3.1   ENGINEERING FUNDAMENTALS

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4 - 2

RATIONALE

A diploma holder has to assist in activities of installation, operation and maintenance etc of different machines and equipments. These activities are not branch specific and instead require him to know basics of civil, electrical and mechanical engineering. The subject of Engineering Fundamentals has been included to impart basic knowledge of electrical, electronics and civil engineering to the students.

DETAILED CONTENTS

PART-A

1.   ELECTRICAL ENGINEERING   (25 Hrs)
Theory

(i)   Application and Advantages of Electricity   (4 Hrs)
- Difference between AC and DC
- Various applications of electricity
- Advantages of electrical energy over other types of energy

(ii)   Basic Quantities of Electricity   (4 Hrs)
- Definition of voltage, current, power and energy with their units
- Name of the instruments used: voltmeter, ammeter, energy meter

(iii)   Distribution System   (4 Hrs)

(iv)   Supply from Poles to Distribution Board   (4 Hrs)

(v)   Electric Motors: (4 Hrs)
- Definition, types and various applications of single phase and three phase motors
- Connection and starting of three phase motors by star delta starter

(vi)   Measuring Instruments   (5 Hrs)
Basics of measurement, principles of measurement of DC voltage and DC current, AC voltage and AC current and resistance using a multimeter block diagram of a CRO and use for the measurement of voltage (DC and AC), frequency and to study waves shape.

LIST OF PRACTICALS

1.   Use of Megger:
      Objective: To make the students familiar with different uses of megger.

2.   Connection of a three phase motor and starter including fuses and reversing of direction of rotation.

Objective: Students may be made familiar with the equipment needed to control a three-phase motor.

The students must experience that by changing any two phases, the direction of rotation is reversed.

3. Trouble shooting in a three-phase motor

   Note: The teacher may create anyone of the following faults
   - (a) Loose connections
   - (b) Blown fuse
   - (c) Tripped overload protection
   - (d) Incorrect direction of rotation
   - (e) Single phasing
   - (f) Burnt winding to be simulated by a loose connection behind a terminal box.

   Objective: The students must be able to detect the most common faults, which may occur in a three-phase motor, using meggar wherever necessary.

4. Treatment of electric shock

   Note: The teacher may give a demonstration how an electric shock must be treated.

   Objective: Students must be trained to treat the persons suffering from an electric shock.

5 Measurement of resistors by an ordinary multimeter and their verification on the basis of colour code.

PART B

2. ELECTRONICS ENGINEERING **(21 Hrs)**

Theory

(i) Introduction (9 Hrs)
Introduction to active and passive components, introduction to intrinsic and extrinsic semiconductor, PN junction diode, mechanism of current flow in PN junction, Diode (PN junction) as rectifier; half wave rectifier, full wave rectifier and filter circuits, brief idea and typical application of power diode, zener diode, photo diode. Concept of bipolar transistor - PNP ad NPN, their characteristics and uses. Field effect transistor and single stage CE amplifier circuit

(ii) Digital Electronics (8 Hrs)
Basic difference between analog and digital signal, binary and hexadecimal number system, binary addition, substraction, multiplication and division. Definition, symbols and truth table of NOT, AND, OR, NAND, NOR, EX-OR Gates, Boolean algebra, Demorgan's theorem
General principle of A/D and D/A conversion techniques and brief idea of their applications

(iii) Programmable Logic Controller (4 Hrs)
Basic concept of PLC, its block diagram and applications

LIST OF PRACTICALS

1. Plotting of formal V-1 characteristics of PN junction diode
2. Rectifier circuits using semiconductor diode, measurement of input and output voltage and plotting of input and output wave shape for (i) half wave rectifier (ii) full wave rectifier
3. Verification and interpretation of truth tables for AND, OR, NOT, NAND, NOR and EX-OR gates
4. Working of a PLC on PLC Trainer

PART C

3. CIVIL ENGINEERING (18 hrs)
Theory

(i) Construction Materials (8Hrs)
Basics of various construction materials such as stones, bricks, lime, cement and timber along with their properties, physical/ field testing and uses, elements of brick masonry.

