MAJOR RESEARCH FACILITIES AT ISM DHANBAD IN DIFFERENT DEPARTMENTS

DEPARTMENT OF APPLIED CHEMISTRY

Research Area	Facilities/ Equipments	Key Applications
Surface Chemistry	Scanning Electron Microscope with EDX Model: S-3400N; Make: Hitachi, Japan	Surface morphology and chemical characterization
Surface Chemistry	Surface Area and Porosity Analyzer Model: Nova 3200e Make: Quantachrome, USA	Surface area and pore volume determination
Spectroscopy	FTIR Spectrophotometer Model: Spectrum 2000 Make: Perkin Elmer, USA	Functional group detection of organic/inorganic compounds
Spectroscopy	UV-Visible Spectrophotometer with facility of solid as well as liquid sample analysis Model: UV-2450 Make: Shimadzu, Japan	Used in analytical chemistry for the quantitative determination of different analytes
Spectroscopy	UV-Visible Spectrophotometer with facility of liquid sample analysis Model: UV-1800 Make: Shimadzu, Japan	Used in analytical chemistry for the quantitative determination of different analytes
Spectroscopy	Fluorescence Spectrophotometer Model: LS55 Make: Perkin Elmer, USA	Fluorescence study of different organic samples.
Chromatography	Binary GPC-HPLC Model: 2414 Make: Waters(I) Pvt. Ltd; USA	Molecular weight determination of polymers and separation & purification of organic compounds
Chromatography	Gas Chromatograph with fixed bed reactor Model: GC2010 Make: CIC, India	On line analysis of gas phase reaction.
Chromatography	Gas Chromatography Model: GC2011 Make: CIC, India	Separating and analyzing of volatile gas & liquid samples
Electrochemistry	Electrochemical Work Station Model: 660 C with 680 Amp Booster Make: CH instruments; USA	Corrosion & electrochemical analysis
Electrochemistry	Electrochemical Impedance and corrosion analysis Model: 660 D Make: CH instruments; USA	Corrosion analysis
Electrochemistry	Potentiostat Model: 7800 Make: Amel Instruments	Corrosion analysis
Drug delivery	Drug Dissolution Apparatus Model: 1912 Make: EI, India	Drug delivery study
Thermal analysis	Differential Scanning Calorimetry Model: DSC7 Make: Perkin Elmer, USA	Thermal characterization

Department of Applied Mathematics

S. No.	Research Area	Software	Applications/Features
1	……	MATHEMATICA version 8.0 for 31 users Network Floating License Add On: Wavelet Tool, Neural Network Tool Kit	Elementary mathematical function library, Special mathematical function library, Matrix and data manipulation tools including support for sparse arrays, Support for complex number, arbitrary precision, interval arithmetic and symbolic computation,2D and 3D data and function visualization and animation tools, Solvers for systems of equations, ODEs, PDEs, DAEs, DDEs and recurrence relations, Numeric and symbolic tools for discrete and continuous calculus, Programming language supporting procedural, functional and object oriented constructs.
2	…….	SPSS 19.0, 10 Users on Desktop/Network	Binary Logistic Regression Logit Response Models Seasonal Decomposition Spectral Analysis Complex Samples Multinomial Logistic Regression Data Preparation Validate Data Anomaly Detection Bootstrapping Spectral Analysis RFM Analysis

Department of Applied Physics

Research Area	Facility/Equipment	Key Application
Thin film deposition	Langmuir Blodgett Apparatus Make: M/s Apex Instruments, Kolkata Model: LB 2007 BC	For deposition of Monolayer /Multilayer of Organic & Inorganic compounds
	Spin Coating Unit Make: M/s Apex Instruments, Kolkata Model: SCU-2005	For deposition of Monolayer /Multilayer Thin films
	Dip Coating Unit Make: M/s Apex Instruments, Kolkata Model: Xdip-SV-1	For deposition of Monolayer /Multilayer Thin films
	Electro-deposition unit Make: ELNOVA	For deposition of Thin films
Material preparation	High Temperature Furnace Make: M/s Naskar & Co., Howrah Model: EN 140 QT	Controlled annealing/ sintering of materials upto 1300°C
	Milli-Q water purification Apparatus Make: Merck Millipore Model: Elix Essential 3	Ultrapure water system
Structural characterization of Materials	X-Ray Diffractometer (XRD) Make: Bruker, Germany Model: D8 Focus	Structure determination, Phase identification
	Fourier Transform Infrared Spectrometer (FTIR) Make: Perkin Elmer Model: Spectrum RXI	Determination of functional groups

Optical characterization of Materials	Thermoluminescence Analyzer Make: M/s Nucleonix Hyderabad Model: TL 1007	Thermoluminescence phenomena, Defect characterization, Identification of trap levels
	Fluorescence Spectrophotometer Make: Hitachi Model: F-2500	Photoluminescence phenomena, Information about the transitions of dopant / host matrix
	Monochromator, Detector and Source Make: Princeton Instruments Model: Acton SP-2300	Photoluminescence/ Up-conversion phenomena
	UV-VIS Spectrophotometer Make: Perkin Elmer Model: Lambda 35	For absorption, transmission and diffuse reflectance studies, Band gap determination
Dielectric characterization of Materials	LCR HITESTER Make: HIOKI Model: 3532-50	Dielectric studies as a function of temperature and frequency
Electrical characterization of Materials	Source meter Make: Keithley Model: 2400	I-V Characteristics
	Low temperature sample holding arrangement Make: Wayne-Kerr Model: SSH-40	For holding the samples during various electrical properties measurements in low temperature range
Fiber Optics	Optical Spectrum Analyzer Make: YOKOGAWA	Analysis of spectrum of wavelength range 600-1700 nm
	Direct Core Monitoring Optical Fibre Fusion Splicer Make: SUMITOM	Splicing of different types of fiber
	Laser sources	Wavelength - 800 nm, 980 nm, 1310 nm, 1550 nm
Bio-medical Physics	Superluminescence Diode Make: Superlum, Russia	Broadband source (Near IR region)

