Curriculum Structure and Course Contents

of

ME –Production and Industrial Engineering

Sr. No.	Courses	Credit Structure	
		No. of Courses	**Credits**
1	Program Core	04	12 (3 each)
2	Open core	02	06 (3 each)
3	Program Elective	03	09 (3 each)
4	Open Elective	01	03
5	Program Lab	02	04 (2 each)
6	Case Histories and industry Experiences	01	01
7	Seminar and Term paper	01	01
8	Project/ Industry based Project	02	12+18=30
Total Credits			66

Course/ Credits Distribution of ME Production & Industrial Engineering

Program Core

Course Code	Course Name	L T P	Credits
PRN 511	Program Core-I : **Design and Manufacture of Mechanical Assemblies**	3-0-0	3
PRN 512	Program Core-II : **Computer Aided Manufacturing**	3-0-0	3
PRN 521	Program Core-III : **Production Management systems**	3-0-0	3
PRN 522	Program Core IV: **Welding Engineering**	3-0-0	3
Total			**12**

Open core

Course Code	Course Name	L T P	Credits
MAN 503	Program Mathematics/ Mathematics (Open Core I): **Advanced Mathematics**	3-0-0	3
MAN 505	Open core-II : **Design of Experiments and Research Methodology**	3-0-0	3
Total			**06**

Program Elective-I, II and III (Any three)

Course Code	Course Name	L T P	Credits
PRN 551	Non Conventional Machining Processes	3-0-0	3
PRN 552	Machining Science	3-0-0	3

PRN 553	Metal Forming	3-0-0	3
PRN 554	Casting Technology	3-0-0	3
PRN 555	Finite Element Analysis	3-0-0	3
PRN 556	Advanced Machine Tool Design	3-0-0	3
IDN 522	Applied Ergonomics	3-0-0	3
PRN 557	Industrial Robotics	3-0-0	3
PRN 558	Flexible Manufacturing Systems	3-0-0	3
PRN 559	Maintenance and Reliability Engineering	3-0-0	3
PRN 560	Industrial automation	3-0-0	3
PRN 561	Non Destructive Testing	3-0-0	3
IDN 551	Materials, Manufacturing and Design		
PRN 562	Plastics Engineering	3-0-0	3
PRN 563	Operation Management	3-0-0	3
Total			**09**
Program Elective Total		**15-0-0**	**09**

Open Elective (Any One)

Course Code	**Course Name**	**L T P**	**Credits**
PRN 571	Quality Management System	3-0-0	3
PRN 572	Value Engineering	3-0-0	3
Total			**03**

Program Lab

Course Code	**Course Name**	**L T P**	**Credits**
PRN 510	Program Lab-I : **Computer Aided Engineering Lab.**	0-0-3	2
PRN 520	Program Lab-II : **Advanced Manufacturing Lab**	0-0-3	2
Total			**04**

Case Histories and industry Experiences

Course Code	**Course Name**	**L T P**	**Credits**
PRN 531	Case Histories and industry Experiences	0-0-2	1
Total			**01**

Seminar and Term Paper

Course Code	**Course Name**	**L T P**	**Credits**
PRN 532	Seminar and Term Paper	0-0-2	1
Total			**01**

Project/ Industry based Project

Course Code	**Course Name**	**L T P**	**Credits**

PRN 598	Project/ Industry based Project -I	0-0-24	12
PRN 599	Project/ Industry-based Project –II	0-0-36	18
Total			**30**

CONSOLIDATED SCHEME-ME Production and Industrial												
Sem							**Lecture Course**	**L**	**T**	**P**	**Weekly Contact**	**Credits**
I	Program Core -I **Design and Manufacture of Mechanical Assemblies: PRN 511 (LTP: 3 0 0)**	Program Core-II **Computer Aided Manufacturing: PRN 512 (LTP: 3 0 0)**	Program Mathematics/Mathematics (Open core I) **Advanced Mathematics: MAN 503 (LTP: 3 0 0)**	Program Elective I **(see list of Electives) (LTP: 3 0 0)**	Program Elective II **(see list of Electives) (LTP: 3 0 0)**	Program Lab I **Computer Aided Engineering Lab. PRN 510 (LTP: 0 0 3)**	5	15	0	3	18	17
II	(Open Core II) **Design of Expt & Research Methodology : MAN 505 (LTP: 3 0 0)**	Program Core-III **Production Management systems PRN 521 (LTP: 3 0 0)**	Program Core-IV **Welding Engineering PRN 522 (LTP: 3 0 0)**	Program Elective III **(see list of Electives) (LTP: 3 0 0)**	Open Elective **(See list Open of Electives) (LTP: 3 0 0)**	Program Lab II **Advanced Manufacturing Lab PRN 520 (LTP: 0 0 3)**	5	15	0	3	18	17
III	Case History and Industry Experiences **: PRN 531 (LTP: 0 0 2)**	Seminar & Term Paper : **PRN 532 (LTP: 0 0 2)**	Project/ Industry Based Project -I : **PRN 598 (LTP: 0 0 24)**				0	0	0	28	28	14
IV	Project/ Industry Based Project-II: **PRN 599 (LTP: 0 0 36)**	-	-	-	-	-	-	0	0	36	36	18

Curriculum Structure of ME –Production and Industrial Engineering

Ist Semester

S. No	Course Code	Course Name	L	T	P	Credits
1.	MAN 503	Open core-1 (Advanced Mathematics)	3	0	0	3
2.	PRN 511	Program core-1 (Design and Manufacture of Mechanical Assemblies)	3	0	0	3
3.	PRN 512	Program core-2 (Computer Aided Manufacturing)	3	0	0	3
4.		Program Elective I	3	0	0	3
5.		Program Elective II	3	0	0	3
6.	PRN 510	Program Lab-I (Computer Aided Engineering Lab)	0	0	3	2
					Total	17

2nd Semester

S. No	Course Code	Course Name	L	T	P	Credits
1.	MAN 505	Open core-2 (Design of Experiments and Research Methodology)	3	0	0	3
2.	PRN 521	Program core-3 (Production Management systems)	3	0	0	3
3.	PRN 522	Program core-4 (Welding Engineering)	3	0	0	3
4.		Program Elective III	3	0	0	3
5.		Open Elective*	3	0	0	3
6.	PRN 520	Program lab – II** **(**Advanced Manufacturing Lab)	0	0	3	2
					Total	17

*** It could be intra/inter department ME course**

**** To include minimum of 2 industrial visits of half day duration to nearby industries.**

3rd Semester

S. No.	Course Code	Course Name	L	T	P	Credit
1.	PRN 531	Case Histories and Industry Experiences[#]	0	0	2	1
2.	PRN 532	Seminar and Technical Writing	0	0	2	1
3.	PRN 598	Project/Industry-based Project – I	0	0	24	12
					Total	14

 # To include 4 to 5 invited lectures from industrial experts.

4th Semester

S. No.	Course Code	Course Name	L	T	P	Credit
1.	PRN 599	Project/Industry-based Project – II	0	0	36	18
					Total	18

List of Program Elective-I , II and III (Any three)

Course Code	Course Name	L T P	Credits
PRN 551	Non Conventional Machining Processes	3-0-0	3
PRN 552	Machining Science	3-0-0	3
PRN 553	Metal Forming	3-0-0	3
PRN 554	Casting Technology	3-0-0	3
PRN 555	Finite Element Analysis	3-0-0	3
PRN 556	Advanced Machine Tool Design	3-0-0	3
IDN 522	Applied Ergonomics	3-0-0	3
PRN 557	Industrial Robotics	3-0-0	3
PRN 558	Flexible Manufacturing Systems	3-0-0	3
PRN 559	Maintenance and Reliability Engineering	3-0-0	3
PRN 560	Industrial automation	3-0-0	3
PRN 561	Non Destructive Testing	3-0-0	3
IDN 551	Materials, Manufacturing and Design	3-0-0	3
PRN 562	Plastics Engineering	3-0-0	3
PRN 563	Operation Management	3-0-0	3
Total			**09**
Program Elective Total		**15-0-0**	**09**

List of Open Elective (Any One)

Course Code	Course Name	L T P	Credits
PRN 571	Quality Management System	3-0-0	3
PRN 572	Value Engineering	3-0-0	3
Total			**03**

Course Name : **ADVANCED MATHEMATICS**
Course Code : **MAN 503**

Credits : **3**
L T P : **3 0 0**

Total no. of lectures: 42

COURSE OBJECTIVE:

To understand Linear programming, Non-linear programming and constrained & unconstrained external problems.

