



**MATS UNIVERSITY**

**Raipur (C.G.)**

**Syllabus Scheme**

**(5<sup>th</sup> Semester)**

**For**

**Bachelor of Engineering**

**In**

**MECHANICAL**



**MATS School of Engineering &  
Technology**

**ARANG , RAIPUR (C.G.)**



# MATS UNIVERSITY

ARANG, RAIPUR



## Subject Code For School of Engineering & Tech. Deptt.

### 5<sup>th</sup> Semester (MECHANICAL)

S.No.	Subject Code	Subject Name
1	BE510	Machine Design -I
2	BE511	Internal Combustion Engine
3	BE512	Computer Aided Design & Manufacturing
4	BE513	Manufacturing Science -II
5	BE514	Power Plant Engineering
6	BE515	Industrial Management
7	BE516	Machine Design -I Lab
8	BE517	Internal Combustion Engine Lab
9	BE518	Computer Aided Design & Manufacturing Lab
10	BE519	Manufacturing Science -II Lab



# MATS UNIVERSITY

## ARANG, RAIPUR



### Scheme of Teaching & Examination

### B.E. V SEMESTER MECHANICAL ENGINEERING

S.N	code	Subject	Periods per week			Scheme of marks		Total Marks
			L	T	P	ESE	IM	
1.	BE510	Machine Design -I	4	1	-	70	30	100
2.	BE511	Internal Combustion Engine	4	1	-	70	30	100
3.	BE512	Computer Aided Design & Manufacturing	4	1	-	70	30	100
4.	BE513	Manufacturing Science - II	4	1	-	70	30	100
5.	BE514	Power Plant Engineering	4	1	-	70	30	100
6.	BE515	Industrial Management	4	1	-	70	30	100
7.	BE516	Machine Design -I Lab	-	-	3	20	30	50
8.	BE517	Internal Combustion Engine Lab	-	-	3	20	30	50
9.	BE518	Computer Aided Design & Manufacturing Lab	-	-	3	20	30	50
10.	BE519	Manufacturing Science - II Lab	-	-	3	20	30	50
Total			24	6	12	500	300	800

L – Lecture, T – Tutorial, ESE – End Semester Examination,

P – Practical, IM – Internal Marks (Include Class Test & Teacher's Assessments)

**MATS UNIVERSITY**  
**SEMESTER – V**  
**BRANCH – MECHANICAL**  
**SUBJECT - MACHINE DESIGN- I**  
**CODE - BE510**

### **UNIT I**

Definition of design ,types of design , design process, need, defining the problem, feasibility, preliminary design alternatives, final design selection, preliminary and final plant drawings. Failure criterion & manufacturing considerations in design, basis of good design, failure of machine parts ,deformations ,wear, corrosion, manufacturing methods, machining tolerance, surface finish, cost design consideration in casting & forging. Mechanical properties , application and designing as per ISI and their equivalence with other standards of engineering materials, selection of material ,temperature effect on properties of material such as cast iron ,plain carbon steel, plastics, polymers & composites & their application .

### **UNIT – II**

#### **Basic Elements Design**

Types of key and design, design of socket-spigot cotter joint, sleeve and cotter joint, gib and Cotter joint, design of Knuckle joint, design of splines.

### **UNIT III**

#### **Threaded Fasteners**

Geometry of thread forms, terminology of screw threads and thread standards, specifications of steel bolts, initial tension, relation between bolt tension and torque, design of statically loaded tension joints, design of bolted joints due to eccentric loading.

#### **Riveted Joints**

Types of rivet heads, types of riveted joints, failure of riveted joint, strength of rivet joint, efficiency of riveted joint, design of riveted joint for boiler.

#### **Welded joint**

Types of welded joints, stresses in butt and fillet welds, strength of welded joints, location and dimension of weld design, eccentrically loaded joint, welded joint subjected to bending moment, design procedure, fillet welds under varying loads, stress relieving techniques.

### **UNIT-IV**

#### **Power Screws**

Power screws, Force analysis-square and trapezoidal threads, Collar friction, Stresses in screw, coefficient of friction, efficiency of thread.

#### **Chain Drives**

Chain drives, roller chains, geometric relationships, dimensions of chain components polygonal effect, power rating of roller chains.

