SRI KRISHNA COLLEGE OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINEERING
CURRICULUM-REGULATIONS 2014
BRANCH: ME CAD/CAM

S.NO	CODE	COURSE	HOURS/WEEK			CREDITS	MAXIMUM MARKS		
			L	T	P		CA	FE	TOTAL
SEMESTER - 1		**THEORY**							
1	14PSM102	Computational Methods	3	1	0	4	40	60	100
2	14PAK101 /14PGK101	Computer Graphics and Applications	3	1	0	4	40	60	100
3	14PAK102 / 14PGK102	Finite Element Methods in Mechanical Design	3	1	0	4	40	60	100
4	14PAK103	CNC and Robotics Systems Design	3	1	0	4	40	60	100
5	14PAK104	Modeling and Analysis of Manufacturing Systems	3	1	0	4	40	60	100
6	14PAK105 / 14PGE301	Rapid Manufacturing and Tooling	3	0	0	3	40	60	100
		PRACTICAL							
1	14PAK106	Computer Aided Engineering Lab	0	0	3	2	40	60	100
2	-	Industrial Visit	0	0	0	-	-	-	-
		TOTAL	18	5	3	25	280	420	700

S.NO	CODE	COURSE	HOURS/WEEK			CREDITS	MAXIMUM MARKS		
			L	T	P		CA	FE	TOTAL
SEMESTER - 2		**THEORY**							
1	14PAK201 / 14PGK201	Vibration Analysis of Mechanical Systems	3	1	0	4	40	60	100
2	14PAK202	Design of Mechanical Drives	3	1	0	4	40	60	100
3	14PAK203	MEMS & NEMS and Applications	3	0	0	3	40	60	100
4	14PAK204	Factory Automation	3	0	0	3	40	60	100
5		Elective – I	3	0	0	3	40	60	100
6		Elective – II	3	0	0	3	40	60	100
		PRACTICAL							
1	14PAK205	Design Engineering Lab	0	0	3	2	40	60	100
2	14PAK206	Technical Seminar	0	0	3	1	100	---	100
3	-	Industrial Visit	0	0	0	-	-	-	-
		TOTAL	18	2	6	23	380	420	800

S.NO	CODE	COURSE	HOURS/WEEK			CREDITS	MAXIMUM MARKS		
			L	T	P		CA	FE	TOTAL
SEMESTER - 3		**THEORY**							
1		Elective – III	3	0	0	3	40	60	100
2		Elective – IV	3	0	0	3	40	60	100
3		Elective – V	3	0	0	3	40	60	100
		PRACTICAL							
1	14PAK301	Project Work Phase – I	0	0	12	6	40	60	100
2	-	Industrial Visit	0	0	0	-	-	-	-
		TOTAL	9	0	12	15	160	240	400

S.NO	CODE	COURSE	HOURS/WEEK			CREDITS	MAXIMUM MARKS		
			L	T	P		CA	FE	TOTAL
SEMESTER - 4		**PROJECT WORK**							
1	14PAK401	Project Work Phase – II	0	0	24	12	40	60	100
		TOTAL	0	0	24	12	40	60	100

TOTAL: 75 CREDITS

L – Lecture T – Tutorial P – Practical C - Credit

CA – Continuous Assessment FE- Final Exam

LIST OF ELECTIVES

II Semester

14PAE201 / 14PGE201 Advanced Tool Design

14PAE202 / 14PGE202 Mechatronic System Design

14PAE203 / 14PGE203 Composite Materials Analysis and Applications

14PAE204 / 14PGE307 Engineering Economics and Cash flow Analysis

14PAE205 / 14PGE205 Computational Fluid Dynamics

14PAE206 /14PGE206 Productivity Management and Re-Engineering

14PAE207 / 14PGE207 Modern trends in Casting, Welding and Forming techniques

14PAE208 / 14PGE208 Facilities Planning and Layout Design

14PAE209 /14 PGE209 Product Design and Development

14PAE210 Competitive Manufacturing Systems

14PAE 211 Applied Materials Engineering

14PAE212 / 14PGE211 Manufacture of Automobile Components

III Semester

14PCK309 Data Structures and Algorithms

14PAE302 Data Communication in CAD / CAM

14PAE303 / 14PGE303 Enterprise Resource Planning

14PAE304 /14PGK103 Tribology in Design

14PAE305 / 14PGE305 Quality Control and Reliability Engineering

14PAE306 /14PGE306 Robust Design of Product/Process

14PAE307 / 14PGE204 Advanced Metrology and Non Destructive Testing

14PAE308 Supply Chain Management

14PAE309 Industrial Safety Engineering

14PAE310 Precision Engineering

14PAE311 /14PGK105 Design for Manufacturing and Assembly

14PAE312 / 14PGE312 Advanced Optimization Techniques

14PAE313 Sensor Interface and System Integration

14PAE314 / 14PGE317 Field Work

Interdisciplinary Subject

14PSM102 COMPUTATIONAL METHODS

L	T	P	C
3	1	0	4

Course objectives

- *To acquire the knowledge in functions, functional dependent on derivatives and functional dependent on functions of several independent variables.*
- *To solve simultaneous equations using different methods.*
- *To solve differential equations using different methods.*
- *To solve Partial differential equations using different methods.*
- *Solving integrals using numerical techniques.*

UNIT I CURVE FITTING AND SOLUTION OF SYSTEM OF EQUATIONS 9

Curve fitting –method of group averages –principle of least squares –method of moments -fitting a straight line and non linear curve fitting-Data fitting with cubic splines.
Solutions of linear systems –Direct methods -Gauss elimination and Gauss Jordan methods– Indirect method –Gauss Seidel method.

UNIT II CALCULUS OF VARIATION 9

Variation and its properties –Euler's equation – Functionals dependent on first and higher order derivatives –Functionals dependent on functions of several independent variables –problems with moving boundaries.

UNIT III NUMERICAL INTEGRATION 9

Newton-Cotes integration formulas –Trapezoidal rule, Simpson's rules and Weddle's rule – Gaussian Quadrature –Double integrals using Trapezoidal and Simpson's rules.

UNIT IV BOUNDARY VALUE AND CHARACTERISTIC VALUE PROBLEMS 9

Solving initial value problems using Taylor's series method and R-K method of fourth order– Boundary value problems –Solution through a set of equations with derivative boundary conditions. Characteristic value problems–Power method and Jacobi method–Inverse power method.

NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS 9

Boundary value problems for ODE –Finite difference methods–Numerical solution of PDE – Solution of Laplace's and Poisson equation–Liebmann's iteration process –Solution of heat conduction equation by Schmidt explicit formula and Crank-Nicolson implicit scheme –Solution of one dimensional wave equation.

STATE OF ART (Not for Exam)

Finite element method, finite difference method, finite volume method.

Note: Assignments using MATLAB to solve design problems

Theory: 45 Tutorial: 15 Total Hours: 60

TEXT BOOKS:

1. Curtis F Gerald and Patrick O Wheatley, "Applied Numerical Analysis", Pearson Education, 2002.
2. Venkataraman, M. K., “Higher Mathematics for Engineering and Science”, National Publishing Company,1992.
3. Grewal, B.S., Numerical methods in Engineering and Science, 7th edition, Khanna Publishers, 2005.

REFERENCES:

1. Douglas J Faires and Riched Burden, "Numerical Methods", Brooks/Cole Publishing Company, 1998, Second Edition.
2. Steven C Chapra and Raymond P Canale, “Numerical Methods for Engineers with Software and Programming Applications”, Tata McGraw Hill Edition, 2004. John H Mathews and Kurtis D Fink, “Numerical Methods using MATLAB”, Prentice Hall, 1998.
3. Rajasekaran S, “Numerical Methods in Science and Engineering –A Practical Approach”, Wheeler Publishing, 1999, Second edition.
4. Gupta, A.S., Calculus of variations with applications, Prentice-Hall of India, New Delhi, 1997.

14PAK101 / 14PGK101 COMPUTER GRAPHICS AND APPLICATIONS

L	T	P	C
3	1	0	4

Course objective

- *To understand the applications of computers in engineering design, tooling and data management.*

UNIT I PRINCIPLES OF COMPUTER GRAPHICS 9

Transformation and mapping of geometric models – inversion transformations and mappings – projection of geometric models – design and engineering applications – model clean up – hidden line, surface and solid removal .

UNIT II GEOMETRIC MODELLING 9

Wire frame models – parametric representation of analytic and synthetic curves – curve manipulators– surface models – parametric representation of analytic and synthetic surfaces – surface manipulations — design and engineering applications in wireframe, surface and solid modeling.

UNIT III SOLID MODELLING 9

Solid models – boundary representation (B-Rep) – constructive solid geometry (CSG) – sweep representation – analytical solid modeling - shading and coloring.

UNIT IV CAD/CAM DATA EXCHANGE 9

Evolution of data exchange format – shape and product data based formats – ISO standard IGES description, data representation, file structure and format – processors – PDES description and data representation.

UNIT V PRODUCT DATA MANAGEMENT 9

Version control – library creation – catalog making – standardization for design – collaborative design among groups – design optimization for geometry – Design check, approval and validation. Introduction to Product Data Management (PDM), PDM systems and importance, reason for implementing a PDM system, barriers to PDM implementation.

STATE OF ART (Not for Exam)

CAD Software packages and languages like Auto LISP/C.

Theory: 45 Tutorial: 15 Total Hours: 60

TEXT BOOKS:

1. Ibrahim Zeid, “CAD/CAM – Theory and Practice” - McGraw Hill, International Edition, 1998.
2. Donald Hearn and M Pauline Baker, “Computer Graphics”, Prentice Hall, 1992.

REFERENCES:

1. William M. Neumann and Robert Sproul, “Principles of Computer Graphics”, McGraw Hill Book Co. Singapore 1989.
2. P.Radhakrishnan, S.Subramanyan and V.Raju, “CAD/CAM/CIM”, New age International (P).Ltd. Publishers, New Delhi.