Lecture wise breakup	**No. of Lectures**
Linear programming problem, Simplex method	**(5)**
Artificial variables and dual phase method	**(4)**
Non-linear programming problems, unconstrained extremal problems, Necessary and sufficient conditions for extrema, Fibonacci and Golden search methods	**(6)**
Gradient methods	**(6)**
Direct search methods	**(4)**
Constrained extremal problems, Equality constraints, Jacobian and Lagrangean methods	**(4)**
Inequality constraints, extension of Lagrangean method, the Kuhn -Tucker conditions	**(5)**
Direct search methods	**(3)**
Separable, Quadratic, Geometric programming and Linear combination method	**(8)**

COURSE OUTCOME:

1. Students should be able to solve problems related to linear programming and non-linear programming.
2. Students should be able to solve problems related to constrained and unconstrained external problems using different methods

Books:

1. Taha, Operations Research, Prentice Hall, 7th ed, 2002.
2. Phillips and Solberg, Ravindran, Operations Research, John Wiley & Sons, 2nd edition 2000.

REFERENCES:

1. Chapra and Canale, Numerical Methods for Engineers, Tata Mc Graw Hill, 4th edition, 2005.
2. S.S.Rao, Engineering Optimization, New Age, 3rd edition, 2000.

Course Name	**:**	**DESIGN AND MANUFACTURE OF MECHANICAL ASSEMBLIES**
Course Code	**:**	**PRN 511**
Credits	**:**	**3**
L T P	**:**	**3 0 0**

Total no. of lectures: 42

COURSE OBJECTIVE:

To understand product life cycle, the relevance of assemblies in this cycle and design & manufacture of assemblies.

Lecture wise breakup **No. of Lectures**

PRODUCT REQUIREMENTS AND TOP-DOWN DESIGN (3)

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 (8)

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 (6)

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 (7)

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

ASSEMBLY SEQUENCE ANALYSIS (6)

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

DATUM FLOW CHAIN (6)

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 DESIGN FOR MANUFACTURING (6)

Sequential versus concurrent engineering, understanding interactions between design and manufacturing, benefits of concurrent engineering, concurrent engineering techniques, design for assembly, design for manufacturing

COURSE OUTCOME:

1. Students should be able to mathematically model a product and carry out constraint analysis and assembly sequence analysis.
2. Students should be able to carry out tolerance analysis and synthesis.
3. Students should be able to apply principles of DFM to consumer products.

BOOKS:

1. Whitney D.E., Mechanical assemblies: Their design, manufacture and role in product development, Oxford University Press, 2004.
2. Zeid Ibrahim, CAD/CAM Theory and Practice, Tata Mcgraw Hill, 2009.

REFERENCES:

1. Singh Nanua, Systems Approach to Computer Integreted Design and Manufacturing, John Wiley & Sons, 1996.
2. Geoffery Boothroyd, Peter Dewhurst, Winston Knight, Product Design for Manufacturing and Assembly, Marcel Dekker , Newyork 2nd edition , 1994.

Course Name	**:**	**COMPUTER AIDED MANUFACTURING**
Course Code	**:**	**PRN 512**
Credits	**:**	**3**
L T P	**:**	**3 0 0**

Total no. of lectures: 42

COURSE OBJECTIVE:

To understand CNC classification, its need, construction details and part programming, adaptive control, inspection and rapid prototyping.

Lecture wise breakup **No. of Lectures**

INTRODUCTION **(4)**
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 **(8)**
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 **(10)**
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.

ADAPTIVE CONTROL SYSTEMS **(6)**
Adaptive control with Optimization, Adaptive control with Constraints, ACC System for Turning.

INSPECTION **(8)**
Offline/online system, Co-Ordinate Measuring Machines Basic types of measuring machines, Operating modes, Programming soft-wares, Measurement and inspection capabilities, Flexible inspection systems, Inspection probes

RAPID PROTOTYPE **(6)**
Introduction, Rapid Prototyping Process Chain, Liquid Based Rapid Prototyping Systems, Solid Based Rapid Prototyping Systems, Powder Based Rapid Prototyping Systems, Applications and Examples.

COURSE OUTCOME:

1. Student should be able to learn part programming and working on the CNC machine.
2. Student should be able to understand about computer aided inspection.
3. Student should have knowledge about rapid prototyping.

Books:

1. Koren Y, Computer Control of Manufacturing Systems, McGraw-Hill, 1986.
2. Pabla B.S & M Adithan, CNC machines, New Age Publishers, 1994.

REFERENCES:

1. Kundra T K, Rao P N, Tewari N K, Numerical Control and Computer Aided Manufacturing, Tata McGraw-Hill, 1993.
2. Groover, M P, Automation, Production Systems, and Computer Integrated Manufacturing, Prentice-hall Int, 2007.
3. Chua C K, Leong K F, Lim C S, Rapid Prototyping-Principles and Applications, World Scientific Publishing Co. Ltd, 2010

Course Name	**:**	**PROGRAM LAB – I (COMPUTER AIDED ENGINEERING LAB)**
Course Code	**:**	**PRN 510**
Credits	**:**	**2**
L T P	**:**	**0 0 3**

Total no. of lectures: 42

COURSE OBJECTIVE:

To understand how to use computer aided engineering softwares for modelling, simulation and analysis.

List of Experiments: (Any 7 out of 11)

1. Introduction to CATIA – getting familiarized with the sketcher module.
2. To model components using part modelling in CATIA.
3. To carry out the tolerance analysis of a sub assembly/consumer product.
4. To carry out the GD & T analysis of a product in CATIA.
5. To model and assemble a consumer product.
6. To model an industrial robot in CATIA and carry out its kinematic simulation
7. To model an industrial work cell and simulate the task carried out by human operator in DELMIA software.
8. To carry out structural analysis using FEA software.
9. To carry out thermal analysis using FEA software.
10. To make a part program for CNC turning job and run it on CNC simulator software.
11. To make a part program for CNC milling job and run it on CNC simulator software.

COURSE OUTCOME:

1. Students should be able to use CATIA software for modeling, tolerance & GD&T analysis of a product.
2. Students should be able to use CATIA software to model a consumer product and industrial robot.
3. Students should be able to use DELMIA software to model an industrial work cell and simulate the task carried out by human operator.
4. Students should be able to carry out structural and thermal analysis using FEA software.
5. Students should be able to make a part program for CNC turning & milling job and run it on CNC simulator software.

