UNIVERSITY OF ENGINEERING AND MANAGEMENT, JAIPUR
Course Description

Title of Course: MACHINING SCIENCE I
Course Code: PE101
L-T scheme: 3-1 **Course Credit: 4**

Objectives:
1. To learn and understand the working principle of various types of machine tools.
2. To provide an understanding of the different types of chip formation during the machining process.
3. To provide an efficient understanding of phenomena of heat generation and its effect.
4. To introduce the students with automation technique applied to machine tools & its merits
5. To show the students basic configuration & Kinematic structure of centre lathe ,shaping, planning and slotting machine, milling machine, capstan lathe ,turret lathe.
6. To enable the students to determine time required for various operations like turning , drilling , shaping , milling.
7. To illustrate the students with the basic feature of Computer numerical controlled machine tools.

Learning Outcomes:
After the completion of this practical course, the student will be able to:
- Know Desirable Properties of good cutting tools
- Know Types of cutting tools
- Know Basic geometry of single point cutting tool
- Know Different angles associated with single point cutting tool
- Know Importance of different angles of single point cutting tool in cutting process
- Describe the advantages of automation and how its affects production rate.
- Draw & explain Kinematic structure of centre lathe ,shaping, planning and slotting machine, milling machine, capstan lathe ,turret lathe.
- Evaluate time required for various operations like turning , drilling , shaping , milling.
- Describe Basic features and characteristics of lathes , milling machines etc, machining centres.

Course Contents:
1. **INTRODUCTION** to Machining: Basic Mechanism involved.
2. **PLASTIC DEFORMATION**: Tensile test; stress and strain; Mechanism of Plastic Deformation- slip, dislocation.
3. **CHIP FORMATION**: Typical lathe tools; Orthogonal cutting; oblique cutting; Types of chips;Mechanism of built-up-edge formation.
4. **TOOL GEOMETRY**: Reference planes; Tools specification in ASA, ORS and NRS; conversation from ASA to ORS; Selection of tools angles; Multi-point cutting tools-geometry of peripheral milling cutters and twist drills.
5. **MECHANICS OF METAL CUTTING**: Merchant's circle diagram- determination of cutting and thrust forces; Coefficient of friction; Stress, strain and strain rate; Measurement of shear angle - direct and indirect methods; Mohr's circle diagram; slip line field method; Thin zone model - Lee and Shaffer's relationship; Thick zone model - Okushima and Hitomi model (analysis) ; Friction in Metal cutting.
6. **MECHANICS OF OBLIQUE CUTTING:** Concept of rake angle measured in different planes; Shear angle; Velocity and force relationship.
7. **PRACTICAL MACHINING OPERATIONS:** Turning, shaping and planning, Drilling, milling and broaching.

8. **MEASUREMENT OF CUTTING FORCES:** Cantilever beams, rings; Dynamometer requirement; turning and drilling.
9. **TOOL WEAR AND TOOL LIFE:** Mechanism of wear; Progressive tool wear; Flank wear; Crater wear; Model of diffusion wear; Tool life : Variables affecting tool life-Cutting conditions; tool geometry; Tool materials; work materials; Work materials; Cutting fluids; Determination of tool life equation; Machinability.
10. **ECONOMICS OF MACHINING:** Minimum production cost criterion; Maximum production rate criterion; maximum profit rate criterion; Restriction on cutting conditions.
11. **ABRASIVE MACHINING PROCESSES:** Introduction; Grinding: Characterstics of a grinding wheel; Specification of grinding wheels; Mechanics of grinding process; Chip length in horizontal surface grinding; External and internal cylindrical grinding; Specific energy in grinding; Wheel wear; Thermal analysis; Selection of grinding wheels; Honning and lapping operations.
12. **THERMAL ASPECTS OF MACHINING:** Regions of heat generation; Distribution of heat generated; Equations of flow due to conduction, transportation, heat absorbed and heatgenerated; Average shear plane temperature; Average chip-tool interface temperature; Experimental determination of cutting temperature - tool-work thermocouple technique, infrared photographic technique.
13. **SURFACE FINISH**: Ideal and natural roughness; Surface finish during turning, milling and grinding.

Text Books:

1.Production technology by PC SHARMA & 2. Manufacturing Technology: Metal Cutting and Machine Tools, 3e

References: 1. Manufacturing Engineering and Technology by Kalpakjian

UNIVERSITY OF ENGINEERING & MANAGEMENT, JAIPUR

Course Description

Title of Course: MACHINING SCIENCE II **Course Code: PE 102**
L-T Scheme: 3-1 **Course Credits: 4**

Introduction:

Advanced manufacturing technologies are key enablers in modern manufacturing and play a significant role in increasing the efficiency, competitiveness and profitability of modern manufacturing industry.

The course is designed to expand the knowledge of new manufacturing technologies and their application in modern manufacturing.