14PAK102 / 14PGK102 FINITE ELEMENT METHODS IN MECHANICAL DESIGN

L	T	P	C
3	1	0	4

Course objectives:

- *To understand the concept of isoparametric elements and their usefulness*
- *To have an insight of the applications of heat transfer and structural dynamics problem with solution procedure.*
- *To have study of magnitude and types of errors that can kept in a FE solution and their remedies.*

UNIT I 2-D ISOPARAMETRIC ELEMENTS 9

Introduction- Four node quadrilateral – shape function-element stiffness matrix – element force vectors- Numerical integration: 2-D integrals – stiffness integration-stress calculations- higher order elements- 4 node quadrilaterals for axisymmetric problems.

UNIT II AXISYMMETRIC SOLIDS, PLATE BENDING AND SHELLS 9

Axisymmtric formulation- modeling with triangular elements- potential energy & Galerkin approach-problem modeling and boundary conditions – Kirchoff and Mindlin plate elements – Analytical problems- General shells – 3 & 4 node elements - curved isoparametric elements- Axisymmetric shell applications.

UNIT III HEAT TRANSFER AND SELECTED FLUID PROBLEMS 9

Introduction-steady state heat transfer- 2D steady state heat conduction- 2D fins- Radiation.Non-linear heat transfer problems- Potential flow, seepage & fluid flow in ducts, 1-D & 2-D acoustics, boundary conditions – problems.

UNIT IV STRUCTURAL DYNAMICS AND VIBRATIONS 9

Dynamic equations – Mass and damping matrices – Natural frequencies and modes – evaluation of eigen values and vectors - Guyan reduction– Modal methods – Explicit and implicit direct integration methods – Harmonic response - Analysis by response spectra.

UNIT V NON-LINEARITY & ERROR ESTIMATES 9

Introduction – Material non – Geometric non – linearity – modeling considerations – sources of error – diagonal decay test- discretization error - convergence rates – Posterior error estimate – adaptive meshing.

STATE OF ART (Not for Exam)

FEA software packages with applications modeling consideration and software use.

Theory: 45 Tutorial: 15 Total Hours: 60

NOTE:

As for the examination, modeling considerations, choice of elements, boundary conditions, loading conditions, and basic procedures only need to be emphasized without expecting a complete numerical solution to practical problems.

TEXT BOOKS:

1. Cook, Robert Davis et al, “Concepts and Applications of Finite Element Analysis”, Wiley, John & Sons, 2002
2. T.R. Chandrupatla and A.D. Belegundu, “Introduction to the finite elements in Engineering”, PHI Learning Private Limited, New Delhi, 2009.

REFERENCES:

1. Logan D.L, “A First Course in the Finite Element Method”, Third Edition, Thomson Learning, 2004.
2. Reddy J.N, “An introduction to the finite element method”, McGraw Hill, International Edition, 2003.
3. Sienkiewicz, O.C and Taylor, R.L., “ The Finite Element Method”, Fourth Edition, Volumes 1 & 2, McGraw Hill International Edition, Physics services, 1991.

14PAK103 CNC AND ROBOTICS SYSTEMS DESIGN

L	T	P	C
3	1	0	4

Course objectives:

- *Students will gain a brief understanding of computer numerical control (CNC) machining processes, operations and design considerations.*
- *To introduce the main concepts, parts of robots and types of robots, drive systems for robot, sensors and their applications in robots, programming of robots.*

UNIT I INTRODUCTION OF CNC MACHINES 7

Working principles of typical CNC, turning centre, machining centre, drive kinematics, gear box, main drive, feed drive, selection of timing belts and pulleys, spindle bearings arrangement and installation. Re-circulating ball screws, linear motion guide ways, tool magazines, ATC, APC, chip conveyors, tool turrets, pneumatic and hydraulic control systems.

UNIT II CNC MACHINE SYSTEM CONTROL AND INTERFACING 8

Open loop and closed loop systems, microprocessor based CNC systems, , description of hardware and software interpolation systems, standard and optional features of a CNC control system, Feedback devices with a CNC system, spindle encoder. Adaptive control**.** standard and optional features of CNC control system – selection of electric motor-selection of control system in CNC machines.

UNIT III DESIGN CONSIDERATION OF CNC MACHINES AND HIGHER LEVEL PART PROGRAMMING 11

Design consideration of CNC Machines to improve machine accuracy – detailed design of machine tool structure to improve machine accuracy – machine structure-design of bed, columns, housing, bases, tables, cross rails, arms, spindles, carriages, rams, guide ways, power screws, slide ways, spindle, spindle support, bearings. Techniques of CNC part programming – higher level CNC programming language – simple program.

UNIT IV FUNDAMENTALS OF ROBOT, DRIVE SYSTEMS & END EFFECTORS 8

Robot – Definition – Robot Anatomy – Co-ordinate Systems, Work Envelope, types and classification – Specifications –Applications. Drives types – Salient Features. End Effectors – Grippers Types– Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations. power transmission system and control robot drive mechanism. Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional), Four Degrees of Freedom (In 3 Dimensional) – Derivations and Problems.

UNIT V ROBOT KINEMATICS AND LANGUAGES 11

Method of robot programming- Teach Pendant Programming, Lead through programming, motion interpolation- commands, branching, capabilities and limitations. Robot programming Languages – Textual robot languages – robot language structure – constants, variables and other data objects, motion commands, end effectors and sensor commands, computations and operations, program control and subroutines, communications and data processing , monitor mode commands - Simple programs.

STATE OF ART (Not for Exam)
Multi axis CNC machine, CNC EDM, CMM, advanced robots for industrial applications.

Total Hours: 45

TEXT BOOKS:

1. P.Radhakrishnan, "Computer Numerical Control ", New Central Book Agency, 1992.
2. C.Elanchezhian, "Computer Aided Manufacturing", Laxmi Publications (p) Ltd, New Delhi. 2006.
3. Mikell P.Groover, "Industrial Robotics – Technology, Programming and Applications", McGraw- Hill, 2001.

REFERENCES:

1. YoramKoren, "Computer Control of Manufacturing Systems ", McGraw-Hill Book Company,1986.
2. S.Kant Vajpayee, "Principles of Computer Integrated Manufacturing ", Prentice Hall of India Ltd., 1999.
3. Fu.K.S. Gonzalz.R.C., and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw-Hill Book Co., 1987

14PAK104 MODELING AND ANALYSIS OF MANUFACTURING SYSTEMS

L	T	P	C
3	1	0	4

Course Objectives

- *To understand the concept of Modeling*
- *To understand the different types of Manufacturing Systems*
- *To gain knowledge about the application of various modeling methods to manufacturing systems*

UNIT – I MANUFACTURING SYSTEMS AND MODELS 9

Principles of Manufacturing Systems – Types of Manufacturing Systems – Manufacturing Models – Types and uses – Physical model – Mathematical Model – Model uses – Model Building

UNIT – II MATERIAL FLOW SYSTEMS 9

Assembly Lines – Reliable Serial Systems – Approaches to Line Balancing – Sequencing mixed models – Transfer Lines – Paced lines without Buffers – Scheduling – Shop Scheduling with many products – Flexible Manufacturing Systems – Planning and Control – Group Technology – Assigning Parts to Machines and Assigning Machines to Groups – Facility Layout

UNIT – III SUPPORTING COMPONENTS 9

Machine setup and operating sequences – Integrated assignment and sequencing – Material Handling Systems – AGV Systems – Conveyor Analysis – Warehousing – Storage and Retrieval Systems – Order picking

UNIT – IV GENERIC MODELLING APPROACHES 9

Analytic Queuing Models - Single workstation – Open and Closed Networks – Empirical Simulation models – Event Models – Process Models – Simulation System –Manufacturing Systems modeling examples

UNIT – V PETRI NETS 9

Classical PETRI NETS – Basic Definitions – Transition Firing and Reachability – Properties – Manufacturing systems modeling examples – Synchronization Manufacturing – Optimization.

STATE OF ART (Not for Exam)

Modeling and Simulation software packages for manufacturing systems

Theory: 45 Tutorial: 15 Total Hours: 60

TEXT BOOKS:

1. Ronald G Askin and Charles R. Strandridge “Modeling and Analysis of Manufacturing Systems “ John Wiley & Sons, INC,1993.
2. N. Viswanathan and Y. Narahari, “Performance Modeling of Automated Manufacturing Systems”, Prentice Hall of India, 1998.

REFERENCE:

1. Mikell. P. Groover, "Automation, Production Systems and Computer Integrated Manufacturing Systems", Pearson Education, 2005.

14PAK105 / 14PGE301 RAPID MANUFACTURING AND TOOLING

L	T	P	C
3	0	0	3

Course Objective:

- *Generating a good understanding of RP history, its development and applications. Expose the students to different types of Rapid prototyping processes, materials used in RP systems and Tooling.*

UNIT – I INTRODUCTION **5**

Need - Development of RP systems – RP process chain - Impact of Rapid Prototyping on Product Development – history of RP systems - Digital prototyping - Virtual prototyping- Rapid Tooling - Benefits- Survey of Applications - growth of RP industry, classification of RP systems.

UNIT – II ENGINEERING & CAD MODELING **11**

Basic concept- Digitization techniques – Model Reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data Requirements – geometric modeling techniques: Wire frame, surface and solid modeling – Software for RP: STL files, overview of solid view, magics, mimics, magics communicator, etc., internet based softwares, collaboration tools. Data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation. Rapid Manufacturing Process Optimization: Factors influencing accuracy, data preparation errors, part building errors, errors in finishing, influence of part build orientation.

UNIT – III LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS **9**

Stereolithography (SLA): Apparatus: Principle, per-build process, part-building, post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and Survey of applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and Survey of applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. laminated object manufacturing(LOM): Working Principles, details of processes, products, materials, advantages, limitations and Survey of applications - Case studies - Goals of research.

UNIT – IV POWDER BASED RAPID PROTOTYPING SYSTEMS **9**

Selective Laser Sintering(SLS): Principle, process, Indirect and direct SLS- powder structures, modeling of SLS, materials, post processing, post curing, surface deviation and accuracy, Survey of applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and Survey of applications– Case Studies. Goals of research.