Department of Computer Science & Engineering

Sl. No.	Broad Research Area	Equipment/Software Available	Application
1	Image & Video Processing	MATLAB with SIMULINK and toolboxes like Image Processing, Statistics, Optimization, Neural Network, Fuzzy Logic, Wavelet, Bioinformatics, Signal Processing, DSP System Toolbox19, Communication System. Toolbox 7.19.	Efficient simulation of problems in the field of Digital Image Processing, Optimization Techniques, Soft Computing, Digital Signal Processing, Bioinformatics and Wavelet Analysis.
2	Wired & Wireless Networks	QualNet Simulator (Teaching (30) & Research license (01))	Simulation of large-scale and heterogeneous networks using graphical user interface and Command line interface.
3	Software Engineering	IBM Rational Software Architect	Advanced and comprehensive application design, modeling and development tool for end-to-end software delivery.
4	VLSI Design & Testing	NI Multisim	It is used to build expertise through practical application in designing, prototyping, and testing electrical circuits. The Multisim design approach helps in saving prototype iterations and optimizes printed circuit board (PCB) designs earlier in the process.

Department of Electrical Engineering

Research area	Facilities/Equipment	Key Applications
On-Line Conditioning Monitoring of heavy duty electrical drives	Conditioning Monitoring Lab	Conditioning Monitoring Mine Winder
Power System operation & Control	Soft Computing Lab., DSPACE-1104, MATLAB along with toolboxes , ETAP Software	Real time implementation of Intelligent Controller for Load Frequency control, SMART GRID, Distributed Energy sources
Power Electronics & Drives	STATCOM and others, Z-source Converter, PSIPCE Software, DSP, FPGA, DSPACE	(a) Simulation of high-frequency mirror inverter for energy efficient induction heated cooking oven using PSPICE (b) Renewable Source Power System
Optimization techniques in Power System, Transmission congestion, FACTS	MATLAB Toolboxes	Power Management & congestion relief, Planning & Co-ordination, Reactive Power sources with FACTS devices.
Process Control, Instrumentation	Programmable Logic Controller (PLC)	Plant logic operation, Control, programming, troubleshooting

DEPARTMENT OF ELECTRONICS ENGINEERING

SI. No.	Broad Research Area	Equipment/ Facility	Application
1.	**Photonics**	Softwares: • *MATLAB* • **OptiBPM** • **OptiSPICE** • OptiFiber • OptiGrating • *Materials Studio* (CASTEP) • Crosslight APSYS Equipments: • *Splice machine* • *Light Runner* • *Lock-in amplifier* • *Tunable Laser diode (1500-1600 nm)* • *DFB Laser(1550 nm)* • 980 nm Laser diode • He-Ne lasers 1-15 mW • Heavy base table tops Newport (6x4, 3x2, 2x2) • Power Meters and Energy Meters • DSO • Fibre optics communication kits • Optical time domain reflectometer (OTDR) • MSO/CRO/FG	***OptiBPM, OptiSPICE***, *OptiFiber*, *OptiGrating* are used for simulation for the design of complex non uniform optical waveguides and devices- Integrated optoelectronics, Fibre Plasmonics, MOEMS, All optical logic Gate, Fiber Bragg Gratings (FBGs), *Materials Studio* CASTEP allows you to perform first-principles quantum mechanics calculations that explore the properties of crystals and surfaces in materials such as semiconductors, ceramics, and metals. *Crosslight APSYS* is simulation of semiconductor nano-structure devices in particularly nano-photonics devices and nano-structure. EDFA hardware, Broad band fiber source, fiber optics gas sensor, *Pressure sensors*, Raman amplifier.

2.	**Microwave and Antenna**	Softwares : • IE3D • HFSS Equipments: • 20 GHz signal generator • 18 GHz Spectrum analyzer • 20 Ghz power meter • Microwave test benches	**IE3D, HFSS** are the industry-standard simulation tool for 3-D full-wave electromagnetic field simulation and is essential for the design of high-frequency and high-speed component design. These equipments are used for generating and analyzing the microwave signals.
3.	**Communications & Signal Processing**	Softwares: • MATLAB, Simulink will tool boxes • *Xilinx* Integrated *Software* Environment Kits • DSP kits Texas instrument • Digilent Kit (Atlys)	These software and hardware are used for simulation and real time implementation of DSP system, respectively specially for speech processing, image processing echo and noise cancellation. Comparison of different algorithms in term of computation time and resource utilization.
4.	**VLSI design & Microelectronics**	Softwares: • *Xilinx* ISE Design *Suite* • *Tanner tools* • *LASI* Kits *Virtex-5 FPGA Development Boards*	These software and hardware are used for simulation of VLSI design.

Department of Environmental Science and Engineering (Centre of Mining Environment)

Research Area	Major Lab facilities	Key Application
Pollution Control Analysis (Air & Water)	• Spectrophotometer (Ultra-Violet, Visible & Infra-red, Shimadzu UV-256). • Total Organic Carbon (TOC) - L (Shimadzu). • Gas Chromatograph (GC 2000A, Chromatograph & Ins. Co., India). • Gas Chromatograph (Thermo Scientific, India; Model CERES 800 Plus). • Electronic Balance(s) (one weighing upto 10 mg & other weighing upto 0.01 mg) - 4 nos. • Soxhlet Extraction Assembly (250 ml capacity)- 2 no; • Model SBR Reactor; Magnetic stirrer; • Model UASB Reactor; Remi- stirrer; • AAS - GBC Avanta Australia including Graphite Furnace GBC with Hydrate generator GF 3000; with the following cathode lamps (20 nos): Aluminium; Antimony; Arsenic; Barium; Boron; Chromium; Calcium; Cobalt; Copper; Iron; Lead; Magnesium, Manganese; Nickel; Potassium; Silver; Sodium; Tin; Vanadium; Zinc. • Specific Ion Meter with Micro-processor (Mettler Toledo MA 235 pH/Ion analyser) with the following Ion Selective Electrodes :; Ammonia, Cyanide, Fluoride, Iodide, Nitrate, Sulphate, Redox • Mercury Analyser (MA 5800E) – EC, Hyderabad • Millipore Water Purification System (RIOS & Elix) – 120 L/hr • Automatic Titrator (Mettler Toledo – DL 50) with microprocessor based • Zeta Potential	Analysis of Water, waste water, industrial effluents, Air pollution analysis

