

LABORATORY:

For each Laboratory

➤List of Major Equipment/Facilities:

CIVIL ENGG.

SI No	Name of the lab	Major equipments
1	Survey Lab	Micrometer Theodolite
		Total Station
		Electronic Theodolite
		Electronic Auto level
		GPS Instrument
		Auto Level
		Theodolite
2	Highway Lab	LOS angeles abrasion
		California Bearing ratio
		Sound Level Meter
		Speedar
3	Concrete Lab	Ductility machine
		Compression Testing machine
		Concrete mixer
		Relative density equipment
4	Soil Mechanics Lab	Direct shear apparatus
		Triaxial Testing machine
		Sample extractor
5	Basic Materials Testing Lab	Universal Testing Machine- 100kN
		Universal Testing Machine- 400kN
		Vicker's hardness testing machine
6	Structures Lab (P.G.)	Loading Frame
		PUNDIT
		Photo-Elastic Bench
7	Computer Lab	51 computers (Overall)
		40 Pentium IV Processors
		6 Pentium III Processors
		Architectural Desktop 2000
		EMRC NISA
		SYSTAT
		STADDPRO 2007
		Scanner Facility
		Laser Printer Facility
8	Environmental Lab	Imhoffcone apparatus
		Photoelectric colourimeter
		Dessicator
		Hot air oven
		Analog pH meter
		Digital pH meter
		Aqua - Test man frame filter
		Auto exhaust analyzer
		Automatic buffer adjustment - pH meter
		Digital spectro photometer
9	Geology Lab	Rocks Minerals samples.
		Hardness determining equipment
		Contract Goniometre
		Compass, clinometer
		Faults, Folds, Crust models
		Polished Gem and decorative stones kit.
10	Fluid Mechanics lab Fluid Machinery lab	Pelton wheel (15HP)
		Francis turbine (15HP)
		Kaplan turbine (20HP)
		Centrifugal pump single stage (3HP)
		Centrifugal pump multi stage (1.1 KW)
		Reciprocating pump double acting (0.5HP)

List of experimental setup

SI No	Name of the lab	Name of the experiment conducted
1	BASIC MATERIALS TESTING LAB	1. Tension test on Mild steel and HYSD bars. 2. Compression test of Mild Steel, Cast iron and Wood. 3. Torsion test on Mild Steel circular sections 4. Bending Test on Wood Under two point loading 5. Shear Test on Mild steel. 6. Impact test on Mild Steel (Charpy & Izod) 7. Hardness tests on ferrous and non-ferrous metals – Brinell’s, Rockwell and Vicker’s 8. Test on Bricks and Tiles 9. Tests on Fine aggregates – Moisture content, Specific gravity, Bulk density, Sieve analysis and Bulking 10. Tests on Coarse aggregates – Absorption, Moisture content, specific gravity, Bulk density and Sieve analysis 11. Demonstration of Strain gauges and Strain indicators
2	SURVEYING LAB -I	Exercise - 1 a) To measure distance between two points using direct ranging b) To set out perpendiculars at various points on given line using cross staff, optical square and tape. Exercise - 2 Setting out of rectangle, hexagon using tape/chain and other accessories Exercise - 3 Measurement of bearing of the sides of a closed traverse & adjustment of closing error by Bowdich method and Transit method Exercise - 4 To set out rectangles, pentagon, hexagon, using tape /chain and compass. Exercise - 5 To determine the distance between two inaccessible points using chain/tape & compass. To locate points using radiation and intersection method of plane tabling Exercise - 7 To solve 3-point problem in plane tabling using Bessel’s graphical solution Exercise -8 To determine difference in elevation between two points using fly leveling technique & to conduct fly back leveling. Booking of levels using both HI and Rise & Fall methods. Exercise - 9 To determine difference in elevation between two points using reciprocal leveling and to determine the collimation error Exercise - 10 To conduct profile leveling for water supply /sewage line and to draw the longitudinal section to determine the depth of cut and depth of filling for a given formation level. Demonstration Minor instruments - Clinometer, Ceylon ghat tracer, Hand level, Box sextant, Planimeter and Pantagraph.
3	SURVEYING LAB-II	Exercise - 1 Measurement of horizontal angles with method of repetition and reiteration using theodolite, Measurement of vertical angles using theodolite. Exercise - 2 To determine the elevation of an object using single plane method when base is accessible and inaccessible. Exercise - 3 To determine the distance and difference in elevation between two inaccessible points using double plane method. Exercise - 4 To determine the tachometric constants using horizontal and inclined line of sight.

		<p>Exercise – 5 To set out simple curves using linear methods – perpendicular offsets from long chord and offsets from chords produced.</p> <p>Exercise – 6 To set out simple curves using Rankine’s deflection angles method.</p> <p>Exercise – 7 To set out compound curve with angular methods with suing theodolite only.</p> <p>Exercise – 8 To set out the center line of a simple rectangular room suing offset from base line</p> <p>Exercise – 9 To set out center lines of columns of a building using two base lines at right angles</p> <p>Demonstration Exposure to use of Total Station. Traversing, Longitudinal sections, Block levelling, Usage of relevant softwares for preparation of the contour drawings.</p>
4	APPLIED ENGINEERING GEOLOGY LABORATORY	<p>Identification of Minerals based on their Physical Properties, Chemical composition and uses.</p> <p>P1 Quartz and its varieties : Rock crystal, Rose quartz, Milky quartz, Amethyst, Grey quartz, Blood stone, Flint, Agate, Chert, Jasper, Chalcedony and Opal.</p> <p>P2 Feldspar group - Orthoclase, Microcline, Plagioclase.</p> <p>Muscovite, Biotite, Hornblende, Augite, Olivine, Serpentine, Asbestos, Kaolin, Talc, Garnet, Corundum, Gypsum and Baryte</p> <p>P3 Carbonates – Calcite, Dolomite, Magnesite.</p> <p>Ore-minerals – Magnetite, Hematite, Limonite, Chromite, Ironpyrite, Chalcopyrite, Pyrolusite, Psilomelane, Bauxite and Galena.</p> <p>Identification of rocks based on their Geological properties.</p> <p>P4 Igneous rocks : Granite, Syenite, Diorite, Gabbro, Dunite, Porphyres, Dolerite, Pegmatite, Basalt, Rhyolite, and Pumice.</p> <p>P5 Sedimentary rocks : Sandstone, Limestone, Shale, Breccia, Conglomerate and Laterite.</p> <p>P6 Metamorphic Rocks : Gneiss, Quartzite, Marble, Slate, Phyllite, Schists and Charnockite.</p> <p>P7 Thickness problems - 3 Types</p> <p>P8 Dip and strike problems - 3 Types</p> <p>P9 Bore hole problems (On level ground)</p> <p>P10 Study and interpretation of standard structural geological maps</p> <p>P11 Lab Internal Test</p>
5	HYDRAULICS AND HYDRAULIC MACHINERY LAB	<ol style="list-style-type: none"> 1. Calibration of triangular, rectangular & trapezoidal notches 2. Calibration of broad crested Weir. 3. Calibration of venturi flume 4. Calibration of Venturi meter 5. Determination of friction losses in pipe. 6. Determination of minor losses in pipe. 7. Determination of hydraulic coefficients for orifices and mouthpieces 8. Impact of jets on vanes 9. Tests on single stage and multistage centrifugal pumps. 10. Performance test on an impulse turbine 11. Performance test on a Reaction turbine.
6.	COMPUTER AIDED DESIGN LAB	<ol style="list-style-type: none"> 2. Design of a singly/doubly reinforced RCC beams by limit state method using Excel Spread sheet. 3. Use of commercial software packages like NISA/STAAD/ANSYS/NASTRAN/GISTUDAL/STRAPP/FEAST for analysis of beams and frames. 4. Use of spread sheet (Excel) for <ol style="list-style-type: none"> a) Design of horizontal and vertical alignment b) Design of super elevation c) Computation of Earth work

		<p>d) Balancing of closed traverse using transit rule</p> <p>e) Water hammer analysis</p> <p>f) Head over ogee weir</p> <p>g) Verification of stability of dams</p> <p>h) Most economical section.</p>
7	GEOTECHNICAL ENGG LAB	<p>1. Tests for determination of specific gravity and moisture content</p> <p>2. Grain size analysis of soil sample (Sieve analysis)</p> <p>3. In situ density by core cutter and sand replacement methods.</p> <p>4. Consistency limits – Liquid limit, plastic limit and shrinkage limit</p> <p>5. Standard proctor Compaction test and modified proctor compaction test</p> <p>6. Coefficient of permeability by constant head and variable head methods</p> <p>7. Strength tests</p> <p>a) Unconfined compression test</p> <p>b) Directed shear test</p> <p>c) Triaxial compression test</p> <p>8. Consolidation test – determination of compression index and coefficient of consolidation</p> <p>9. Laboratory vane shear test</p> <p>10. a) Demonstration of miscellaneous equipments such as Augers, Samplers, Rapid moisture meter, Proctor’s needle</p> <p>b) Demonstration of Hydrometer test</p> <p>c) Demonstration of Free swell index test</p> <p>d) Demonstration of determination of relative density of sands.</p>
8	ENVIRONMENTAL ENGG LAB	<p>1. Determination of solids in Sewage, Total solids, Suspended solids, Dissolved solids, Volatile solids, fixed solids, settable solids.</p> <p>2. Electrical Conductivity, Determination of Chlorides and Sulphates</p> <p>3. Determination of Alkalinity, Acidity and pH.</p> <p>4. Determination of calcium, Magnesium and total hardness.</p> <p>5. Determination of Dissolved Oxygen. Determination of BOD</p> <p>6. Determination of COD</p> <p>7. Determination of percentage of available chlorine in bleaching powder, Residual Chlorine and Chlorine Demand.</p> <p>8. Jar test for Optimum Dosage of Alum, Turbidity determination</p> <p>9. Determination of Iron</p> <p>10. Determination of Fluorides.</p> <p>11. Total Count Test and MPN determination</p> <p>12. Determination of Nitrates.</p>
9.	CONCRETE AND HIGHWAY MATERIALS LAB	<p>1. CEMENT – Normal Consistency, Setting time, Soundness by Autoclave method, Compression strength test and Air permeability test for fineness, Specific gravity of cement.</p> <p>2. FRESH CONCRETE – Workability slump, Compaction factor and Vee Bee tests.</p> <p>3. HARDENED CONCRETE – Compression strength and split tensile tests.</p> <p>4. AGGREGATES – Crushing, abrasion, impact and shape tests, (Flaky, Elongation, Angularity number) specific gravity and water absorption.</p> <p>5. BITUMINOUS MATERIALS AND MIXES Specific gravity, Penetration, Ductility, Softening point, Flash and Fire point, Viscosity, Marshall stability tests.</p> <p>6. SUBGRADE SOIL – CBR test.</p>
10	P G LAB	Not Applicable