UNIT – V RAPID TOOLING **11**

Concept Modelers: Principle, Thermo jet printer, Sander's model market, 3-D printer, Genisys Xs printer, JP system 5, object quadra system. Rapid Tooling: Indirect rapid tooling - silicone rubber tooling, aluminum filled epoxy tooling, spray metal tooling, cast Kirksite. direct rapid tooling - direct AIM, quick cast process, copper polyamide, rapid tool, DMILS, prometal, sand casting tooling, laminate tooling, soft tooling Vs hard tooling. Allied Processes: 3DP, SDM, SLM,EBM,

Vacuum casting, surface digitizing, surface generation from point cloud, surface modification, data transfer to solid models.

STATE OF ART (Not for Exam)
RPT techniques to model the prototype for automotive and aerospace applications.

Total Hours: 45

FIELD STUDY & MINI PROJECT WORK:

Field Study: (for internal assessment – 10 marks)

The students are expected to submit a report at the end of the semester covering the various aspects of his/her observation in RP training centers / industry visits.

Mini project work: (for internal assessment – 10 marks)
Modeling of Proto Model/ Physical Model Built up by using RP Techniques.

TEXT BOOKS:

1. Pham. D. T. and Dimov. S. S., "Rapid Manufacturing", Verlag, London, 2001.
2. Chee Kai Chua, Kah Fai Leong, Chu Sing Lim**, "**Rapid prototyping: principles and applications" 2001.

REFERENCES:

1. Rapid Prototyping and Engineering applications : A tool box for prototype development, Liou W.Liou, Frank W.Liou, CRC Press, 2007.
2. Terry Wohlers, "Wohlers Report 2001", Wohlers Associates, 2001
3. Rapid Prototyping: Theory and practice, Ali K. Kamrani, EmadAbouel Nasr, Springer, 2006

14PAK106 COMPUTER AIDED ENGINEERING LAB

L	T	P	C
0	0	3	2

CAD

Modeling and assembly of mechanical components using parametric and feature based packages. Introduction to CAD software, Part – Assembly – Drafting model of mechanical machine components like – Flange coupling, Universal coupling, Screw jack etc.

View: Orthographic view, Isometric view, Sectional view, Exploded view.

GD&T: Standard, Part list, Bill of Material, Machining symbols, Tolerance – Fits and Geometric.

FEA: Basics of FEA

- Static analysis of a corner bracket.
- Statically indeterminate reaction force analysis.
- Determination of Beam stresses and Deflection.
- Bending analysis of a Tee-shaped beam.

CAM

- Use of advanced Simulation and Machining packages (Edge CAM/ Master CAM)

Total Hours: 45

INDUSTRIAL VISIT

- All ME students are expected to visit at least 3 industries every semester either by means of regular industrial visits organized by the department or through self interest.
- These visits could be a formal visit to learn the practices followed in the industries.
- In-plant trainings and internships will also be considered as industrial visits.
- Every student should submit an ‘Industrial Visit’ report at the end of each visit to the Year In-charge/Advisor of that branch. The report should explain the practices and methodologies adopted in the visited industry in an understandable manner.
- The student should also make a presentation about the experiences gained in the industry in front of the panel of faculty experts, including the Head of the Department.

14PAK201 / 14PGK201 VIBRATION ANALYSIS OF MECHANICAL SYSTEMS

L	T	P	C
3	1	0	4

Course objectives

- *To understand the Fundamentals of Vibration and its practical applications*
- *To understand the various Vibration control strategies*

UNIT-I UNDAMPED AND DAMPED FREE VIBRATIONS 9

Importance and scope definition and terminology, representation of harmonic motions, introduction to various types of vibrations and types of excitation,

Undamped Free Vibrations: Single Degrees of Freedom Systems - D Alemberts Principle, Energy method, Rayleigh method, simple applications of these methods, equivalent spring stiffness.

Damped Free Vibrations: Introduction to different types of damping, Viscous damping, sub-critical, critical and over damping, logarithmic decrement, frequency of damped oscillations.

UNIT-II FORCED VIBRATIONS 9

Single Degree of Freedom System - Solution for simple harmonic excitation, steady state vibrations, Rotating and reciprocating unbalance, base excitation, vibration isolation and transmissibility, whirling of shaft without friction.

UNIT-III TWO DEGREE OF FREEDOM SYSTEMS 9

Free vibration of spring coupled systems, Two degrees of freedom mass coupled systems,

Forced vibration of an undamped two degrees of freedom system, Undamped vibration absorbers, Vibration isolation. Torsional vibrations of two rotor systems.

Applications: Dynamic vibration absorber, centrifugal pendulum absorber, torsional vibration absorber,

UNIT-IV MULTI-DEGREE OF FREEDOM SYSTEMS 9

Lagrange's equation, dunker ley's approximation method, rayleigh method, matrix method, matrix iteration, orthogonality principle, modal analysis, stodola method, holzer method, galerkin method, rayleigh- ritz method

UNIT-V CONTINUOUS SYSTEMS 9

Longitudinal vibrations of bar, transverse vibration of beam, torsion of vibrations of circular shaft with various end conditions, vibration instruments, vibration exciters, transducers and measurement devices, Analysis of SHM, Fourier theorem and simple problems.

STATE OF ART (Not for Exam)

Application of Computer software in vibration Analysis

Theory: 45; Tutorial: 15; Total Hours: 60

TEXT BOOKS:

1. V.P. Singh, "Mechanical Vibrations", DhanpatRai & Company Pvt. Ltd., 3rd edition, 2006.
2. W.T. Thomson and Marie Dillon Dahleh, "Theory of Vibration with Applications", Pearson
   Education 5th edition, 2007
3. GopalKrishan Grover, "Mechanical Vibrations", Nem Chand, 1977.

REFERENCES:

1. S.S. Rao, " Mechanical Vibrations", Pearson Education Inc, 4th Edition, 2003.
2. S. Graham Kelly, " Mechanical Vibrations", Schaum's Outline Series, Tata McGraw Hill, Special Indian edition, 2007.
3. J.S. Rao& K. Gupta, "Theory & Practice of Mechanical vibrations", New Age International Publications, New Delhi, 2001.

14PAK202 DESIGN OF MECHANICAL DRIVES

L	T	P	C
3	1	0	4

Course objectives

- *To understand the Fundamentals of mechanical drives and its practical applications*
- *To understand the various Design strategies*

UNIT-I INTRODUCTION **10**

Power Transmission systems: General considerations, principal types, comparative study of different drives, applications, limitations.

UNIT-II DESIGN OF SPEED DRIVES **10**

Design of spur, helical, bevel and worm gears. Design of speed gear boxes, standardization of spindle speeds, speed diagrams, selection of bearings, design of housings, lubrication considerations, selection of servo and stepper motors, timing belts.

UNIT-III DESIGN OF FEED DRIVES **10**

Requirements, types, feed drive using feed boxes, design of power screws, lead screws, selection of recirculating ball screws, LM guide ways, rotary indexing drives, cam drives, applications, feeding mechanisms in automated plants, pneumatic feed units, Principles

UNIT-IV DESIGN OF FRICTION DRIVES **10**

Partial friction drives, couplings, clutches, toothed clutches, unidirectional clutches, safety clutches, drum, disk brakes, design principles

UNIT-V VARIABLE SPEED DRIVES **5**

Need, different types, applications.

STATE OF ART (Not for Exam)

Design of feeding mechanisms for automation, Design of cam drive for automate.

Theory: 45; Tutorial: 15; Total Hours: 60

TEXT BOOKS:

1. Maitra G M, “Hand Book of Gear Design”, Tata McGraw Hill, 1988.
2 Shigley, “Mechanical Engineering Design”, McGraw Hill, 1992.

REFERENCES:

1. Faculty of Mechanical Engineering, PSG College of Technology, “Design Data Book ", DPV Printers, 1993.
2. Reshetov N, “Machine Design”, MIR Publishers, 1982.
3. Acherkan N, “Machine Tool Design”, MIR Publishers, 1973.
4. CMTI, “Machine Tool Design Hand Book”, Tata McGraw Hill, 1989

14PAK203 MEMS & NEMS AND APPLICATIONS

L	T	P	C
3	0	0	3

Course objectives:

- *To expose the students to the evolution of micro electromechanical systems, to the various fabrication techniques.*
- *To make students to be aware of micro actuators.*

UNIT – I INTRODUCTION TO MEMS AND NEMS **9**

MEMS and NEMS – multidisciplinary nature of MEMS/NEMS – working principles: as micro sensors (acoustic wave sensor, biomedical and biosensor, chemical sensor, optical sensor, capacitive Sensor, pressure sensor and thermal sensor), micro actuation (thermal actuation, piezoelectric actuation and electrostatic actuation – micro gripers – micro motors – micro valves – micro pumps – Accelerometers – micro fluidics and capillary electrophoresis, active and passive micro fluidic devices.

UNIT – II MATERIALS FOR MEMS/NEMS **9**

Silicon – Compatible material systems, Silicon, Silicon oxide and nitride, Thin metal films, Polymers, Other materials and substrates, Glass and fused quartz substrates, Silicon carbide and diamond, Gallium Arsenide and other group III-V compound semi conductors, Shape - memory alloys transduction, Important material properties and physical effects, Pizoresistivity, Piezoelectricity and thermoelectricity, Inter atomic bonds, Material structures.

UNIT – III MEMS/NEMS DESIGN, PROCESSING AND TECHNOLOGIES **9**

Basic process tools, Epitaxy, Oxidation, Sputter deposition, Evaporation, Chemical vapor deposition, spin on methods, Lithography, Lift off process, Bulk Micro machining, Etching processes – Wet etching, Plasma etching, Ion milling, Wafer bonding – Silicon fusion bonding, Anodic bonding, Silicon direct bonding, sol gel deposition methods, Self assembled mono layers, EFAB,LIGA electro magnetic micro drive.Ion implanation. Diffusion process.Oxidation-thermal oxidation.Silicon diode.Thermal oxidation rates. Oxide thickness by colour.Chemical vapour deposition-principle, reactants in CVD.

UNIT – IV MEMS/NEMS SCALING ISSUES AND PACKAGING **9**

Introduction – Scaling of physical systems – Geometric scaling, Mechanical system scaling, Thermal system scaling, Fluidic system scaling, Electrical system scaling, Packaging-package design considerations, Process steps, Wafer thickness and dicing issues, Thermal management, Hermetic packaging, Electrical//Micro fluidic/and optical interconnects, Quality control-reliability and failure modes and analysis, Signal mapping transduction. Trimmer force scaling vector-scaling in electrostatic forces, electromagnetic forces.