Course Name	**:**	**DESIGN OF EXPERIMENTS AND RESEARCH METHODOLOGY**
Course Code	**:**	**MAN 505**
Credits	**:**	**3**
L T P	**:**	**3 0 0**

Total no. of lectures: 42

COURSE OBJECTIVE:

To understand various techniques of experimental design, analysis and research methodology

Lecture wise breakup	**No. of Lectures**
Basic principles of design of experiment, Error analysis in experiments.	**(4)**
Classification of experimental designs, Design and analysis of one factor experiments Completely randomized and randomized complete block designs, Analysis of variance.	**(7)**
Estimation of parameters, Residual analysis and model checking, Sample size problem.	**(4)**
Design with two blocking variables, Latin squares, Analysis of data from a Latin square.	**(2)**
Experiment with two factors- Introduction, Main effects and interactions, Two-factor analysis of variance, Graphic analysis, Choice of sample size.	**(6)**
Design of Experiments with the help of orthogonal arrays, Taguchi's Robust parameter design, Analysis, Noise factors, Tolerance on control factors.	**(5)**
Research Methodology – Nature and course objective of research, Research topic, Literature review, Formulation of problem, Research design, Sampling techniques, Data collection, Statistical and sensitive analysis of data, Interpretation of result and report writing.	**(9)**
RSM Technique - Introduction to Response Surface Methodology (RSM): Fundamentals and Goals of RSM, Approximating Functions, Empirical Model Building: Checking for Lack of Fit, Checking for Collinearity Problems, 2k Factorial Designs: The General 2k Design, In Two, Four, 2p Blocks.	**(5)**

COURSE OUTCOME:

1. Students should be able to use various techniques of experimental design.
2. Students should be able to analyze and optimize the research problems.
3. Students should be able to write a research report using research methodology.

Books:

1. Ronald E. *Walpole*, Myers and Ye, Probability and Statistics for Engineers and scientists, Pearson Education, 7th ed, 2002.
2. Richard A. Johnson, Irwin Miller, John Freund, Miller and Freund's probability and statistics for engineers, Prentice Hall, 2009.

REFERENCES:

1. Phillip J.R.S.S., Taguchi Techniques for quality engineers, MCGRAW HILL

publication, 1988.

Course Name	**:**	**PROGRAM LAB – II (ADVANCED MANUFACTURING LAB)**
Course Code	**:**	**PRN 520**
Credits	**:**	**2**
L T P	**:**	**003**

Total no. of lectures: 42

COURSE OBJECTIVE:

To understand various manufacturing processes and industrial robotic applications

List of Experiments

Note: - Any 7 out of 9 Experiments to be performed

1. To analyze the effect of Submerged Arc Welding process parameters on bead geometry.
2. To analyze the effect of Metal Inert Gas Welding process parameters on bead geometry.
3. Study the effect of resistance spot welding process parameters on weld nugget.
4. Design gating and risering system for a given casting.
5. Study the effect of Abrasive flow machining on material removal rate and surface roughness.
6. Study the effect of EDM process variables on material removal rate (MRR) and surface roughness.
7. To analyze the effects of machining process parameters on surface roughness.
8. To develop the trajectory of an industrial robot for pick-and-place operations of objects.
9. To optimize the path of a robot for a spot welding operation on the inner back door of an automobile.

COURSE OUTCOME:

1. Students should be able to analyze the effect of various welding process parameters on the bead geometry.
2. Students should be able to design gating and risering system for a given casting
3. Students should be able to understand AFM, EDM machining process.
4. Students should be able to develop the trajectory of an industrial robot and to optimize the path of a robot for a spot welding operation.

Course Name	**:**	**PRODUCTION MANAGEMENT SYSTEMS**
Course Code	**:**	**PRN 521**
Credits	**:**	**3**
L T P	**:**	**3 0 0**

Total no. of lectures: 42

COURSE OBJECTIVE:

To understand the concept of world class manufacturing, dynamics of material flow, OPT and Lean manufacturing.

Lecture wise breakup **No. of Lectures**

GLOBAL COMPETITION IN MANUFACTURING (12)

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 (8)

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

DYNAMICS OF MATERIALS FLOW (8)

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

OPTIMITED PRODUCTION TECHNOLOGY AND SYNCHRONOUS MANUFACTURING (8)

Shop scheduling and rescheduling, objectives of OPT, Maximizing Global Manufacturing Performance, Nine OPT Principles, Development of OPT Schedules, Theory of Constraints, The Drum-Buffer-Rope Strategies, Shop scheduling and rescheduling.

LEAN AND AGILE MANUFACTURING CONCEPTS (6)

MIS (Management information system), ERP (Enterprise Resource Planning) / SAP (System Application & Products)

COURSE OUTCOME:

1. Students should be able to compare the existing industry with WCM companies.

Books:

1. P. Gibson, G. Greenhalgh, R. Kerr, Manufacturing Management Principles and Concepts, Chapman and Hall Publication, 1995.
2. Eliatt Goldratt, Eliyahu M. Goldratt, The goal, North river Press, 2004

REFERENCES:

1. Thomas G Gunn, 21st Century Manufacturing by Harper Business Publication, New York, 2011.
2. Shgeo Shingo, Toyota Production System, Productivity Press Cambridge, 1988.

Course Name	**:**	**WELDING ENGINEERING**
Course Code	**:**	**PRN 522**
Credits	**:**	**3**
L T P	**:**	**3 0 0**

Total no. of lectures: 42

COURSE OBJECTIVE:

To understand different welding processes, design of welding joint, defects and weldability of different materials.

Lecture wise breakup **No. of Lectures**

INTRODUCTION **(4)**
Classification of welding processes, physics of welding arc, arc stability, arc blow, polarity, welding symbols, safety and hazards in welding.

METAL TRANSFER **(2)**
Various forces acting on a molten droplet, different modes of metal transfer & their importance in arc welding.

POWER SOURCES **(2)**
Types of V-I characteristics, different types of power sources, selection of the power sources.

WELDING CONSUMABLES **(2)**
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 **(3)**
Effects of voltage current, polarity, welding speed etc. on the bead geometry and mechanical properties of the weld.

WELDING PROCESSES **(12)**
Principle, advantages, disadvantages, application and limitations of SMAW MIG I MAG, TIG, electro-slag, electro-gas thermit welding, SAW, EBW, LBW, USW, PAW, explosive, friction and spot, seam, projection, butt, flash butt resistance welding processes, microwave welding, hybrid welding, selection of welding processes.

WELDABILITY **(3)**
Definition, different tests of weldability, weldabitity of steel, stainless steel, cast iron, aluminum and titanium.

JOINING OF CERAMICS AND PLASTICS **(4)**
Processes used in joining of ceramics & plastics, adhesive bonding.

ALLIED WELDING PROCESSES **(5)**
Brazing, soldering, metal spraying, and gas & arc cutting of steels, stainless steel and cast iron, Thermal spraying, Plasma cutting.

WELDING DEFECTS **(3)**
Different types of welding defects, causes and remedies, testing for identifying defects.

WELDING DISTORTION AND RESIDUAL STRESSES **(2)**
Types, factors affecting the distortion and residual stresses, methods of reducing the distortion.

COURSE OUTCOME:

1. Student should be able to know about welding and design the joints.
2. Student should be able to understand welding defects and their remedies.

Books:

1. Jean Cornu, TIG and MIG welding process, Springer, 1988.
2. Jean Cornu, Advanced welding systems, IFS, 1988.
3. Parmar R.S., Welding engineering and technology, Khanna Publications, New Delhi, 1997.

REFERENCES:

1. Arthur L. Phillips, Charlotte Weisman, American Welding Society Hand book Volume 1 to 5, 1984.
2. Richard L Little, Welding and Welding Technology, Tata McGraw Hill Publishing Co., New Delhi, 1990.

Course Name	**:**	**CASE HISTORIES AND INDUSTRIAL EXPERIENCES**
Course Code	**:**	**PRN 531**
Credits	**:**	**1**
L T P	**:**	**0 0 2**

In the Course on case Histories and Industry Experiences, documented case histories shall be presented by the course instructor and, in addition, industry experts shall be invited to talk about industry experiences.