Land/Soil Pollution	• Particle Size Analyzer (CILAS/1064 liquid/dry, USA), laser based attached with on line image capturing facilities. • Microwave Digestion System (O.I Analytical, USA) • TCLP Apparatus (Millipore, France, Zero Head Space Extractor, Dispensing Pressure Vessels, Rotary Agitator & Vacuum Pressure Pump. • Test Master (Jar test); • Bacteriological Incubator; • Hot air oven; • Centrifuge, • Rotary shaker • pH & Conductivity Meters; • Ammonia distillation assembly; • Filtration Pumps (Vaccum); • Muffle furnace; • Sieve shaker; with sieve sets • Analytical Balance, • Field Kits for water holding capacity, • Double Ring Infiltrometer	Toxicity of soil, Particle size of soils and other physic-chemical parameters of soil
Environmental Geotechnology	• Consolidation Test Apparatus (3-Gang Electronic) • Compaction Test Apparatus. • Liquid Limit Device with Counter manually operated • Shrinkage Limit Set • Pycnometers • Cone Penetrometer, Automatic • Pore Pressure Apparatus • Universal Automatic Compactor • Laboratory Permeability Apparatus • Digi- Triaxial Test Apparatus • Swell Test Apparatus • Rifle Sampler, sample Extractor • Relative Density Apparatus • Viscometer	Land Reclamation, stability of mine dump, waste dump analysis, slurry transportation of minerals, waste etc
Water chemistry	• pH Meter with combined glass-calomel electrode (Portable and Table models) Cyber Scan 510 (MEPC); • TDS/Conductivity Meter (Cyber Scan 200, MERCK); • Spectrophotometer (Aqamate, MERCK); • Flame Photometer (Microprocessor based, Systronics Model 128); • Turbidity Meter (MERCK, Turbiquant 3000T; 0-1000 NTU); • Immersion Thermostat (LAUDA, E100) - Bath/Circulation Thermostats, upto 110°C (set point 450°C); • BOD Incubator; • COD Reflux Unit; • Double Distillation Unit (2 Nos)	Water Quality Analysis

Microbiology	• Universal Trinocular Research Microscope (OLYMPUS, BX60, Japan) – Digital Camera with online image capturing & analysis with Micro lite Image plus 4.0; • Trinocular Stereozoom Microscope (LEICA, 56D, 6.3:1) – Cold light Illumination System, Leica CLS 150 X; • Millipore Membrane filtration for Coliform Organisms testing – including suction pump (Millipore), filtration & incubator; • Colony Counter (Electronic); • Laminar Flow Chamber (horizontal); • Leaf Area Meter (Systronics); • pH Meter; Research Centrifuge (REMI – R24); • Bacteriological incubator • Autoclave ,	Microbiological studies with respect to soil pollution and biodiversity
Land use & Hydrogeology lab	• Stereoscopic Microscope; • Ground truth Radiometer; • Optical Pantograph (5x); • Clinometer; Liquid Permeameter (Ruska Haustan, 1013-801, Texas); • Planimeter; Flow meter with recorder; Rotameter; • Electronic Digital Planimeter.	Hydrological Studies
Noise pollution	• Modular Precision Sound Level Meter (Type 2231) with octave filter set (Type 1625) (Bruel & Kjaer, Denmark) - 1 no; • Sound Level Meter (CRL-703A, Cirrus Research PLC, UK)-1 no; • Modular Sound Analyzer (Type 2260, Bruel & Kjaer, Denmark) - 1 no; • Noise Dosimeter (Type 4428, Bruel & Kjaer, Denmark); • Noise Dosimeter (eg 5; 3M company); • Dosimeter (CEL 420, CEL Instruments, UK); • Audiometer (AP 251, Alfred Peters Ltd., UK); • Noise source (Type: 4224, Bruel & Kjaer, Denmark) • Environmental growth chamber	Study of Industrial and residential noise level and its impact analysis
Air pollution sampling	• High Volume Air Sampler (Envirotech APM-410) - 5 nos; • Respirable Dust Sampler (RDS) - 10 nos; (PM10 & PM2.5 Samplers) • Real Time Aerosol Monitor (RAM-1) with size classifier - 2 nos; • Gravimetric Dust Sampler, (UK) - 1 no; • Cascade Impacter (Sera Anderson, USA)- 2 nos; • Fume Hood Chamber; • Personal Dust Sampler (Environtech)- 2nos; • Stack Monitoring kit (Envirotech)- 1 nos; • HVS Calibration kit (Envirotech) - 2 no; • Green House Gas Monitor (Teledyne, USA)- online CO, CH_4, N_2O and CO_2 Gas Monitoring;	Field sampling for air pollution monitoring and modeling

	• Spectrophotometer (Spectrochem); • Portable CO Monitor. • Auto Exhaust Monitor (CO & HC) for diesel vehicle • Auto Exhaust Monitor (CO & HC) for petrol vehicle • Microbiological Air Sampler – 2 nos (Millipore)	
Micrometeorological	• Continuous Weather Monitoring Station (Envirotech WM-300) - 1 no; • Mechanical Wind Recorder (Wilh Lambercht Gmbtt Gottingen Type-1482) - 3 nos; • Raingauge.	Weather Monitoring
Remote Sensing & GIS lab	• ERDAS – imagine (var 6), ARC- GIS, A0- scanner & plotter	Remote Sensing for landuse planning, mapping, planning, contour maps, drainage patterns, etc