➤ **List of Major Software Packages available**

- a. Package – NISA Civil
- b. AUTO CADD Architectural Desktop 2000
- c. Systat, STADD-2007.

LABORATORY:

For each Laboratory

➤List of Major Equipment/Facilities:

MECHANICAL ENGG.

SI No	Name of the lab	Major equipments
1	Material Testing Laboratory	1.Universal Testing Machine(1000 KN) - 1 No 2. Hardness Testing Machines - 5 No a. Brinell Hardness Testing Machine - 2 No b. Rockwell Hardness Tester - 2 No c. Vicker's Hardness Tester - 1 No. 3. Impact Testing Machine- 1 No 4. Torsion Testing Machine - 1No 5. Fatigue Testing Machine - 1 No 6. Wear Testing Machine - 1 No 7. Microscopes - 6 Nos
2	Engineering Drawing Lab (CAED/CAMD Lab)	1.Desktop computers (140 Nos.) 2.Server (2 Nos.) 3.Multimedia projectors (2 Nos.)
3	Machine Shop Lab	1. HMT Lathe L20-17Nos. 2. Kirloshar GD2 Lathe-14Nos 3. Shaping Machines-9 Nos. 4. Milling Machine- Universal -2 Nos Vertical- 1 Nos Horizontal-2 Nos 5. Planar-1 No. 6. Slotting machine-1No 7. Radial drilling Machine-1 No 8. Surface grinding Machine -1 No 9. Tool and cutter grinding Machine-1 No 10. Bench grinding Machine-2 Nos 11. Radial drilling Machine-1 No 12. Drilling Machine-1No(0 to 19mm) 13. Power hacksaw Machine-1 No 14. Air compressor-1 No 15. Surface Plate- 3 Nos 16. Bench Vice-1 No 17. Wood turning lathe-12 Nos
4	Work shop Lab	1 Bench Vice-39 Nos 2 Leg Vice- 8 Nos 3 Surface Plate- 10Nos 4 Stakes set- 20 Nos 5 Pipe vice- 1 No 6 Bench grinding Machine-2 Nos 7 Bench drilling Machine-2Nos 8 Radial drilling Machine-2 Nos 9. Power hacksaw Machine-2 Nos 10. Welding Machine-4 Nos
5	Manufacturing Process Lab	1.Moisture content 2.Sieve analysis 3.Permeability test 4.Compression strength test 5.Shear strength tester 6.Tensile strength tester 7.Bending strength tester 8.Clay content tester 9.Heating Furnace 10.Wood working lathes---10No.s

6	Measurements and Metrology.	<p>Meaurements</p> <ol style="list-style-type: none"> 1. Pressure gauge 2. Thermocouple 3. LVDT 4. Load cell 5. Strainguges(young's Modulus). 6. Strain gauges(Rigidity Modulus) <p>Metrology:-</p> <ol style="list-style-type: none"> 1. Optical profile projector 2. Tool Makers Microscope 3. Sine Bar 4. Sine centre 5. Autocollimator 6. Lathe tool dynamometer 7. Stroboscope 8. Gear roll tester 9. Pneumatic comparator 10. HMT Lathe 11. Floating carriage 12. Gear tooth vernier 13. Slip gauges 14. Monochromatic checklite 15. Talysurf
7	Design Laboratory	<ol style="list-style-type: none"> 1.Pressre distribution in Journal Bearing 2.Vibration Test Rig-2No.s 3)Universal Governor-2 No.s 4)Whirling of shafts-2No.s 5)Photoelastiity Apparatus 6)Gyroscope
8	Fluid Mechanics an Machines Laboratory (Turbomachines Lab.)	-
9	Applied Thermodynamics Laboratory	<ol style="list-style-type: none"> 1.2stroke petrol Engine (mechanically Loaded) 2. 2 stroke petrol Engine (Electrically loaded) 3. 4 stroke petrol Engine (VCR) 4. Multi cylinder petrol Engine 5. 4 stroke diesel Engine 6. Centrifugal blower 7. Multistage Air Compressor 8. Refrigeration test rig
10	Heat Transfer Laboratory	<ol style="list-style-type: none"> 1Air Conditioning Test Rig 2.Refrigeration Test Rig 3.Shell and Tube Heat Exchanger 4.Parallel and Counter flow Heat Exchanger
11	R&D Laboratory	<ol style="list-style-type: none"> 1. Stress corrosion crack test setup-1 2. Fatigue testing machine -1 3. Polishing machine 4. Tensometer -1 5. Abrasive cutting machine -1 6. Specimen moulding/mounting machine -1 7. Electric furnaces(2 melting+2HT) -4 8. Microscope (with camera/photographic attachment) -1 9. Cutting machine-1 10. Melting furnace 11. Heat treatment furnace 2 12. Ageing furnace 1 13. U T machine(Hydraulic pressing machine) 14. Four stroke Diesel Engine -1 15. Eddy current loading equipment-1

		16. Computerised test ring for Four stroke Diesel Engine -1 17. Exhaust gas Analyser-1 18. Fuel preparation mixers -1 19. Arc Evaporation chamber F8 synthesis of CNT-1 20. Ball mill 1 21. Ultrasonicator -1 22. Heat treatment furnace -2 23. Hydraulic press-1 24. Metallographic polishing machine-1
12	CIM and Automation Laboratory	1. P4 Lenovo systems (60 Nos.) 2. Servers (2 Nos.) 3. UPS (2Nos.,15+10 Kw each) 4. ESPRIT SOFTWARE (20 License) 5. PREDATOR SOFTWARE(05 License) 6. CNC milling machine (Trainer)-1No. 7. CNC Lathe (Train Master) 1 No.
13	CAMA Lab	1. P4 Lenovo systems (60 Nos.) 2. Servers (2 Nos.) 3. UPS (2Nos.,15+10 Kw each) 4. Autodesk Inventor - (25 License) 5. MDT (25 License) 6. CATIA (5 License) 7. MSc. Master Key (50 License) 7. ANSYS (5 License) 8. EMRC Nisa (1 License) 9. DEFROM (1 License) 10. STAR CD (1 License) 11. Hyperworks (125 Units) 12. HP Design jet plotter (1 No.) 13. HP Laserjet printer (2 Nos)

List of experimental setup

SI No	Name of the lab	Name of the experiment conducted
1	Material Testing Laboratory	1. Tension Test 2. Compression Test 3. Bending Test 4. Shear Test 5. Brinell Hardness Test 6. Rockwell Hardness Test 7. Vickers Hardness Test 8. Impact Test 9. Torsion Test 10. Wear Test
2	Machine Shop Lab	Lathe 1. Plain turning and step turning. 2. Taper Turning and Knurling 3. Thread cutting 4. Eccentric turning Milling Machine 1. spur and Bevel gear cutting 2. Rectangular groove cutting Shaping Machine 1. Facing 2. Square Groove 3. V groove 4. Dovetail Groove Drilling Machine 1. Drilling

3	Work Shop Lab	<p>Fitting</p> <ol style="list-style-type: none"> 1. Rectangular Bar /Square joint. 2. V joint. 3. Dovetail Joint. 4. Semi circular joint <p>Welding</p> <ol style="list-style-type: none"> 1. Butt Joint 2. Lap Joint 3 T Joint 4. L Joint <p>Sheet Metal\</p> <ol style="list-style-type: none"> 1.Square/Rectangular Box 2.Cylinder 3.Cone
4	Manufacturing Process Lab	<ol style="list-style-type: none"> 1.Moisture content test. 2.Sieve Analysis of base sand 3.Permeability Test 4.Compression strength test for moulding sand 5.Shear strength test for core 6.Clay content test 7.Preparation of sand mould without using patterns 6.Preparation of sand mould by using single piece solid pattern 9.Preparation of sand mould using split pattern 10,Electric Furnace 11.Smithy And Forging Models
5	Measurements and Metrology Laboratory	<p>Meaurements</p> <ol style="list-style-type: none"> 1. Pressure gauge 2. Thermocouple 3. LVDT 4. Strain gauges(young's Modulus). 5.Strain gauges(Rigidity Modulus) <p>Metrology:-</p> <ol style="list-style-type: none"> 1. Optical profile projector 2. Tool Makers Microscope 3. Sine Bar 4. Sine centre 5. Autocollimator 6. Lathe tool dynamometer 7. Stroboscope 8. Gear roll tester 9. Pneumatic comparator 10. HMT Lathe 11. Floating carriage 12. Gear tooth vernier 13. Slip gauges 14. Manochromatic checklite 15. Demonstration Experiment- surface roughness test.
6	Design Laboratory	<ol style="list-style-type: none"> 1.Pressure Distribution in Journal Bearing. 2.Spring mass system. 3.Transverse Vibration 4.Longitudinal Vibration of spring mass system loaded through beam. 5.Single rotor system 6.Two rotor system 7.Porter Governor 8.Hartnell Governor 9.Whirling of shafts 10.Fringe constant of circular disc specimen using Photo elasticity equipment 11. Fringe constant of Pure bending specimen using Photo elasticity equipment