### **UNIT-V**

Design of transmission Shafts on the Basis of Strength , rigidity and critical speed. ASME Code for shaft Design, Design of Stepped shaft Axle splined Shaft, Design of axle. Design of couplings –muff, rigid and Flexible coupling, design of axle.

### **BOOKS**

- 1) Mechanical Design of Machine : Maleev hartman.
- 2) Machine Design : P. H. Black.
- 3) Mechanical Engg. Design : J. E. Shigley.
- 4) Design of Machine Element : V. Bhandari , TMH PUBLICATIONS
- 5) Design of Data for Machine Elements : B. D. Shiwalkar.

**MATS UNIVERSITY**  
**SEMESTER – V**  
**BRANCH – MECHANICAL**  
**SUBJECT - INTERNAL COMBUSTION ENGINE**  
**CODE - BE511**

**UNIT – I** Air Standard Cycles: Internal and external combustion engines; classification of I.C. Engines, Cycles of operation in four stroke and two stroke I.C. Engines, Wankel Engines, Assumptions made in air standard cycle; Otto cycle; diesel cycle, dual combustion cycle, comparison of Otto, diesel and dual combustion cycles; sterling and Ericsson cycles; air standard efficiency, specific work output, specific weight; work ratio; mean effective pressure; deviation of actual engine cycle from ideal cycle. Problems.

**UNIT – II** Carburetion, fuel Injection and Ignition systems: Mixture requirements for various operating conditions in S.I. Engines; elementary carburetor, Requirements of a diesel injection system; types of inject systems; petrol injection, Requirements of ignition system; types of ignition systems ignition timing; spark plugs. Problems. performance against mixture strength.

**UNIT – III** Combustion in I.C. Engines : S.I. engines; Ignition limits; stages of combustion in S.I. Engines; Ignition lag; velocity of flame propagation; detonation; effects of engine variables on detonation; theories of detonation; octane rating of fuels; pre-ignition; S.I. engine combustion chambers, Stages of combustion in C.I. Engines; delay period; variables affecting delay period; knock in C.I. engines, Cetane rating; C.I. engine combustion chambers. performance of diesel engine .

**UNIT – IV** Lubrication and Cooling Systems: Functions of a lubricating system, Types of lubrication system; mist, wet sump and dry sump systems; properties of lubricating oil; SAE rating of lubricants, engine performance and lubrication, Necessity of engine cooling; disadvantages of overcooling; cooling systems; air-cooling, water cooling; radiators.

**UNIT – V** Engine Testing and Performance: Performance parameters: BHP, IHP, mechanical efficiency, brake mean effective pressure and indicative mean effective pressure, torque, volumetric efficiency; specific fuel consumption (BSFC, ISFC), thermal efficiency; heat balance; Basic engine measurements; fuel and air consumption, brake power, indicated power and friction power, heat lost to coolant and exhaust gases; performance curves. Problems. Air pollution from I.C. Engine and Its remedies: Pollutants from S.I. and C.I. Engines, Methods of emission control; alternative fuels for I.C. Engines; the current scenario on the pollution front.

**Text Books:**

- 1. Internal Combustion Engines –V. Ganesan, Pub.-Tata McGraw-Hill.**
- 2. Gas Turbines – V. Ganesan, Pub.- Tata McGraw Hill.**
- 3. Engineering fundamental of the I.C.Engine – Willard W. Pulkrabek Pub.-PHI,India**

**Reference Books:**

- 1. Internal Combustion Engines & Air pollution- Obert E.F, Pub.-Hopper & Row Pub., New York**
- 2. Internal Combustion Engines Fundamentals- John B. Heywood, Pub.-McGraw Hill, New York**

**MATS UNIVERSITY**  
**SEMESTER – V**  
**BRANCH – MECHANICAL**  
**SUBJECT - COMPUTER AIDED DESIGN AND MANUFACTURING**  
**CODE - BE512**

**UNIT – I**

**Introduction CAD/CAM**

The influence of computers on manufacturing environment, Introduction of CAD/CAM, the product cycle & CAD/CAM, automation and CAD/CAM, the common database as linkage to various computerized applications.

Product engineering, Benefits of CAD/CAM, Concurrent engineering.

**UNIT – II**

**Geometric Modeling**

Data base: Design database concept, objectives, data structures, creation of data files in application programs and relational database management system.