UNIT – V MEMS/NEMS APPLICATIONS **9**

Applications in automotive industry – health care – aerospace – industrial product consumer products – lab on chip – molecular machines – data storage devices – micro reactor – telecommunications, Servo systems.

STATE OF ART (Not for Exam)

Micro accelerometers-design theory and damping coefficients. Thermomechanics.Thermal stresses.

Total Hours: 45

TEXTBOOKS:

1. NadimMalut and Kirt Williams, "An introduction to Micro electro mechanical Systems Engineering" – Second edition – Artech House, Inc, Boston.
2. James J Allen, "Micro electro mechanical systems Design", CRC Press–Taylor.

REFERENCES:

1. BharathBhushan, "Springer Hand Book of Nano Technology", Springer.
2. Sergey Edward Lysherski ," Nano and Micro electro Mechanical systems", CRC Press.
3. NicolaeLobontiu and Ephrahim Garcia Kluwer, "Mechanics of micro electro mechanical systems", Academic Publishers – Boston

14PAK204 FACTORY AUTOMATION

L	T	P	C
3	0	0	3

Course objectives:

- *To understand the concept of Programmable Logic Controllers*
- *To understand the concept of sensors, vision system and interface standards.*

UNIT I INTRODUCTION 9

Historical perspective of factory automation- Origin- Evolution, Current and Future trends- Components of automation systems and their functionalities, soft and hard automation- Low cost automation with an examples. Flexible Manufacturing Systems- Automatic feeding lines, AS/RS, transfer lines, Automatic Inspection- Computer Integrated Manufacturing- CNC, Intelligent automation.

UNIT II MEASUREMENT DEVICES AND SENSORS IN AUTOMATION 9

General principle of measurement system- Force measurement- Equal arm balance, Unequal arm balance, Pendulum scale, Elastic force meter, Hydraulic load cell, Pneumatic load cell. Pressure measurement- Bourdon tube pressure gauge, Elastic diaphragm gauge Mechanical/Electronic, Bellow gauges. Temperature measurement- Bimetallic strips, pressure thermo meter. General principle of sensors- Sensor for motion and position measurement- Force sensor- Pressure sensor- Torque sensor – Tactile sensor - Temperature sensor- Ultrasonic sensor- Piezoelectric sensor. Application of sensors in modern industry.

UNIT III VISION SYSTEMS 9

Vision Systems, Illumination techniques, Image capture- solid state cameras- Image representation- Gray scale and colour images, Image sampling and quantization- Image processing and analysis- Image data reduction- segmentation- Feature extraction- Object Recognition- Image capture and communication.

UNIT IV PLC AND INTERFACE STANDARDS 9

PLC- Role of PLC in automation- Architecture of PLC- Advantages- Types of PLC- Types PLC Programming- simple process control programs using relay ladder logic and Boolean logic methods- PLC arithmetic and comparison functions. RS232, GPIB- IEEE488, TCP\IP Protocols, Network topologies- Star, ring, bus and tree, Repeaters, Bridges, Routers, Gateways, Hubs and Switches.

UNIT V COMPONENTS AND CIRCUIT DESIGN FOR FACTORY AUTOMATION 9

Components- Linear actuators- single acting, double acting, cushion type, telescopic, double rod and tandem cylinders. Direction control valves – 3/2, 4/2 and 5/2. Filter, Regulator and Lubricator. Pumps- working principle of gear pump, vane pump, piston pump and its types. Accumulators- types, application circuits. Intensifier with application circuit, shuttle valve (OR), two way pressure valve (AND), quick exhaust valve, time delay valve. Circuit design- travel step diagram & state matrix, cascade method, KV (Karnaugh-Veitch) map method.

STATE OF ART (Not for Exam)

Robots implemented assembly line system, Food processing application, Advanced CNC machines, CMM, Pressure reducing valve with application circuit, Pressure relief valve, Unloading valve with application circuit, Sequence valve with application circuit, Counter balance valve with application circuit.

Total Hours: 45

TEXT BOOKS:

1. Fu K.S., Gonzalez R.C., Lee C.S.G., "Robotics: Control, sensing, Vision and Intelligence", McGraw Hill Book Company, 1987.
2. Deh S R., "Robotics Technology and Flexible Automation", Tata McGraw Hill Publishing, Company Ltd., 1994.
3. Srinivasan R., "Hydraulic and Pneumatic Controls", Tata McGraw Hill Publishing, Company Ltd., 2010.

REFERENCES:

1. Jon Steneroson, "Fundamentals of Programmable Logic Controllers, Sensors and Communication" ,Prentice Hall, 2004
2. Dick Caro, "Automation Network Selection- The instrumentation Systems and Automation Society", 2004.
3. Richard L Shell and Ernest L Hall, "Hand Book of Industrial Automation" Marcel Dekker,2000
4. A K Gupta, Laxmi Publications Pvt. Ltd. "Industrial Automation and Robotics", 2014.

14PAK205 DESIGN ENGINEERING LAB

L	T	P	C
0	0	3	2

A) **Analysis of Mechanical Components** – Using FEA Packages like ANSYS/NASTRAN etc.

- Thermal Analysis of mechanical systems
- Modal Analysis
- Machine elements under Dynamic loads
- Aerodynamic Analysis

B) Advanced Simulation and Computer based Experimental Design

- Modeling and Analysis of real time systems (Eg. Roll cage/Chassis of Vehicles/Trusses, etc.)
- Design of experiments and analysis of data using MacAnova/Minitab, etc.

C) **Simulation of mechanical linkages**- Using kinematics and dynamics simulation \ software like ADAMS, MATLAB.

- Analysis of velocity and acceleration mechanism

Total Hours: 45

14PAK206 TECHNICAL SEMINAR

L	T	P	C
0	0	3	1

1. It is mandatory that each student will give individually two seminars in the third semester.
2. During the seminar session each student is expected to prepare and present a topic on engineering/ technology, for duration of not less than 45 minutes.
3. Also, the student has to submit a hard copy of the technical topic, in the form of a report consisting of a title page, Introduction, body chapters and a conclusion with references, running to not less than 20 pages; this will be evaluated by the faculty coordinator/guide.
4. In a session of three periods per week, 3 students are expected to present the seminar.
5. For each student, a faculty guide will be allotted and he / she will guide and monitor the progress of the student and maintain attendance also.
6. Students are encouraged to use various teaching aids such as power point presentation and demonstrative models.
7. This will enable them to gain confidence in technical presentation skills and to face the placement interviews.

14PAK301 PROJECT PHASE – I

L	T	P	C
0	0	12	6

1. Each student is expected to do an individual project.
2. Every student shall have a guide who is the member of the faculty of the institution. Identification of faculty guide has to be completed within a week from the day of beginning of third semester.
3. The student has to identify and select the problem to be addressed as his/her project work; make through literature survey and finalize a comprehensive aim and scope of his/her work to be done.
4. 25% of the total project work has to be completed by the end of third semester.
5. A mini project report (of the phase-I) to this effect has to be submitted by each student.
6. One mid semester review and another end semester review of the progress of the project work have to be conducted by a team of faculty (minimum 3 and a maximum of 5) along with their faculty guide as a member of the faculty team.
7. At the end of semester exam, one internal examiner and one external examiner, appointed by the COE will examine the project phase I done by the students.

14PAK401 PROJECT WORK PHASE – II

L	T	P	C
0	0	24	12

8. The entire semester shall be utilized by the students to receive the directions from the guide, for library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project.
9. The progress of the project is to be evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department.
10. Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion. This final report shall be typewritten form as specified in the guidelines issued by the COE.
11. The project work is evaluated jointly by external and internal examiners constituted by the COE based on oral presentation and the project report.

14PAE201 / 14PGE201 ADVANCED TOOL DESIGN

L	T	P	C
3	0	0	3

Course objectives

- *To understand the types of tooling materials and heat treatment*
- *To understand the principles involved in the design of jigs, fixtures and dies*
- *To understand the tool design for Numerically Controlled machine tools*

UNIT I TOOL-DESIGN METHODS **9**

Introduction – The Design Procedure – Statement of the problem – The Needs Analysis – Research and Ideation – Tentative Design Solutions – The Finished Design – Drafting and Design Techniques in Tooling drawings – Screws and Dowels – Hole location – Jig-boring practice – Installation of Drill Bushings – Punch and Die Manufacture – Electro-discharge machining for cavity.

UNIT II TOOLING MATERIALS AND HEAT TREATMENT **9**

Introduction – Properties of Materials – Ferrous Tooling Materials – Tool steels – Cast Iron – Mild, or low-carbon Steel – Nonmetallic Tooling Materials – Nonferrous Tooling Materials – Metal cutting Tools – Single-point cutting tools – Milling cutters – Drills and Drilling – Reamer classification – Taps – Tap classification- the selection of carbide cutting tools – Determining the insert thickness for carbide tools

UNIT III DESIGN OF DRILL JIGS **9**

Introduction – Fixed Gages – Gage Tolerances – The selection of material for Gages – Indicating Gages – Automatic gages – Principles of location – Locating methods and devices – Principles of clamping – Drill jigs – Chip formation in drilling – General considerations in the design of drill jigs – Drill bushings – Methods of construction – Drill jigs and modern manufacturing

UNIT IV DESIGN OF FIXTURES AND DIES **9**

Introduction – Fixtures and economics – Types of Fixtures – Vise Fixtures – Milling Fixtures – Boring Fixtures – Broaching Fixtures – Lathe Fixtures – Grinding Fixtures – Types of Die construction – Die-design fundamentals – Blanking and Piercing die construction – Pilots – Strippers and pressure pads- Presswork materials – Strip layout – Short-run tooling for Piercing – Bending dies – Forming dies – Drawing operations.

UNIT V TOOL DESIGN FOR NUMERICALLY CONTROLLED MACHINE TOOLS **9**

Introduction – Fixture design for numerically controlled machine tools – Cutting tools for numerical control machines– Tool holding methods for numerical control – Automatic tool changers and tool positioners – Tool presetting – Introduction – General explanation of the Brown and sharp machine – tooling for Automatic screw machines.