DEPARTMENT OF ME & MME

Research Area	Major Lab facilities	Key Application
Power Hydraulics	**1. Computer controlled Closed Circuit and Open circuit Hydrostatic Transmission System of 15 kW capacity** It consists of open-loop and closed-loop hydraulic systems, where the load on the hydrostatic motor is controlled through pump loading. Open circuit system consists of pressure compensated axial piston pump with Raidia piston motor, whereas closed circuit system consists of swashplate controlled variable displacement pump and Low Speed High Torque radial piston motor In both the systems, the performance of the hydrostatic transmission systems in open and closed configurations can be tested by: • Controlling the load on the hydrostatic motor through pump loading • Controlling the speed of the hydrostatic motor by varying flow supplied by the main pump either by changing the swashplate angle or by varying its speed • Controlling the speed of the motor through flow control valve • Inertia load **2. Computer controlled Laboratory Model Hydraulic Excavator** A small in-house fabricated digger / backhoe is operated through hydraulic systems. The movement of the front attachment of the hydraulic back-hoe is accomplished through the flow supplied from proportional valves that are controlled by the in-house developed PLC. The following experiments / studies can be performed: • Study of the kinematics of hydraulic backhoe • Control of the actuators of the backhoe through proportional valves that are operated through PLC • Interfacing hydraulic system with computer through AD/DA cards. **3.Computer controlled Proportional valve controlled hydraulic motor test set-up of 7.5 kW capacity**	Control and operation in Hydraulic drives

	The system consists of two valve controlled open circuit hydrostatic drives; where either bent-axis motor or Gerotor motor can be controlled either through proportional valve or servo-proportional valve. In both cases, the load on the motor shaft is controlled through pump loading. In both the systems, the performance of the hydrostatic drives can be evaluated in open and closed circuit conditions by: • Controlling the load on the hydrostatic motor through pump loading • Controlling the speed of the hydrostatic motor by varying flow through proportional valves The system can also be used for determining the pressure-flow characteristics of the proportional and the servo-proportional valves. **4.Hydraulic system with Accumulator** The system consists of 7.5 kW power pack with two 10 liter and 20 litre capacities of Accumulators. It supplies hydraulic power to a bent axis hydrostatic motor which is loaded through pump loading. The following experiments can be performed: • Energy saving of the system using different capacities of accumulators • Energy saving of the system at varying load • Energy saving of the system at different pre-charge pressure of the accumulators **5. Programmable Logic Controlled Two-Motor Hydrostatic Summation Drive** It is a closed loop hydrostatic transmission system of 15 kW capacity. The system consists of a swashplate controlled variable displacement pump and two bent axis motors. Either one or two motors can be connected hydraulically with the pump in closed loop configuration through PLC. Depending on the load controlled through PLC, the closed loop system can be operated either with one or two motors The following experiments can be performed: • Performance of the closed loop hydrostatic transmission system with single motor drive at varying load achieved through pump loading. The pump flow is varied by changing its swashplate angle through PLC. • Performance of the closed loop hydrostatic transmission system with	

	two motor drive at varying load achieved through pump loading. The pump flow is varied by changing its swashplate angle through PLC. • Automatic changing from single motor to two motor drive or vice-versa with the changing of motor loading thorugh PLC **6. Hydrostatic transmission system with pump loading** This is sponsored by DST, New Delhi, under fast tract SERC project (project value: Rs. 17.4 Lakh) during the tenure 2009-2012. The setup comprises of a hydraulic power pack, a hydraulic motor with a control valve, a pump with loading circuit and a PLC (Programmable Logic Controller) operated Control Panel. The load on the system can be varied by changing set-pressure of a Pressure Relief Valve (PRV). The fluid pressures at the inlet and outlet side of the hydraulic motor and outlet side of the pump are measured by pressure transducers and data are transmitted to PC through Data Acquisition System (DAS) mounted inside the control panel for the purpose of continuous monitoring, performance analysis and online fault diagnosis.	
Air-conditioning & Refrigeration	**1. Refrigeration and air-conditioning accessories display and cut models** The various components those are used in refrigeration and air-conditioning applications are mounted on display board. Some of the components which are on display are: Cut section models various types of compressors, condensers, expansion devices, condenser fan blades, air-conditioning blower blades, domestic refrigerator, window-type air-conditioner etc. **2.Vapour compression refrigeration cycle test rig** The system has been designed for demonstrating refrigeration cycle, calculating coefficient of performance, heat balance at evaporator, at condenser, at overall system, plotting of Pressure-Enthalpy diagram and calculating compressor efficiency ay various loads. The system consists of hermetically sealed compressor, air cooled condenser, thermostatic expansion valve and an evaporation chamber with cooling coil immersed in a tank of water with an immersion type heater fitted in the evaporator tank which acts as cooling load. The control panel of the setup consists of Pressure Gauge, Compound Gauge, Multi-channel Temperature Indicator for showing temperatures	Air Conditioning, Vapor Compression, Solar radiation, Clean energy

	at various points of the setup, Digital Thermostat, Rotameter showing flowrate of liquid refrigerant, HP – LP cutout and Digital Wattmeter for compressor power consumption. The setup enables study of vapor compression refrigeration cycle and the components used in the cycles, determination of refrigeration effect, actual COP, Carnot COP, theoretical COP and refrigeration capacity. One can also calculate the heat balance for evaporator, for condenser and for overall system, plot pressure-enthalpy diagram and determine compressor efficiency at various loads. **3.Ice plant experimental setup** The system has been designed for the study of demonstration of refrigeration cycle, calculation of coefficient of performance in ice manufacturing, calculation of heat balance at evaporator, condenser, overall system and study of ice manufacturing process. The system consists of hermetically sealed compressor, air cooled condenser, thermostatic expansion valve and an ice plant box, which is an insulated S. S tank with brine solution and ice cans, The control panel of the setup consists of Pressure Gauge, Compound Gauge, Multi-channel Temperature Indicator for showing temperatures at various points of the setup, Digital Thermostat, Rotameter showing flowrate of liquid refrigerant, HP – LP cutout and Digital Wattmeter for compressor power consumption. The setup enables study of vapor compression refrigeration cycle, the ice manufacturing process and the components used in a typical ice plant, determination of refrigeration effect, actual COP, Carnot COP, theoretical COP and refrigeration capacity. One can also calculate the heat balance for evaporator, for condenser and for overall system, plot pressure-enthalpy diagram and determine compressor efficiency at various loads. **4. Pyranometer – Solar Radiation Recorder** The setup measures solar radiation upto 2000 W/m2 with user programmable Logging Interval from 1 min to 24 hour. It uses Rechargeable SMF batteries with integral solar panel, which keeps the batteries charged throughout the year with user-friendly application	