(ii) Foundations (6Hrs)
Types of various foundations and their salient features, suitability of various foundations for heavy, light and vibrating machines.

(iii) Factors to be considered for installation/erection and commissioning of plastic processing machinery. Vibrations- their effects, methods to control vibrations. General method of alignment/leveling. (4Hrs)

LIST OF PRACTICALS

a) The students should be taken to different construction sites to show them various construction materials, concreting process and construction of RCC structural elements, foundations and other civil works

Note: While imparting instructions, teachers are expected to lay more emphasis on concepts and principles. It will be better if the classes for general engineering are conducted in the laboratories and organized demonstrations for explaining various concepts and principles

INSTRUCTIONAL STRATEGY

Teachers should give emphasis on understanding of concept and explanation of various terms used in the subject. Industrial/field visits must be arranged for the students.

RECOMMENDED BOOKS

Electrical Engineering

1. Electrical Technology Part 1: Basic Electrical Engineering by Theraja, BL; S Chand and Company, New Delhi
2. Principles of Electrical Engineering by Gupta BR, S Chand and Company, New Delhi
3. Basic Electricity and Measurements by Suryanarayan NV and N Delhi; Tata McGraw Hill, 1987, New Delhi
4. Basic Electrical and Electronics Engineering by SK Sahdev; Dhanpat Rai and sons, New Delhi

Electronics Engineering

1. Electronics Devices and Circuits by NN Bhargava; Tata McGraw Hill Publishing, New Delhi
2. Basic Electronics by VK Mehta; S Chand and Co., New Delhi

Civil Engineering

1. Materials of Construction by Ghosh; Tata McGraw Hill Publishing Co., Ltd., New Delhi
2. Civil Engineering Materials by TTTI, Chandigarh; Tata McGraw Hill Publishing Co. Ltd., New Delhi
3. Concrete Technology by Gambhir; Tata McGraw Hill Publishing Co., Ltd., New Delhi
4. Building Construction by J Jha and Sinha; Khanna Publishers, Delhi
5. Soil Mechanics and Foundation Engineering by SK Garg; Khanna Publishers, Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	25	39
2	21	33
3	18	28
Total	**64**	**100**

3.2   PAINT TECHNOLOGY - I

                                                          L T P
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RATIONALE

Formulation of coatings is based on optimization and balancing of three major components; resin, pigments and solvents and their interactions . This subject imparts knowledge regarding paint formulation and manufacturing to the students.

DETAILED CONTENTS

1.   Introduction   (4 hrs)

General introduction to paint industry, definition of paints, varnishes and lacquers, their constitution and functions, source and composition of oils, non-glyceride.

2.   Formulations   (8 hrs)

Principles of paint formulation, formulation elements, mathematics and steps. PVC, CM, P/B ratio, Sp gravity. Typical formulations of primers, undercoats and finish coats, industrial and site applied coating for steelwork under mild, moderate and severe conditions.

3.   Solvents   (2 hrs)

Types of volatile solvents and their properties.

4.   Steps in Paint Manufacturing   (6 hrs)

Phenomenon of wetting, grinding and dispersion, Important considerations in pigment dispersion, important considerations in rheology of pigment dispersion.

5.   Mixing Equipment   (24 hrs)

Heavy duty mixers, double blade mixers, W& P banding, sigma kneaders, pug mills. Ball, pebble and bead mills, cascading and factors affecting effectiveness of milling such as size and speed of mill, volume, composition, size and shape of grinding medium, mill base, attritors and vibration mill, Sand mill, type of grinding media, sand grinding, process efficiency of mill, Horizontal sand mills like dyno mills, pearls mills. Mill base let down source of let down, trouble, optimum let down condition

6.   Safety   (4 hrs)

Safety measures, protection, factory layout principles and general considerations, typical flow diagram, single and multi storeyed building, sections of a paint factory and their location.