STATE OF ART (Not for Exam)

Recent Advances in tool design-Advanced materials for tool-automated jigs and fixtures Application-Advances in Die design for cutting and forming operation.

Total Hours: 45

TEXT BOOKS:

1. Edward G.Hofffman, "Jigs and fixtures Design" Delmar Publishers, Singapore, Fourth Edition.
2. Cyrll Donaldson, George H.LeCain, V.C. Goold, "Tool Design", Tata McGraw Hill Publishing Company Ltd., 2000.

REFERENCES:

1. J.R.Paquin, R.E.Crowley, "Die Design fundamentals", Second Edition, Industrial Press Inc.
2. V.Korsakov, "Fundamentals of fixture design", Mir Publishers, Mascow.
3. Prakash Hiralal Joshi, "Tooling data", Wheeler Publishing, 2000

14PAE202 / 14PGE202 MECHATRONIC SYSTEM DESIGN

L	T	P	C
3	0	0	3

Course Objective

- *To understand the concept of sensors, actuators, real time interfacing and their applications.*

UNIT – I MODELING AND SIMULATION **9**

Definition, Key elements, Mechatronics approach for Design process, analogy approach of modeling, block diagram approach of modeling, simulation, software and hardware in loop simulation.

UNIT – II SENSORS AND TRANSDUCERS **9**

Sensors for motion and position measurement, force, torque, tactile, temperature sensors, ultrasonic sensors, magneto strictive sensors.

UNIT – III ACTUATORS FOR MECHATRONICS SYSTEM **9**

Types of actuators and their working principles, control valves, direction, pressure and flow, comparison of hydraulic, pneumatic and electrical actuators, proportional pressure and flow valves. Automation system Design- Pneumatic elements, proportional pressure and flow control valves, electro pneumatic system, circuit design, examples, hydraulic elements, electro hydraulic system, circuit design, examples, casecade and Karnaugh Veitch map methods.

UNIT – IV REAL TIME INTERFACING **9**

Introduction of data acquisition and control system, Overview of I/O process, interfacing of various sensors, stepper Motor with PC, virtual Instrumentation.

UNIT – V ADVANCED APPLICATIONS **9**

Sensor for condition monitoring, mechatronic control in automated manufacturing, microsensors, case studies. Traditional Vs Mechatronics approach, integrated product design, mechanisms, load conditions, design, flexibility, modeling and simulation. Structures – load conditions, environmental isolation, and modeling. Man-machine interface, industrial design and ergonomics, information transfer, safety. Bond Graph Technique, Case studies of Mechatronics systems.

STATE OF ART (Not for Exam)

Control systems-Sequence control and programmable controllers, logic control and sequencing elements, ladder diagram, PLC, Programming the PLC.

Total Hours: 45

TEXT BOOKS:

1. Bradley. D.A, Dawson.D., Buru.N.C. and Loader.A.J., “Mechatronics”, Chapman and Hall,1993.
2. Devdas Shetty and Richard A.Kolk., “Mechatronics System Design”, PWS Publishing company, USA,1997

REFERENCES:

1. Sanjay Gupta and Joseoh John,”Virtual Instrumentation using Lab VIEW” Tata McGraw Hill Publications, 2005.
2. Sabrie soloman, “Sensors and control system in Manufacturing” McGraw Hill, Inc, 1994.

14PAE203 / 14PGE203 COMPOSITE MATERIALS ANALYSIS AND APPLICATIONS

L	T	P	C
3	0	0	3

Course Objective

- *To impart on types, physical properties and processing of polymer matrix and composites, metal matrix composites and ceramics matrix composites*
- *To study matrix material, particulates and fibers of polymer matrix composites, MMC and ceramic matrix composites.*
- *To develop knowledge on processing, interfacial properties and application of computers.*

UNIT – I INTRODUCTION TO FIBERS AND COMPOSITE MATERIALS 9

Fibres – Fabrication, Structure, properties and applications - Glass, Boron, carbon, organic, ceramic and metallic fibers whiskers– Matrix materials structure – polymers, – metals and ceramics – Physical and chemical properties

UNIT – II PROCESSING OF POLYMER MATRIX COMPOSITES 9

Open mould process, bag moulding, compression moulding with BMC and SMC filament winding – pultrusion – centrifugal casting – injection moulding – structure, properties and application of PMC's – Carbon Matrix Composites - Interfaces – Properties – recycling of PMC.

UNIT – III PROCESSING OF METAL MATRIX COMPOSITES AND CERAMIC MATRIX COMPOSITES 9

Solid state fabrication techniques – diffusion bonding – powder metallurgy techniques plasma spray, chemical and physical vapour deposition of matrix on fibers Chemical vapour infiltration – Sol gel – liquid state fabrication methods – infiltration – squeeze, casting – rheo casting – compo casting - interfaces properties– application of MMC and ceramic matrix composites.

UNIT – IV MECHANICS 9

Rule of mixture -volume and mass fractions – density - void content, Evaluation of four elastic moduli based on strength of materials approach and Semi-Empirical model-Longitudinal Young's modulus transverse Young's modulus–major Poisson's ratio-In-plane shear modulus, Ultimate strengths of a unidirectional lamina. Characteristics of Fiber-reinforced lamina– laminates– lamination theory, Inter laminar stresses

UNIT – V PERFORMANCE AND DESIGN 9

Static Mechanical Properties – Fatigue and Impact Properties – Environmental effects – Long term properties, Fracture Behavior and Damage Tolerance, Failure Predictions, Laminate Design Consideration-design criteria-design allowable design guidelines, Joint design-Bolted and Bonded Joints, Design Examples-Design of a tension member – design of a compression member – design of a beam-design of a torsional member, Application of FEM for design and analysis of laminated composites.

STATE OF ART (Not for Exam)

Application of PMC, MMC and CMC in automotive industries and space applications. ASTM standards for composite materials.

Total Hours: 45

TEXT BOOKS

1. Mallick, P.K., "Fiber Reinforced Composites: Materials, Manufacturing and Design", Marcel Dekker Inc, 1993.
2. Krishnan K Chawla, Composite Materials Science and Engineering, International Edition, Springer, 2006

REFERENCES

1. Autar K. Kaw, "Mechanics of Composite Materials" CRC Press, 2006
2. Agarwal, B.D., and Broutman L.J., "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York, 1990.
3. Ronald Gibson, "Principles of Composite Material Mechanics", Tata McGraw Hill, 1994.

14PAE204 / 14PGE307 ENGINEERING ECONOMICS AND CASH FLOW ANALYSIS

L	T	P	C
3	0	0	3

Course Objectives

- *To understand the principles of value engineering*
- *To study the various methods of depreciation*

UNIT I INTRODUCTION TO ECONOMICS **9**

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics - Elements of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis- V ratio, Elementary economic Analysis – Material selection for product Design selection for a product, Process planning.

UNIT II VALUE ENGINEERING **9**

Make or buy decision, Value engineering – Function, aims, and Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor-Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

UNIT III CASH FLOW **9**

Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods

UNIT IV REPLACEMENT AND MAINTENANCE ANALYSIS **9**

Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

UNIT V DEPRECIATION **9**

Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-Evaluation of public alternatives- introduction, Examples, Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

STATE OF ART (Not for Exam)

Case studies from few local industries regarding make (or) buy decisions, Break even analysis and Economics of maintenance.

Total Hours: 45

TEXT BOOKS

1. Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, NewDelhi, 2001
2. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002

REFERENCES

1. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2002
2. Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Macmillan, New York, 1984.
3. Grant.E.L., Ireson.W.G., and Leavenworth, R.S, "Principles of Engineering Economy", Ronald Press, New York,1976.

14PAE205/14PGE205 COMPUTATIONAL FLUID DYNAMICS

L	T	P	C
3	0	0	3

Course Objectives:

- *To introduce Governing Equations of viscous fluid flows.*
- *To introduce numerical modeling and its role in the field of fluid flow and heat transfer.*
- *To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.*
- *To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.*

UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 9

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behavior of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

UNIT II FINITE DIFFERENCE METHOD 9

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – solution methods for finite difference equations – Elliptic equations – Iterative solution Methods – Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations.

UNIT III FINITE VOLUME METHOD (FVM) FOR DIFFUSION 9

Finite volume formulation for steady state One, Two and Three - dimensional diffusion problems. One dimensional unsteady heat conduction through Explicit, Crank – Nicolson and fully implicit schemes.

UNIT IV FINITE VOLUME METHOD FOR CONVECTION DIFFUSION 9

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes- properties of discretization schemes – Conservativeness, Boundedness, Trasnportiveness, Hybrid, Power-law, QUICK Schemes.

UNIT V CALCULATION FLOW FIELD BY FVM 9

Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants. Turbulence models, mixing length model, two equation (k-Є) models – High and low Reynolds number models.

STATE OF ART (Not for Exam)

Application of CFD in a single heat transfer and fluid flow systems, Eg: heat transfer in water tube boiler, typical heat exchanger, evaporator and condenser of air conditioner, etc., Validation of the above using fluent, openfoam or equivalent softwares.

Total Hours: 45

TEXT BOOKS:

1. Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The finite volume Method", Longman, 1998.
2. Ghoshdastidar , P.S., "Computer Simulation of flow and heat transfer", Tata McGraw Hill Publishing Company Ltd., 1998.

REFERENCES:

1. Patankar, S.V. "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation, 2004.
2. Muralidhar, K., and Sundararajan, T., "Computations Fluid Flow and Heat Transfer", Narosa Publishing House, NewDelhi, 1995.
3. T.J. Chung, "Computational Fluid Dynamics", Cambridge University, Press, 2002.

14PAE206 / 14PGE206 PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING

L	T	P	C
3	0	0	3

Course Objectives

- *To study the different types of productivity models*
- *To understand the various re-engineering process improvement models*
- *To understand the tools and techniques in Business Process Re-engineering*

UNIT I PRODUCTIVITY **9**

Productivity Concepts – Macro and Micro factors of productivity – Dynamics of Productivity - Productivity Cycle Productivity Measurement at International, National and Organization level - Productivity measurement models

UNIT II SYSTEMS APPROACH TO PRODUCTIVITY MEASUREMENT **9**

Conceptual frame work, Management by Objectives (MBO), Performance Objectivated Productivity (POP) – Methodology and application to manufacturing and service sector.

