

SYLLABI FOR PH.D. ADMISSION TEST IN DEPARTMENT OF PRODUCTION ENGG.

Course Name : PRODUCT DEVELOPMENT: DESIGN AND MANUFACTURING

PRODUCT REQUIREMENTS AND TOP-DOWN DESIGN

Chain of delivery of quality, Key characteristics, Variation risk management, Examples, Key characteristics conflict, Assembly in the context of product development, Assembling a product, Present status of assembly

MATHEMATICAL AND FEATURE MODELS OF ASSEMBLIES

Types of assemblies: Distributive systems, Mechanism and structures, Types of assembly models, Matrix transformations: Nominal location transforms, Variation transforms, Assembly features and feature-based design, Mathematical models of assemblies, Examples of assembly models

CONSTRAINT IN ASSEMBLY

Kinematic design, Features as carriers of constraints, Use of screw theory to represent and analyze constraints, Design and analysis of assembly features using screw theory, Constraint analysis

DIMENSIONING AND TOLERANCING PARTS AND ASSEMBLIES

Dimensional accuracy in manufacturing, KCs and tolerance flowdown from assemblies to parts, Geometrical dimensioning and tolerancing, Statistical and worst-case tolerancing, Modelling and managing variation buildup in assemblies

ASSEMBLY SEQUENCE ANALYSIS

Assembly sequence design process, Bourjault method of generating feasible sequences, Cutset method, Checking stability of sub-assemblies

DATUM FLOW CHAIN

DFC definition, Mates and contacts, KC conflict and its relation to assembly sequence and KC priorities, Assembly precedence constraints, DFCs, tolerances and constraints, Design procedure for assemblies

DESIGN FOR ASSEMBLY AND OTHER 'ILITIES'

DFM/DFA as local engineering methods, DFM/DFA as product development integrators, DFA as a driver of product architecture, effect of DFM/DFA strategies on time and cost distributions in manufacturing, General approach to DFM/DFA, Traditional DFM/DFA : Boothroyd method, Hitachi assembleability evaluation method, Hitachi assembly reliability method, Westinghouse DFA calculator, Toyota ergonomic evaluation method, Sony DFA methods, DFx in the large : Product Structure, Use of assembly efficiency to predict assembly reliability, Design for disassembly including repair and recycling, Example DFA analysis, DFx place in product design.

BOOK:1. Mechanical assemblies: Their design, manufacture and role in product development by D.E. Whitney, Oxford University Press

REFERENCES:1. CAD/CAM Theory and Practice by I Zeid, TMH

Course Name : CNC MACHINES AND COMPUTER AIDED INSPECTION

INTRODUCTION

Basics and need of NC/CNC/DNC, applications and advantages of CNC machines and its role in FMS, classifications of CNC machines.

CONSTRUCTIONAL DETAILS CNC MACHINES

Machine structure, slideways, motion transmission elements, swarf removal and safety considerations, automatic tool changer, multiple pallet systems, feed back devices, machine control unit, and interpolators.

CNC PART PROGRAMMING

Introduction to Part Programming, Axis identification and coordinate systems, structure of CNC part program, programming formats, Radius and Length Compensation Schemes, Advanced Programming Features & Canned Cycles, Computer Aided CNC part programming using APT language.

TOOLING FOR CNC MACHINES

Tooling requirements of CNC machines, work and tool holding devices in CNC machines.

ADAPTIVE CONTROL SYSTEMS

Adaptive control with Optimization, Adaptive control with Constraints, ACC System for Turning.

CO-ORDINATE MEASURING MACHINES

Basic types of measuring machines, Operating modes, Programming soft-wares, Measurement and inspection capabilities, Flexible inspection systems, Inspection probes.

TESTING OF MACHINE TOOLS

Verification of Technical Specifications, Verification of Functional Aspects, Verification During Idle Running, Verification of Machine Tool Accuracy and Workpiece Accuracy. Metal Removal Capacity Test.

BOOK:

1. HMT, Mechatronics, Tata McGraw-Hill.

REFERENCES:

1. Koren Y, Computer Control of Manufacturing Systems, McGraw-Hill, 1986.
2. T K Kundra, P N Rao, N K Tewari, Numerical Control and Computer Aided Manufacturing, Tata McGraw-Hill
3. Groover, M P, Automation, Production Systems, and Computer Integrated Manufacturing, Prentice-hall Int.
4. Madison J, CNC Machining Handbook, Industrial Press Inc., 1996

Course Name : WORLD CLASS MANUFACTURING

GLOBAL COMPETITION IN MANUFACTURING

The globalization of business, New Manufacturing- Environment, World Class Manufacturing Performance Measures, The Value Chain, Generic Competitive Advantages, Manufacturing Strategies for Global Competitiveness

MANUFACTURING PLANNING AND CONTROL SYSTEMS FOR WORLD CLASS MANUFACTURING

Growth of Manufacturing Resource Planning, Fundamentals of Manufacturing Resource Planning, JIT Production System, Integrating MRP with JIT System.