This course will provide you with an understanding of specific advanced and emerging manufacturing technologies and skills relating to the implementation of these technologies in modern industry within both global and local contexts. The focus is on additive technologies both metal and polymer based such as Selective Laser Melting, Direct Laser Metal Deposition, Electron Beam Melting and Fused Deposition Modelling.

Objectives:

This course contributes to the following program learning outcomes:

1. Needs, Context and Systems
   - Describe, investigate and analyse complex engineering systems and associated issues (using systems thinking and modelling techniques)

2. Analysis
   - Comprehend and apply advanced theory-based understanding of engineering fundamentals and specialist bodies of knowledge in the selected discipline area to predict the effect of engineering activities

Learning Outcomes:

Upon successful completion of this course you should be able to:

1. Define and describe the fundamentals and principals of advanced manufacturing processes.
2. Apply relevant theories to solve manufacturing problems
3. Explain manufacturing processes via experimental and theoretical analyses
4. Relate manufacturing theory to practice through laboratory experiments
5. Improve a manufacturing process either working in a team or individually.

Course Contents:

Limitations of conventional machining process. General classification of unconventional machining, ECM, electric discharge machining, electron beam machining, laser beam machining, ion beam machining, and plasma arc machining, AJM, USM, Non conventional finishing process. Comparative evaluation of different processes. Conventional machining with modifications.

TEXT BOOKS:

1. *Fundamentals of Modern Manufacturing* by Mikeel P. Grover– 3E Wiley
2. Automation, Production systems and CIM – M.P. Groover , Prentice Hall
3. *Non conventional machining* – P.K. Mishra, Narosa

REFERENCES:

4. *Manufacturing science* – Ghosh & Mullick, EWP
5. *Rapid prototyping* – A. Ghosh, EW Press
6. *Non traditional Manufacturing Processes* by Gary F. Benedict– Marcel Dekker
7. *Micromaching of Engineering* Material by Mc Geongh, J.A. – Marcel Dekker
8. *Advanced Machining Process, Nontraditional and Hybrid Machining Processes* by Hassan Abdel- Gawad El-
Hofy – McGraw Hill, Mechanical Engineering Science

UNIVERSITY OF ENGINEERING AND MANAGEMENT, JAIPUR
Course Description

Title of Course: Metal Forming
Course Code: PE103
L-T-P Scheme: 3-1-0 **Course Credits: 4**

Introduction:

Metal Forming has played a central role as societies have developed. Metal forming has played a significant role in manufacturing development. With the advent of the industrial revolution many changes occurred.
The "vital revolution", which was the product of advances in European agriculture, enabled larger populations to be fed there was a dramatic population increase due to the ability to feed larger populations, industrialization became widespread, causing urbanization.
Until the industrial revolution, manufacturing was done at a job-shop level, but with advent of new power sources, came the ability to manufacture on a larger scale. Innovation and automation steadily increased with a concomitant increase in the complexity of products.

Objective: The course offers students the knowledge necessary for simplified mathematical representation of forming processes while applying the physical, chemical, mechanical and thermodynamic principles of metallic bodies changing from the elastic into the plastic state, and when these bodies are plastically deformed into the required shape. Students will learn how to determine the loading of the forming tool or machine, and how to determine the critical values of deformation.

Learning Outcomes:

After learning the course the students should be able to:

- Identify various forming process
- Identify and determine various methods rolling processes
- Identify and determine various methods to forging processes
- Identify and determine various methods to extraction processes
- Identify and determine various methods to Drawing processes
- Identify and determine various methods to Sheet metal forming processes

Course Contents:

Plasticity
Introduction - stress, strain, invariants, stress-stress strain relations; Yield and Flow/ Yield criteria; Plastic Anisotropy/ Anisotropic yield criterion; Governing equations and formulations of plasticity problem; Plastic instability slab method; Slip-line field theory; Upper and Lower Bound Techniques.

Analysis of Forming Processes
Forging; Strip, wire and tube drawing; Extrusion; Rolling; Deep drawing; High velocity forming (Explosive/ Electromagnetic process)
Term Paper on recent trends in metal forming

Text Book:

1. Ghosh A. and Mallik A. K., "Manufacturing Science", East -West Press
2. Juneja B. L., “Fundamentals of Metal Forming Processes”, New Age International Publishers,
3. Hosford William F. and Caddell R. M., "Metal Forming Mechanics and Metallurgy", Prentice Hall.

Reference Books:

1. Wangoner Robert H. and Jean-Loup Chenot, "Fundamentals of Metal Forming", John Wiley & Sons
2. Beddoes J. and Bibby M. J., "Principles of Metal Manufac turing Processes", Viva Books.