Course Name	**:**	**SEMINAR AND TECHNICAL WRITING**
Course Code	**:**	**PRN 531**
Credits	**:**	**1**
L T P	**:**	**0 0 2**

Students will individually present a seminar on state-of-art technology in a specific area of Production and Industrial Engineering. They will be required to submit a technical report of same.

Course Name	**:**	**NON CONVENTIONAL MACHINING PROCESSES**
Course Code	**:**	**PRN 551**
Credits	**:**	**3**
L T P	**:**	**3 0 0**

Total no. of lectures: 42

COURSE OBJECTIVE:

To understand the various non conventional machining processes, applications and comparative analysis of various processes.

Lecture wise breakup **No. of Lectures**

INTRODUCTION

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. **(2)**

ABRASIVE JET MACHINING AND ABRASIVE FLOW MACHINING **(3)**

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

ULTRASONIC MACHINING **(4)**

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 **(4)**

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

ELECTROCHEMICAL MACHINING (ECM) **(5)**

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, optimization 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) **(5)**

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

ELECTRICAL DISCHARGE MACHINING **(5)**

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, optimization analysis of metal removal rate in EDM process, selection of tool materials, choice of dielectric fluid, conclusion, problems.

LASER BEAM MACHINING **(2)**

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 **(3)**

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 **(3)**

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

STUDY OF RECENT DEVELOPMENTS **(6)**

AJM, AFM, USM, CM, ECM, ECG, EDM, LBM, PAM, EBM, HVFM, E-HF, E-MF, HSH Forgings, & HS Extrusions through journals & e-journals.

COURSE OUTCOME:

1. Students should be able to select the non conventional machining process for particular application.
2. Students should have knowledge of various parameters which are affecting the non conventional machining process.
   Students should have exposure to the recent developments in the non conventional machining process.

Books:

1. Pandey P.C. & Shan H.S., Modern Machining Process, Tata McGraw-Hill. New Delhi 2002
2. Adithan M, Modern manufacturing, New Age International Publication, 1987
3. HMT, 'Production Technology', HMT, 2001.

REFERENCES:

1. ASTME, High velocity forming of metals Printice Hall of India, 1968
2. Nagpal G.R., Metal forming Processes Khanna Publ. New Delhi, 1998

Course Name : **MACHINING SCIENCE**
Course Code : **PRN 552**
Credits : **3**
L T P : **3 0 0**

Total no. of lectures: 42

COURSE OBJECTIVE:

To understand the concept of tool nomenclature, tool geometry, machining processes

Lecture wise breakup **No. of Lectures**

INTRODUCTION **(5)**
Latest development in tool materials, tool nomenclature, interrelation between different systems of rake angle nomenclature, various methods of metal removal, mechanics of metal removal

CUTTING FLUID **(3)**
Types of cutting fluid, properties, mechanics of lubrication, selection of cutting fluid for different tool-work materials

TOOL GEOMETRY **(6)**
Wear mechanisms, experimental methods for tool wear measurement, tool life, tool life equations, tool failure criteria, factors affecting tool life, tool life criteria, tool life tests, machinability, machinability of different work materials

THERMAL ASPECTS OF METAL CUTTING **(6)**
Analysis of temperature at tool- work interface, different methods of temperature measurement of chip

ANALYSIS OF MACHINING PROCESSES **(10)**
Chip formation process in different machining processes, orthogonal and oblique cutting velocity relationship, cutting forces in metal cutting, stress distribution at chip-tool interface, effect of cutting variables on chip reduction coefficient, Merchant's theory of metal cutting, Leshafte's theory, analysis of oblique cutting

ABRASIVE MACHINING PROCESSES **(6)**
Abrasive machining processes, mechanics of grinding process, grinding wheel wear

MACHINING ECONOMICS **(6)**
Optimum cutting speed for maximum production rate, minimum cost and maximum profit rate, restrictions on optimum cutting conditions, generalized analysis for optimization of cutting conditions Recent Development in machining technology

COURSE OUTCOME:

1. Student should be able to know about machining processes and various machining parameters and their effects on machining.
2. Student should be able to know about thermal aspects of metal

cutting.

Books:

1. Amitabh Bhattacharyya, Metal cutting Theory and Practices: New Central Book Agency (P) Ltd, 1975.
2. Juneja B.L., Sekhon G.S., Fundamentals of metal cutting and machine tools, New age International Publishers, 2012.

REFERENCES:

1. Geomey Boothroyd & Winston A Knight, Fundamentals of Machining and Machine Tools, CRC Press, 2005.
2. Juneja B.L., Sekhon G.S, Fundamentals of metal cutting and machine tools, John Wiley & Sons, New Delhi, 1987.

Course Name	**:**	**METAL FORMING**
Course Code	**:**	**PRN 553**
Credits	**:**	**3**
L T P	**:**	**3 0 0**

Total no. of lectures: 42

COURSE OBJECTIVE:

To understand the concept of forming processes along with its causes/remedies of forming defects.

Lecture wise breakup **No. of Lectures**

INTRODUCTION (10)
Classification of forming process, variables in metal forming, work hardening and Anisotropy in yielding, elements of theory of plasticity, stress-strain relations in elastic and plastic deformations, determination of flow stress, yield criteria based on Tresca and von-Mises theories, relationship between tensile yield stress and shear yield stress, Metallurgical factors in metal working, role of impurity in metal working,

METAL FORMING LUBRICATION (9)
Influence of friction in metal working process, lubrication mechanisms, boundary and extreme pressure lubricants, mixed lubrication, hydrodynamic lubrication, lubricants used in industrial forming processes, elasto-hydrodynamics, lubrications

TECHNOLOGY AND ANALYSIS OF METAL FORMING PROCESSES (10)
Important metal forming processes, formulation of plastic deformation problems, upper and lower bound methods, slip line field theory, Analysis of important metal forming processes - forging, rolling, extrusion, wire drawing, sheet metal forming processes like deep drawing, bending, introduction to finite element analysis of metal forming processes. ANSYS applications in metal forming

DEFECTS (3)
Causes and remedies of important forming defects

UNCONVENTIONAL FORMING PROCESSES (10)
Hydrostatic extrusion, high energy rate forming processes, hydro-forming of sheets and tubes, electro-hydraulic and electro- magnetic forming process, explosive forming process

APPLICATION OF SOFTWARE IN METAL FORMING

COURSE OUTCOME:

1. Student should be able to know about forming.
2. Student should be able to know about forming defects.

Books:

1. Rowe G. W, Principles of Metal Forming Processes, St. Martin's Press, New York, 1965.

2. Sadhu Singh, Theory Of Plasticity And Metal Forming Processes, New delhi, India : Khanna, 1999.

REFERENCES:

1. Kurt Lauge, Hand book of Metal Forming, Society of Manufacturing Engineers, 1994
2. George E. Dieter, Jr., Mechanical Metallurgy, McGraw-Hill, 1988

Course Name	**:**	**CASTING TECHNOLOGY**
Course Code	**:**	**PRN 554**
Credits	**:**	**3**
L T P	**:**	**3 0 0**

Total no. of lectures: 42

COURSE OBJECTIVE:

To understand the concept of various materials, gate/riser design and different casting process

Lecture wise breakup **No. of Lectures**

INTRODUCTION **(8)**

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

SOLIDIFICATION OF CASTING **(5)**

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

CASTING PROCESSES **(7)**

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

GATE AND RISER DESIGN **(5)**

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 **(3)**

Causes and remedies

HEAT-TREATMENT OF CASTINGS **(4)**

Heat treatment of steel, iron and stainless steel castings

MISCELLANEOUS **(10)**

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

COURSE OUTCOME:

1. Student should be able to know in detail about Casting process.
2. Student should be able to know about casting defects.