DYNAMICS OF MATERIALS FLOW

Materials flow patterns, Regulating Materials Flow, Push vs. Pull Systems, V, A, and T Plants, Effect of Process Variability on Materials Flow.

OPT AND SYNCHRONOUS MANUFACTURING

Objectives of OPT, Maximizing Global Manufacturing Performance, Nine OPT Principles, Development of OPT Schedules, Theory of Constraints, The Drum-Buffer-Rope Strategies

LEAN AND AGILE MANUFACTURING CONCEPTS

BOOK:

1. Manufacturing Management Principles and Concepts by Gibson, Greenhalgh and Kerr Chapman and Hall Publication

REFERENCES:

1. 21st Century Manufacturing by Thomas G Gunn, Harper Business Publication.
2. Toyota Production System by Shigeo Shingo, Productivity Press Cambridge

Course Name : **WELDING ENGINEERING**
Course Code : **PR 505**
Credits : **4**
L T P : **4 0 0**

Lecture wise breakup **No. of Lectures**

INTRODUCTION

Classification of welding processes, physics of welding arc, arc stability, arc blow, polarity, welding symbols, safety and hazards in welding

METAL TRANSFER

Various forces acting on a molten droplet, different modes of metal transfer & their importance in arc welding

POWER SOURCES

Types of V-I characteristics, different types of power sources, selection of the power sources

WELDING CONSUMABLES

Classification and selection of welding electrodes and filler rods, welding fluxes, characteristics and manufacturing of the welding fluxes, characteristics of different shielding gases.

EFFECT OF WELDING PARAMETERS ON BEAD GEOMETRY

Effects of voltage current, polarity, welding speed etc. on the bead geometry and mechanical properties of the weld.

WELDING PROCESSES

Principle, advantages, disadvantages, application and limitations of SMAW MIG / MAG, TIG, electro-slag, electro-gas thermit welding, EBW, LBW, USW, explosive, friction and spot, seam, projection, butt, flash butt resistance welding processes, selection of welding processes

WELDABILITY

Definition, different tests of weldability, weldability of steel, stainless steel, cast iron, aluminum and titanium

JOINING OF CERAMICS AND PLASTICS

Processes used in joining of ceramics & plastics, adhesive bonding

ALLIED WELDING PROCESSES

Brazing, soldering, metal spraying, and gas & arc cutting of steels, stainless steel and cast iron

WELDING DEFECTS

Different types of welding defects, causes and remedies

WELDING DISTORTION

Types, factors affecting the distortion, methods of reducing the distortion.

BOOKS:

1. TIG and MIG welding process- Jean Cornu
2. Advanced welding systems- Jean Cornu

REFERENCES:

1. American Welding Society Hand book Volume 1 to 5
2. Welding and Welding Technology-Richard L Little

Course Name : NEW TECHNOLOGY

Need for new technology, classification of new technology, historical background of new technology process Definition and application of various processes, comparative analysis of various new technological processes

Mechanical processes

ABRASIVE JET MACHINING AND ABRASIVE FLOW MACHINING

Fundamental Principles, application possibilities, process parameters, schematic lay out of machine and operational characteristics, conclusion

ULTRASONIC MACHINING

Introduction, range and application of possibilities of ultrasonic machining, fundamental principles, processes parameter, purpose of slurry and selection of abrasive, tool design, tool feeding mechanism, transducer megnetostriction, megnetostrictive material, analysis for metal removal rate, design of horn (velocity transformer), analysis of process parameters, conclusion, exercises

CHEMICAL MACHINING

Introduction, fundamental principle, process parameter, classification and selection of etch ant resistant material, selection of etchant, conclusion.

ELECTROCHEMICAL MACHINING (ECM)

Background of ECM process ,classification of ECM processes, fundamental principles of ECM, determination of metal removal rate, evaluation of metal removal rate of an alloy, electrochemistry of ECM, dynamics of ECM process, hydrodynamics of ECM process, optimisation analysis of ECM parameters, choice of electrolytes, conclusion, problems. Such as explosive forming, electro-hydraulic forming, Electro-Magnetic forming, high speed hot forging

ELECTROCHEMICAL GRINDING (ECG)

Introduction, fundamental principle, electrochemistry of ECG, basic scheme of the process, classification of ECG, process of parameter ECG, conclusion.

ELECTRICAL DISCHARGE MACHINING

Introduction, mechanism of metal removal, basic EDM circuitry and their principle of operation, analysis of relaxation and RLC type of circuits, evaluation of metal removal rate, evaluation machining accuracy, optimisation analysis of metal removal rate in EDM process, selection of tool materials, choice of dielectric fluid, conclusion, problems.