LIST OF PRACTICALS

1. To check refractive index of oils (Drying, semidrying and non-drying)
2. To determine specific gravity of oils (Drying, semidrying and non-drying)
3. To check colour of oils (Drying, semidrying and non drying)
4. To determine acid value of oils
5. To determine acid value of resins
6. To prepare stand oil
7. To test the flash point of solvents
8. To test the aromatic content in the material

INSTRUCTIONAL STRATEGY

Field visits   to paint industry should be arranged so that the students can witness the making of various machines used in paint industry. Also they can see the processes involved in paint manufacturing.   Students can also learn through simple and small experiments of paint formulations.

RECOMMENDED BOOKS

1. Automotive Paint and Coating by Karl Friedrich, Dossel; Berkeley Publication, New York.
2. Paint Technology Hand Book by Rodger, Talbert; CRC Press.
3. Paint Hand Book by Goyo E. Wismantel; McGraw Hill Publishers.
4. Paint, Varnish, Solvent, Thinner, Coating and Lacquer Technology by John S. Dick; Klower Academic Publishers.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	04	10
2	08	15
3	02	05
4	06	15
5	24	45
6	04	10
Total	**48**	**100**

3.3   FLUID FLOW

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RATIONALE

This subject aims at the basic concepts of fluid flow, measurement techniques involved for the same and equipments used for the transportation of fluids. With this background, students will be able to quantitatively find out material and power requirement for a process.

DETAILED CONTENTS

1.   Various types of flow – steady and unsteady, uniform and non-uniform flow, streamline flow, laminar and turbulent flow, rotational and irrotational flow.

(7 hrs)

- Types of fluid: compressible and incompressible fluid, Newtonian and non-Newtonian fluid, properties of fluids.

2.   Fluid statics and dynamics, Pascal's law, hydrostatic law, various types of manometers : U tube manometer and differential manometer.   (17 hrs)

- Continuity equation, Bernoullis theorem, flow through pipes and open channels: Hagen poiseulli's equation, friction factor charts, friction losses in pipes, friction loss from sudden enlargement and contraction, effect of roughness in pipes.

- Simple numerical problems related to the above topics.

3.   Flow measurement: flow through venturimeter, orifice meter, flow nozzle, pitot tube, rotameter.   (10 hrs)

4.   Flow through Fluid Machinery.   (30 hrs)

- Classification of pumps, construction and working of reciprocating pump, centrifugal pump and rotary pump, priming and NPSH, cavitation, power requirement, efficiency of centrifugal pump, specific speed. Blowers and compressors.

- Pipe and Fittings: Different types of pipes, schedule Number, ID and OD of pipe, colour coding of industrial piping used for transportation of various fluids, different types of valves and fittings: Globe valve, Butterfly valve, Gate valve, Ball valve and Needle valve.

- Dimensional analysis: Rayleigh's method, Buckingham Pi method, dimensionless numbers and their significance.

LIST OF PRACTICALS

1.   Verification of Bernoullis equation
2.   Determination of friction loss in flow through pipe
3.   Calibration of orifice meter and calculation of Cd, Cv, Cc
4.   Calibration of Venturi meter
5.   Calibration of Rotameter
6.   Determination of discharge coefficient of V-notch
7.   Study of constructional feature of centrifugal, gear, reciprocator diaphragm pump, blower and compressors and assembling and disassembling
8.   Study of characteristics, curves of centrifugal, reciprocating pump
9.   Study of fluidized bed characteristics
10. Calculation of Reynolds number

INSTRUCTIONAL STRATEGY

The students should be imparted theoretical as well as practical knowledge about all the topics supplementing with electronic media.

RECOMMENDED BOOKS

1.   Unit Operations of Chemical Engineering by McCabe W.L. & Smith J.C. McGraw Hill.
2.   Chemical Engineering Hand Book by Perry K. Chilton.
3.   Chemical Engineering Vol.I and II by Coulson and Richardson. Pergamota Press Publications.
4.   Introduction to Chemical Engineering by Bedger and Banchero, McGraw Hill Publication.
5.   Principles of Unit Operations by Alen Foust, John Willey Publicaiton.
6.   Chemical Engineering Fluid Mechanics by K.A. Gavahane, Nirali Publications.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1.	7	10
2.	17	30
3.	10	15
4.	30	45
Total	**64**	**100**

3.4   POLYMER SCIENCE

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RATIONALE

The subject is designed to enable the students to acquire basic knowledge of polymers, their advantages, application, classification and conversion. This will help the students in identifying different polymeric materials to be processed in the industry and determine their quality based on physical and chemical properties.

