



# Research Facilities

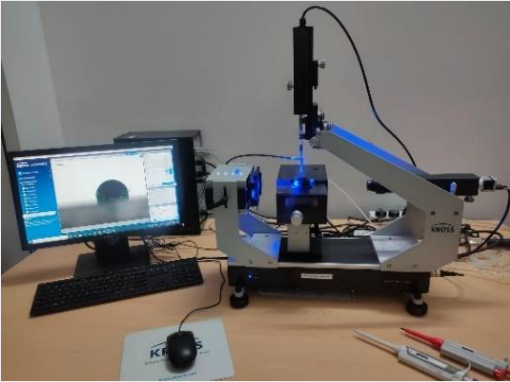


**Department of Mechanical Engineering**

**Indian Institute of Technology Bhilai**

## Thermal and Fluid Engineering:

### Drop Shape Analyzer



Make: KRUSS GmbH.

Model: KRUSS/DSA25

Applications: Contact angle measurement from the shadow image of a sessile drop, surface tension or interfacial tension from the shadow image of a pendant drop.

Specifications:

- Max. Sample space: 320 mm x ∞ x 165 mm (W x D x H)
- Droplet contact angle and surface energy measurement
- High power monochromatic (470 nm) light source.
- Software controlled dosing system with a droplet discharge rate of 0.02 to 25  $\mu\text{L/s}$  having a resolution 0.1 $\mu\text{L}$
- High speed camera with manual focus and 6.5x zoom (1920 x 1200 pixels, 2300 fps)
- Climate controlled chamber with temperature and humidity sensor.

### IR Thermal Camera



Make: FLIR Systems.

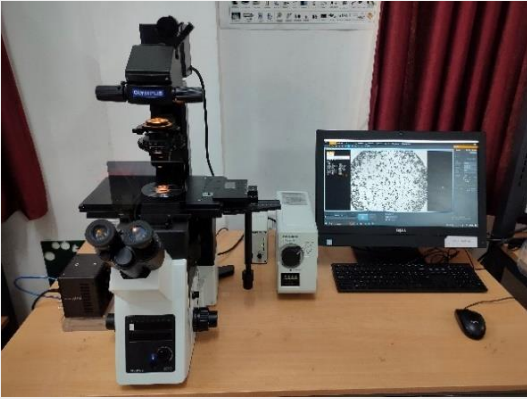
Model: Flir X6540sc - BB

Applications: Infrared and Thermal imaging, FLIR, Active thermography for non-destructive material testing and manufacturing process, Thermography

Specifications:

- Detector type: Focal Plane Array (FPA)
- IR resolution: 640 x 512 or 327680
- Temperature range
- Detector pitch (or) pixel size: 15 microns.
- Thermal sensitivity / NETD: less than 25 mK, typically 18 mK.
- Temperature measurement accuracy:  $\pm 1^\circ\text{C}$  (1.8 $^\circ\text{F}$ ) or  $\pm 1\%$
- Maximum frame rate: 146 Hz @ 640 x 512/IWR  
528 Hz @ 320 x 256/ IWR 1510 Hz @ 160 x 128/IWR 3699 Hz @ 132 x 8/IWR.

## Olympus Inverted Microscope



Make: Olympus medical system India

Model: Olympus IX 73

Applications: Used for high-resolution live cell imaging and observation.

Specifications:

- Optical system- UIS2
- Fluorescence light source- 130 W Halogen light
- 232 mm (X) × 240 mm (Y) stage size, stage insert plate exchangeable (Ø110 mm)
- Gliding stage- Upper circular stage 360° rotatable, 20 mm (X/Y) travel.
- Transmitted light illuminator- 30 W halogen illuminator
- Magnification: 5x, 10x, 20x, 40x, and 60x

## Thermal Conductivity Analyzer



Make: Hot Disk

Model: TPS 2500S

Applications: To measure Thermal conductivity of material

Specifications:

- Temperature range: -60° C to 750° C.
- Radius of disk spiral: 3.3mm to 14.65mm
- Diameter of sample size:  $\geq 50$ mm
- Thickness of sample size: 0.1mm to 10mm
- Thermal conductivity range: 1W/m-K to 500W/m-K.
- Reproductivity - Thermal conductivity:  $\pm 2\%$   
-Thermal Diffusivity:  $\pm 5\%$   
-Specific Heat (per unit volume):  $\pm 3\%$

## Internal Combustion Engine Test Setup



Make: Accurate Test Equipment's and Engineers  
Test Setup: Internal combustion engine with transient dynamometer

Highlights:

- Test setup is equipped twin-cylinder, 793 cc, four stroke water cooled engine with CRDI injection system
- Engine setup is coupled with Transient dynamometer to perform tests
- Setup is capable to perform detailed combustion (in-cylinder parameters, performance, and emissions tests)
- Engine Rating:
  - Power Rated: 24 KW@3500 RPM
  - Rated Torque: 75 MN@ 200 RPM

## Emission Analyzer



Make: AVL India

Model: AVL DiTEST MDS 450

Applications: Finding composition of the exhaust gases that are coming out of the engine

Highlights:

- Measures CO, CO<sub>2</sub>, HC, O<sub>2</sub> and NO with high accuracy.
- Configurable to different C/H ratio for possible alternative fuels.
- Coupled with AVL DiSMOKE 480 BT to measure exhaust opacity.
- Measurement resolution up to 1 ppm for HC and NO measurement.

## High speed camera 1



Make: FASTCAM

Model: Mini UX50

Applications: Videography of high-speed events such as microfluidics, molten pool dynamics during welding, machining

Specifications:

- Frame rates: 2,000 fps (at full resolution) to 1,00,000 fps (at reduced resolution)
- Full resolution: 1.3 MP CMOS Monochrome sensor

On-board memory: 16 GB

## High speed camera 2



Make: Photron

Model: Nova S9

Applications: Videography of high-speed events such as impact testing, high speed machining, spray cone measurement, droplet dynamics

Specifications:

- Full Frame Performance: 9,000fps, 1024 x 1024 pixels
- 1-Megapixel CMOS Image Sensor
- Maximum Frame Rate: 900,000fps (128 x 16 pixels)
- Minimum Exposure Time: Global electronic shutter to 0.2 $\mu$ s
- Dynamic Range (ADC): 12-bit monochrome

## 3D Scanner



Make: Altem Technologies (P) Ltd

Model: Artech 3D/Artech Eva

Applications: Creating high-precision 3D models of real-world objects.

Specifications:

- Output formats:
  - 3D mesh formats- OBJ, PLY, WRL, STL, AOP, ASC, PTX, E57, XYZRGB
  - CAD formats- STEP, IGES, X\_T
  - Formats for measurements- CSV, DXF, XML
- 3D point accuracy, up to: 0.1mm
- 3D resolution, up to: 0.2mm
- 3D accuracy over distance, up to: 0.1mm + 0.3mm/m
- Working distance: 0.4 – 1m
- 3D reconstruction rate, up to: 16 fps.

## Multicomponent Gas Analyzer

Make: GASMAT

Model: GT5000 TERA

Applications: Used to measure multiple emission gases.

Highlights:

- Measuring principle - Fourier transform infrared, FTIR
- Multigas capability - Simultaneous analysis of up to 50 gas compounds
- Response Time - Typically < 120 s, depending on the measured components and measuring time



- Spectrometer –
  - Resolution – 8  $\text{cm}^{-1}$
  - Scan frequency – 10 scans / s
  - Detector – Peltier cooled MCT
  - Beamsplitter – ZnSe
  - Wave number range – 900 – 4 200  $\text{cm}^{-1}$

## Manufacturing and Material Science:

### CNC Turning Centre



Make: DMG MORI Asia Pvt. Ltd.

Model: DMG MORI/CLX350 V3

Applications: Turning, Thread cutting, Grooving, Drilling, Indexing, Boring, Chamfering and end milling.