Books:

1. Richard W. Heine, Principles of Metal Casting Processes, McGraw Hill, 2004
2. Jain P.L., Principles of Foundry Technology, Tata McGraw hill, 2003

REFERENCES:

1. Oscar John Horger, ASME Foundry Hand book Vol 1, McGraw-Hill, 1965

Course Name	**:**	**FINITE ELEMENT ANALYSIS**
Course Code	**:**	**PRN 555**
Credits	**:**	**3**
L T P	**:**	**3 0 0**

Total no. of lectures: 42

COURSE OBJECTIVE:

To understand the concept of designing & development of products and modeling & analysis of a system using finite element analysis.

Lecture wise breakup **No. of Lectures**

Product development driven by concurrent engineering; role of CAE (Computer-Aided Engineering) in Product design; mathematical abstractions of product for functionality verification **(3)**

INTRODUCTION TO FEM (4)

The Finite Element Method, Elements and Nodes, Modeling the problem and Checking Results, Discretization and other Approximations, Responsibility of the user, Elementary Matrix Algebra.

BARS AND BEAMS (4)

Linear Static Analysis: Stiffness Matrix Formulation: Bar Element, Stiffness Matrix Formulation: Beam Element, properties of stiffness matrices – Avoiding Singularity, Mechanical Loads and Stresses, Thermal Loads and Stresses

PLANE PROBLEMS (6)

Constant Strain Triangle (CST),s Linear Strain Triangle (LST), Bilinear Quadrilateral (Q4), Quadratic Quadrilateral (Q8), Improved Bilinear Quadrilateral (Q6), Elements with "Drilling" dof, Elements of more General Shape, Loads, Stress Calculation.

ISOPARAMETRIC ELEMENTS AND SOLUTION TECHNIQUES (6)

Node Numbering and Matrix Sparsity, Equation solving, Transformations, Isoperimetric Elements Formulation, Gauss Quadrature and Isoperimetric Elements, Choice of Quadrature Rule and Instabilities, Stress Calculation and Gauss Points, Nature of Finite Element Solution, Convergence Requirements – Patch Test, Infinite Media and Infinite Elements, Substructures, Symmetry, Constraints.

MODELING, ERRORS AND ACCURACY IN LINEAR ANALYSIS (7)

Modeling in General, Structure Behavior and Element Behavior, Element Tests and Element Shapes, Test Cases and Pilot Studies, Material Properties, Loads, Connections,

Boundary Conditions, Planning the Analysis, Numerical Error : Sources and Detection, Common Mistakes, Checking the Model, Critique of FE Results, Stress Concentrations – Sub-modeling, Convergence with Mesh Refinement, Error Measures and Adaptivity.

THERMAL ANALYSIS (6)

Some Basic Equations, Finite Elements in Thermal Analysis, Radiation and Other Nonlinearities, Thermal Transients, Modeling Considerations.

VIBRATION AND DYNAMICS (6)

Basic equations – Vibration, Mass matrices, Undamped Free Vibration, Damping, Reduction, Modeling Equations.

CASE STUDIES

COURSE OUTCOME:

1. Students should be able to solve problems using finite element analysis.
2. Students should be able to carry out structural and thermal analysis.
3. Students should be able to carry out finite element analysis of consumer products.

BOOKS:

1. Cook R D, Finite Element Modeling for stress Analysis, John Wiley and Sons, Inc. 1995
2. Chandrupatla & Belegundu, 'Finite Elements in Engineering', Prentice Hall of India Pvt. Ltd., 1997.

REFERENCES:

1 Rao.S.S., Finite Element Methods in Engineering, Pregamon Press, 1989.

2 Reddy J.N, An Introduction to Finite Element Method, MCGRAW HILL International Editions,1993.

Course Name	**:**	**ADVANCED MACHINE TOOL DESIGN**
Course Code	**:**	**PRN 556**
Credits	**:**	**3**
L T P	**:**	**3 0 0**

Total no. of lectures: 42

COURSE OBJECTIVE:

To understand the concept of design of machine tool structures, industrial automation and control systems in machine tools

Lecture wise breakup	**No. of Lectures**
INTRODUCTION	**(4)**
General Requirements of Machine Tool Design, Machine Tool Drives,	
DESIGN OF MACHINE TOOL STRUCTURES	**(10)**
Gear box design. Design Criteria for Machine Tool Structures, Materials of Machine Tool Structures, Static and Dynamic Stiffness, Profiles of Machine Tool Structures, Basic Design Procedure of Machine Tool Structures, Design of Beds, Design of Columns, Design of Housings, Design of Bases and Tables.	
DESIGN OF GUIDEWAYS AND POWER SCREWS	**(6)**
Design of Slideways for Wear Resistance, Design of Slideways for Stiffness, Design of Hydrodynamic Slideways, Design of Hydrostatic Slideways, Design of Power Screws and Recirculating Ball Screws	
DESIGN OF SPINDLE AND SPINDLE SUPPORTS	**(8)**
Functions of Spindle Unit and Requirements, Materials of Spindles, Effect of Machine Tool Compliance on Machining Accuracy, Design Calculations of Spindles, Antifriction Bearings, Sliding Bearings,	
AUTOMATION	**(8)**
Index for Degree of Mechanization, The Semiautomatics-Capstan and Turret Lathes, Bar Feeding Mechanisms for Turrets and Capstans, Indexing the Turret, Swiss-type Automatic Machines, Automatic Loading and Feeding of Work pieces, Transfer Devices, Modular Design Concept.	
CONTROL SYSTEMS IN MACHINE TOOLS	**(6)**
Functions, Requirements and Classification, Control Systems for Changing Speeds and Feeds, Automatic Control Systems, Adaptive Control Systems.	

COURSE OUTCOME:

1. Students should be able to design machine tools.
2. Students should know about industrial automation

Books:

1. Mehta N K, Machine Tool Design and Numerical Control, Tata McGraw-Hill, 2004.
2. Sen G C, Bhattacharyya A, Principles of Machine Tools, New Central Book Agency, 1969

REFERENCES:

1. CMTI, Machine Tool Design Hand Book, Tata McGraw-Hill, 1988.
2. Acherken N, Machine Tool Design, Vol. I-IV, Mir Publishers, Mascow, 1958.
3. Tobias S A, Machine Tool Vibration, Blackie, London, 1965.

Course Name	**:**	**APPLIED ERGONOMICS**
Course Code	**:**	**IDN 522**
Credits	**:**	**3**
L T P	**:**	**3 0 0**

Total no. of lectures: 42

COURSE OBJECTIVE:

To understand the concept of designing a job for a worker considering various factors affecting a human ergonomically.

Lecture wise breakup **No. of Lectures**

INTRODUCTION **(3)**

Human Factors and Systems. Human Factors Research Methodologies

INFORMATION INPUT **(9)**

Information Input and Processing, Text, Graphics, Symbols and Code, Visual Display of Dynamic Information, Auditory, Tactual and Olfactory Displays, Speech Communications

HUMAN OUTPUT AND CONTROL **(8)**

Physical Work and Manual Materials Handling Motor Skills, Human Control of systems, Controls and Data Entry devices, Hand tools and devices,

WORKPLACE DESIGN **(7)**

Applied Anthropometry, Work-space design and Seating, Arrangement of Components within a Physical Space, Interpersonal Aspects of Workplace Design

ENVIRONMENTAL CONDITIONS **(6)**

Illumination, Climate, Noise, Motion

HUMAN FACTORS APPLICATIONS **(9)**

Human Error, Accidents and Safety, Human Factors and the Automobile. Human Factors in Systems design

COURSE OUTCOME:

1. Students should be able to understand human factors & systems and human output & control.
2. Students should be able to design a job for a worker considering various factors affecting a human ergonomically.

3. Students should be able to design a workplace.

BOOKS:

1. Mark Sanders, Ernest McCormick, Human Factors In Engineering and Design, 7th edition, McGraw-Hill International Editions, 1993.
2. Martin Helander, A Guide to human factors and ergonomics, Taylor and francis, 2005.