7	Manufacturing process Lab	<ol style="list-style-type: none"> 1. Moisture content test 2. Sieve analysis of base sand 3. Permeability test 4. Compression strength test for moulding sand 5. shear strength of moulding sand 6. Clay content test 7. Preparation of a sand mould without using patterns Preparation of a sand mould by using single piece solid pattern Preparation of a sand mould using split pattern Preparation of casting by using molten aluminium Preparation of 3 smithy models
8	Computer Aided Modeling and Analysis	<ol style="list-style-type: none"> 1. Stress analysis of a tapered bar of rectangular cross sectional area 2. Stress analysis of a tapered bar of circular cross sectional area 3. Analysis of plane trusses 4. Analysis of Beams 5. Analysis of beams with uniformly distributed loads and uniform varying loads 6. Stress analysis rectangular plate with circular hole subjected to tension and determination of the stress concentration factor. 7. . Stress analysis rectangular plate with circular hole subjected to bending and determination of the stress concentration factor. 8. Thermal analysis of walls and cylinders of different thermal conductivities 9. Thermal analysis of Fin 10. Dynamic analysis of cantilever beam natural frequency determination. 11. Dynamic analysis of bar for natural frequency determination 12. Dynamic analysis of cantilever beam for forcing function.
9	Applied Thermodynamics Lab (ECLab)	<ol style="list-style-type: none"> 1. Performance test on 2 stroke petrol Engine (Mechanically loaded) 2. Performance test on 2 stroke petrol Engine (Electrically loaded) 3. Performance test on 4 stroke petrol Engine (VCR) 4. Morse test on multi cylinder Engine 5. Performance test on 4 stroke diesel Engine and heat balance analysis 6. Determination of Flash and firepoint of oils using Abel's and Pensky martin apparatus 7. Valve Timing diagram of 4-s Engine 8. Determination of viscosity of oil using Torsional and Redwood viscometers 9. Determination of CV of solid fuel using Lewis Thomsons calorimeter 10. Measurement of Irregular area using Planimeter 11. Performance test on air blower 12. Performance test on 2stage reciprocating air compressor 13. Refrigeration test Rig

10	Heat Transfer Lab	<ol style="list-style-type: none"> 1. Thermal conductivity of Metal rod 2. Heat transfer in natural convection. 3. Heat transfer in forced Convection 4. Heat transfer from external surface [pin-fin] 5. Emissivity measurement Apparatus. 6. Stefan Boltzmann apparatus. 7. Critical Heat flux apparatus 8. Parallel flow heat exchanger. 9. Counter flow heat exchanger 10. Refrigeration tutor 11. Vapour compression Air conditioning set up. 12. Shell and Tube heat exchanger 13. composite wall. 14. Transient conduction Heat transfer. 15. Boiling and condensation of vapour
11	Engineering Drawing Laboratory	<ol style="list-style-type: none"> 1. Points 2. Lines 3. Planes 4. Solids 5. Isometric 6. Developments
12	Computer Integrated Manufacturing & Automation	<ol style="list-style-type: none"> 1. Using Esprit software create the geometry and perform the turning operations Simulate the tool path, Generate NC codes 2. Using Esprit software create the geometry and perform the milling operations Simulate the tool path, Generate NC codes 3. Using Predator Editor & Predator Virtual CNC Software, Write NC part program to turn the work piece and simulate the tool path 4. Using Predator Editor & Predator Virtual CNC Software, Write NC part program to mill the work piece and simulate the tool path 5. Demonstration of CNC lathe and Milling machine
13	Computer Aided Machine Drawing Laboratory	<ol style="list-style-type: none"> 1. Sections 2. Iso. to Ortho. 3. Ortho. To Iso. 4. Couplings 5. Fasteners 6. Assembly Drawings of Machine Components (2D and 3D) -Screw Jack, Tail stock, Tool Head connecting rod etc.

LABORATORY:

For each Laboratory

➤ List of Major Equipment/Facilities:

ELE. & ELO. ENGG.

SI No	Name of the Lab	Major equipments
1	High Voltage Lab	High Voltage Test Transformer, 2x0.22/100/0.22 KV
		2x11.4/0.05/15.1A Rated O/p 5 KVA, 50 Hz
		Capacitor 140 KV, 25000 PF
		Resistor, 140 KV, 28 M Ohms
		Diode, 140 KV, 20mA, 100 K ohms
		Diode, 140 KV, 20mA, 100 K ohms

		Measuring Spark gap. Sphere dia 100 mm, 100 KV
		Digital Storage Oscilloscope
		Electrolytic Tank
		DSP based motor controller trainee-Kit with MG set Lot.No. 200604RO1-04
		Over voltage / Under voltage Relay
		Over current Relay
		Over current relay & Earth fault relay
2	Electrical Machines Lab & Circuits Lab	Digital Storage Oscilloscope - 100MHz
		Power factor Meter 2.5/5A 125/250/500V
		Power factor Meter 5/10A 125/250/500V
		Power factor Meter 5/10A 250V
		Signal Generator 0-1 Mhz
		Wheat stone bridge
		D.C. Potentiometer
		CRO, 20 MHz, 15 MHz
		Kelvins Double bridge
		3 Phase Auto transformer I/O 0-415V, O/P 0-470V
		Phase Shifter 400V/110V
		Motor Protection Kit
		3 Phase Auto Transformer 415/0-470 V 15A
		Current Transformer 12.515A, 2515A
		VRPS, 300V, 1A
		1 phase Auto transformer I/O 40V, 50Hz, O/P 0-27V, 8A
		3 Phase Induction Motor, 400V, 7.5 H.P, 12A, 1440 RPM
		1 Phase Induction Motor, 1420 RPM, 220/240V, 3.7A
		3 Phase Induction Motor 1140 RPM, 3.7 H.P
		D.C. Generator, 2KW, 220V, 9.1A, 1150 RPM
		D.C. Motor Shunt, 2.85 H.P, 220V, 11.6 A, 1140 RPM
		3 Phase Alternator, 400V, 1.6A, 3 KVA, 1500 RPM
		D.C. Motor, 220V, 5 H.P, 1500 RPM, 19A, 220V
		Exciter 80V, 1.5A
		3 Phase Synchronous Motor 400V, 6.5 A, 1500 RPM
		Transformer 2 KVA, 230/120V
		D.C. Generator, 1.75 KW, 25.75/35A, 1440 RPM
		D.C. Generator, Compound, 230V, 3 KW, 13A, 1500 RPM
		Transformer 2 KVA, 230/120V
3	Programmable Logic Controllers Lab	Siemens S7 PLC kit
		Training Modules – Conveyer module, Elevator module, Electrolytic tank module, Input module, Output module, Pneumatic Actuator

List of experimental setup

SI No	Name of the lab	Name of the experiment conducted
1	Electrical Machines Lab	Swinburne's test Hopkinson's test Load characteristics of DC Motors Load characteristics of DC Generators OCC of DC Generators Retardation test Separation of losses by brush lifting method Speed control by Ward-Leonard method Speed control by flux variation, armature voltage variation EMF, MMF and ZPF Methods of voltage regulation V and inverted V curves of synchronous motor Parallel operation with bus bar Separation of iron losses in transformer OCC of DC Generator Load characteristics of DC Generator Load test on Induction Motor

		<p>Load test on Induction Generator No load and blocked rotor test on Induction Motor Parallel operation of DC generators with Busbar Load test Noload test and blocked rotor test OC & SC test , Load test, Sumpner's test Parallel operation 3 Phase Transformer connections Scott connection</p>
2	Circuits & Measurements Lab	<p>Energy Meter Calibration Energy Meter Calibration Calibration of Ammeter, Volt meter and Watt meters Measurements of Low resistance Measurements of Medium resistance Measurements of capacitance and Inductance Determine the ratio and phase angle error at different currents.(CT) Measurement of Power and Power factor(Star connection) Measurements of Power and Power factor (Delta connection) Resonance Characteristics Verification of KCL and KVL Verification of Thevenin's Theorem Frequency Response for RC coupled Amplifier RC phase shift Oscillator Non-Inverting and Scale changing of signals using OPAMP Rectifier circuits Diode clipping and clamping using simulation package.</p>
3	High Voltage & Relay Lab	<p>Flashover characteristics of air gaps Breakdown test on Transformer oil Flashover characteristics of air gaps Protection against over current, over voltage, under voltage, negative sequence and thermal shootups characteristics of Over Voltage Relay characteristics of Over Current Relay characteristics of Microprocessor based Over voltage Relay characteristics of Microprocessor based Over current Relay Field Mapping of different Models</p>
4	Control Systems lab	<p>Time response of Second order system Lead Compensation Lag Compensation Lag-Lead compensation AC Servomotor Speed-Torque Characteristic DC Servomotor Speed-Torque Characteristic Frequency Response of second order system DC Position Control system Bode Plot Root Locus</p>
5	Power Electronics Lab	<p>Static characteristics of SCR Static characteristics of MOSFET and IGBT SCR turn on circuit using synchronized UJT relaxation oscillator. SCR Digital triggering circuit for a single-phase controlled rectifier OR A.C voltage controller. Single phase full-wave rectifier with R and R-L loads. A.C. voltage controller using TRIAC and dia combination connected to R and R-L loads. Speed control of a separately excited D.C. motor using an IGBT or MOSFET chopper. Speed control of a stepper motor Speed control of a universal motor and a single-phase induction motor using A.C. voltage controller. MOSFET OR IGBT based single-phase full-bridge inverter connected to R load.</p>