UNIT III ORGANIZATIONAL TRANSFORMATION **9**

Elements of Organizational Transformation and Reengineering – Principles of organizational transformation and re-engineering, fundamentals of process re-engineering, preparing the workforce for transformation and re-engineering, methodology and guidelines.

UNIT IV RE-ENGINEERING PROCESS IMPROVEMENT MODELS **9**

PMI models, PASIM Model , Edosomwan model, Moen and Nolan strategy for process improvement, LMICIP model, NPRDC model.

UNITV RE-ENGINEERING TOOLS AND IMPLEMENTATION **9**

Analytical and process tools and techniques – information and Communication Technology – implementation of Reengineering Projects –success Factors and common implementation Problem –cases.

STATE OF ART (Not for Exam)

Modern Engineering Tools Drive Productivity In Manufacturing
Business Drivers for Manufacturers, Evolution and Vision of Engineering Tools, Total Integrated Automation Portal Integrates in Engineering Tools.

Total Hours: 45

TEXT BOOKS

1. Sumanth, D.J., “Productivity Engineering and management ", TMH, New Delhi, 1990.
2. Edosomwan, J.A., “Organizational transformation and process re-engineering", British Library cataloging in pub. data, 1996.

REFERENCES

1. Rastogi, P.N. “Re-Engineering and Re-inventing the enterprise ", Wheeler pub. New Delhi,1995.
2. Premvrat, Sardana, G.D. and Sahay, B.S, “Productivity Management - A systems, Narosa Publishing House, 01-Jan-1998.

14PAE207 / 14PGE207 MODERN TRENDS IN CASTING, WELDING AND FORMING TECHNIQUES

L	T	P	C
3	0	0	3

Course Objectives

- The course is designed to provide students with the metallurgical and engineering principles of casting, welding and forming techniques. The influence of process variables on casting, weld and forming quality is emphasized.

UNIT – I CASTING METALLURGY AND DESIGN 9

Principles of melting practice-fluxing- Degasification and inoculation - Principles of gating and risering - Heat transfer between metal and mould-Solidification of pure metal and alloys-Shrinkage in cast metals -progressive and directional solidification- Designing for directional and mono crystal solidification and minimum stresses- casting defects.

UNIT – II MODERN CASTING PROCESSES 9

Shell moulding, Precision investment casting, CO_2 moulding, centrifugal casting, vacuum casting, Die casting, Continuous casting, squeeze casting, semisolid metal casting and forging - pollution control techniques. Modeling of temperature distribution - Design for casting, application of finite element method in casting - modeling of flow in molds, modeling of heat transfer in castings – case studies -Goals of research.

UNIT – III WELDING METALLURGY AND DESIGN 9

Classification of welding and allied process overview – process modeling – welding procedure – welding terms and characteristics - joint design - heat flow in welding – welding metallurgy – welding of specific alloys – residual stress and distortion – design of weldments.

UNIT – IV MODERN WELDING PROCESS 9

Gas welding, arc welding, shielded metal arc welding, submerged arc welding, gas tungsten arc welding, gas metal arc welding, plasma arc welding, stud welding, resistance welding, electro slag welding – electron beam welding – ultrasonic welding – friction stir welding - laser welding. Design of weldment, application of finite element method in welding – determination of temperature distribution and distortion in weldments for an modern material- case studies - Goals of research.

UNIT – V SPECIAL FORMING PROCESS 9

Forming – theory of plastic deformation – coordinates – conventional process HERF techniques – Explosive forming – Electro Hydraulic Forming – Magnetic pulse forming – Perforation of sheet metals – overview of FEA applications in metal forming analysis. Metal forming Survey of applications - case studies -Goals of research.

Total Hours: 45

STATE OF ART (Not for Exam)

Analysis and Optimization of process parameters in casting, welding and forming techniques.

FIELD STUDY & MINI PROJECT WORK

Field Study: (for internal assessment – 10 marks)

The students are expected to submit a report at the end of the semester covering the various aspects of his/her observation in (any casted / welded / forming) industry visits.

Mini Project work: (for internal assessment – 10 marks)

Cast or weld or form any one of the modern materials / alloys/composites and test their properties. OR Design/ analysis / optimization of casted / welded / forming samples.

TEXT BOOKS

1. Jain, "Principles of Foundry Technology ", Tata McGraw Hill, 3rd Edition, 2000.
2. Parmar, "Welding processes and technology" Khanna Publishers, 2nd Edition, 2007.

REFERENCES

1. Heine, Loper & Rosenthal," Principles of Metal Casting ", Tata McGraw Hill, 1976, 38th reprint 2014.
2. Srinivasan, "Welding Technology", Khanna Publishers, 2nd Edition, 2005.
3. Ravi B, "Metal Casting: Computer Aided Design and Analysis", Prentice Hall, 2005.
4. Larry Jeffus, "Welding: Principles and Applications", Delmar Publishers, 2004.

14PAE208 / 14PGE208 FACILITIES PLANNING AND LAYOUT DESIGN

L	T	P	C
3	0	0	3

Course Objectives

- *To analyze the factors involved in facility location*
- *To understand the principles of layout design*
- *To understand the principles of materials handling and warehousing*

UNIT I FACILITY LOCATION AND ANALYSIS **9**

Location decisions - Qualitative and Quantitative factors, Simple models in single facility and multi facility problems.

UNIT II LAYOUT DESIGN **9**

Facilities requirement, need for layout study – types of layout; Design cycle – SLP procedure – Algorithms – ALDEP, CORELAP, CRAFT.

UNIT III CELLULAR LAYOUT **9**

Group technology – Production Flow analysis (PFA), ROC (Rank Order Clustering) – Assembly Line balancing.

UNIT IV INTRODUCTION TO MATERIAL HANDLING **9**

Principles, unit load concept, material handling system design, handling equipment types, selection and specification, containers and packaging.

UNIT V WAREHOUSE DESIGN **9**

Introduction – Measuring & Benchmarking warehouse performance – Warehouse operations, Receiving and put away principles, Pallet Storage and Retrieval system - Case Picking systems – Warehouse layout – Computerizing warehouse operations.

STATE OF ART (Not for Exam)

Software in Facilities layout and design

Introduction to Factory CAD, Layout planning models and design algorithms for different operations, designing an integrated System for material handling.

Total Hours: 45

TEXT BOOKS

1. Sundaresh Heragu, “Facilities Design”, PWS Publishing Company, Boston, 1997
2. James Apple, M. “Plant layout and Material Handling”, John Wiley, 1977.

REFERENCES

1. Tompkins, J.A. and J.A.White, “Facilities planning”, John Wiley, 2003
2. Richard Francis.L. and John A.White, “Facilities Layout and location - An analytical approach, Prentice Hall of India Pvt. Ltd. 2006.
3. Edward Frazelle, “World-Class Warehousing and Material Handling”, McGraw Hill Publishers, 2002

14PAE209 / 14PGE209 PRODUCT DESIGN AND DEVELOPMENT

L	T	P	C
3	0	0	3

Course objectives

- *To study about the successful product development strategies, product planning activities, specifications, various methods for concept selection and architecture planning*

UNIT– I INTRODUCTION 9

Nature and scope of product engineering - creative thinking and organization. Characteristics of Successful Product Development –Development Processes and Organizations – A Generic Development Process – Concept Development– Product Development Process Flows – The AMF Development Process- Product Development Organizations – The AMF Organization.

UNIT – II PRODUCT PLANNING AND SPECIFICATIONS 12

Product Planning Process – Identify Opportunities – Evaluating and Prioritizing Projects– Allocating Resources and Timing – Pre-Project Planning – Reflect on the Results and the Process – Identifying Customer Needs – Raw Data from Customers – Interpreting Raw Data in Terms of Customer Needs – Organizing the Needs into a Hierarchy –Establishing the Relative Importance of the Needs – Reflecting on the Results and the Process- Establishing product specifications.

UNIT – III CONCEPT GENERATION, SELECTION & TESTING 8

Concept generation-search externally and internally-Explore systematically - reflect on the solutions and processes - concept selection - methodology – benefits – Concept screening – Concept scoring – Concept Testing Methodologies.

UNIT – IV PRODUCT ARCHITECTURE 7

Product Architecture – Implications of the Architecture – Establishing the Architecture –Delayed Differentiation – Platform Planning – Related System – Level Design Issues.

UNIT –V INDUSTRIAL DESIGN 9

Need for industrial design-Impact of Industrial Design – Industrial Design design process - Management of the industrial design process - Assessing the quality of industrial design.

STATE OF ART (Not for Exam)

Toyota Production system – Product design and development.

Total Hours: 45

TEXT BOOKS:

1. Karl T.Ulrich and Steven D. Eppinger, "Product Design and Development", McGraw Hill International Edition, 1999.
2. A.K.Chitale and R.C.Gupta, "Product Design and Manufacturing", Prentice-Hall of India Pvt.Ltd., New Delhi, 2008.

REFERENCES:

1. Kemnneth Crow, "Concurrent Engg. /Integrated Product Development", DRM Associates, 26/3, Via Olivera, Palos Verdes, CA 90274(310) 377-569.
2. Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin, Homewood, 1992, ISBN, 1-55623-603-4.
3. Stuart Pugh, "Tool Design – Integrated Methods for successful Product Engineering", Addison Wesley Publishing, 1991.

14PAE210 COMPETITIVE MANUFACTURING SYSTEMS

L	T	P	C
3	0	0	3

Course objective

- *To emphasize the knowledge on the quality improvement, automation, and advanced manufacturing techniques to create the highest-caliber products quickly, efficiently, inexpensively, and in synchronization with the marketing, sales, and customer service of the company.*

UNIT I MANUFACTURING IN A COMPETITIVE ENVIRONMENT 9

Automation of manufacturing process - Numerical control - Adaptive control – material handling and movement - Industrial robots - Sensor technology - flexible fixtures – Design for assembly, disassembly and service.

UNIT II GROUP TECHNOLOGY & FLEXIBLE MANUFACTURING SYSTEM 9

Part families - classification and coding - Production flow analysis - Machine cell design - Benefits. Components of FMS - Application work stations - Computer control and functions - Planning, scheduling and control of FMS - Scheduling - Knowledge based scheduling - Hierarchy of computer control - Supervisory computer.