DETAILED CONTENTS

1.   Introduction to Polymers   (6 hrs)

Classification of polymers: Natural, Semisynthetic, Synthetic, Linear, Branched, Cross linked polymers, Thermoplastic, Thermoset, Commodity, Engineering, Speciality, Condensation, Addition, Polymer blends and alloys, Plastics, Elastomers, Fibers.

2.   Brief history of Polymer Engineering. Scope of Polymer Engineering and Comparison with Conventional Materials (Metal, Wood etc.).Study of Polymers in new emerging areas like membrane separations, conducting polymers and biomedical applications.   (4 hrs)

3.   Degree of polymerization, molecular weight and molecular weight distribution, polydispersity, measurement of molecular weight by dilute solution, viscometry, membrane osmometry, vapourphase osmometry, cryoscopy, ebulliometry, light scattering, centrifugation, Gel. permeation chromatography.

(4 hrs)

4.   Physical states of polymers - amorphous and crystalline behaviour. Polymer dissolution - dissolution and solvent selection for polymers, thermodynamics of polymer solutions, solubility parameter   (4 hrs)

5.   Thermal transmissions in polymer - Glass transition temperature, its importance and the factors which influence it, techniques for its determination, melting temperature, relationship of polymer properties   with structure   (4 hrs)

6.   Concept of functionality and Carother's equation for condensation, polymerization, relation between conversion and degree of polymerization, gel phenomenon. Macromolecular concept, secondary bonding in polymers, stereo isomerism in polymers.   (6 hrs)

7. Free radical polymerization, different types of initiators, inhibition, retardation, chain transfer agents etc. Auto-acceleration, ceiling temperature, ionic polymerization. Ziegler-Natta polymerization (10 hrs)

8. Techniques of polymerization: bulk, solution, emulsion and suspension, their relative advantages and disadvantages, introduction to Rheology and Visco-elasticity, time dependent and time independent viscosity behaviour; power law fluids; Zero sheer viscosity, Maxwelll and Voigt models of visco-elastic materials

(10 hrs)

INSTRUCTIONAL STRATEGY

Industrial visit or a laboratory scale polymerization should be shown to the students.

RECOMMENDED BOOKS

1. Polymer Science and Technology by Joel R., published by CRC Press, London

2. Polymer Science by Gowariker Fried, Prentice Hall of India publication, New Delhi, 2000

3. Polymer Material by J.A. Brydson, Published by M/S Butterworth Heinemann, Linacre House, Jordan Hill, UK

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	6	10
2	4	10
3	4	10
4	4	10
5	4	10
6	6	10
7	10	20
8	10	20
Total	**48**	**100**

3.5   CHEMICAL PROCESS CALCULATIONS

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4 - -

RATIONALE

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

DETAILED CONTENTS

1.   Definition of Chemical Engineering with brief history, future and career opportunities for chemical engineers.   (4 hrs)

1.   Difference between Unit Operations and Unit Processes.   (6 hrs)

2.   Units and dimensions, inter conversion of units of pressure, volume, force, work, energy, viscosity, temperature, specific gravity and heat in S1, CGS, MKS and simple numerical problems.   (10 hrs)

3.   Boyle's law, Charle's Law, Ideal gas equation, Dalton's law, Amagat's law, Relation between Vol% = Mole% = Press%, Average molecular weight of gas mixture, Density   of   gas   mixture   and   simple   numerical problems.   (6 hrs)

4.   Concept of mole, gm moles, gm atoms, mole fraction and concentration of solution in different ways like molarity, molality and normality, mass%, mass fraction, volume%, volume fraction.   (6 hrs)

