.10 Product Database Format</p> <p>2.0 Automated Process Planning</p> <p>2.1 CAD Based Process Planning.</p> <p>2.2 Group Technology</p> <p>3.1 CNC Programming Based On CAD.</p> <p>3.2 Description Of The System</p> <p>i) Geometry Definition</p> <p>ii) Geometry Modification</p> <p>iii) Machining</p> <p>iv) Tool Definition</p> <p>v) Three Dimensional Geometry</p> <p>vi) Multi-axis Machining</p> <p>vii) DNC Link</p> <p>viii) Output</p> <p>4.0 Simulation's</p> <p>4.1 Definition Of Simulation, Examples Of Simulations, Need For Simulation's , Common Term Used In Simulation, Types Of Simulation Approaches, Steps In Simulation, Advantages &amp;</p>	<p>4.1 Identifications of machine over travel limits and emergency stop. Work and tool setting CNC M/C Part program preparation, Simulation &amp; Automatic Mode Execution. Simple turning &amp; Facing (step turning)</p> <p>4.2 Linear interpolation, assignments and simulations on software. Circular interpolation, assignment and simulations on soft ware. Work off set measurement and entry in CNC Control. Tool off set measurement and entry in the Part program preparation, Simulation &amp; Automatic Mode Execution CNC M/C.</p> <p>5.1 Manual Data Input (MDI) mode operations and checking of zero offsets and tool offsets. Part program preparation, Simulation &amp; Automatic mode Execution Of CNC Machine</p> <p>Geometry and wear offset correction. Part program Preparation, Simulation &amp; Automatic Mode Execution</p> <p>1. Practical on wire frame modeling.</p> <p>2. Practical on surface modeling.</p> <p>3. Practical on solid modeling.</p> <p>4 Solid modeling based Applications.</p> <p>5 Concept of haft space.</p> <p>6 Triangular element Co- ordinate system</p> <p>7 Examples of Diff simulations.</p> <p><b>8 Term-work:-</b></p>

<p>Disadvantages Of Simulation</p> <p>5.0 CNC Part Programming</p> <p>5.1 Introduction , CNC Coding ,</p> <p>5.2 Tooling For CNC Machines Controls ,</p> <p>5.3 Part Programming, Program Format, Program Structure, Direction, Of Movement, Dimensional Notation's,</p> <p>5.4 Lathe, Milling, &amp; Drilling Cycles, Subroutine,</p> <p>5.5 Computer Assisted Part Programming</p> <p>5.6 The APT Language.</p> <p>6.0 CAD/CAM Integration</p> <p>6.1 Conceptual Design Through 3 D Modeling.</p> <p>6.2 2D Drafting And Drawing.</p> <p>6.3 Relation Database Management</p> <p>6.4 M I S</p> <p>6.5 Communication Network.</p> <p>7.0 Case Studies In CAD / CAM Integration.</p> <p>7.1 Mould Making</p> <p>7.2 Bracket</p> <p>7.3Aeronautical Industry.</p>	<p><b>Term</b> work to be submitted along with the jobs, it should contain the following</p> <p>2) Job drawing</p> <p>3) Student has to maintain file of printouts from CAD practical.</p> <p>4) Student has to maintain work book, Drawing &amp; Note book of part programming of Diff jobs.</p>

### List of Books

- 1] Prof. R.B.Kelkar and Vinayak Mule CAD/CAM & Automation, Nishant prakashan
- 2] Groover, CAD / CAM
- 3] Radhakrishnan. Subramanyan CAD / CAM / CIM NewAge International publication,Pune
- 4] S.K. Hajra Choudhari A.K. Hajra Choudhari Elements of workshop Technology- II

## List of Tools and Equipment

1	CNC 2 axis turning center with Fanuc Oi-Make TC / SIEMENS SINUMERIK 802 D / LMW 20 T	1
2	CNC 3 axis Vertical machining center with FANUC / SIEMENS SINUMERIK 802 D CNC control and tooling package installation and commissioning , Hydraulic vice , maintenance kit MC – 4VA	1
3	Tool presetting m/c with digital read out for measuring length and radius with all accessories Model CARL-ZEISS PRISMO 5 VAST	1
4	CNC part program simulation soft ware with CAD – CAM Facility for SIEMENS SINUMERIK 802 D / FANUC Oi MB Turning Modules 2 Axis 8 licenses , Milling Modules 4 axis 8 licenses MASTER CAM Lathe Version 9.1 or latest	1
5	UPS power system 1 KVA , ISO 9000 certified 04	1
6	Intel Pentium IV ( 3 GHz )Computer system or latest, with 1GB RAM, 320 GB HDD, DVD Writer with Win XP license copy	5
7	Master CAM 9 or latest edition for Lathe , Mill and Design	1