Requirement of Geometric Modeling, Geometric models, Geometric construction Methods, other modeling methods, curve representation, desirable modeling facilities & rapid prototyping. 3D representation of surfaces and solids; Plane surface, surfaces of revolution, Bezier surfaces, spline surfaces, Solid entities, basic set theory.

**UNIT – III**

**Numerical Control**

Introduction to Numerical Control, Basic components of an NC system, the NC procedure, NC coordinate systems, NC motion control systems, applications of Numerical Control, Introduction to Computer Control in NC, problems with conventional NC, Computer Numerical Control, Direct Numerical Control, Combined DNC/CNC system, Adaptive control machining system,

**NC Part Programming**

Introduction to NC Part Programming, Manual part programming, Computer assisted part programming, the APT (Automatically Programming Tool) language, MACRO statement in APT, Advantages of CAD/CAM in NC programming.

**UNIT – IV**

**Group Technology**

introduction to group technology, part families, parts classification & coding, three parts classification & coding system, group technology machine cells, benefits of group technology

**Computer integrated manufacturing (CIM) system**

Introduction of CAPP, Flexible manufacturing system, benefits.

**UNIT V**

**Finite Element method**

Introduction, types of analysis, general procedure of finite element analysis- stiffness matrix, solution procedure, one dimensional problem.

**TEXT BOOKS**

1. CAD/CAM Principles & Applications – P.N. Rao – TMH Publication
2. CAD/CAM Computer Aided Design & Manufacturing – Mikell P. Groover, Emory W. Zimmer - Pearson Education
3. Concept and application of Finite element analysis, R D Cook, John Wiley

**REFERENCES BOOKS**

1. CAD/CAM Theory & Practice – Ibrahim Zied – TMH Publication
2. CAD/CAM – Surendra Kumar & A.K. Jha – Dhanpat Rai & Company
3. Finite element analysis

**MATS UNIVERSITY**  
**SEMESTER – V**  
**BRANCH – MECHANICAL**  
**SUBJECT-MANUFACTURING SCIENCE-II**  
**CODE - BE513**

#### **UNIT – I**

**Forging** - Principle, types, tools and fixture of forging, forging dies, forging machines, forging design, drop forging die design ,upset forging die design, forging practice and process capability, forging defects, Inspection and testing of forged parts.

#### **Extrusion**

Principle, extrusion processes, process parameters, extrusion equipment, extrusion defects.

#### **UNIT – II**

**Rolling** - Principle, classification of rolled products, types of rolling, rolling mill train components, roll pass design for continuous mill.

#### **Drawing**

Wire drawing, tube drawing: Principle, setup, type, process capability.

#### **UNIT – III**

**Press Working** - Types of presses, selection of press, components of a simple press, press working operations – shear, bending, drawing etc., types of dies, die sets, considerations in die design, scrap strip layout.

#### **Jigs & Fixtures**

Degree of freedom, principles of location and clamping, locating, clamping and indexing devices, principles of design, design of simple jigs and fixtures.

#### **UNIT – IV**

**Grinding** - Processes, machines, design consideration for grinding, specification of grinding wheel, process parameters, economics of grinding.

#### **Gear Cutting**

Principle of gear generations, principle motion and kinematic arrangement of gear shaping and gear hobbing machines, gear cutting on milling machines.

#### **UNIT – V**

**Unconventional Machining** - Advantages, application and limitation, survey of Non-conventional machining processes, mechanics of metal removal, tooling, equipment, process parameters and surface finish obtained & specific application of following processes - EDM, ECM, USM, AJM, EBM and LBM.

#### **Flow Turning**

Principles, production of conical, cylindrical and parabolic shapes, spinability test, forces in power spinning, numerical problems.

#### **Thread Rolling**

Principle, advantages and disadvantages, types of thread rolling, numerical problems.

#### **TEXT BOOKS**

1. Manufacturing Technology (Vol. - I & II) – P.N. Rao – Tata McGraw Hill Pub. Company, New Delhi
2. A Text Book of Production Technology(Manufacturing Processes) – P.C. Sharma – S. Chand and Company Ltd., New Delhi

#### **REFERENCE BOOKS**

1. Manufacturing Engineering and Technology – S. Kalpakjian & S.R. Schmid – Addison Wesley Longman, New Delhi
2. Tool Engineering & Design – G.R. Nagpal – Khanna Publishers – New Delhi
3. A Text Book of Production Technology – O.P. Khanna – Dhanpat Rai & Sons, New Delhi
4. Manufacturing Science – A. Ghosh & A.K. Mallik – East West Press Pvt. Ltd., New Delhi
5. Production Technology – R.K. Jain – Khanna Publishers, New Delhi