6	Power System Simulation Lab	MATLAB fundamentals, matrices, etc Saving & Loading data, script files Loops branches and control flow Y bus formation for psystmes with & without mutual coupling Determination of Bus currents, bus power & line flows ABCD parameters Determination of power angle diagrams Determination of fault current & voltages in a single transmission line system Determination of swing curve, critical clearing time Load flow analysis a 3 Bus system Formation of Jacobian for a system not exceeding 4 buses Conduction of load flow analysis using Newton Raphson method. Optimal generator scheduling for thermal power plants.
7	Programmable Logic Controller Lab	Simulation : Digital Gate's functions, Latching Circuit, Disagreement Circuit, Majority Circuit, Always ON circuit, Always OFF circuit, Hardware Emulation: Three Floor Elevator Control, Liquid level control, Conveyor control, Latching Contact. Emulation of Process Control functions

➤ **List of Major Software Packages available**

PSPICE Software Package	: Students version
Mi Power Software Package	: 15 user license
Electrical CAD Software Package	: 10 user license
PS CAD Software Package	: 5 user license
Intellisuite	: 10 user license
Simatic S7	: For 1 terminal

LABORATORY:

For each Laboratory

➤ **List of Major Equipment/Facilities:**

ELECTRONICS & COMMN. ENGG.

Sl No	Name of the lab
1	Simulation & DSP Lab
2	Analog Electronics Lab
3	R & D Centre

List of Major equipments

Simulation and DSP Lab

Sl. No	Description	Company	Quantity
1.	Pentium IV Server	Adithya	01
2.	Pentium IV Systems	Adithya	53
3.	Pentium III Systems	Adithya	12
4.	Deskjet 930C Printer	Adithya	01
5.	HP 5300C Scanner	Adithya	01
6.	VHDL Trainer Kit	AMD	10
7.	Logic Analyzer	AMD	04
8.	DC Motor Interface for VHDL Kit	AMD	02
9.	Temperature Controller Interface for VHDL Kit	AMD	01

10.	Stepper Motor Interface for VHDL Kit	AMD	01
11.	Dual Dac Interface for VHDL Kit	AMD	01
12.	PIC Microcontroller 16F84	SIMS	02
13.	PIC Microcontroller 16F877	SIMS	03
14.	Stepper Motor Interface for PIC Microcontroller	SIMS	01
15.	TMS 320006711 DSP Starter Kit	Cranes Software	02
16.	TMS 320005402 DSP Starter Kit	Cranes Software	08
17.	8051 Microcontroller Kit	ESA	10
18.	DC Motor Interface	ESA	03
19.	Temperature Transducer Interface	ESA	03
20.	Keyboard Interface	ESA	03
21.	Elevator Interface	ESA	03
22.	LCD Interface	ESA	03
23.	Logic Controller Interface	ESA	03
24.	Data Communication Trainer Kit	Khodyas Systems	04
25.	LAN Trainer Kit	Khodyas Systems	06
26.	PCIDOT Add on Card for 8086	ESA	30
27.	MATLAB V6.5, Simulink V4.5, DSP Blockset, Signal Processing Toolbox	Cranes Software International Ltd	
28.	48-lines I/O Card, 16 bit Programmable timers	Electro Systems Associates Pvt Ltd	30
29.	Logic Analyzer	ADM Code Development	05
30.	VLSI Development Board	ADM Code Development	10
31.	VLSI Development Boards	CG Corel Technologies	15
32.	TMS320C6713 DSK	Sitech	02

Analog and Power Electronics Lab

Sl. No	Description	Quantity
1.	100MHz Oscilloscope	01
2.	50MHz Oscilloscope	01
3.	Spectrum Analyzer	01
4.	25MHz Oscilloscope	05
5.	20MHz Oscilloscope [APLAB]	20
6.	20MHz Digital Storage Oscilloscope	06
7.	20MHz Oscilloscope (Scientific)	20
8.	100KHz Function Generator	05
9.	1MHz Function Generator	01
10.	20MHz Sine Wave Generator	06
11.	1MHz Function Generator	06
12.	1MHz Signal Generator	27
13.	AM / FM Signal Generator	03
14.	10MHz Function Generator	04
15.	Universal Time & Frequency Counter	03
16.	Digital LCR Meter	01
17.	4 ½ Digit DMM	05

18.	4 ½ Digit DMM	11
19.	Digital Multimeter	04
20.	DMM - Hand type	01
21.	DMM - Hand type	04
22.	Motwane Multimeter	28
23.	0-30V / 1Amp Power Supply	53
24.	0-30V Dual Power Supply	10
25.	0-30V / 1Amp Power Supply	05
26.	0-300V / 0.2Amp Power Supply	14
27.	15 - 300V High Voltage Power Supply	04
28.	+5V Fixed Power Supply	17
29.	± 12V Fixed Power Supply	29
30.	+5V, ±12V Fixed Power Supply	06
31.	± 15V Fixed Power Supply	07
32.	0-60V Power Supply	02
33.	Auto Digital IC Tester	02
34.	Decade Capacitance Box	19
35.	Decade Resistance Box	25
36.	Decade Inductance Box	14
37.	2/20/200mA DC Milliammeter	30
38.	DC Chopper Power Unit	06
39.	DC Chopper Triggering Unit	06
40.	Forced Commutation Study Unit	06
41.	Series Inverter	06
42.	Single Phase Fully Controlled Power Circuit Unit	05
43.	Single Phase Fully Controlled Triggering Unit	10
44.	DC Motor Speed Control Power Circuit Unit	05
45.	SCR, TRIAC, DIAC, MOSFET, IGBT, Characteristic Study Unit	05
46.	1KVA Isolation Transformer	05
47.	2Amp Loading Inductor	05
48.	Universal Motor (0.375 watt)	05
49.	Digital Firing Circuit	06
50.	Stepper Motor Controller	07
51.	Stepper Motor	07
52.	0-30V / 2Amp Power Supply	10
53.	50Ω / 2Amps Rheostat	10
54.	0.375W DC Motor with Mechanical Loading	05
55.	Digital Non-Contact Tachometer	05
56.	5KVA Voltage Stabilizer	03
57.	4 ½ Digit ESCORT Dual Display Bench Top Digital Multimeter	01
58.	2MHz Function Generator	10
59.	20MHz CRO	28

Research And Development Centre

Sl. No	Description	Make / Co.,	Quantity
1.	Workstations	Dell 2002	04
2.	1.3GHz Digital Spectrum Analyzer (S-5022A) including STS 2024 Analysis, Software	Rising Edge Systems Pvt Ltd.	
3.	LAN & Data Communication Trainer (Intel Strongarm based platform)	Rising Edge Systems Pvt Ltd.	
4.	Antenna & Transmission Line Trainer Kit - Model ATS2001 with 20 types of Antenna	Rising Edge Systems Pvt Ltd.	
5.	Fiber Optic Lab Trainer Kit	Rising Edge Systems Pvt Ltd.	

6.	Matlab With Tool Boxes	Cranes Software International Ltd	
7	Digital Media Developer KIT	Cranes Software International Ltd	
8.	Computer	Aditya Sytems	17
9	LCD Projector		5
10	Lap Tops		2
11	Bio-Metric kit	Aditya Systems	01

List of experimental setup

SI No	Name of the lab	Name of the experiment conducted
1	Analog Electronics Lab	<ol style="list-style-type: none"> 1.Design an RC coupled amplifier; plot the frequency response and derive the gain. 2. Design Clipping and Clamping circuit. 3. Design a Bridge rectifier (with and without filter). 4. Using BJT design Hartley, Colpitt's, RC phase shift oscillator. 5. Design a class B push pull power amplifier. 6. Design and verify the Thevenin's theorem and Maximum power transfer theorem. 7. Design and verify the following basic op-amp applications <ol style="list-style-type: none"> i) Inverting amplifier ii) Non inverting amplifier iii) Voltage follower iv) Summer v) Integrator and Differentiator circuit 8. Using Op-amp design the Schmitt trigger circuit. 9. Using Op-amp design the Astable multivibrator circuit. 10. Design the Voltage regulator using IC 723.
2	Power Electronics Lab	<ol style="list-style-type: none"> 1. Static Characteristics of SCR & DIAC 2. Static Characteristics of MOSFET & IGBT 3. Controlled HWR & FWR using RC Triggering Circuits 4. SCR Turn - off using LC Circuit ii) Auxiliary comm.. 5. UJT Firing circuit for HWR and FWR circuits 6. Generation of Firing signals for thyristors/ trials using digital Circuits Microprocessors. 7. AC voltage Controller using TRIAC & DIAC combination 8. Single phase Fully controlled bridge converter with R and R-L loads 9. Voltage Communicated Chopper both constant frequency and variable frequency operations. 10. Speed control of separately excited DC motor 11. Speed control of Universal Motor 12. Speed control of stepper Motor 13. Parallel & Series INVERTERS
3	VLSI lab	<p>Digital Design Lab</p> <p>1. Write verilog code for the following circuits and their test bench for verification, observe the waveform and synthesis the code with technological library with given constraints. Do the initial timing verification with gate wlevel simulation</p> <ol style="list-style-type: none"> a) An Inverter b) A Buffer c) Transmission Gate d) Basic / Universal gates e) Flip-flop -RS, D, JK, MS, T f.) Serial & Parallel adder g) 4-bit counter (Synchronous and Asynchronous counter) h) Successive approximation register (SAR)