REFERENCES:

1. Stanton N et al, Handbook of human factors and ergonomic methods, CRC press, 2004.
2. Gallwey T J, Ergonomics Laboratory Exercises, CRC Press, 2009.
3. Bridger R.S., Introduction to ergonomics, MCGRAW HILL, 1995.

Course Name	**:**	**INDUSTRIAL ROBOTICS**
Course Code	**:**	**PRN 557**
Credits	**:**	**3**
L T P	**:**	**3 0 0**

Total no. of lectures: 42

COURSE OBJECTIVE:

To understand the concept of robot fundamentals, robot mechanics and study of robot sensors, end effectors and machine vision applications.

Lecture wise breakup **No. of Lectures**

ROBOT FUNDAMENTALS **(5)**

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

ROBOT MECHANICS **(12)**

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 SENSORS AND ACTUATORS **(5)**

Robot sensors, sensor classification, micro-switches, proximity sensors, photo-electric sensors, rotary position sensors, force and torque sensors, tactile sensors, sensor usage and selection, sensors and control integration, Robotic actuating systems.

ROBOT END-EFFECTORS **(2)**

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

IMAGE PROCESSING AND ANALYSIS **(8)**

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 **(10)**

Programming methods and languages, space position programming, motion interpolation. Robot applications – Material handling, processing, assembly, inspection applications, evaluating the potential of a robot application

COURSE OUTCOME:

1. Student should be able to learn in detail about industrial robots.
2. Student should be able to learn about Robot Programming.

Books:

1. Niku S.Y., Introduction to Robotics: Analysis, systems and applications, Pearson Education, 2010
2. Craig J.J., Introduction to Robotics, Pearson Education, 2005

REFERENCES:

1. Fu KS, Gonzalez P, Lee CSG, McGraw Hill, 1987
2. Saha S.K., *"*Introduction to Robotics*",* Tata McGraw-Hill Publishing Company Ltd, 2008.

Course Name	**:**	**FLEXIBLE MANUFACTURING SYSTEMS**
Course Code	**:**	**PRN 558**
Credits	**:**	**3**
L T P	**:**	**3 0 0**

Total no. of lectures: 42

COURSE OBJECTIVE:

To understand the concept of group technology and various models of manufacturing systems

Lecture wise breakup	**No. of Lectures**
Introduction to Manufacturing systems, Volume Variety relationships for understanding manufacturing systems, Models of manufacturing systems including transfer lines and FMS, Calculation of Performance measures, including through put, in-process inventory.	**(8)**
Flexibility and automation Different types of flexibility in manufacturing Different types of FMS building blocks of flexible manufacturing system; Work station, Storage retrieved system, material handling systems and computer control system.	**(7)**
Design, Planning and Loading Problems of FMS	**(3)**
Machining system of FMS; Horizontal & Vertical machining Centers	**(2)**
Integrated Material Handling , Automated Guided Vehicles and AGV's Design for FMS	
Automatic Storage and Retrieved System	**(6)**
FMS control System	**(1)**
Group technology; Part families, Part classification and coding, Production flow analysis, Machine Cell design, Computer Aided Process Planning**.**	**(5)**
Layout consideration for flexible manufacturing, Real time control of Scheduling of flexible manufacturing system.	**(2)**
FMS simulation, Future Development in FMS	**(2)**
Case Studies of FMS & RMS	**(6)**

COURSE OUTCOME:

1. Student should be able to know about FMS and its various aspects
2. Student should be able to understand the concept of group technology.

Books:

1. N and Jha K., Hand-book of Flexible Manufacturing Systems, Academic Press Inc, 1991.
2. Groover MP., Automation, Production Systems and Computer integrated Manufacturing, Prentice-Hall, Inc., 1980.

REFERENCES:

1. Singh Nanua, Systems Approach to Computer integrated Design and Manufacturing,Wiley, 1996.

Course Name	**:**	**MAINTENANCE AND RELIABILITY ENGINEERING**
Course Code	**:**	**PRN 559**
Credits	**:**	**3**
L T P	**:**	**3 0 0**

Total no. of lectures: 42

COURSE OBJECTIVE:

To understand the basic concepts of concepts of reliability, reliability models and its failure analysis.

Lecture wise breakup **No. of Lectures**

BASIC CONCEPTS OF RELIABILITY **(4)**

Concept, Terms, course objectives, applications, area of use, use of reliability in industry. Introduction to Probability Concepts

BASIC RELIABILITY MODELS **(4)**

The Reliability function**,** mean time to failures, hazard rate function, bath tub curve, conditional reliability, probability density function, failure rate, failure density, hazard rate, uncertainty measures.

CONSTANT AND TIME DEPENDANT FAILURE MODELS **(3)**

Exponential, weibull, normal and lognormal distributions

RELIABILITY OF SYSTEMS **(5)**

Series and parallel-connected systems, Concept of redundancy, k out of n standby system, course objectives, applications, redundant standby systems, system structure functions, minimal cuts and minimal paths, common mode failures, three state devices.

DETERMINATION OF RELIABILITY (STATE DEPENDANT SYSTEMS) **(4)**

Markov analysis, load sharing system, standby systems, degraded systems, Reliability allocation with redundancies

FAILURE ANALYSIS **(4)**

Introduction to failure mode and effect analysis, FMEA and FMECA, criticality analysis, Fault tree diagram, event tree.

AVAILABILITY **(3)**

Concept and definitions, availability models, system availability.

INTRODUCTION TO MAINTENANCE **(4)**

Course objectives and importance of maintenance, Functions of Maintenance, maintainability vs. maintenance.

TYPES OF MAINTENANCE **(5)**

Corrective, Breakdown, Predictive, Replacement, Preventive and Proactive maintenance strategies, Preventive maintenances v/s. repair, Computerized Maintenance Management System, Reliability under preventive maintenance.

DESIGN FOR MAINTAINABILITY **(4)**

Quantifiable measures of maintainability, maintainability management tasks during the product life cycle, life cycle costing,

life cycle cost estimation models, spare parts management

Introduction to TPM and RCM **(2)**

COURSE OUTCOME:

1. Student should be able to understand the concepts of reliability and maintenance engineering.
2. Student should be able to learn about TPM.

Books Recommended

1. Clifton R H, Principles of Planned Maintenance, McGraw Hill, New York, 2001.

2. Ebling CE, An introduction to Reliability and .Maintainability Engineering, Tata Mc Graw Hill, Delhi, 2004.

REFERENCES:

1. Srinath L S Reliability Engineering, Affiliated East-West Press Limited, New Delhi, 2002.
2. Dhillon B S, Engineering Maintainability, Prentice Hall of India, New Delhi,2000.Wireman Terry, Preventive Maintenance, Reston Publishing Company, Reston Virginia, 1998

Course Name	**:**	**INDUSTRIAL AUTOMATION**
Course Code	**:**	**PRN 560**
Credits	**:**	**3**
L T P	**:**	**3 0 0**

Total no. of lectures: 42

COURSE OBJECTIVE:

To understand the concept of bit microcontroller, pic microcontroller, embedded systems and concurrent systems.