6.   Definition and meaning of material balance, basic steps to be followed in the material balance calculation, numerical problem based on material balance without chemical reaction; unit operations like distillation, drying, evaporation, meaning of by bass, recycle and purge system of material balance.   (12 hrs)

7.   Definition and meaning of energy balance, standard heat of reaction, and formation, sensible heat, latent heat, heat capacity at constant pressure, relation between Cp and Cv, standard heat of reaction: heat of formation and heat of combustion, Hess's law of constant heat summation.   (10 hrs)

8.   Definition of combustion, heat of combustion, air requirement (theoretical air, excess air and theoretical oxygen requirement).   (10 hrs)

INSTRUCTIONAL STRATEGY

Emphasis should be laid on problem solving in all the area of material and energy balance. Simple practicals relating to wet bulb temperature, dry bulb temperature and humidification chart should be done. Students should be encouraged to make flow sheets for various processes. This will help the students to understand the subject better and solve intricate problems in various areas.

RECOMMENDED BOOKS

1. Solved Example in Chemical Engineering by G.K. Roy, Khanna publication.

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

3. Stoichiometry by Bhatt and Vohra,Tata McGraw Hill Publicaiton.

4. Basic Principles and Calculations in Chemical Engineering Himmelblaw, Prentice Hall Publication.

5. Stoichiometry by K.A. Gavhane, Nirali Publishers

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1.	4	5
2.	6	10
3.	10	15
4.	6	10
5	6	10
6	12	20
7	10	15
8	10	15
Total	**64**	**100**

3.6   MECHANICAL OPERATIONS

L T P
3 - 3

RATIONALE

This subject will impart knowledge to the students on working of individual mechanical operations and their significance in chemical industries. With this information student can control the operation of equipment and regulate production.

DETAILED CONTENTS

1.   Characterization of Solid Particles   (8 hrs)

Particle shape, particle size, mixed particle sizes and size analysis, expressions for specific surface of mixture, average particle size, number of particles in mixture (no derivation).

2.   Size Reduction   (14 hrs)

i)   Energy and power requirements in crushing, crushing efficiency, mechanical efficiency, expression for power required by machines.

ii)   Crushing laws: Rittinger's law, Bond's law and Kick's law

iii)   Size reduction equipment: classification and names; study of machines: Blake crusher, Jaw crusher, Dodge crusher, Grinding rolls, Roll crusher Impactor, Attrition mill, Ball mill, Fluid energy mill, Colloid mill, Rotary knife cutter, Flow sheet for closed circuit grinding

3.   Mechanical Separation   (26 hrs)

i)   Screen analysis, Tyler standard screen series, material balances over screen capacity and screen effectiveness, definition and final expression only.

ii)   Screening equipment: Gyrating screens, Stationary screens and Grizzlies vibrating screens

iii)   Filteration: (Qualitative treatment only) classification of filteration, filter media, filter aids, mechanisms of filteration, discontinuous pressure filters, Filter press, Shell and leaf filters; Continuous: Vacuum filters, Rotary drum filters, Centrifugal filters; Suspended batch centrifuges; Clarifying filters.

iv)   Separation based on the motion of particles through fluids; Gravity classifiers, Sorting classifier; Thickeners: Batch sedimentation, rate of sedimentation; centrifugal settling process: Cyclone, Hydro-cyclone, Tabular centrifuge, Disk centrifuge, Nozzle discharge centrifuge

v)   Mixing of solids and pastes, Change can mixer, Double motion paste mixers, Two arm Kneader, Kneader and disperser blades

LIST OF PRACTICALS

1.   To find the sieve analysis of a given sample of solid particles by sieve shaker
2.   To determine the grindability of solids by ball-mill
3.   To determine the crushing efficiency by a roll crusher using a sample of solid particles
4.   To find the rate of filtration with the help of filter press
5.   To perform an experiment on rotary vacuum filter and find rate of filtration
6.   To perform an experiment on a cyclone separator and find collection efficiency
7.   To perform an experiment on mixers for liquid-liquid mixing and find rate of mixing
8.   To perform an experiment on mixer for solid-liquid mixing and find rate of mixing
9.   To perform and experiment on separation of solid particles using a sedimentation tank

INSTRUCTIONAL STRATEGY

Adequate competency needs to be developed by giving sufficient practical knowledge to mechanical operation (characterization of solid particles, size reduction, energy requirement and mechanical separation).   A field visit may be conducted to expose the working of various conveyers and filtration equipment in industries.