Specifications:

- Max. workpiece diameter: 320mm
- Max. workpiece length: 530mm
- Max. chuck size: 250 mm
- Max. spindle motor speed: 5,000 rpm
- Drive power rating (100% DC): 11 kW (AC) Max. bar capacity diameter: 65
- Siemens Controller

### 4 axis CNC Vertical Machining Centre



Make: ACE Manufacturing Systems Ltd.

Model: 540V.

Applications: Face milling, Sizing, Slot milling, Side Milling, Indexing, Gear cutting, Drilling, Tapping, Reaming, Incremental forming.

Specifications:

- Travel (X, Y and Z axes): 500 x 400 x 450 mm
- 40 / 40 / 40 m/min rapid rate for X/Y/Z axes
- 20 tool ATC
- Spindle speed: 60-6000 RPM
- Additional 4<sup>th</sup> axes for related operations.
- CNC Control: FANUC 0I MF

### CNC Wire EDM machine



Make: Electronica India Ltd.

Model: ECOCUT

Applications: Preparation of Specimen for various characterisation, contour cutting.

Specifications:

- Workspace: 250 x 350 mm
- Max. workpiece height: 150 mm
- Max. table size: 370 x 600 mm
- Max. cutting speed: 70 mm<sup>2</sup>/min
- Taper:  $\pm 5^\circ$  over 100 mm

### High-speed Micro-machining Centre



Make: MicroMach Innovations Pvt. Ltd., India

Model: HSM 080

Applications: Micro drilling, Micro milling, Surface texture, Manufacturing micro channel and variety of micro components,

Specifications:

- Travel distance: 100 mm (X-Y), 60 mm (Z)
- Feed Rate: 0.06-6000 mm/min
- Resolution: 0.5  $\mu$  m (X-Y), 1 nm (Z)
- Accuracy:  $\pm 0.5 \mu$  m (X-Y),  $\pm 0.3 \mu$  m (Z)
- Spindle Speed: 5000 -80000 rpm with variable frequency drive.
- Spindle torque: 11.9 N-cm (80000 rpm)

### Metal Inert Gas Welding Machine



Make: Kemppi India Private Limited

Model: Fast MIG X450c

Applications: Welding thin/thick materials, Additional features such as root wise, root thin, scratch TIG etc.

Specifications:

- Multi-process power solution: MIG, 1-MIG, pulsed MIG, MMA
- voltage range 10V to 50V
- Current: 450 A
- Materials- Cu, Al, Fe.



## Friction stir welding machine



Make: ETA Technology Pvt. Ltd.

Model: ETA /WS007

Applications: Friction stir welding, processing and solid-state additive manufacturing

Specifications:

- Max. Axial thrust of 50kN.
- Linear CNC machine with maximum axis movement- 500mm length x 300 mm Width.
- Spindle speed- up to 3000 rpm
- Weld speed- up to 250 mm/min

## Stir-Casting Facility



Make: SwamEquip

Applications: Casting of aluminium, magnesium alloys and composites

Key specifications:

- Casting Options: Gravity casting, Vacuum Die Casting, Squeeze Die Casting, Centrifugal Casting
- Maximum temperature: 900°C
- Squeeze casting load: 400 kN
- Die/Mould: Few standard moulds for cylinders and rectangular plates available.

## Hot Extrusion Setup



Make: SwamEquip

Applications: Used to Extrude samples of aluminium, magnesium alloys and composites

Specifications:

- Hydraulic Press
  - Load capacity: 100 tons
  - RAM: Diameter -200 mm, Stroke - 250 mm
- Sample heating furnace Maximum temperature :650°C

## High energy Planetary Ball mill



Make: Mechmin

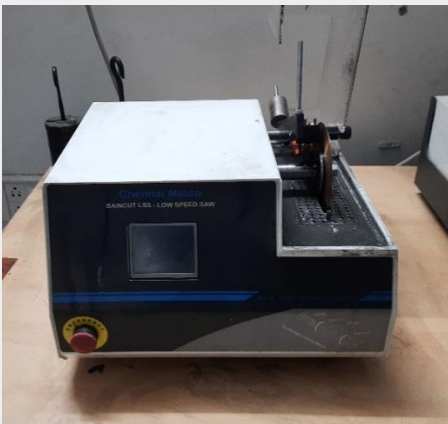
Model: MM2502

Applications: To make powder metals, Milling, Mixing and Alloying.