Lecture wise breakup	**No. of Lectures**
8 BIT MICROCONTROLLER- 8051 Architecture memory organization, SFR's addressing modes, Instruction set, assembly language programming	**(10)**
PIC MICROCONTROLLER Introduction to 68HC11 family of microcontroller, CPU, Architecture & pipelining memory organization, CPU family registers, addressing modes Instruction set, Assembly language programming, using timers, subroutines, Interrupts I/O ports special feature	**(10)**
INTERFACING: Interfacing ADC, DAC, LED, Switches, LCD with examples, RS – 232 / 422 link	**(4)**
FUNDAMENTALS OF EMBEDDED SYSTEM Real time systems, Multitasking system, operating system structures, building an embedded application	**(6)**
CONCURRENT SOFTWARE Foreground / background systems, multithreaded programming, shared resources & critical sections.	**(6)**
SCHEDULING Thread states, pending threads, context switching, round robin scheduling, priority based scheduling, assigning priorities, deadlock.	**(6)**

COURSE OUTCOME:

1. students will get knowledge about various types of microcontrollers, their functioning and applications
2. Student should be able to learn about fundamentals of embedded system.

Books:

1. Mazidi Muhammed Ali & Mazidi J G, The 8051 Microcontroller & Embedde Systems, Pearson Education Inc., 2006.
2. Ayala Kennith J, The 8051 Microcontroller Architecture Programming & Application, West Publication Company, 1991.

REFERENCES:

1. Miller Gene H, Microcomputer Engineering, Prentice Hall, 2003.
2. Lewis Danial W., Fundamentals of Embedded software, Prentice Hall, 2002.

Course Name	**:**	**NON DESTRUCTIVE TESTING**
Course Code	**:**	**PRN 561**
Credits	**:**	**3**
L T P	**:**	**3 0 0**

Total no. of lectures: 42

COURSE OBJECTIVE:

To understand the concept of various types of non destructive testing methods, radiographic examination and magnaflux methods.

Lecture wise breakup **No. of Lectures**

ITRODUCTION **(6)**

Classification of techniques of material testing, need and significance of non Destructive testing, types of non Destructive testing methods, Dye-penetration testing, Principle , Applications and limitations of dye penetrate testing, eddy current testing.

RADIOGRAPHIC EXAMINATION **(10)**

Radiant energy and Radiography , practical application , X-Ray and gamma –ray equipment, effect of variables on radiographs, requirement of a good radiograph, interpretation of radiograph , safety precautions, Xeroradiography, Neutron Diffraction method

MAGNAFLUX METHODS **(10)**

Basic Principles , scope and application , magnetic analysis of steel bars and tubing magnetization method, equipment , inspection medium, preparation of surfaces, Fluorescent Penetration inspection , Demagnetization

ELECTRICAL AND ULTRASONIC METHODS **(10)**

Basic principles, flaw detection in rail and tubes (Sperry detector), ultrasonic testing, surface roughness, moisture in wood , Detection of defect in ferrous and non ferrous metals , plastics , ceramics , measurement of thickness, hardness stiffness, sonic material analyzer, proof tests, concrete test hammer.

PHOTOELASTICICITY **(6)**

Concept and application of plane and circular polarization, photo stress, models

COURSE OUTCOME:

1. Student should be able to understand various types of non destructive techniques
2. Student should be able to understand about magna flux methods.

Books:

1. Davies H.E., Troxell G.E, Hauck GFW, The Testing of Engineering Materials, Mc Graw Hill Publishers, 1982.
2. Armstrong W.H., Mechanical inspection, Literary Licensing, LLC, 2012

REFERENCES:

1. Baldev Raj, Practical Non – Destructive Testing, Narosa Publishing House, 1997.
2. Hull B. and John V., Non-Destructive Testing, Macmillan, 1988.

3. Josef and Krautkramer Hebert, Ultrasonic Testing of Materials, 3rd edition, New York, Springer-Verlag, 1983.

Course Name	**:**	**MATERIALS, MANUFACTURING AND DESIGN**
Course Code	**:**	**IDN 551**
Credits	**:**	**3**
L T P	**:**	**3 0 0**

Total no. of lectures: 42

COURSE OBJECTIVE:

To study various engineering materials and their selection for particular application and suitable design for specific property.

Lecture wise breakup **No. of Lectures**

INTRODUCTION **(4)**
Materials Structure, nucleation & growth, phase diagrams application of phase diagram

ENGINEERING MATERIALS **(5)**
Metals and their properties, ferrous and non-ferrous metals, uses, production, forming and joining of metals.

CERAMICS AND GLASSES **(6)**
Structures of ceramics and glasses, design properties, ceramics uses, production, forming and joining of ceramics.

POLYMERS AND COMPOSITES, MMC, FRC **(7)**

MATERIAL SELECTION **(7)**
Sources of information on materials properties, methods, of materials selection

DESIGN PROCESS **(8)**
Materials in design, design for brittle fracture, design for fatigue failure, design for corrosion resistance, design with plastic.

CASE STUDIES IN MATERIAL SELECTION **(5)**

COURSE OUTCOME:

1. Students should be able to understand the various properties of the engineering materials.
2. Students should be able to select engineering materials for particular application.
3. Students should be able to design for a specific property of a material.

Books:

1. Ashby M.F., Engineering Materials, Pergamon Press
2. Dieter, GE, engineering design, A material and processing approach, MCGRAW HILL.

REFERENCES:

1. Callister, Material science and engineering, John wiley and sons.

Course Name	**:**	**PLASTICS ENGINEERING**
Course Code	**:**	**PRN 562**
Credits	**:**	**3**
L T P	**:**	**3 0 0**

Total no. of lectures: 42

COURSE OBJECTIVE:

To understand the various plastics materials, mould materials and their selection criteria & product design.

Lecture wise breakup **No. of Lectures**

PLASTICS MATERIALS **(8)**

Plastics materials selection for products based on Mechanical properties and thermal behavior of plastics.

MOULD MATERIALS AND DESIGN **(18)**

Mould materials and their selection criteria, classification of Compression Moulds, Transfer mould design, Blow mould design, Injection mould design,

RAPID TOOLING **(4)**

Direct & indirection tooling

PLASTICS PRODUCT DESIGN **(12)**

Design of thermoplastics and thermosetting type of polymers under static and dynamic loads, Tribological properties of polymers, abrasion and wear, design of abrasion and wear resistant products, Designing with sample composites, Product characterization, Product faults and optimum processing, Effect of processing on product performance, product characterization and service behavior.

COURSE OUTCOME:

1. Student should be able to about different plastic materials and their properties & applications.
2. Students should be able to select mould materials and to carry out mould design.
3. Students should be able to carry out problems related to the plastics product design.

BOOKS:

1. Crawford R.J., Plastics Engineering, Pergamon Press,1988
2. Levy S. & Dubois J.H., Plastic Product Design Engineering Hand Book, , Van Nostrand Reinhold Co., New York, 1977

REFERENCES:

1. Pye R.G.W., Injection mould Design, 1989

2. Miller Edward, Marcel Dekker, Plastics Products Design Hand Book, Hanser Pub.,2006
3. Malloy Robert A., Plastic Part Design for Injection Moulding, Hanser Pub., Munich Vienna NY, 1994
4. Belofsky H., SPE, Plastics Product Design and Process Engineering, , Hanser Publication, Munich Vienna NY, 1995.

Course Name	**:**	**OPERATIONS MANAGEMENT**
Course Code	**:**	**PRN 563**
Credits	**:**	**3**
LTP	**:**	**3 0 0**

Total no. of lectures: 42

COURSE OBJECTIVE:

To understand the concept of aggregate planning and design of product, service work systems.

Lecture wise breakup

No of Lectures

INTRODUCTION TO PRODUCTION AND OPERATIONS MANAGEMENT (8)

Production Systems – Nature, Importance and organizational function. Characteristics of Modern Production and Operations function. Organization of Production function. Recent Trends in Production and Operations Management. Role of Operations in Strategic Management. Production and Operations strategy – Elements and Competitive Priorities. Nature of International Operations Management.