**MATS UNIVERSITY**  
**SEMESTER – V**  
**BRANCH – MECHANICAL**  
**SUBJECT - POWER PLANT ENGINEERING**  
**CODE - BE514**

### **UNIT-I**

#### **Elements of Power Plant**

General Sources of power, renewable and non renewable concepts of public and private power stations, Distribution of power generation, transmission, and utilizations, Importance of Central Power Stations, types of power stations – steam, nuclear, diesel and hydro – Elements of modern power stations (Steams only) brief layout and arrangement of elements and complements, sitting of different power stations, foundation. Elements of Electric power systems primary and secondary distribution substations (in brief).

### **UNIT – II**

#### **Steam Power Plant**

Steam power plants selection of working medium, Heat Balance in stem cycles, Heat rates, comparison of efficiencies gas loop, fuels and fuel handling. Equipments, fuel gas cleaning and ash handling. Air pre-heater, feed water pre-heaters, steam re-heaters, deaerators, feed water treatment, pumping and regulation water walls, modern developments in steam boilers, Important instrumentation and piping of gas and water loop. Factors to be controlled from maximum efficiency and variable output. Pollution generated by thermal power plants, pollution abatement, clearance from pollution boards, equipments used for reducing pollution – ESP, bag filter and chimney.

### **UNIT – III**

**Hydro Electric power station** – Potential power with reference to rainfall and catchments area, Water storage, equipment used in hydro electric power stations. Characteristics of hydraulic turbines. Comparison of the factors governing the cost of hydro steam and diesel power stations.

**Diesel power station** – Suitability of diesel engines for bulk power, advantages and limitations of diesel, power stations, efficiency and heat balance.

### **UNIT – IV**

#### **Nuclear Power Station**

Evolution of nuclear energy from atoms by fission and fusion. Chain reactions, fission materials, types of reactors ,gas cooled, boiling water liquid, metal cooled and fast reactor, arrangements of various elements in a nuclear power station, stem cycles and boilers coolant heat exchangers, Reactor control, Reactor shielding and safety methods.

### **UNIT – V**

**Variable load problems** – Idealized and realized load curves, effect of variable load on plant design and operation variable load operation and load dispatch.

**Power station Economics** – Source of income, cost of plant and production, elements of cost, depreciation and replacement theory of rates.

**Pollution-Board:-**concept of state and central pollution Board , power board.

#### **TEXT BOOKS**

1. A Text Book of Power Plant Engineering – R.K. Rajput – Laxmi Publications
2. A Course in Power Plant Engineering – Arora, Domkundwar – Dhanpat Rai & Co., 2005

#### **REFERENCE BOOKS**

1. Power Plant Engineering, 2nd Edn. – P.K. Nag – Tata McGraw-Hill Pub. Com., New Delhi, 2004
2. Power Plant Engineering – P.C. Sharma – S.K. Kataria & Sons, 2003



**MATS UNIVERSITY**  
**SEMESTER – V**  
**BRANCH – MECHANICAL**  
**SUBJECT - INDUSTRIAL MANAGEMENT**  
**CODE - BE515**

## **UNIT – I**

### **Principles of management :**

Definition of management, Administration organization, Functions anagement, Planning, Organizing, Co-ordination and control, Structure and function of industrial organisations, Leadership- Need for ledership, Factors to be considered for accomplishing effective leadership, Communication -Importance, Processes, Barriers to communication, Making communication, Effective, formal and informal communication, Motivation - Factors determining motivation, Positive and negative motivation, Methods for improving motivation, Incentives, Pay promotion and rewards, Controlling - Just in time, Total quality management, Quality circle, Zero defect concept. Concept of Stress.

## **UNIT – II**

### **Human Resource Management**

Nature and Scope of Human Resource Planning, Training and Development, Recruitment and Selection, Career Growth, Grievances, Motivation and its types, Need for Motivation, Reward and Punishment, Need, wants, satisfaction chain. Maslow hierarchy of needs. Quality of working life, job enrichment and job enlargement.

## **UNIT – III**

### **Marketing Management**

Marketing Environment: Consumer Markets and Buyer Behaviour, Marketing Mix, Advertising and Sales Promotion, Channels of Distribution.