		<p>Analog Design</p> <ol style="list-style-type: none"> 1. Design an inverter with given specifications*, completing the design flow mentioned below <ol style="list-style-type: none"> a. Draw a schematic and verify the following DC analysis Transient Analysis b. Draw the layout and verify the DRC, ERC c. Check for LVS d. Extract RV and back annotate the same and verify the design e. Verify & optimize for time, power and area to the given constraint 2. Design the following circuits with given specifications, completing the design flow mentioned below: <ol style="list-style-type: none"> a. Draw the schematic and verify the following DC Analysis AC Analysis Transient Analysis b. Draw the Layout and verify the DRC, ERC c. Check for LVS d. Extract RC and back annotate the same and verify the Design. A Single Stage differential amplifier Common source and Common Drain amplifier 3. Design an op-amp with given specification using given differential amplifier Common source and Common Drain amplifier in library and completing the design flow mentioned below: <ol style="list-style-type: none"> a. Draw the schematic and verify the following <ol style="list-style-type: none"> i) DC Analysis ii) AC Analysis iii) Transient Analysis b. Draw the layout and verify the DRC, ERC Check for LVS Extract RC and back annotate the same and verify the Design 4. Design a 4 bit-R-2R based DAC for the given specification and completing the design flow mentioned using given op-amp in the library <ol style="list-style-type: none"> i) DC Analysis ii) AC Analysis iii) Transient Analysis <ol style="list-style-type: none"> b. Draw the layout and verify the DRC, ERC c. Check for LVS d. Extract RC and back annotate the same and verify the Design 5. For the SAR based ADC mixed signal schematic and verify the functionality by completing ASIC design FLOW.
4	HDL Lab	<ol style="list-style-type: none"> 1. Write HDL code to realize all logic gates 2. Write a HDL program for the following combinational designs <ol style="list-style-type: none"> a) 2 to 4 decoder b) 8 to 3 encoder (with priority and without priority) c) 8 to 1 multiplexer d) 4 bit binary to gray converter e) Multiplexer, demultiplexer, comparator 3. Write a HDL code to describe the functions of a full adder using three modeling styles 4. Write a model for 4-bit ALU. 5. Develop the HDL code for the following flipflops: SR, D, JK, T 6. Design a 4bit binary, BCD counters (synchronous reset and asynchronous reset) and any sequence counters

5	Microprocessor Lab	<p>1. Programs involving Data Transfer instructions like :</p> <p>a) Byte and Word data Transfer in different addressing modes. b) Block move (with and without overlapping) c) Block interchange.</p> <p>2) Programs involving Arithmetic and Logical operations like :</p> <p>a) Addition and subtraction of Multi precision numbers. b) Multiplication and Division of unsigned Hexadecimal numbers.</p> <p>3) Programs involving :</p> <p>a) ASCII adjustment instructions. b) Code conversions (Binary to BCD and Vice-versa on 8/16 bit data). c) Arithmetic Programs to find square, cube, LCM, GCD and factorial.</p> <p>4) Programs involving Bit manipulation instructions like checking :</p> <p>a) if given data is Positive or Negative. b) if given data is Odd or Even. c) logical 1's and 0's in a given data. d) 2 out of 5 code. e) Bitwise and nibble wise palindrome.</p> <p>5) Programs involving Branch/Loop instructions like:</p> <p>a) Programs on arrays: addition/subtraction of N numbers finding largest/smallest number, ascending/descending order. b) Near and Far Conditional and Unconditional jumps, Calls and Returns.</p> <p>6) Programs on String manipulations like string transfer, string reversing, searching for a character in a string, palindrome.</p> <p>7) Programs involving Software Interrupts.</p> <p>8) Programs to use DOS interrupt INT 21H Function Calls for: Reading a character from Keyboard, Buffered Keyboard input, Display of character / String on Console, Creation of a new file, read / write from a file, read system date, set system date, read system time, set system time.</p>
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➤ **List of Major Software Packages available**

Sl. No.	Package	Company	Quantity in Nos/Users
1.	Motorola DSP Software	Motorola	30
2.	Polar Plot (R&D Lab)	Falcon	1
3.	Code Composer Studio V.2.0	Texas	30
4.	Matlab R13 with Simulink, Signal Processing & Control tool box (Server License) for 06 Users	Matlab	30
5.	Xilinx 7.1i	Xilinx	30
6.	Model Sim	Xilinx	30
7.	Microwind & VLSI Software for 60 users. (Server License)	SIMS	60
8.	Matlab With Tool Boxes	Cranes Software Internationa Ltd	01
9.	Digital Media Developer KIT	Cranes Software Internationa Ltd	01
10.	VLSI lab	Mentor Graphics & Xylinx Corporation	01

LABORATORY:

For each Laboratory

➤List of Major Equipment/Facilities:

COMPUTER SC. & ENGG.

SI No	Name of the lab	Major Equipments
1.	Computer Lab-1	<p>1. Windows 2003 Server</p> <ul style="list-style-type: none"> Windows 2003 Server based on Intel certified server with 2.8 GHz. CPU dual Xeon CPU with 3 GB RAM, 320 GB HDD – 3 nos. 72 GB 10 K RPM SCSI Ultra 320 HDD- 3 nos for RAID 5 architecture. Software: M S Windows 2003 Enterprise Edition for 65 clients, M S Office professional, M S Visual Studio 6.0 Enterprise Edition, Oracle 9i, Kaspersky Anti-Virus 6.0.3.837 Server Edition. <p>2. Linux Server</p> <ul style="list-style-type: none"> Linux Server based on Intel certified server with 2.8 GHz. CPU dual Xeon CPU with 2 GB RAM, 36 GB HDD – 2 nos. 72 GB 10 K RPM SCSI Ultra 320 HDD- 3 nos for RAID 5 architecture. Software: Red hat Linux 9.0 for 130 clients. <p>3. Windows 2003 Exam server</p> <ul style="list-style-type: none"> Pentium D , 1 GB RAM , 160 GB HDD, DVD Writer, Mother Board Intel 945, ACER TFT Monitor, ACER Multimedia Key Board, Optical Mouse Software: M S Windows 2003 Enterprise Edition for 65 clients, M S Office professional, M S Visual Studio 6.0 Enterprise Edition, Oracle 9i, Kaspersky Anti-Virus 6.0.3.837 Server Edition. <p>4. Windows XP client node (2 Nos)</p> <ul style="list-style-type: none"> Zenith PIV, 512 MB RAM, 40 GB HDD, 2 GHz, DVD-RW Pentium D , 1 GB RAM , 3.40 GHz, 160 GB HDD, DVD Writer, Mother Board Intel 945, ACER TFT Monitor, ACER Multimedia Key Board, Optical Mouse <p>5. UPS 500VA (Wipro Make) (2 nos)</p> <p>6. HP LaserJet 4 Plus Printer (1 No.)</p> <p>7. HP Scanjet 730 C scanner (1 No.)</p> <p>8. Windows XP Client Nodes (65 No's)</p> <ul style="list-style-type: none"> 65 Client nodes with IBM ThinkCentre Series Desktop PC with Intel E8400 Series, 3GHz Core 2 Duo CPU, 2GB DDR2 RAM, 250GB HDD, DVD Recordable, IBM Key board, Mouse, 19" TFT Color Monitor, Gigabit Ethernet On Board Sound & IBM Chasis. Software : Microsoft Windows XP, Red Hat 11.00 with all packages, dual OS. <p>9. LCD Projector</p> <ul style="list-style-type: none"> VT 37G NEC LCD Projector <p>10. IBM Laptop (Temporarily transferred to HOD)</p> <p>a. PIV, 512 MB RAM, 40 GB HDD</p> <p>11. Air Purifier, Ionizer – 6 nos.</p> <p>12. White Board (Moveable) - 1no</p> <p>13. White Board with Stand - 1no</p>