UNIT III COMPUTER SOFTWARE, SIMULATION AND DATABASE OF FMS 9

System issues - Types of software - specification and selection - Trends - Application of simulation - software - Manufacturing data systems - data flow - CAD/CAM considerations - Planning FMS database.

UNIT IV LEAN MANUFACTURING: 9

Origin of lean production system – Customer focus – Muda (waste) – Standards – 5S system – Total Productive Maintenance – standardized work – Man power reduction – Overall efficiency - Kaizen – Common layouts - Principles of JIT - Jidoka concept – Poka - Yoke (mistake proofing) - Worker Involvement– Quality circle activity – Kaizen training - Suggestion Programmes – Hoshin Planning System (systematic planning methodology) – Lean culture.

UNIT V JUST IN TIME 9

Characteristics of JIT - Pull method - quality -small lot sizes - work station loads – close supplier ties – flexible work force - line flow strategy - preventive maintenance – Kanban system - strategic implications - implementation issues - Lean manufacture.

STATE OF ART (Not for Exam)

Lean Manufacturing, Just in Time in Industries, Group Technology concepts in Applications.

Total Hours: 45

TEXT BOOKS:

1. Groover M.P., " Automation, Production Systems and Computer Integrated Manufacturing ", Third Edition, Prentice-Hall, 2007.
2. Pascal Dennis, “Lean Production Simplified: A Plain-Language Guide to the World's Most Powerful Production System”, (Second edition), Productivity Press, New York, 2007.

REFERENCES:

1. Jha, N.K. “Handbook of Flexible Manufacturing Systems ", Academic Press Inc., 1991.
2. Kalpkjian, “Manufacturing Engineering and Technology ", Addison-Wesley Publishing Co., 1995.
3. Taiichi Ohno, Toyota, " Production System Beyond Large-Scale production Productivity Press (India) Pvt.Ltd. 1992.

14PAE211 APPLIED MATERIALS ENGINEERING

L	T	P	C
3	0	0	3

Course objective

- *To emphasize the knowledge in the areas Of Industrial Metallurgy, chemical Properties, heat treatment, advanced materials and selection of materials for important applications.*

UNIT I PLASTIC BEHAVIOUR & STRENGTHENING 8

Mechanism of Plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals –Strengthening mechanism, work, hardening, solid solutioning, grain boundary strengthening, Poly phase mixture, precipitation, particle fibre and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behavior – Super plasticity.

UNIT II FRACTURE BEHAVIOUR 8

Griffith's theory stress intensity factor and fracture toughness-Toughening mechanisms – Ductile, brittle transition in steel-High temperature fracture, creep – Larson-Miller, Parameter – Deformation and fracture mechanism maps – Fatigue. Low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law – Effect of surface and metallurgical parameters on fatigue – fracture of non metallic materials – Failure analysis, sources of failure, procedure of failure analysis.

UNIT III SELECTION OF MATERIALS 8

Motivation for selection, cost basis and service requirements – selection for Mechanical properties, strength, toughness, fatigue and creep – Selection for surface durability corrosion and wear resistance – Relationship between materials selection and processing – Case studies in materials selection with Relevance to aero, auto, marine, machinery and nuclear applications.

UNIT IV MATERIAL PROCESSING 9

Processing of engineering materials – Primary and Secondary processes – astability, Weldability, forgeability and malleability Criteria – Process induced defects – Monitoring and control.

UNIT V MODERN MATERIALS AND TREATMENT: 12

Dual phase steels, high strength low alloy (HSLA) Steel transformation included plasticity (TRIP), Steel, maraging steel, shape memory alloys, properties applications of engineering plastics and composites materials advanced structural ceramics – WC, Tic, Tac, Al2o3, Sic, Si3N4, CBN diamond, heat treatment alloy and tool steels, vapour deposition – Plasma, PVD-thick and thin film deposition – Nano materials- production of Nano sized materials.

STATE OF ART (Not for Exam)

Recent development of materials in aerospace, automobile and marine Applications.

Total Hours: 45

TEXT BOOKS:

1. George E. Dieter, “Mechanical Metallurgy”, McGraw Hill, 1988.
2. Charles, J.A., Crane, F.A.A and Furness, J.A.G., “Selection and use of Engineering Materials”, (3 rd Edition, Butterworth – Heiremann, 1977).

REFERENCES:

1. The Hand book of Advance Materials, James k.Wessel, Wiley, Intersam,john, Wilson Publishers., 2004.
2. “Surface Engg of Meterials”- Principles of Equipment, Techniques, TadensZ Burakonsa & T.Wierzchan.
3. Thoas h.Courtney , “Mechanical Behaviour of Meterials” ,(2nd edition), McGraw Hill, 2000.
4. Flinn,R.A.and Trojan ,P.K.., “Engg Meterials and their Applications” (4th Edition), Jaico, 1999.
5. www.appliedmaterials.com/carrers/agu-ei.html
6. www.astm.org/labs/pages/131350.html

14PAE212 / 14PGE211 MANUFACTURE OF AUTOMOBILE COMPONENTS

L	T	P	C
3	0	0	3

Course Objective

- *To impart knowledge at an all the manufacturing process steps and their level in automobile engineering components/ parts.*

UNIT I MANUFACTURE OF ENGINE & ENGINE COMPONENTS 9

Introduction to basic production process - welding - casting - plastic moulding - powder metallurgy - manufacture of composite materials. Introduction - Casting of engine block - drilling of cylinder holes - water cooling passages - Preparation of casting for cylinder heads - design of cores. Forging of crankshafts and connecting rod, casting piston and drilling of oil holes - Upset forging of valves. Heat treatment of crankshafts and connecting rod. Drilling of oil holes and grinding of crank shafts. Forging and heat treatment of camshafts.

UNIT II MANUFACTURE OF CLUTCH, GEAR BOX AND PROPELLER SHAFT COMPONENTS 9

Manufacturing friction plates - manufacture of composite friction lining - Composite moulding of phenol formaldehyde lining.

Casting of gear box casing - Introduction to gear milling - hobbling - manufacturing and inspection of gears.

Casting of propeller shaft. Extrusion of propeller shaft - extrusion dies - heat treatment and surface hardening of propeller shaft.

UNIT III MANUFACTURE OF AXLES, SPRINGS & BODY PANELS 9

Forging of axles, Casting of front and rear axles - Provision of KPI. Wrap forming of coil springs. Introduction - Thermoforming and hydro forming – Press forming. Welding of body panels - resistance welding and other welding processes.

UNIT IV MANUFACTURE OF AUTOMOTIVE PLASTIC COMPONENTS 9

Introduction - Principle of injection moulding- injection moulding of instrument panel- moulding of bumpers - tooling and tooling requirements - hand lay-up process for making composite panels - Filament winding of automotive spring and propeller shaft. Manufacture of metal/Polymer/Metal panels.

UNIT V MANUFACTURE OF ENGINE COMPONENTS USING CERAMIC MATRIX COMPOSITES AND ADVANCED MACHINING PROCESS 9

Introduction, Ceramic matrix piston rings, Chemical vapour deposition, Cryogenic grinding of powders, Sol-gel processing .

Machining concepts using NC, generation of numerical control codes using Pro-E and IDEAS package, interfacing the CNC machine and manufacturing package. Introduction to rapid prototyping - rapid prototyping of using resins.

STATE OF ART (Not for Exam)

Design and manufacturing of automotive components by using hybrid composite materials with the help of modern machineries.

Total Hours: 45

FIELD STUDY & MINI PROJECT WORK

Field Work: (for internal assessment – 10 marks)

The students are expected to submit a report at the end of the semester covering the various aspects of his/her observation in automobile component manufacturing industry visits.

Project Work: (for internal assessment – 10 marks)

Manufacture of automobile components using modern materials and techniques and provide an innovative for improving their performance.

TEXT BOOK:

1. Kalpakjian," Manufacturing Engineering and Technology", Addison-Wesley Publishing Company, inc., Third Edition, 1995.
2. Anil Chhikare, Automobile Engineering Volume 1 &2, Satya Prakashan, New Delhi.

14PCK309 DATA STRUCTURES AND ALGORITHMS

L	T	P	C
3	0	0	3

Course objectives

- *To understand the various ADTs so as to use them in program design.*
- *To design algorithms to various problems based on the design strategies.*
- *To analyze algorithms to find out their time complexity.*

UNIT – I ALGORITHM ANALYSIS 5
Mathematical Background, Model, Running Time calculations, General Rules.

UNIT – II DATA STRUCTURES 15
ADT, List ADT: linked list, doubly linked list, circular linked list; applications in polynomials. Stack ADT: applications, Queue ADT: applications, Priority Queues.

UNIT – III TREES 14
Definitions – Implementation - Binary Trees and Traversals - Expression Trees, Binary Search Trees, AVL Trees, B-Trees.

UNIT – IV SORTING, SEARCHING AND HASHING 13
Bubble Sort, Insertion Sort, Merge Sort, Quick Sort, Heap Sort, Concepts of searching - Sequential searching - Indexed sequential searching table – Hash Search Table

UNIT – V GRAPH ALGORITHMS 13
Definitions, Representation of Graphs, Shortest – path algorithms, Minimum Spanning Tree, Graph Traversals - Applications of Depth-First Search.

START OF ART (Not for Exam)
Red-Black Trees - External Sorting - Network Flow Problems.

Total Hours: 45

TEXT BOOKS:

1. GAV Pai, "Data Structures and Algorithms", Tata-McGraw Hill, 2008
2. Alfred V. Aho, John E Hopcroft and Jeffrey D Ullman, "Data Structures and Algorithms", Pearson Education Inc., Low Price Edition, 2003.

REFERENCE:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Pearson Education Inc., Third Edition, 2006.