### **Financial Management**

Book keeping, financial statement Analysis, Financial Ratios, Capital Budgeting, Break-Even Analysis.

### **Material Management :**

Objective of a good stock control system - ABC analysis of inventory, Procurement and consumption cycle, Reorder level, Lead time, Economic order quantity, Pruchasing procedure, Stock keeping, Bin card.

## **UNIT - IV**

### **Management Information System**

Role of information in decision making, Definition of MIS, computer based user machine system, integrated system, MIS v/s Data processing, subsystem of an MIS, MIS DSS and expert system. Evolution and effectiveness of Information system.

## **UNIT – V**

### **Flexibility in Management**

Definition, connotation of flexibility, systematic concept of flexibility, foundation of flexible system management, types of flexibility and its applications in management of modern organizations.

### **LABOUR, INDUSTRIAL AND TAX LAWS :**

Importance and necessity of industrial legislation, Types of labour laws and dispute, Factory Act 1948, Payment of Wages Act 1947, Employee State Insurance Act 1948, Various types of taxes - Production Tax, Local Tax, Trade tax, Excise duty, Income Tax.

### **TEXT BOOKS**

1. Essential of Management: H. Koonz and h. Weihrich
2. Marketing Management - Kotler Philip- Prentice Hall of India
3. MIS conceptual foundation, structure and development, G B Davis & M H Olson.
4. Flexibility in Management, Sushil, Vikas publication, New Delhi

### **REFERENCE BOOKS**

1. Human Resource Management - Luthans Fred - McGraw Hill, Inc.
2. Organizational Behavior Concepts, Controversies Applications - Stephen, P. Robbins- Prentice Hall, Englewood Cliffs, New Jersey
3. Financial Management – M.Y. Khan and P.K. Jain - Tata Mc-Graw Hill
4. Competitive Advantage - Porter Michael - The Free Press
5. Competitive Strategy - Porter Michael - The Free Press, 1985
6. Fundamentals of Business Organizations and Management – Y.K. Bhusan – S. Chand and Sons
7. Industrial Management – K.K. Ahuja - Khanna Publishers

**MATS UNIVERSITY**  
**SEMESTER – V**  
**BRANCH – MECHANICAL**  
**SUBJECT - MACHINE DESIGN I LAB**  
**CODE - BE516**

**EXPERIMENTS TO BE PERFORMED**

Each student shall submit two-assembly design report along with the drawing for assembly/sub assembly for any mechanical system consisting of not less than four machine elements included in the syllabus.

**MATS UNIVERSITY**  
**SEMESTER – V**  
**BRANCH – MECHANICAL**  
**SUBJECT - INTERNAL COMBUSTION ENGINE LAB**  
**CODE - BE517**

**LIST OF EXPERIMENTS TO BE PERFORMED**

1. Study of IC Engine models
2. Study of working of four stroke petrol engine and four stroke diesel engine with the help of cut section models.
3. Study of working of two stroke petrol and two stroke diesel engine with the help of cut section models.
4. Study of fuel supply system of a petrol engine (fuel pump and simple carburettor)
5. Study of complete carburettor (Solex carburettor)
6. Study of Petrol Injection System.
7. Study of fuel supply system of a Diesel engine (fuel pump and fuel injector)
8. Study of Ignition systems of an IC Engine (Battery and Magneto ignition system) and Electronic ignition system.
9. Study of Lubrication system of an IC Engine (mist, splash and pressure lubrication)
10. Study of cooling systems of an IC Engine (air cooling and water cooling)
11. To conduct a performance test on diesel engine to draw heat balance sheet for given load and speed
12. To determine friction power of diesel engine by Willan's line or fuel rate extrapolation method.
13. To conduct a performance test on the variable compression ratio engine and to draw the heat balance sheet for given compression ratio, speed and load and plot the performance curves.
14. To conduct a performance test on a four cylinder four stroke petrol engine and to draw the heat balance sheet and performance curves.
15. To calculate the indicated power, friction power and mechanical efficiency of four stroke four cylinder petrol engine at full load and rated speed by Morse test.
16. To draw the valve timing diagram of a Four stroke S.I. or C.I. Engine using experimental setup.
17. Analysis of engine exhaust gases using Orsat apparatus / gas analyzer.