LASER BEAM MACHINING

Introduction, background of laser action, production of photon cascade in a solid optical laser, machining application of laser, other application of laser in workshop technology, conclusion.

ELECTRON BEAM MACHINING

Introduction, background of electron beam action, a dimensionless analysis to establish correlation between EBM parameters generation of electron beam, advantage and limitation of EBM

PLASMA ARC MACHINING

Introduction, plasma, non thermal generation of plasma, metal removal, process parameter, operation data, quality of cut, metallurgical effects, work environment, equipment, other application of plasma jet reference.

FORMING OF METALS (HVFM)

High Velocity Explosive forming:, Introduction, scheme of explosion forming process, Development of velocity forming processes, comparison of conventional and high velocity forming methods, stress waves and deformation 9in solids, explosive fabrication, electro hydraulic forming, magnetic pulse forming, pneumatic mechanical high velocity forming, criteria of formability, applications and energy requirements for high velocity forming process.

STUDY OF RECENT DEVELOPMENTS

AJM, AFM, USM, CM, ECM, ECG, EDM, LBM, PAM, EBM, HVFM, E-HF, E-MF, HSH Forgings, & HS Extrusions through journals & e-journals. BOOK:1. P.C.Pandey & H.S.Shah 'Modern Machining Process' Tata McGraw-Hill. New Delhi 2002

REFERENCES:

- Amitabha bhattacharya 'New Technology' Institution of Engineers(s) India. 1975.
- ASTME, High velocity forming of metals Printice Hall of India IH1968
- G.R.Nagpal Metal forming Processes Khanna Publ. New Delhi 1998

Course Name : INDUSTRIAL ROBOTICS

ROBOT FUNDAMENTALS

Robot components, robot classification and specification, Work envelopes, Other basic parameters of robots

ROBOT MECHANICS

Robot kinematics - spatial descriptions and transformations, inverse transformation matrices, conventions of fixing frames to links, inverse robot kinematics – solvability, algebraic vs geometric solutions, examples of inverse manipulator kinematics. Differential motion and velocities - Differential motions of a robot and its hand frame, tool configuration jacobian, resolved motion rate control, manipulator jacobian, static forces and moments Robot dynamics - Lagrangian mechanics, effective moments of inertia, dynamic equations for multi-degree of freedom robots.

Trajectory planning - joint space trajectories vs Cartesian space trajectories

ROBOT ACTUATORS

Characteristics of actuating systems, Drives - electric, hydraulic, pneumatic and their relative merits. Speed reduction

ROBOT SENSORS

Robot sensors, sensor classification, micro-switches, proximity sensors, photo-electric sensors, rotary position sensors, sensor usage and selection, sensors and control integration

ROBOT END-EFFECTORS

Types, mechanical grippers, gripper force analysis, gripper selection, process tooling, compliance

IMAGE PROCESSING AND ANALYSIS

Image acquisition, histogram of images, thresholding, connectivity, noise reduction, edge detection, segmentation, Image analysis - object recognition, depth measurement with vision systems, stereo imaging

ROBOT PROGRAMMING AND APPLICATIONS

Programming methods and languages, space position programming, motion interpolation. Robot applications - Material handling, processing, assembly, inspection applications, evaluating the potential of a robot application BOOK:1. Introduction to Robotics: Analysis, systems and applications by S.Y. Niku, Pearson Education. REFERENCES:

- Introduction to Robotics by J.J. Craig, Pearson Education
- Robotics: Control, sensing, vision and intelligence by KS Fu, P Gonzalez, CSG Lee, McGraw Hill

Course Name : **CASTING TECHNOLOGY**
Course Code : **PR 513**
Credits : **4**
LTP : **400**

Lecture wise breakup

No. of Lectures

INTRODUCTION

Ferrous and non-ferrous materials and their properties, pattern allowance, sand properties, testing and control, special sand additives, metallurgical consideration of cast iron, steel and aluminum for casting process.

SOLIDIFICATION OF CASTING

Nucleation and growth, segregation, progressive and directional solidification, relationship between solidification time and modules of the casting.

CASTING PROCESSES

Machine, shell, investment, vacuum, full mould, CO₂, injection, die and centrifugal casting processes

GATES AND RISEN

Design of gates for ferrous and non-ferrous materials, different methods for riser design, different methods for improvement of efficiency of a riser.

CASTING DEFECTS

Causes and remedies

HEAT-TREATMENT OF CASTINGS

Heat treatment of steel, iron and stainless steel castings.

MISCELLANEOUS

Foundry mechanization, pollution control in foundries, inspection, repair and salvage of castings, quality Control in foundries, casting design consideration.

BOOK:

1. Principles of Metal Casting Processes-Heine

REFERENCES:

1. ASME Foundry Hand book