	software. Data retrieval is by pocket size data shuttle in computer. **Clean Energy Trainer – Experiment Set for Energy Generation, Storage and Supply** The experimental setup introduces the students to renewable energies like solar energy and wind energy and their combination with hydrogen fuel cell technology, illustrating the complete energy chain. The setup allows use of Solar, wind and hydrogen components separately with PC-supported measurement and experimentation, while USB data monitor serves as electronic load and power supply. The setup consists of • Wind generator with fan and anemometer to generate electrical energy from wind, • Solar Module with lamp and photometer to generate electrical energy from solar energy • Fuel Cell Stack with Electrolyzer and Hydrogen Storage to produce hy¬drogen and oxygen and to use these gases generate electrical energy in fuel cell stack. • USB Data Monitor which is used for data acquisition, as an electronic load or as a power supply for the electrolyzer. The setup enables study of wind generators, solar cells and fuel cells, production of hydrogen from renewable energy, operate multiple loads with wind generators, solar cells and fuel cells, determination of characteristic curves and calculate the efficiency of energy components.	

IC Engine & Thermal Engg, Heat & Mass Transfer	**1.Computerized 4-S, 4-Cylinder Petrol Engine (Power: 47 kW @ 5500 RPMM, Max. Torque: 96 N-m @ 3000 RPM)** This is highly sophisticated experimental setup fitted with Hydraulic Dynamometer, MPFI System, Fuel Level, Pressure and Temperature Sensor, Differential Pressure Transmitter, Data Acquisition Card and National Instrument (NI) Lab View. All the data transmitted by all the measuring sensors is sent to Computer in real time through Data Acquisition (DAQ) Card. Following test facilities are available by this setup. 1. Performance Test 2. Heat Balance Sheet 3. P- θ Diagram 4. P-V Diagram 5. Morse Test **2. Computerized Single Cylinder, 4-S Dual Fuel (Diesel and Petrol) Variable Compression Ratio(VCR) Engine:** This computerized engine setup consists of single cylinder, four stroke, multi-fuel connected to Eddy Current Dynamometer. The operation mode of the engine can be changed from Diesel to Petrol or Petrol to Diesel by varying the compression ratio without stopping the engine and without altering the combustion chamber geometry. Lab View based Engine Performance analysis Software package is provided with this setup for on line performance evaluation. The specifications of different modes are given below. Diesel Mode: Power: 3.5 k W @ 1500 RPM, CR range: 12:1 – 18:1, Petrol Mode: 4.5 k W @ 1800 RPM, CR range: 6:1 – 10:1). **3. Jet Plate and Longitudinal Fins Solar Air Heater:** This non –conventional solar air heater fabricated for R&D purpose having two air channels formed between jet plate and absorber plate with downward longitudinal fins and jet plate and bottom plate. In this solar air heater, the flow impinges out of the holes in the jet plate and hits the bottom of the absorber plate before mixing with the flow in the channel. The impinging air jet increases the value of the convection heat transfer coefficient. This results in significant useful heat gain and collector efficiency.	IC Engine and Heat and mass Transfer

4. Plate Type Heat Exchanger:

The plate heat exchanger normally consists of corrugated plates assembled into a frame. The hot fluid flows in one direction in alternating chambers while the cold fluid flows in true counter-current flow in the other alternating chambers. Traditionally, plate and frame exchangers have been used almost exclusively for liquid to liquid heat transfer. Plate Heat Exchangers are best known for having overall heat transfer coefficients in excess of 3-5 times the U- value in a shell and tube designed for the same service.

5. Concentric Tube Heat Exchanger (Plane and Finned: Comparator type):

This is a recuperative type counter flow water –air type heat exchanger in which a plane and finned tubes are fitted for comparing the performance of the heat exchanger. The objectives of this setup are to determine Log Mean Temperature Difference (LMTD), Overall Heat Transfer Coefficient(U) and Effectiveness(E). Generally finned tube heat exchangers are used in the industries for heat transfer enhancement.

6. Cross –Flow Heat Exchanger:

In this heat exchanger, the directions of two fluids are perpendicular to each other. Engine Radiators and condenser are the best examples of this heat exchanger. In the present heat exchanger setup, both working fluids are used as air.

7. **Drop wise and Film wise Condensation Apparatus:**

In drop wise condensation, the droplets of condensate collected over the condenser surafce are fallen due to gravity and every time fresh vapour is in contact with the condenser surface. In film wise condensation, the film of the condensate wets the surface of the condenser. The present setup is used for the studies of the above two mechanism of condensation and this also helps for visualization of the formation of droplets and film over the condenser surface.

	8. 4-stroke, 4-cylinder Turbocharged, inter-cooled Diesel engine experimental set-up with hydraulic dynameter: The setup has stand-alone type independent panel box consisting of air box, fuel tank, manometer, fuel measuring unit, digital speed indicator and digital temperature indicator. Engine jacket cooling water inlet, outlet and calorimeter temperature is displayed on temperature indicator. Rotameters are provided for cooling water and calorimeter flow measurement. The setup enables study of engine for brake power, BMEP, brake thermal efficiency, volumetric efficiency, specific fuel consumption, air fuel ratio and heat balance.	