RECOMMENDED BOOKS

1.   Chemical Engineering, Vol. I and II by Coulson and Richardson, Pergamon Press Publication
2.   Unit Operation of Chemical Engineering by McCabe and Smith; McGraw Hill Publication
3.   Introduction to Chemical Technology by Badger and Banchero, McGraw Hill Publication
4.   Fluid Mechanics and Its Applications by Gupta and Gupta, Wiley Eastern Publication
5.   Principles of Unit Operations by Alen Foust, John Wiley Publication
6.   Unit Operations-I, by KA Gavahane, Nirali Publication
7.   Unit Operations by Chattoupadhay

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1.	8	20
2.	14	30
3.	26	50
Total	**48**	**100**

3.7 **COMPUTER AIDED DRAFTING**

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-   - 3

RATIONALE

Computer aided drafting these days is extensively being used in the industry. This subject has been added to enable a diploma holder to make drawings using computer software and take prints/plots.

PRACTICE WORK

1. Introduction to AutoCAD : Starting up, practice on – how to create a new drawing file, setting drawing limits & saving a file, drawing lines in different ways using absolute co-ordinates, user co-ordinates, WCS, UCS, drawing circles, drawing arcs, drawing ellipses. Drawing polygons, drawings splines. Drawing polylines, using window, zoom commands.

2. Practice on Edit commands such as erase, copy, mirror, array, offset, rotate, oops, undo, redo, scale, stretch, trim, break, extend, chamfer, fillet, O snap command

3. Practice on Text commands: editing text, text size, text styles, change properties commands.

4. Practice on Layer Commands: creating layer, freeze, layer on/off colour assigning, current layer, load line type, lock & unlock layer, move from one layer to other.

5. Practice on Hatching, Hatch pattern selection.

6. Practice on Dimensioning, linear dimensioning, angular dimensioning radius/.diameter dimensioning O-snap command, aligned dimensioning, editing of dimensioning, tolerances in dimensioning.

7. Practice on print/plot commands. Export/import commands.

8. Practice on making complete drawings of components by doing following exercises:

    a)   Detail and assembly drawing of the following using AUTOCAD (2D)
                                                                    (4 sheets)
         -   Plummer Block
         -   Wall Bracket
         -   Stepped pulley, V-belt pulley
         -   Flanged coupling
         -   Machine tool Holder (Three views)
         -   Screw jack or knuckle joint

b)   Isometric Drawing by CAD using Auto CAD (one sheet)

       Drawings of following on computer:
- Cone
- Cylinder
- Isometric view of objects

9.   Modelling   (02 sheets)

     3D modelling, Transformations, scaling, rotation, translation

10.   Creating Chamfer and Fillet

     Practice on surface modeling, create part file, practice on assembly of parts, creating assembly view, orthographic views, section view (Practice on different views, practice on data transfer)

11.   Introduction to Other Softwares;

     (Pro Engineer/CATIA / Inventor/Unigraphics/Solid Work: Salient features.

INSTRUCTIONAL STRATEGY

1.   Teachers should show model or realia of the component/part whose drawing is to be made.

2.   Emphasis should be given on cleanliness, dimensioning, & layout of sheet.

3.   Teachers should ensure use of IS codes related to drawing.

RECOMMENDED BOOKS

1.   Engineering Drawing with AutoCAD 2000 by T. Jeyapooran; Vikas Publishing House, Delhi.

2.   AutoCAD for Engineering Drawing Made Easy by P. Nageswara Rao; Tata McGraw Hill, New Delhi.

3.   AutoCAD 2000 for you by Umesh Shettigar and Abdul Khader; Janatha Publishers, Udupi.

4.   Auto CAD 2000 by Ajit Singh, TMH, New Delhi.