UNIVERSITY OF ENGINEERING AND MANAGEMENT, JAIPUR

Course Description

Title of Course: Metrology and Computer Aided Inspection
Course Code: PE104
L-T-P Scheme: 3-1-0 **Course Credits: 4**

Introduction:

Metrology is "the science of measurement, embracing both experimental and theoretical determinations at any level of uncertainty in any field of science and technology. The field of metrology is important for establishing a common understanding of units, which is crucial in linking human activities

Computer Aided Inspection (CAI) is a new technology that enables one to develop a comparison of a physical part to a 3D CAD model. This process is faster, more complete, and more accurate than using a Coordinate Measuring Machine (CMM) or other more traditional methods. An automatic inspection method and apparatus using structured light and machine vision camera is used to inspect an object in conjunction with the geometric model of the object. Camera images of the object are analyzed by computer to produce the location of points on the object's surfaces in three dimensions

Objective: Advanced Metrology and Computer Aided Inspection application can be seen in various areas of engineering. Its application we can see in mass production section, Automobile section.

Learning Outcomes:

Upon successful completion of this course, the student will be able to:
(a) Operate the co-ordinate measuring machines.
(b) Operate the Laser Interferometry.
(c) Determining combined standard uncertainty.
(d) Know the algorithms and sampling methods used in data analysis, thermal and environmental effects.

Course Contents:

Metrological concepts – Concept of accuracy, Need for high precision measurement associated with high precision measurements. Accuracy of numerical control system, Inaccuracy due to thermal aspects.

Detailed surface roughness concept, Dimensioning & Dimensional chains, Surface and form metrology flatness, roughness, waviness cylindricity, etc., Methods of improving accuracy & surface finish, Influence of forced vibration on accuracy, Dimensional wear of cutting tools and its influences on accuracy.

Standards for length measurement standards and their calibration - Light interference - Method of Coincidence - Measurement errors. Various tolerances and their specifications, gauging assembly, comparators. Angular measurements - principles and instrument measurements.

Computer Aided Metrology - Principles and interfacing, soft metrology - Application of lasers in Precision measurements- laser interface, laser scanners, Coordinate measurement machine (CMM), Type of CMM & applications, Non contact CMM, Electro optical sensors for dimension, contact sensors for surface finish measurements. Image processing and its Metrology. Acoustical measurements, Digital techniques in mechanical measurements, Assessing and presenting experimental DATA.

Text Book:

1. Ghosh, A. and Mallik, A. K., Manufacturing Science, Affiliated East-West Press (2010).

2. Groover, M. P., Fundamentals of Modern Manufacturing: Materials, Processes, and Systems Wiley-India (2012).

3. C. Elanchezhian, B. V. Ramnath, T. S. Selwyn, Engineering metrology, Eswar press, Chennai, 2004.

4. R. K. Jain, Engineering Metrology, Khanna Publishers, Delhi, 20th Edition, 2009

Reference Books:

1. J. D. Meadows and M. D. Meadows, Geometric Dimensioning and Tolerancing: Applications and Techniques for Use in Design: Manufacturing, and Inspection, Taylor & Francis, 1995.
2. C. Dotson, Dimensional Metrology, Delmar Cengage Learning, 1st Edition, 2009.

UNIVERSITY OF ENGINEERING AND MANAGEMENT, JAIPUR

Course Description

Title of Course: Manufacturing lab
Course Code: PE191
Year: 1st Year **Semester: First**
L-T-P Scheme: 4-0-0 **Course Credits: 2**

Introduction:

Production engineering is a combination of manufacturing technology, engineering sciences with management science. A production engineer typically has a wide knowledge of engineering practices and is aware of the management challenges related to production. The goal is to accomplish the production process in the smoothest, most-judicious and most-economic way.

Production engineering encompasses the application of castings, machining processing, joining processes, metal cutting & tool design, metrology, machine tools, machining systems, automation, jigs and fixtures, die and mould design, material science, design of automobile parts, and machine designing and manufacturing. Production engineering also overlaps substantially with manufacturing engineering and industrial engineering. The names are often interchangeable.

In industry, once the design is realized, production engineering concepts regarding work-study, ergonomics, operation research, manufacturing management, materials management, production planning, etc., play important roles in efficient production processes. These deal with integrated design and efficient planning of the entire manufacturing system, which is becoming increasingly complex with the emergence of sophisticated production methods and control systems.

Objective:

- This laboratory is aimed at providing an introduction to the Know-how of common processes used in industries for manufacturing parts by removal of material in a controlled manner.
- Auxiliary methods for machining to desired accuracy and quality will also be covered.
- The emphasis throughout the laboratory course will be on understanding the basic features of the processes rather than details of constructions of machine, or common practices in manufacturing or acquiring skill in the operation of machines.
- Evidently, acquaintance with the machine is desirable and the laboratory sessions will provide adequate opportunity for this.

UNIVERSITY OF ENGINEERING AND MANAGEMENT, JAIPUR

Course Description

Course Contents:

- Calculate the machining time of cylindrical turning on a lathe and compare with the actual timing.
- Study tool wear of a cutting tool while drilling on a drilling machine
- Study the speed, feed, tool, preparatory (geometric) and miscellaneous function for NC part programming
- Study the part programming on a NC Lathe: Step Turning, Taper Turning, Drilling.
- Study the part programming on a NC Milling Machine for a Rectangular Slot.