Specifications:

- Mode of grinding: Dry and wet.
- Materials: soft, hard, brittle, and fibrous, metals (Al, Ti, Ni, etc.) and non-metals ( $Al_2O_3$ , SiC, WC, etc.).
- Feed size  $\leq 10$  mm approx. dia.
- Final fineness  $\leq 1 \mu m$  approx. dia.
- For colloidal (wet) grinding  $\leq 0.1 \mu m$  approx. dia
- Speed ratios- planetary disk: grinding bowl speed ratio - 1:2
- Sun wheel speed - 500 rpm and Jar speed 1000rpm.
- Feed quantity- 100ml and 250 ml  
Jar and ball material available- harden steel, Zirconia and Tungsten carbide.

## Low speed precision diamond cutter



Make: Chennai metco

Model: Baincut LSS003

Applications: It is applicable to accurate cutting of all materials especially Hard materials like high value fragile artificial crystals

Specifications:

High precision Tabletop machine.

- Cutting capacity up to 20mm using 4 inch wheel and up to 30mm using 5 inch wheel.
- Continuously variable speed 60rpm to 600rpm.
- Positioning accuracy 0.01mm
- Arbor size- 12.7mm.

## Hot mounting press



Make: Chennai metco

Model: MPH007A

Applications: Fully automatic hydraulic hot mounting press for various characterisation

Specifications:

- Automatic water-cooling system
- Temperature: 180°C and pressure: 150 bar
- Mould size: 30mm, 40mm

## Dual-disc sample polisher



Make: Chennai metco

Model: PMV018

Applications: Grinding and Polishing of materials for metallurgical application

Specifications:

- Double 8"-disc (standard), 10"/12" disc (Optional) polisher with individual drive.
- Variable speed from 50-100RPM.
- The Working disc can be operated clockwise/counter clockwise.
- accessories: Air drier, Ferromagnetic carrier sheet for sandpaper/cloth and water filtering system

## Equipment's expected to arrive by first Quarter of 2023

**2kW laser**

**Universal sheet metal testing**

**Hot rolling**

**High temperature tubular furnace**

**High temperature tribometer**

## Material Testing and Characterization:

### Micro-indentation Hardness Tester



Make: INNOVATEST

Model: FALCON 502

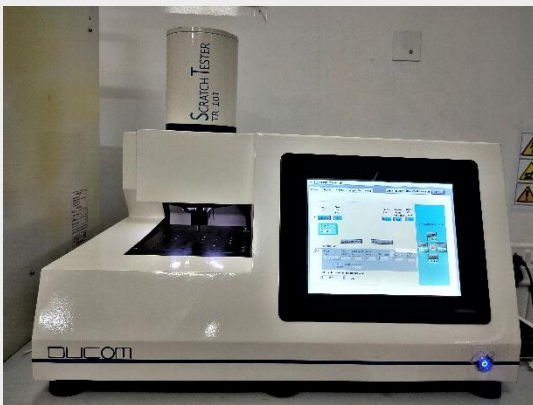
Applications: Hardness measurement.

Specifications:

- Indenters- Vickers and Knoop.
- Magnification- 100x, 200x and 500x.

Motorized CNC X-Y stage, total load upto 100kgf max, Displacement- 100x100mm, Resolution- 0.001mm, Repeatability-  $\pm 0.003$ mm.

### Scratch Tester



Make: DUCOM

Model: DUCOM TR101

Applications: Used to measure coating adhesion, scratch resistance of materials.

Specifications:

- Load range (N): 2-20, 20-200
- Tangential Force (N): 0-20, 20-200
- Stroke (mm): Up to 50
- Speed (mm/sec): Up to 5
- Loading Rate (N/sec): 0.1-20
- Stylus: Diamond indenter Rockwell C, with tip radius R2000

### Non-contact type 3D Optical surface Profilometer



Make: Sensofar

Model: S neox

Applications: Used to study the surface features such as roughness, flatness, and topography of various materials.