Dynamics of Machines & Theory of Machine	**1.Twin Rotor MIMO System.** This functionally represents the model of a helicopter, perticularly from maneuvering control and stability viewpoint. Some control experiments are done in this set-up using MATLAB. Helicopter position and velocity is controlled through the rotor velocity variation. There is a significant cross coupling between the two rotors like in a real helicopter. **Inverted Pendulum.** Some control experiments are done in this set-up using MATLAB. The set-up consists of a cart moving along the 1 meter length track. The cart has a shaft to which two pendulums are attached and are able to rotate freely. The cart can move back and forth causing the pendulums to swing. The movement of the cart is caused by pulling the belt in two directions by the DC motor attached at the end of the rail. By applying a voltage to the motor we control the force with which the cart is pulled. The value of the force depends on the value of the control voltage, which is the control signal. **Static & Dynamic Balancing Apparatus :** The following experiments can be performed in this set-up: (i) To balance the masses statically and dynamically of a single rotating mass system (ii) To observation of effect of unbalance in a rotating mass system **Universal Vibration Apparatus:** The set-up consists of exciter unit with FHP Motor and speed controller, ordinary strip chart recorder and damper with arrangement for changing damping. Scope of Experimentation: (i) To verify the relation simple pendulum (ii) To verify the relation of compound pendulum & to determine the radius of gyration (iii) To study radius of gyration of bi-filar suspension (iv) To study the undamped free vibration of spring mass system (v) To study the longitudinal vibration of helical coiled spring (vi) To study the forced vibration of simply supported beam for different damping. (vii) Undamped torsional vibrations of single rotor system (viii) Undamped torsional vibrations of double rotor system (ix) To study the damped torsional vibration of single rotor system and to determine the damping co-efficient (x) Verification of Dunkerley's Rule (xi) To study the forced damped vibration of spring mass system:	

Fluid Flow Machines Laboratory & Fluid Mechanics & Fluid Machines	**1.Reciprocating Air Compressor Experimental Set up** Title: Performance test of reciprocating air compressor Aim: To conduct a test on reciprocating air compressor and to determine the volumetric efficiency and isothermal efficiency at various delivery pressures Specifications: Power 7.5 HP, Rpm: 800, DISPL'T: 20.5 CFM **2. Blower Testing Rig** Title: Performance test of Blower Aim: To conduct a test on Blower to determine overall efficiency Specifications: Motor power: 7.5 HP, Motor rpm: 2880, Diameter of impeller: 428 mm, Type of impellers: backward, forward & radial **3. Two Stage Axial Flow Fan Testing Rig** Title: Performance test of Blower Aim: To conduct a test on Blower to determine overall efficiency Specifications: Capacity: 180-370 m3/min, Speed: 2880 rpm, Head: 60-250 mm of W.I, Power: 15 Kw **4.Kaplan Turbine Experimental Set up** **:** Title: Performance test of Kaplan turbine Aim: To determine the efficiency of Kaplan turbine in closed circuit Specifications: Net head: 10 meters, Discharge: 1700 LPM, Rated Speed: 1000 rpm, and Power: 1.5 Kw **5.Pelton Wheel Experimental Set up:** Title: Performance test of pelton wheel Aim: To determine the efficiency of pelton wheel at constant speed and in open circuit Specifications: Net head: 46 meters, Discharge: 840 LPM, Rated Speed: 750 rpm, and Power: 3.72 Kw **6. Multiple experimental set up of** **• Verification of Bernoulli's Theorem** **The experimental set up is a self contained bench mounted unit consisting of the convergent divergent test section**	Fluid Mechanics

	• **Apparatus for measuring losses in pipe** **Aim of the experiment is to determine the coefficient of friction for a set of given pipes** • **Calibration of a circular orifice** **To determine the hydraulic coefficients for a circular edged orifice** • **Calibration of Venturimeter** **Aim of the experiment is to determine the coefficient of discharge for a horizontal venturimeter**	
Tribology Laboratory	**1. Sine Wave Vibro Viscometer** Range: 0.3 mPa.s – 10 Pa.s, Operating Temperature: 10-40°C, Accuracy: 1% of Repeatability, Temperature Measurement: 0-160°C The thin sensor plates are immersed in a sample are vibrated with a uniform frequency, the amplitude varies in response to the quantity of the frictional force produced by the viscidity between the sensor plates and the sample. The vibro viscometer controls the driving electric current to vibrate the spring plates in order to develop uniform amplitude. The driving force required for the viscidity is directly proportional to the viscosity × density. Therefore, when vibrating the spring plates with a constant frequency to develop uniform amplitude for samples with differing viscosities, the driving electric current (driving power) is also directly proportional to the product of viscosity and density of each sample. •	Friction Wear and Lubrication
CAD Laboratory	FEA Software • ANSYS – an engineering simulation software developer. • ABACUS – a calculating tool used primarily in parts for performing arithmetic processes. • ALTAIR-HYPERMESH is a high-performance finite element pre-processor for popular finite element solvers. • MEMS Software • COMSOL- an engineering design and finite element analysis software environment for the modeling and simulation. • INTELLISUITE – a tightly integrated design environment that link entire MEMS organization together. • COVENTORWARE integrated suite of design simulation software. • LEDIT – a line editor allows using shell commands with control	Computer Aided Designs

	characters. • AUTO-CAD/Auto-Desk Inventor •	
Strength of Material	**1.Universal testing machines** The most common testing machines are universal testers, which test materials in tension or compression. Their primary function is to create the stress strain curve. Testing machines are either electromechanical or hydraulic. The principal difference is the method by which the load is applied. Electromechanical machines are based on a variable-speed electric motor; a gear reduction system; and one, two, or four screws that move the crosshead up or down. This motion loads the specimen in tension or compression. Crosshead speeds can be changed by changing the speed of the motor. A microprocessor-based closed-loop servo system can be implemented to accurately control the speed of the crosshead. Hydraulic testing machines are based on either a single or dual-acting piston that moves the crosshead up or down. However, most static hydraulic testing machines have a single acting piston or ram. In a manually operated machine, the operator adjusts the orifice of a pressure-compensated needle valve to control the rate of loading. In a closed-loop hydraulic servo system, the needle valve is replaced by an electrically operated servo valve for precise control. Universal testing machines Hounsfield: H50Ks, Model: THE- 5000N, Capacity: 500 KN, Serial number: E0909 Specification: ASI: Universal testing machines (An ISO 9001: 2008 Co.) Model: CCUTM Serial number: 81277, Maximum Capacity: 20000N **2. Micro Hardness Testing Machine** With the 270VRSD HARDNESS TESTER all operations are managed by a single drive including automatic research of test piece. Pushing the Start button, the 270VRSD hardness tester head moves down to reach the test surface from distance multiples of 50 mm and automatically starts the hardness test cycle in automatic succession without breaching a phase. Automatic control and selection of pre-loads and major loads through a software controlled closed-loop load cell (AFFRI® patent) Optical gauge high definition 0.1 micron for	Physical properties of Material