2.	Computer Lab-3	<p>1. IBM Server</p> <ul style="list-style-type: none"> • IBM Server with XSER 225 – 2.4 G 512/OHDs, 36.4G , 15 K RPM 4320 SHS HDD, XSER 2.4 G, 512 Processor UPGR • Software : Microsoft Windows 2003 Server Edition <p>2. Novel Netware Server (1 No)</p> <ul style="list-style-type: none"> • Pentium III, 600 MHz, 35 GB HDD, 256 MB RAM, 14" SAMSUNG SVGA Monitor, Logitech Mouse & Keyboard, CD ROM Drive. <p>3. Windows Vista Client (1 No)</p> <p>Pentium D , 1 GB RAM , 3.40 GHz ,160 GB HDD, DVD Writer, Mother Board Intel 945,ACER TFT Monitor, ACER Multimedia Key Board, Optical Mouse</p> <p>4. LCD Projector</p> <ul style="list-style-type: none"> • VT 37G NEC LCD Projector <p>5. HP Laser Jet 1000 Series (1 No.)</p> <p>6. HP 3770 Scanner (1 No.)</p> <p>7. UPS 500VA (Wipro Make) (3 nos)</p> <p>8. Windows 2000 Client Nodes (35 No's)</p> <ul style="list-style-type: none"> • IBM-X86 based PC, Intel Pentium IV CPU, 3.00GHz, 512 MB RAM, 80GB Hard Disk, DVD ROM combo, 1.44" FDD. a. Software : Microsoft Windows XP, RedHat Linux 9.0, Novel Netware Client <p>9. Windows 2000 Client Nodes (30 No's)</p> <p>IBM-X86 based PC, Intel Pentium IV CPU, 3.00GHz, (2GB+512 MB) RAM, 80GB Hard Disk, DVD ROM combo, 1.44" FDD.</p> <ul style="list-style-type: none"> b. Software : Microsoft Windows XP, RedHat Linux 9.0, Novel Netware Client. <p>10. Digital Copier cum Printer (Xerox Machine) (1 No.)</p> <p>11. Air Purifier, Ionizer – 6 nos</p> <p>12. White Board (Moveable) - 1 no.</p> <p>13. Windows Client (4 nos)</p> <ul style="list-style-type: none"> • P-IV, 3.00G.Hz, 1 GB RAM, 60GB HDD, 17" Monitor, Keyboard, Mouse <p>UPS Room</p> <ul style="list-style-type: none"> • UPS (Computer Lab-1) : (5 nos) • 5 KVA Online UPS with 80 AH batteries (10 nos) along with stand, two hours backup serving 130 machines. (3nos) • 2 KVA online UPS for Server. (1 no) • APC 5 KVA online UPS with 16 batteries (1 no) (connected to chasis switch) • UPS (Computer Lab-3) (2 nos) <ul style="list-style-type: none"> • 10 KVA Online UPS with 75 AH, 192 V batteries (16 nos) along with stand two hours backup serving 45 machines + n/w rack • 5 KVA Online UPS with 80 AH batteries (10 nos) along with stand, two hours backup serving 20 machines. (1no)
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		<p><u>Computer Science Faculty rooms ,HOD Chamber, Office</u></p> <ol style="list-style-type: none"> 1. Windows XP Client (9 Nos) Zenith PIV with 512 MB RAM, 40 GB HDD, 3GHZ, DVD-RW, With 500 VA UPS 2. Windows XP Client (9 Nos) IBM PIV 512 MB, 40 GB HDD, 3.00 GHZ, With 500 VA UPS 3. Windows XP Client (10 Nos) (7 nos. -Staff rooms + 2 (Lab1+Lab3)+1(Data Mining Lab ACER Dual Core PIV 160 GB HDD,1 GB RAM, With 500 VA UPS 4. Printers <ul style="list-style-type: none"> • HP Laser Jet 1022 (Black & White) (1 no) • HP Laser 2605 DN (color) (1 No) 5. LCD Projector (1 no) 6. Notebook Computers <ul style="list-style-type: none"> • IBM Lap top, PIV, 512 MB RAM, 40 GB HDD, 3 GHZ, DVD-RW (4 Nos) • HP Laptop, PIV, Dual Core, 1.8G.Hz, 1 GB RAM, 80 GB HDD (2 Nos)Compaq Lap top , Presario, 1505, PIV, 2 GHZ, 128 MB RAM (2 nos)
3.	Wireless Networking Laboratory	<ol style="list-style-type: none"> a. Desktop Personal computers - 6 Nos. P4, 2.0 GHz b. Notebook Computers - 2 Nos. (AK,HOD Office) Compaq Presario 1505, P4, 2.0 GHz c. Wireless PCI cards for Desktops - 2 Nos. Model: Dlink IEEE 802.11b - 11 Mbps d. Wireless PCMCIA cards for Notebooks - 2 Nos. Model: Dlink IEEE 802.11b - 11 Mbps e. Laser printer - 1 No. HP - LJ1000 f. CD RW Writer - 1 No. Samsung 40X CD-RW Drive g. Software: <ul style="list-style-type: none"> o Red Hat Linux OS-V8.0 . o Windows XP (Home Edition) o Windows 2000 Professional h. Research Tools: <ul style="list-style-type: none"> o NS-2 (Network Simulator 2) o OMNET++
4.	Image Processing & Computer Vision Laboratory	<ol style="list-style-type: none"> 1. Windows Clients: (3 Nos.) <ul style="list-style-type: none"> • 4 Client nodes based on Intel Pentium IV, 2.4 GHz, 256 MB DDR RAM, 40 GB HDD with win 2000 OS. <p>Software : MATLAB 6.5</p>

5.	BRNS Lab	<ul style="list-style-type: none"> • HP Workstation (3 Nos) Intel Core 2 Duo, 1.86Ghz, 2/4 MB L2 Cache, 2 GB DDR2 Ram, 160 GB SATA Hard disk, ATI Fire GL PCI Express Card, 19" TFT Color Monitor, HP Keyboard, DVD R/W, Optical Mouse, HP Chassis, WIN XP Prof 64 Bit • Note Book (1 No.) SONY VGN-SZ453N/B Notebook with INTEL Core 2 Duo @ 2 Ghz, with 1 GB DDR2 RAM, 120 GB Hard Disk, 13.3' TFT Screen, WI-FI, Blue Tooth, Finger Print Reader, 1.3 MEG Camera, 51/2 Hours Battery Backup, Microsoft Vista, Bussiness Ready S/W. • HP LaserJet 2600N, Network Ready Color Laser Printer • HP3010, A4 Size Flat Bed Scanner • SONY Make 6 Megha Pixel Digital Video Camera Model SONY DV-CAM908. • Web Camera (2 nos)
6.	Data Mining Lab	<ol style="list-style-type: none"> 1. PIV Computers 3 Numbers Pentium IV, 900 MHz, 80 GB HDD, 512 MB RAM, 14" SAMTRON SVGA Monitor, Logitech Mouse & Keyboard, Zip Drive, DVD Combo 2. Laptop: 1 no Compaq Presario, Centrino Processor, 512MB RAM, 120 GB Hard Disk 3. Printers: 1020 HP Laserjet Printer 3050 HP All-in-One(Printer, Copier, Scanner, Fax) 4. Scanner- HP Scanner
7.	Embedded Lab	<ol style="list-style-type: none"> 1. Windows XP client node (28 Nos) <ul style="list-style-type: none"> • Pentium Core II Deo , 1 GB RAM , 160 GB HDD, DVD Writer, Mother Board Intel 945,ACER TFT Monitor,ACER Multimedia Key Board, Optical Mouse <p>Hardware Equipments</p> <ol style="list-style-type: none"> 2. 48006- PIC Microcontroller Starter pack 3. 48003- Mobile Phone Solution 4. 48012 - Embedded Internet Training Solution 5. 48001- PIC Microcontroller Starter pack 6. 48013 - Bluetooth Training Solution 7. 48008- CAN Bus Training Solution 8. 48004-ARM Starter pack 9. 48005-ARM Starter pack 10. 48014- E-Blocks FPGA & CPLD Solutions 11. Internet Evaluation Board(8051 EVB) (AT89C57RD2) based with Remote Controller Module 12. SuperPRO 280V Universal Programmer 13. ESA-PICE52E In-Circuit Emulator 14. 8051 Trainer kit 15. 89C51 Advanced Eval. kit for GSM/GPRS 16. 89C61X2 Flash Microcontroller Board 17. 8086 DSP Trainer kit

		18. ARM9 Starter Kit (MCB2100) 19. ARM7 Starter Kit (MCB2140) 20. Ulink USB-JTag connector 21. Evaluation Board for ST STR9 Series 22. ATMEL ARM Board 23. Altium Designer 6.0, Nano Board 24. DSP Starter Kit for TM5320C6713 with CCS 25. DSP Starter Kit for TM5320VC5416 with CCS 26. Pattern Generator / Logic Analyzer 27. Digital I/O Card 28. Signal Generator 29. ESA-Keil MCBX51 (Software) 30. CYGNAL 8051 Kit + Manual (Software)
8.	PG Class Room/Lab	<ul style="list-style-type: none"> ● Windows Vista Client Nodes (20 Nos) Intel Core Duo CPU, 2 GB RAM, E7300, 2.66M HZ, 160GB HDD, TFT Monitor, Keyboard, Mouse ● Ethernet Switch (1no)
9.	Analog & Digital Electronics Lab	1. Windows XP client node (12 Nos) <ul style="list-style-type: none"> ● Pentium D , 1 GB RAM , 3.40GHz, 160 GB HDD, DVD Writer, Mother Board Intel 945,ACER TFT Monitor, ACER Multimedia Key Board, Optical Mouse ● Software : Windows XP, VHDL, PSpice Student Evaluation Version, Rational Rose suit 7.0 2. 25 Dual Trace CRO (10 Nos) 3. Function Generators (10 Nos) 4. Table Top Multimeter (3 nos) 5. Handled Multimeter (12 Nos) 6. Power Supplies 0-30V with digital Display (15 Nos) 7. Fixed Power Supply 12V / 15 VA amps (15 Nos) 8. Trainer Kits, Digital IC Trainer (12 nos) 9. Spring Boards (20 nos) 10. Component Organizer (2 nos) 11. Mains Transformer (5 Nos) 12. Digital Ammeter (5nos) 13. UPS (1) <ul style="list-style-type: none"> a. 15 KVA online UPS with 20 batteries 14. LCD Projector (1) <ul style="list-style-type: none"> ● HCL- Hitachi Projector-RX70 LCD Projector Model : CP-RX070EF 15. Windows XP (1no) IBM PIV 512 MB, 40 GB HDD, 3.00 GHz (16. White Board (Movable) (1no)