Specification:

- Measuring principle: Confocal, PSI, ePSI, CSI, Ai Focus variation and thin film
- Observation types: Brightfield, DIC, Sequential Color RGB, Confocal, Interferential phase contrast
- Measurement types: Image, 3D, 3D thickness, profile and coordinates
- Camera 5Mpx: 2448x2048 pixels (60 fps)
- MAG- 25x, 50x, 100x, 200x, 500x, 1000x.
- XY Travel range (mm)- Manual: 40x40, Motorized: 154x154.
- Sample weight up to 25 Kg

## Digital Stereo-zoom Microscope



Make: Leica

Model: S9i

Applications: Used to take macro images of specimen.

Specifications:

- Viewing angle: 35°, Focusing range: 135 mm
  - Working distance: 122 mm, Optics carrier rotatable through 360°
  - Magnification: 10×, 20×, 30×, 40×, and 50×
- Integrated camera: 10 MP resolution, Live image up to 35 fps (1,024 × 768 pixels)

## Inverted Metallurgical Microscope



Make: Leica

Model: DMI8

Applications: Used to study micro and macro surface/microstructure.

Specifications:

- Focus: Manual 2-gear
- Magnification: 25 to 1000x
- Contrasting techniques: Incident light (BF, UC-3D, DIC, Pol) and Transmitted light.
- Illumination: LED Halogen.

## Digital Image correlation



Make: Dantec

Model: Q-400

Applications: Measurement of in-plane and out of plane displacements/deformations of structures subjected to external loading

Specifications:

- Displacement resolution: Up to 1/100 of the Field of View depending on measuring conditions.
- CMOS-resolution: up to 12.5 Mpx
- Measuring range: From a few microns up to several millimetres
- Measuring area: 50 mm x 70 mm down to 3 mm x 4 mm

## Servo Hydraulic UTM



Make: MTS Landmark

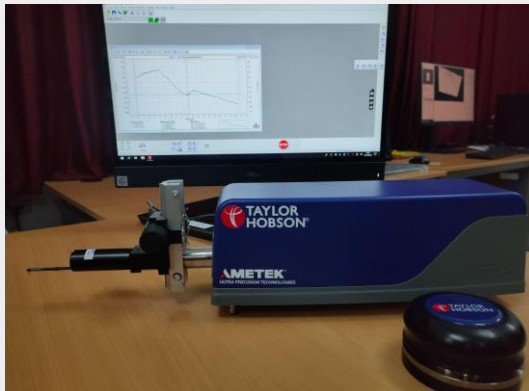
Model: Servo Hydraulic System MTS 370.10

Applications: Tensile testing, Compression testing, Three-point and four-point bending testing, fatigue, fracture test.

Specifications:

- Max load capacity: 100 KN
- Travel Extension: -100 to +100mm
- Grippers: For  $\leq 5\text{KN}$ - Pneumatic grippers  
 $\geq 5\text{KN}$ - Hydraulic grippers
- Max. frequency for fatigue: 10 Hz

## Contact type Surface Roughness Tester



Make: Taylor Hobson

Model: Intra touch

Applications: To measure various Surface roughness parameters on both flat and curved specimen, generation of 2D profile

Specifications:

- 90 mm Z height adjust and optional 350 mm column to accommodate large or tall components.
- Gauge with up to 2 mm (0.08 in) of range and an outstanding range to resolution ratio of 262,144:1.
- Measurement speeds from 0.25mm/sec to 10mm/sec.
- 0.20 $\mu\text{m}$  / 20mm straightness error.
- Contains all kind of stylus and other accessories comes with this instrument.
- RMS Repeatability:  $<0.01$  nm
- RMS Precision:  $<0.1\text{nm}$

## Software's:

1. CAD Modelling: SOLIDWORKS, Solid Edge
2. Numerical Analysis: ANSYS, DEFORM-3D, ABAQUS, LS DYNA, LabVIEW, GT-Suite
3. Statistical: Minitab
4. CNC Programming: Mastercam

## Contact Us



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