	very accurate Vickers and Brinell measurements. Automatic compensation of deflection up to 50 mm. Fully operational even in the presence of vibrations, sudden changes in temperature or dusty environments. Repeatability and Reproducibility in all test conditions. Graphical lighted display with high contrast to obtain clear, rapid and accurate readings. Automatic control and selection of pre-loads and loads. Automatic correction of measurements on round surfaces and memorization of results. **3. Torsion Testing Machine** Torsion testing equipment consists of: (a) A twisting head: with a chuck for gripping the specimen and for applying twisting moment to the specimen. (b) A weight head: grips the other end of the specimen and measure the twisting moment of torque. Specification: ASI: Torsion testing machine (An ISO 9001:2000 Co.) Model: AMI, Serial number: 1213, Maximum capacity: 200KGM	
Mechanical Vibration	1. A test rig resembling mine ventilation fan for studying various type of mechanical faults and vibration behavior. 2. Machine Fault Simulator It is a working model designed to perform research and study of all the mechanical faults and unwanted vibration raised from the faults. 3. **The Function Generator and Shaker are used for developing excitation force with known magnitude and frequency.**	Analysis of Machine Vibration

CAE Laboratory	**STAR CCM CFD Software – provides comprehensive engineering physics simulation inside a single integrated package**	Computational Fluid Mechanics
Material Handling	**1. Working model of an electro-magnetic type vibratory feeder to determine rate of feed, influence of moisture content/ material size etc. on the feed rate.** **2. A setup consisting of bins with different hopper angle to study the discharge rate of materials.** **3. A working model of mechanical type vibratory feeder with unbalance weight underneath a hopper** **4. A model of a mechanical type vibratory screen with unbalance weight.** **5. An experimental setup to fluid friction angle of different type of rock/ore.** **6. Working model of an electro-magnetic type vibratory feeder to determine rate of feed, influence of moisture content/ material size etc. on the feed rate.** **7. A setup consisting of bins with different hopper angle to study the discharge rate of materials.** **8. A working model of mechanical type vibratory feeder with unbalance weight underneath a hopper**	Experiments related to Bulk Solid Handling
Mining Machinery Model Laboratory	**1. An apron conveyor working model to study its constructional features and operational principle** **2. A model of ground mounted friction winder to study the basic components of the winder.** **3. A test setup to examine the torsional rigidity of individual steel wire.** **4. A bench top test setup to determine the fatigue strength of individual steel wire.**	Mechanisms of Mining Machinery
Drilling Engineering Laboratory	**A wagon drill machine with its different accessories for study purpose.**	
Manufacturing Facilities	**1. Hydraulic Mounting Press and Semi- automatic Polishing Machine -** Hydraulic mounting press is used for the purpose of mounting of sample in order to view microstructure and surface finish as well as for edge retention and semi	Manufacturing different components

automatic polishing machine is used for the purpose of polishing to get mirror finish surface in order to get clear view of the micro structure of the specimen.

2. CNC Machining Lab

This lab consists of computer numerical control (CNC) trainer turning machine with fanuc control system and CNC trainer milling machine control along with fanuc programming with latest software for manufacture of fine tolerance components.

3.EDM/ECM Lab

This Laboratory houses Wire Cut Electrical Discharge Machine (EDM) Plant With CNC Control System for Machining of very hard and complex shaped and Electro Chemical Machining (ECM) Equipment for machining parts components having Fine tolerance.

Metrology Lab

This Laboratory has Auto- Collimator, Metallurgical Microscope, Mechanical/Digital Vernier Calipers, Mechanical/Digital Micrometer, Standard Wire Gauge Slip Gauge, Mechanical Vernier Height Gauge, Mechanical Gear Tool Vernier Calipers, Flange/ Disc Micrometer, Sine Bar, Dial Gauge apart from other measuring instruments for dimensional measurement

Welding Shop

This shop houses Manual Metal Arc Welding Machine, Submerged Arc Welding Machine, Oxy-Acetylene Gas Welding Machine, Plasma Arc Cutting Machine, Tungsten Inert Gas (TIG) Welding Machine, Metal Inert Gas (MIG) Welding Machine, Profile Cutting Machine, Welding Fume Extraction Downdraft Table apart from other tools and equipments.

Machine Shop

This shop houses Lathe Machine, Milling Machine, Shaper, Slotter, Drilling Machine, Grinding Machine, Gear Hobbing Machine, Gear Shaping Machine, Tool & Cutter Grinder, Surface Grinder, Centerless Cylindrical Grinder apart other tools and equipment

	Foundry Shop This shop houses Induction Heating Furnace, Mueller Machine, Ovens, Permeability Tester, Green Compression Strength Tester apart from various important foundry tools and Equipment. The Casting Of Metals Is carried out after making suitable mould.	