List of experimental setup

Sl. No.	Name of the Lab	Name of the Experiment conducted
1.	Fundamental of Computing Lab (I sem) Autonomous	<p>Programming Exercises to include the following programs, but not limited to (Includes General Syntax, Flowchart and Algorithms):</p> <p>Addition/subtraction of n numbers, Multiplication of two numbers, Factorial of given number, Generating Fibonacci Series, Linear and Binary Search, Bubble, Insertion and Selection Sort, Finding the roots of the quadratic equation, Calculator Program using Switch and else if ladder, To check whether a given number is palindrome or not, Addition/Multiplication of $n*n$ matrix.</p>
2.	Electronics Circuit - Analysis & Design Lab (III Sem) Autonomous	<p>Simulate and Design the following and Verify Outputs</p> <ol style="list-style-type: none"> 1. Study the working of positive clipper, double-ended clipper and positive clamper using diodes. 2. To determine the frequency response, input impedance, output impedance, and bandwidth of Voltage Amplifier, CE, CC, CB Amplifier using ICS 3. FET detail study and design applications 4. Study the working of MOSFETS, frequency effects, negative feedback amplifiers 5. Study the working of linear / nonlinear OP AMPS circuits, Oscillators, Regulated power supplies 6. Design and study Wave shaping Circuits
3.	Digital Design with VHDL Lab (III Sem) Autonomous	<p>Write the Verilog/VHDL code for the following, Simulate and verify its working.</p> <ol style="list-style-type: none"> 1. Number systems, Arithmetic operations. 2. Combinational logic circuits K-Map & two-level implementation. 3. Combinational Logic design Adders, subtractions, multipliers. 4. PLAs HDL representations -VHDL Encoders, Decoders, Multiplexers 5. Arithmetic circuits & ALU design Sequential circuits. 6. State diagram and sequential circuit design. 7. Registers & counters Algorithmic State Machines- H/W control and Micro programmed control
4.	Data Structures with C Lab (III Sem) Autonomous	<ol style="list-style-type: none"> 1. Implement the following Data Structures using C <ol style="list-style-type: none"> a. Stacks, b. Queues, c. Recursion, d. Linear lists, e. Trees, f. Heaps, 2. Implement Sorting & Search techniques using C 3. File Handling Operations using C 4. String Manipulation using C
5.	OOPs lab with C++ (III Sem) Autonomous	<p>Write programs in C++ to practice the following OOPS concepts</p> <ol style="list-style-type: none"> 1. Static members 2. Function and operator overloading 3. Type conversion operators 4. Object constructor and destructor 5. Inheritance, polymorphism, 6. Templates 7. Exceptions, exception specifications 8. Virtual functions

6.	System Software lab (V Sem)	<ol style="list-style-type: none"> 1. Simple Lex Programs 2. Simple Yacc Programs <p>Implement the following (Qn. no 3 to Qn. no 10) using C or C++</p> <ol style="list-style-type: none"> 3. Write a program to convert mnemonic code to opcode of some given instructions. Use opcode table for this. 4. Construct Symbol Table and Literal Table. Resolve the symbols in the assembly language code. 5. Implement 1 pass assembler. 6. Implement 2 pass assembler. 7. Implement absolute Loader. 8. Implement relocatable Loader. 9. Implement Linking Loader. <p>Implement Macroprocessor</p>
7.	Database Programming Lab with DB2 (V Sem)	<p>Lab Exercise to practice Database Concepts using DB2</p> <ul style="list-style-type: none"> • Creating Database and populating data in the database. • Querying Database using SQL on DB2. <ul style="list-style-type: none"> • Data Definition commands and Data Manipulation commands. • Building a small database packages using DB2 as backend and Visual Basic as front end.
8.	Web Programming Laboratory (VII Sem)	<ol style="list-style-type: none"> 1. Develop and demonstrate a XHTML document that illustrates the use external style sheet, ordered list, table, borders, padding, color, and the tag. 2. Develop and demonstrate a XHTML file that includes Javascript script for the following problems: <ol style="list-style-type: none"> a) Input: A number n obtained using prompt Output: The first n Fibonacci numbers b) Input: A number n obtained using prompt Output: A table of numbers from 1 to n and their squares using alert 3. Develop and demonstrate a XHTML file that includes Javascript script that uses functions for the following problems: <ol style="list-style-type: none"> a) Parameter: A string Output: The position in the string of the left-most vowel b) Parameter: A number Output: The number with its digits in the reverse order 4. <ol style="list-style-type: none"> a) Develop and demonstrate, using Javascript script, a XHTML document that collects the USN (the valid format is: A digit from 1 to 4 followed by two uppercase characters followed by two digits followed by two upper-case characters followed by three digits; no embedded spaces allowed) of the user. Event handler must be included for the form element that collects this information to validate the input. Messages in the alert windows must be produced when errors are detected. b) Modify the above program to get the current semester also (restricted to be a number from 1 to 8) 5. <ol style="list-style-type: none"> a) Develop and demonstrate, using Javascript script, a XHTML document that contains three short paragraphs of text, stacked on top of each other, with only enough of each showing so that the mouse cursor can be placed over some part of them. When the

		<p>cursor is placed over the exposed part of any paragraph, it should rise to the top to become completely visible.</p> <p>b) Modify the above document so that when a paragraph is moved from the top stacking position, it returns to its original position rather than to the bottom.</p> <p>6. a) Design an XML document to store information about a student in an engineering college affiliated to VTU. The information must include USN, Name, Name of the College, Branch, Year of Joining, and e-mail id. Make up sample data for 3 students. Create a CSS style sheet and use it to display the document.</p> <p>b) Create an XSLT style sheet for one student element of the above document and use it to create a display of that element.</p> <p>7. a) Write a Perl program to display various Server Information like Server Name, Server Software, Server protocol, CGI Revision etc.</p> <p>b) Write a Perl program to accept UNIX command from a HTML form and to display the output of the command executed.</p> <p>8. a) Write a Perl program to accept the User Name and display a greeting message randomly chosen from a list of 4 greeting messages.</p> <p>b) Write a Perl program to keep track of the number of visitors visiting the web page and to display this count of visitors, with proper headings.</p> <p>9. Write a Perl program to display a digital clock which displays the current time of the server.</p> <p>10. Write a Perl program to insert name and age information entered by the user into a table created using MySQL and to display the current contents of this table.</p> <p>11. Write a PHP program to store current date-time in a COOKIE and display the 'Last visited on' date-time on the web page upon reopening of the same page.</p> <p>12. Write a PHP program to store page views count in SESSION, to increment the count on each refresh, and to show the count on web page.</p> <p>13. Create a XHTML form with Name, Address Line 1, Address Line 2, and E-mail text fields. On submitting, store the values in MySQL table. Retrieve and display the data based on Name.</p> <p>14. Using PHP and MySQL, develop a program to accept book information viz. Accession number, title, authors, edition and publisher from a web page and store the information in a database and to search for a book with the title specified by the user and to display the search results with proper headings.</p>
9.	Networks Lab (VII Sem)	<p style="text-align: center;">PART A - Simulation Exercises</p> <p>The following experiments shall be conducted using either NS228/OPNET or any other suitable simulator.</p> <p>1. Simulate a three nodes point - to - point network with duplex links between them. Set the queue size and vary the bandwidth and find the number of packets dropped.</p>

		<ol style="list-style-type: none"> 2. Simulate a four node point-to-point network with the links connected as follows: n0 - n2, n1 - n2 and n2 - n3. Apply TCP agent between n0-n3 and UDP between n1-n3. Apply relevant applications over TCP and UDP agents changing the parameter and determine the number of packets sent by TCP / UDP. 3. Simulate the different types of Internet traffic such as FTP and TELNET over a network and analyze the throughput. 4. Simulate the transmission of ping messages over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion. 5. Simulate an Ethernet LAN using n nodes (6-10), change error rate and data rate and compare throughput. 6. Simulate an Ethernet LAN using n nodes and set multiple traffic nodes and determine collision across different nodes. 7. Simulate an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source / destination. 8. Simulate simple ESS and with transmitting nodes in wire-less LAN by simulation and determine the performance with respect to transmission of packets. <p style="text-align: center;">PART-B</p> <p>Implement the following in C/C++:</p> <ol style="list-style-type: none"> 1. Write a program for error detecting code using CRC-CCITT (16- bits). 2. Write a program for frame sorting technique used in buffers. 3. Write a program for distance vector algorithm to find suitable path for transmission. 4. Using TCP/IP sockets, write a client - server program to make the client send the file name and to make the server send back the contents of the requested file if present. 5. Implement the above program using as message queues or FIFOs as IPC channels. 6. Write a program for simple RSA algorithm to encrypt and decrypt the data. 7. Write a program for Hamming code generation for error diction and correction. 8. Write a program for congestion control using leaky bucket algorithm.
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List of Major Software Packages available:

Sl. No.	Name of the software	No. of users	Year of Purchase
1.	Kaspersky BusinessSpace Security, Internatioanl Edition	1000	2008
2.	IBM Rational Rose	30	2008
3.	Windows Vista Business English UPG OLP NL AE	260	2007
4.	Oracle 9i Application Server	25	2004
5.	Office Pro 2003 Win32 English OLP NL AE	65	2004
6.	Windows XP Professional English UPG OLP NL AE	65	2004
7.	Windows SVR Enterprise 2003 English OLP NL AE	1	2004
8.	Windows Server CAL 2003 English OLP NL AE User CAL	100	2004
9.	Symantec Norton Antivirus -1	5	2004
10.	Win Zip Software	10	2004
11.	Turbo C++ Suite Scholar Ed. for Windows	50	2003