**LIST OF EQUIPMENTS/MACHINES REQUIRED**

1. Model Of Two & Four Stroke Petrol Engine
2. Model Of Two & Four Stroke Diesel Engine
3. Scooter Engine In Cut Section
4. Four Stroke, Four-Cylinder Petrol Engine In Cut Section
5. Carburettors In Cut Section / without cut section.
6. Model of Petrol Injection System
7. Bosch Fuel Pump In Cut Section
8. Nozzles In Cut Section
9. Diesel Injectors In Cut Section
10. Four Stroke Single-Cylinder Diesel Engine Test Rig
11. Variable Compression Ratio Engine Test Rig
12. Four Stroke Multi-Cylinder Petrol Engine Test Rig
13. Experimental setup for drawing valve timing diagram of Four stroke S.I. or C.I. engines.
14. Orsat apparatus / gas analyzer for engine exhaust gas analysis.

**MATS UNIVERSITY**  
**SEMESTER – V**  
**BRANCH – MECHANICAL**  
**SUBJECT - COMPUTER AIDED DESIGN AND MANUFACTURING LAB**  
**CODE - BE518**

**EXPERIMENTS TO BE PERFORMED**

**CAD (COMPUTER AIDED DESIGN)**

1. Introduction & different features of the CAD Software
2. 2-D Drafting
3. 3-D Modeling
4. 3-D Advanced Modeling
5. Assembly modeling
6. Feature Modification and Manipulation
7. Detailing
8. Sheet Metal Operations
9. Surface Modeling
10. One Dimensional problems of Finite Element Method.

*(These exercises may be performed by any of the following Advanced CAD Software)*

**CAM (COMPUTER AIDED MANUFACTURING)**

1. To prepare part programming for plain turning operation.
2. To prepare part programming for turning operation in absolute mode.
3. To prepare part program in inch mode for plain turning operation.
4. To prepare part program for taper turning operation.
5. To prepare part program for turning operations using turning cycle.
6. To prepare part program for threading operation.
7. To prepare part program for slot milling operation.
8. To prepare part program for gear cutting operation.
9. To prepare part program for gear cutting using mill cycle.
10. To prepare part program for drilling operation.
11. To prepare part program for multiple drilling operation in Z-axis.
12. To prepare part program for multiple drilling in X-axis.
13. To prepare part program for multiple drilling in X and Z axis using drilling cycle.

**LIST OF EQUIPMENTS/MACHINES REQUIRED**

1. Computer Numerically Control Lathe Trainer
2. P-IV (IBM) 2.6 GHz, 80 GB HDD, 256/512 SD RAM (As Compatible with CAD Software)  
52 X CD RW, 1.44 MB  
FDD, 17" Colour Monitor, Laser Scroll Mouse
3. Software – Pro-E, Solid-work, CATIA, ANSYS
4. CNC Controlled Milling Machine
5. CNC Controlled Drilling Machine

**MATS UNIVERSITY**  
**SEMESTER – V**  
**BRANCH – MECHANICAL**  
**SUBJECT - MANUFACTURING SCIENCE-II LAB**  
**CODE -BE519**

### **EXPERIMENTS TO BE PERFORMED**

1. Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe machine.
2. Bolt (thread) making on Lathe machine
3. Tool grinding (to provide tool angles) on tool-grinder machine.
4. Gear cutting on Milling machine.
5. Machining a block on shaper machine.
6. Finishing of a surface on surface-grinding machine.
7. Drilling holes on drilling machine and study of twist-drill.
8. Study of different types of tools and its angles & materials.
9. Experiment on tool wear and tool life.
10. Experiment on jigs/Fixtures and its uses
11. Resistance welding experiment.
12. Experiment on unconventional machining.
13. Experiment on unconventional welding.
14. Experiment on TIG/MIG Welding.
15. Macro and Microstructure of welding joints, HAZ.

### **LIST OF EQUIPMENTS/MACHINES REQUIRED**

1. Center Lathe
2. Grinding Machine
3. Shaper Machines
4. Milling Machines
5. TIG and MIG Welding Machines
6. Resistance welding machines.
7. Drilling machines.
8. Various types of cutting tools.
9. jigs and fixtures.
10. Measurement Tools
11. Equipments for costing of nonferrous material.
12. EDM, ECM, USM, AJM, EBM and LBM.
- 13.**gear shaping and gear hobbing machines, gear cutting on milling machines.