FORECASTING, CAPACITY AND AGGREGATE PLANNING (7)

Demand Forecasting – Need, Types, course objectives and Steps. Overview of Qualitative and Quantitative methods. Capacity Planning – Long range, Types, Rough cut plan, Capacity Requirements Planning (CRP), Developing capacity alternatives. Aggregate Planning – Approaches, costs, relationship to Master Production schedule. Overview of MRP, MRP II and ERP.

DESIGN OF PRODUCT, SERVICE AND WORK SYSTEMS (9)

Product Design – Influencing factors, Approaches, Legal, Ethical and Environmental issues. Process – Planning, Selection, Strategy, Major Decisions. Service Operations – Types, Strategies, Scheduling (Multiple resources and cyclical scheduling). Work Study – Course objectives, Procedure. Method Study and Motion Study. Work Measurement and Productivity– Measuring Productivity and Methods to improve productivity.

MATERIALS MANAGEMENT (9)

Materials Management – course objectives, Planning, Budgeting and Control. Overview of Materials, Management Information Systems (MMIS). Purchasing – course objectives, Functions, Policies, Vendor rating and Value Analysis. Stores Management – Nature, Layout, Classification and Coding. Inventory – Course objectives, Costs and control techniques. Overview of JIT.

PROJECT AND FACILITY PLANNING (9)

Project Management – Scheduling Techniques, PERT, CPM, Crashing CPM networks – Simple Problems. Facility Location – Theories, Steps in Selection, Location Models – Simple Problems. Facility Layout – Principles, Types, Planning tools and techniques

COURSE OUTCOME:

1. Student should be able to understand about materials management.
2. Student should be able to know about project management.

TEXT BOOKS

1. Aswathappa K and Shridhara Bhat K, Production and Operations Management, Himalaya Publishing House, Revised Second Edition, 2008.

2. Pannerselvam R, Production and Operations Management, Prentice Hall India,

Second Edition, 2008.

3. Norman Gaither and Gregory Frazier, Operations Management, South Western Cengage Learning, 2002.

REFERENCES

1. Bedi Kanishka, Production and Operations Management, Oxford University Press, 2004.

2. Russel and Taylor, Operations Management, Wiley, Fifth Edition, 2006.
3. Chary S. N, Production and Operations Management, Tata McGraw Hill, Third Edition, 2008.
4. Chase Jacobs, Aquilano & Agarwal., Operations Management, Tata McGraw Hill, 2006.
5. Mahadevan B, Operations Management Theory and practice, Pearson Education, 2007

Course Name	**:**	**QUALITY MANAGEMENT SYSTEM**
Course Code	**:**	**PRN 571**
Credits	**:**	**3**
L T P	**:**	**3 0 0**

Total no. of lectures: 42

COURSE OBJECTIVE:

To understand the concept of Quality engineering and tolerance design**.**

Lecture wise breakup **No. of Lectures**

STATISTICAL METHODS IN MANUFACTURING **(8)**

Use of Statistics to ensure Quality of Manufacturing Processes, to Predict the Reliability of Products and Processes and to Improve Manufacturing Designs and Processes.

QUALITY ENGINEERING IN PRODUCTION SYSTEMS **(10)**

Quality Value and Engineering, Quality Engineering in Product Design and Design of Production Processes, Taguchi's philosophy of Robust Design, Loss Function and Quality Level, Derivation of Loss Function, Uses of Loss Function, The Loss Function and Justification for Improvements.

TOLERANCE DESIGN AND TOLERANCES **(10)**

Quality Levels and Types of Tolerances, Determination of Tolerances, Process Capability and Product Tolerances, Statistical Build of Tolerances, Multiple Tolerance Chains.

ON-LINE FEED BACK QUALITY CONTROL **(8)**

Feed Back Control for Variable and Attribute Characteristics, Methods for Process Improvements.

RELIABILITY ENGINEERING **(6)**

Evaluation of Reliability, Reliability Assurance and Reliability Design

COURSE OUTCOME:

1. Student should be able to know about reliability engineering.
2. Student should be able to understand statistical methods in manufacturing**.**

Books:

1. Elsayed and Hsiang, Quality Engineering in Production Systems by Taguchi, MCGRAW HILL Publication, 1989.
2. Emick Norbert Lloyd, Quality Reliability and Process Improvement, Industrial Press Inc. New York, 1985.

REFERENCES:

1. Clements Richard Barrett, Handbook of Statistical Methods in Manufacturing, Prentice Hall, 1991.
2. Bieda John, Practical Product Assurance Management, ASQ Quality Press, 1997.

Course Name	**:**	**VALUE ENGINEERING**
Course Code	**:**	**PRN 572**
Credits	**:**	**3**
L T P	**:**	**3 0 0**

Total no. of lectures: 42

COURSE OBJECTIVE:

To understand the concept of value analysis and value engineering.

Lecture wise breakup **No of Lectures**

CONCEPTS AND APPROACHES OF VALUE ANALYSIS AND ENGINEERING **(3)**

Concept of value, Maximum value, normal degree of value, importance of value, value oriented work, use of value resources, value work expands market and jobs, approach to prepare the mind for the value analysis techniques

CLASIFICATION OF FUNCTIONS **(3)**

Use and aesthetic functions, Identification, clarification and naming functions, quantifying functions, unifying the function and its specifications, Analysis of Aesthetic functions, Classification of functions

EVALUATION OF FUNCTIONS **(6)**

Evaluation of Function, Evaluation of Functions by Comparison, Case Studies on evaluation of a single function, three functions, interactive Functions, Evaluation of all functions by comparison

PROBLEM SETTING SYSTEM **(3)**

Identify Functions, Separate Functions, Group Functions, Case study on Problem Setting, overlap of problem setting and problem solving.

PROBLEM SOLVING SYSTEM **(5)**

The Value Analysis Job Plan: Information step, Analysis step, Creativity step, Judgment step, Development planning step, Case study.

SETTING AND SOLVING MANAGEMENT-DECISION-TYPE PROBLEMS **(5)**

Types of Management problems, Setting the precise problem, Case Study -Should a company build manufacturing facilities for an important purchased assembly.

USING THE SYSTEM **(5)**

Three Basic Steps, Example of procedure, Basic Step I: identify the function, Basic Step-II: Evaluate the Function, Basic Step-III: cause value alternatives to be developed, interrelation of Basic Steps, Job Plan steps, and results- accelerating techniques

EFFECT ON OTHER WORK IN THE BUSINESS **(5)**

Accounting, Appearance design, Cost reduction activities, Cost reductions versus value analysis.

EFFECTIVE ORGANISATION FOR VALUE WORK **(2)**

Smallest and smaller business, One man Set Up, Two man Set Up, Three man Set Up, Four or more consultant, structuring the company, Decision Criteria-Performance and time, Decision Criteria-Performance, time, and Cost, Understanding the research and development problem.

ADVANCE TECHNIQUES **(5)**

Function Analysis System Technique (FAST), How to use FAST Diagram, FAST diagram cost allocation, Case Study, Quantitative evaluation of ideas. FAST for Product services and other processes, Value optimization, Cohesive Theory, Structure Frame Work, Flow charting, Step by Step Techniques. Developing a Template for

Life cycle, Cost, Customer, FAST to conduct value study.

COURSE OUTCOME:

1. Student should be able to understand advance techniques for value engineering.
2. Student should be able to know about value engineering.

Books:

1. Miles Lawrence D., Techniques of Value Analysis & Engineering, Eleanor Miles Walker, 1990.
2. Kaoufman Jerry, Value Analysis's Tear Down- A New Process for Product Development and innovation, Yashihiko Sato Industrial Press, 2004.

REFERENCES:

1. Mudge Arthur E, Value Engineering - A systematic approach , Part I, J. Pohl Associates, 1989.
2. Bytheway Charles W, FAST Creativity and Innovation: Rapidly Improving Processes, Product Development and Solving Complex Problems, J. Ross Publishing, 2007.