12.	SUN SOLARIES Version 8.0	8	2003
13.	DB2 UDB package	-	2001
14.	Visual Age for JAVA	-	2001
15.	IBM Web Sphere Application Server	-	2001
16.	Windows NT 4.0 OS	1	1998
17.	Windows NT 4.0 CAL User CAL	5	1998
18.	Windows 98 Software	20	1998
19.	MS Office Professional 97	-	1998
20.	MS Visual Studio 6.0 Enterprise Ed.	-	1998
21.	SCO Unix 5.0	30	1996
22.	Microsoft C++ 2.0	-	1996
23.	Power Builder 4.0 Enterprise Ed.	-	1996
24.	Microsoft Windows 3.11 for workgroups	-	1996
25.	Borland C++ 4.0 with SDK	-	1996
26.	Anti Virus Software F-PROT	-	1996
27.	Desktop publishing software COREL VENTURA 5.0	-	1996
28.	Kannada Word Processor PRAKASHAK	-	1996
29.	SCO-ODT server	64	1996
30.	Neural Network Simulator Matlab Neural network toolbox	-	1996
31.	Oracle 7.0 workgroup/2000 RDMS with SQL Net (Client) (Sco Unix version)	16	1996
32.	Oracle Developer 2000	1	1996
33.	Microsoft Macro Assembler 6.0	-	1995
34.	Turbo C++ 3.0	-	1995
35.	SOFTEK COBOL,PASCAL,FORTRAN	-	1995
36.	Novel Netware OS version 3.11	100	1995
37.	Norton Editor	-	1995
38.	Unix System V	-	1995

LABORATORY:

For each Laboratory

➤List of Major Equipment/Facilities:

CHEMICAL ENGG.

SI No	Name of the lab	Major equipments
1	Process Control	Time constant determination and response to step change of thermometer, Single tank system - 1 order Non - Interacting tanks in series Interacting tanks in series Pressure tank Level Controller Flow Process Controller Pressure Process Controller Temperature Process Controller pH Controller Valve Characteristics Valve Actuator Flapper- Nozzle system Pressure Measurement Module RTD Characteristics Trainer Thermocouple Module Flow Measurement Trainer

2	Mass Transfer	Diffusion
		Distillation - Simple (Differential) distillation
		Packed column
		Steam distillation
		Solid - liquid leaching
		Surface evaporation
		Tray dryer
		Adsorption studies
		Liquid - Liquid equilibrium
		Liquid extraction - (Continuous), Spray
		Holdup studies
		Vaccum dryer
		Rotary dryer
		Wetted wall column
		Cooling tower
Solid dissolution		
Vapor liquid equilibrium still		
3	Chemical Reaction Engineering	Batch reactor
		Plug Flow reactor
		Mixed Flow reactor
		RTD Studies in Plug Flow reactor
		RTD Studies in Mixed Flow reactor
		Catalytic reactor
		Effect of Temperature on rate constant
		Catalyst preparation and property determination.
		Semi-batch reactor
		Effect of Temperature on reaction rate
		Segregated Flow reactor
4	Heat Transfer	Transient heat Conduction
		Natural convection in bare tube
		Natural convection in tubes with fins.
		Vertical condenser
		Insulation thickness
		Emissivity determination
		Effect of Geometric shape on natural convection
		Horizontal condenser
		Shell and tube condenser
		Packed bed heat Transfer
		Heat transfer in fluidized bed
		Double pipe heat exchanger, Vap - Gas
		Double pipe heat exchanger, Vap - Liq
		Double pipe heat exchanger, Gas - Gas
		Double pipe heat exchanger, Liq - Liq
		Evaporator, Single effect
		Solar heater
		H.T. in jacketed vessel
Spiral plate heat exchanger		
Boiler, with modernization and automatic operation		
5	Pollution Control and Instrumentation	Analysis using U.V. spectrophotometer
		Flame Photometer
		Dissolved Oxygen Analyser
		Turbidometer
		Polarography
		Potentiometric titration
		Thin layer chromatography
		Karl-Fisher Autotitrater ((for moisture)
		Bomb calorimeter
		Viscometer
		Abbe Refractometer
		Conductivity meter
		Analysis of exhaust by Orsat apparatus

6	Mechanical Operations Lab	Air elutriation
		Air permeability
		Ball mill
		Batch sedimentation
		Beaker decantation
		Cyclone separator
		Drop weight crusher
		Grindability index
		Belt conveyor
		ICI sedimentation
		Jaw crusher, Blake
		Leaf filter
		Plate and frame filter press
		Screw conveyor
		Screen effectiveness (Rotap sieve shaker)
		Sieve analysis (Rotap sieve shaker)
7	Momentum Transfer Lab	Thickener
		Roll crusher
		Pneumatic conveyor, Hammer mill
		Friction in Circular Pipes
		Friction in Non-Circular Pipes
		Friction in Helical/Spiral Coils
		Flow rate measurement using venturi meter and orifice meter
		Local velocity measurement using Pitot tube
		Flow over Notches
		Hydraulic coefficients - Open Orifice
		Packed bed
		Fluidized bed
		Study of characteristics for centrifugal pump
Study of pipe fittings and their equivalent lengths		
Venturi/ Orifice meters, Air flow measurement		
8	Computer Applications & Simulation Lab	Server, IBM P4 with 17" Color Monitor, 80 GB HDD
9	R & D Lab (Not in syllabus)	Atomic Absorption Spectrometer
		Gas Chromatography
		Incubator

List of experimental setup

SI No	Name of the lab	Name of the experiment conducted
1	MECHANICAL OPERATION LAB	Studies on Ball Mill
		Studies on Air elutriation
		Studies on Air permeability
		Studies on Ball mill
		Studies on Batch sedimentation
		Studies on Beaker decantation
		Studies on Cyclone separator
		Studies on Drop weight crusher
		Studies on Grindability index
		Studies on ICI sedimentation
		Studies on Jaw crusher, Blake
		Studies on Leaf filter
		Studies on Plate and frame filter press
		Studies on Air elutriation
		Studies on Air permeability
2	MOMENTUM TRANSFER LAB	Determination of Friction in Circular Pipes
		Determination of Friction in Non-Circular Pipes
		Determination of Friction in Helical/Spiral Coils

		Flow rate measurement using venturi meter and orifice meter
		Determination of Local velocity measurement using Pitot tube
		Flow over Notches
		Determination of Hydraulic coefficients - Open Orifice
		Studies on Packed bed
		Studies on Fluidized bed
		Study of characteristics for centrifugal pump
		Study of pipe fittings and their equivalent lengths
		Venturi/ Orifice meters, Air flow measurement
3	HEAT TRANSFER LABORATORY	NATURAL CONVECTION IN BARE AND FINNED TUBE
		VERTICAL SHELL AND TUBE HEAT EXCHANGER (CONDENSER)
		HORIZONTAL SHELL AND TUBE HEAT EXCHANGER (CONDENSER)
		HELICAL COIL HEAT EXCHANGER
		EMISSIVITY DETERMINATION
		EFFECT OF GEOMETRY ON NATURAL CONVECTION
		HEAT TRANSFER IN PACKED BEDS
		DOUBLE PIPE HEAT EXCHANGER
		HEAT TRANSFER IN JACKETED VESSEL
		DETERMINATION OF INSULATION THICKNESS
		TRANSIENT HEAT CONDUCTION
		HEAT TRANSFER IN FLUIDIZED BEDS
		EVAPORATOR
		SPIRAL PLATE HEAT EXCHANGER
		CROSS FLOW HEAT EXCHANGER
4	POLLUTION CONTROL AND INSTRUMENTATION ANALYSIS LABORATORY	ANALYSIS OF EFFLUENTS FOR PH, ALKALINITY AND TURBIDITY
		DETERMINATION OF COD AND BOD
		VOLATILE, FIXED, FILTERABLE AND DISSOLVED SOLID ANALYSIS
		MEASUREMENT OF PARTICULATE MATTER IN AIR
		ANALYSIS OF EXHAUST BY ORSAT APPARATUS
		ANALYSIS OF FLUE GASES BY GAS CHROMATOGRAPH
		UV SPECTROPHOTOMETER
		KF AUTO TITRATOR
		FLAME PHOTOMETER
		TURBIDOMETER
		DISSOLVED OXYGEN MEASUREMENT
		BOMB CALORIMETER
		VISCOMETER
		POLAROGRAPH
		POTENTIOMETER TITRATION
5	CHEMICAL REACTION ENGINEERING LABORATORY	BATCH REACTOR
		ISOTHERMAL PLUG FLOW REACTOR
		MIXED FLOW REACTOR
		SEMI BATCH REACTOR
		HETEROGENEOUS CATALYTIC REACTOR
		SEGREGATED FLOW REACTOR
		ADIABATIC REACTOR
		PACKED BED REACTOR
		RTD STUDIES IN TUBULAR REACTOR
		EFFECT OF TEMPERATURE ON RATE OF REACTION
		BIO CHEMICAL REACTION (BATCH)
		ENZYME CATALYZED REACTIONS IN BATCH REACTOR
6	MASS TRANSFER LABORATORY	Diffusion of organic vapours in air
		Simple Distillation
		Packed column/ plate column distillation
		Steam distillation
		Solid - liquid leaching
		Surface evaporation