DEPARTMENT OF MINING ENGINEERING

Research Area	Major Facilities/ Instruments
Mine Ventilation and sub-surface Environmental Engineering	○ **Precise instruments,** for carrying out pressure – quantity surveys in mines. ○ **Experimental set-up,** for studying methane emission from coal seams. ○ **Quick thermal conductivity meter,** to measure the thermal conductivity of rocks**.** ○ **Real time aerosol monitor, gravimetric dust sampler, personal dust sampler, konimeter with projector,** for studying the air borne respirable dust concentration in mine air. ○ **Digital sound level meter with recorder,** for studying noise levels in mines and mining areas. ○ **Facilities** for studying CPT and IPT, Sz-index and U-index for finding the susceptibility of coal to spontaneous heating. ○ **Experimental set-up,** to study coal-dust explosion hazard. ○ **Microprocessor based Gas Chromatograph System,** for detection and measurement of different gases in the mine air. ○ **Mine ventilation computation laboratory,** for computation of ventilation problems, is a part of the Mine Ventilation and Environment Laboratory. ○ **Artificial lung machine and related set-up** for simulation of rescue operations in mines, the first of its kind in an educational institution
Rock Mechanics & Ground Control	○ **Material Testing System (MTS) (100 tonnes),** an electro-hydraulic stiff testing machine, is used for testing the various physico-mechanical properties of rocks under different conditions of loading. ○ **Compression testing machine (600 tonnes),** is used for determining various strength parameters of rocks & building materials and for testing of mine supports including hydraulic legs for longwall roof support. ○ **Transducers and Sensors,** consist of precision Load Cells, Pressure Transmitters, Pressure Transducers, Strain Gauges and LVDTs. These are invariably used with on-line PC based Data Acquisition System for recording test parameters. ○ **PC Based Data Acquisition System,** a state of the art 8-Channel Data Acquisition System with sampling rate of 9999 samples per second for on-line acquisition of test data like strain, displacement, pressure, load, temperature etc. This

	is used invariably in all the laboratory experiments. ○ **MINIFRAC** is used for determining the in-situ stresses in rock mass by hydro-fracturing technique. ○ **Hydraulic Leg testing facility,** for testing Powered Roof Support used in longwall mining. This is a DGMS approved facility. ○
Mine Surveying & Geomatics	○ **Electronic total station,** for all types of spot surveying with high speed and accuracy. ○ **Gyro mat,** for determination of True North in Underground as well surface. ○ **Laser eyepiece,** for correlation survey with high accuracy. ○ **Digital & Precise level,** for carrying out subsidence survey & monitoring ○ **Micro-optic theodolite**, **precise & digital levels and other instruments,** for all types of surveying and leveling. ○ **Global Positioning System** (GPS). ○ **Mine surveying computation laboratory with surveying software (LISCAD, SURPAC, SKI-PRO, T-COM, LEICA-GEOFFICE, PROLINK etc.)** forms a part of the Survey Laboratory. ○ **Digitizer, Scanner (AO) and plotter** for development of survey plans, digitization of old plans and converting. ○ **GIS Software mainly ARCGIS suites and Geomedia Professional,** for extracting and processing the information from mine plans and to update them with the latest information. ○ **Remote Sensing Softwares mainly ERDAS imagine and Leica Photogrammetry suites** for processing satellite imageries.
Design of Excavation Systems & Mechanical Cutting of Rocks	○ **High speed video camera,** for study of mechanics of rock fragmentation, and movement of rock mass and projectiles. ○ **Fragblast software,** for rock fragmentation and distribution analysis using the digital images acquired by a video camera. ○ **Vibration recorders and sophisticated chip based micro seismographs,** to record blast vibration levels and analyze peak particle velocity, dominant frequency, FFT analysis and safe vibration levels. ○ **VOD probe,** for measuring velocity of detonation of explosives inside a blast hole. ○ **Digital storage oscilloscope** along with borehole pressure transducer, for recording detonation pressure inside blast holes. ○ **Cerchar hardness apparatus,** for estimation of drilling parameters and machine specifications from small rock samples. ○ **Sequential blasting machine,** for providing very precise and wide range of delays in blasting circuits. ○ **Near-field acceleration measuring set-up,** for understanding the rock–explosives interaction for blast

	damage assessment.
Numerical Modelling in Mines	○ **Strand – 7 (Version 2.3.6) Finite Element package,** for solving 2-D & 3-D linear and non-linear static and dynamic problems. ○ **FLAC – 2D (Version 4.0) Finite Difference software** for solving linear and non-linear problems including support problems for excavations in rock. ○ **ANSYS 10. Finite Element Modelling Package** for solving linear and non-linear problems including support problems for excavations in rock. ○ **Galena for** slope stability problem
Mine modeling & simulation	○ **SURPAC (Version 5) Mine Planning software** package, for mine planning and design ○ **MATLAB 6 for simulation & modeling**
Longwall Mining	○ **An unique 30 Meter longwall mock gallery with Powered Support, Shearer, AFC, Stage Loader, Power Pack** etc, a facility which is not available in any other institute in India

DEPARTMENT OF PETROLEUM ENGINEERING

Generic Name of Equipment	Research Area	Model, Make & year of purchase	Key Application
i). Syringe pump for injecting oil, water and polymer solutions through the core	Enhanced oil recovery	Teledyne Isco 65MD; (2 Nos)	Core flooding Experiments
ii). Rheometer	Rheological Study	Physica MC1,	Rheological study of different solutions
iii). Polarizing Microscope with image processing software	Morphology of liquid/solution	OLYMPUS, BX51P,	Microscopic picture of liquid/solutions
iv). Core cutting machine for various diameter core plugs.	Core cutting	Indigenous, 2000	Cutting of reservoir rock of different sizes
v). TOC Analyzer	Waste water analysis	Alliance Technology	Total oil content in waste water
vi). Gas Chromatography	Compositional analysis of gases and liquids	Thermofisher, 1000	Compositional analysis of gases and liquids
vii). Helium Porosity meter	Petrophysical properties of rock	Corelab	Measurement of porosity of rock
viii). FTIR	Solid/liquid functional group analysis	Perkin Elmer	infrared spectrum of absorption of solid liquid samples
ix). Spinning drop tensiometer	Interfacial energy	Dataphysics	Ultra-low interfacial tension between two immiscible liquids
x). Tensiometer	Interfacial energy	Kruss	IFT measurement by Du-Nouy principle