14PAE302 DATA COMMUNICATION IN CAD / CAM

L	T	P	C
3	0	0	3

Course Objectives

- *To understand the different types of Operating systems*
- *To understand the concepts of data communication*
- *To understand the fundamentals of computer networks and internet*

UNIT – I DIGITAL COMPUTERS & MICRO PROCESSORS 9

Block diagram - register transfer language - arithmetic, logic and shift micro operations – instruction, code - training and control instruction cycle - I/O and interrupt design of basic computer.Machine language - assembly language - assembler. Registers ALU and Bus Systems - timing and control signals - machine cycle and timing diagram - functional block diagrams of 80 x 86 and modes of operation. Features of Pentium Processors

UNIT – II OPERATING SYSTEM & ENVIRONMENTS 9

Types - functions - UNIX & WINDOWS NT - Architecture - Graphical User Interfaces. Compilers -Analysis of the Source program - the phases of a compiler - cousins of the compiler, the grouping of phases - compiler construction tools.

UNIT – III COMMUNICATION MODEL 9

Data communication and networking - protocols and architecture - data transmission concepts and terminology - guided transmission media - wireless transmission – data encoding - asynchronous and synchronous communication - base band interface standards RS232C, RS449 interface.

UNIT – IV COMPUTER NETWORKS 9

Network structure - network architecture - the OSI reference model services – network standardization– example - Managing remote systems in network - network file systems - net working in manufacturing.

UNIT – V INTERNET 9

Internet services - Protocols - intranet information services - mail based service - system and network requirements - Internet tools - Usenet - e-mail - IRC - www - FTP - Telnet.

STATE OF ART (Not for Exam):

Softwares in data communication, E-Networks, ABB Architecture

Total Hours: 45

TEXT BOOKS:

1. Morris Mano. M., "Computer System Architecture", Prentice Hall of India, 1996.
2. Gaonkar R.S., "Microprocessor Architecture, Programming and Applications of 8085", PenramInternational, 1997

REFERENCES:

1. Peterson J.L., Galvin P. and Silberschaz, A., "Operating Systems Concepts", Addison Wesley, 1997.
2. Alfred V. Aho, Ravi Setjhi, Jeffrey D Ullman, "Compilers Principles Techniques and Tools", Addison Wesley, 1986.
3. William Stallings, "Data of Computer Communications" Prentice Hall of India, 1997.

14PAE303 / 14PGE303 ENTERPRISE RESOURCE PLANNING

L	T	P	C
3	0	0	3

Course objectives

- *To know the basics of ERP*
- *To understand the key implementation issues of ERP*
- *To know the business modules of ERP*
- *To be aware of some popular products in the area of ERP*

UNIT I ERP – AN OVERVIEW **9**

Business functions and processes – Integrated management information – business modeling – Introduction to ERP – Advantages of ERP – roadmap for successful implementation of ERP – Risk factors of ERP implementation.

UNIT II ERP AND RELATED TECHNOLOGIES **9**

Business process Re-engineering (BPR) – Data warehousing – Data mining – On Line Analytical Processing (OLAP) – Supply chain management – Customer relationship management – Geographical Information Systems (GIS) – ERP security.

UNIT III ERP – FUNCTIONAL MODULES **9**

Functional modules of ERP software – Financial module, Manufacturing module – HR module – Materials management module – Production planning module – Plant maintenance module – Quality management module – Purchasing module – Sales and distribution module.

UNIT IV ERP IMPLEMETATION AND PROCUREMENT & ISSUES **9**

ERP package selection – Challenges in ERP implementation – Transition strategies: Big bang strategy – phased implementation – Parallel implementation – Hybrid transition strategy – Performance measurement – Problem resolution – ERP training and selection – Success and failure factors – Maintenance of ERP system – Trends in market – Outsourcing ERP.

UNIT V ERP – PRESENT AND FUTURE **9**

ERP to ERP II – Best practices of ERP II – ERP II to ERP III – Future trends: New markets – Fast implantation methodologies – Easier customization tools – New business segments – Need based application – Reduction in implementation time – Popular ERP packages: MFG / PRO – BAAN IV – SAP R/3 – SARA / EMS.

Total hours: 45

STATE OF ART (Not for Exam)

Analysis of cases from 2 Indian companies and 2 international companies.

TEXT BOOKS:

1. Alexis Leon, “ERP Demystified”, Tata McGraw Hill, New Delhi, 2000.
2. T.J. Biggerstaff, “Design recovery for maintenance and reuse”, IEEE Corpn. July 1999.

REFERNCES:

1. Jagan Nathan Vaman, “ERP in Practice”, Tata McGraw Hill, 2008.
2. Alexis Leon, “Enterprise Resource Planning”, Second Edition, Tata McGraw Hill, 2008.
3. Mahadeo Jaiswal and Ganesh Vanapalli, “ERP” Macmillan India, 2006.
4. Donald R.Honsa, “Co-ordinate measurement and reverse engineering”, ISBN 1555897, American Gear Manufacturers Association.

14PAE304 / 12PGK103 TRIBOLOGY IN DESIGN

L	T	P	C
3	1	0	4

Course Objectives:

- *To provide greater insight into the science and technology of interacting surfaces in relative motion.*
- *To give detailed study of surfaces, friction and wear surface coatings and their effect.*
- *To apply the concepts to the design of hydro dynamic and hydro static and rolling element bearings.*

UNIT – I INTRODUCTION **9**

Nature of surfaces and contact, surface topography, friction and wear mechanisms and effect of lubricants, methods of fluid film formation.

Selection of Rolling Element Bearings

Nominal life, static and dynamic capacity, equivalent load, probabilities of survival, cubic mean load, bearing mounting details, preloading of bearings, condition monitoring using shock pulse method.

UNIT – II HYDRODYNAMIC BEARINGS **9**

Fundamentals of fluid film formation – Reynold's equation; Hydrodynamic journal bearings – Sommerfeld number -performance parameters – optimum bearing with maximum load capacity – friction – heat generated and heat dissipated. Hydrodynamic thrust bearings: Raimondi and Boyd solution for hydrodynamic thrust bearings – fixed and tilting pads, single and multiple pad bearings – optimum condition with largest minimum film thickness.

UNIT – III HYDROSTATIC BEARINGS **9**

Thrust bearings – pad coefficients – restriction – optimum film thickness – Journal bearings – design procedures. Aerostatic bearings: thrust bearings and journal bearings, design procedure.

Dry Rubbing bearings: Porous metal bearings and oscillatory journal bearings, qualitative approach only.

UNIT – IV LUBRICATION: **9**

Choice of lubricant type, oil, grease and solid lubricants, additives, lubrication systems and their selection, selection of pump, filters, piping design, oil changing and oil conservation.

Seals: Different types, mechanical seals, lip seals, packed glands, soft piston seals, mechanical piston rod packing, labyrinth seals and throttling bushes, oil flinger rings and drain grooves, selection of mechanical seals.

UNIT – V TRIBOLOGY IN INDUSTRIES & TRIBO MEASURMENTS **9**

Tribology in Metal working industries – effects of friction, wear and lubrication in metal working – classification of plastic deformation processes – rolling – drawing – extrusion – forging – sheet metal working – metal removal. Paper and pulp industries – paper making

processes – tribological considerations and applications. Glass fiber industries – making of glass fiber – tribological considerations. Measurement techniques – contact and non-contact type.

STATE OF ART (Not for Exam)

Failure analysis of plain bearings, rolling bearings, gears and seals, wear analysis using SOAP and Ferrography, Green tribology - introduction, feature and its latest applications

Theory: 45; Tutorial: 15; Total Hours: 60

TEXT BOOKS:

1. S.K.Basu, S.N.Sengupta, B.B.Ahuja "Fundamentals of Tribology" PHI Learning Pvt Limited.
2. Prasanta Sahoo, "Engineering Tribology", PHI Learning Pvt Limited, New Delhi.

REFERENCES:

1. Sushilkumarsrivastava "Tribology in Industries" S.Chand&Company Ltd, New Delhi, 2001.
2. Neale M J, "Tribology Handbook", Neumann Butterworths, 1975.
3. Hydrostatic and Hybrid Bearing Design – Rowe W W & O' Dionoghue – Butterworths & Co. Publishers Ltd.

14PAE305 / 12PGE 305 QUALITY CONTROL AND RELIABILITY ENGINEERING

L	T	P	C
3	0	0	3

Course objectives

- *To Understand the basics of quality control and its tools*
- *To understand the concepts of reliability engineering*

UNIT-I INTRODUCTION AND PROCESS CONTROL FOR VARIABLES 9

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality cost-Variation in process- factors - process capability - process capability studies and simple problems -Theory of control chart- uses of control chart-Control chart for variables - X chart, R chart and s chart.

UNIT-II PROCESS CONTROL FOR ATTRIBUTES 9

Control chart for attributes -control chart for proportion or fraction defectives - p chart and np chart - control chart for defects - C and U charts, State of control and process out of control identification in charts.

UNIT-III ACCEPTANCE SAMPLING 9

Lot by lot sampling - types - probability of acceptance in single, double, multiple sampling techniques-O.C. curves - producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans.

UNIT-IV LIFE TESTING - RELIABILITY 9

Life testing - Objective - failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate, system reliability, series, parallel and mixed configuration - simple problems. Maintainability and availability- simple problems. Acceptance sampling based on reliability test - O.C Curves.

UNIT-V QUALITY AND RELIABILITY 9

Reliability improvements -techniques- use of Pareto analysis - design for reliability - redundancy unit and standby redundancy - Optimization in reliability - Product design - Product analysis - Product development - Product life cycles.

STATE OF ART (Not for Exam)

E-ERP, Software tools for MRP I&MRPI, E-PERT

Note: Use of approved statistical table permitted in the examination.

Total Hours: 45

TEXT BOOKS:

1. Grant, Eugene .V, "Statistical Quality Control", McGraw-Hill, 1996.
2. L.S.Srmah, "Reliability Engineering", Affiliated East west press, 1991.

REFERENCES:

1. R.C.Gupta, “Statistical Quality control”, Khanna Publishers, 1997
2. Besterfield D.H., “Quality Control”, Prentice Hall, 1993.
3. Sharma S.C., “Inspection Quality Control and Reliability”, Khanna Publishers, 1998.

14PAE306 / 12PGE306 ROBUST DESIGN OF PRODUCT/PROCESS

L	T	P	C
3	0	0	3

Course Objectives:

- Designing quality into products and processes using design of experiments, including robust/parameter design and tolerance design techniques.
- To improve the product and/or process quality for a given design.
- To examine the design in order to acquire a better product and process quality.
- To give engineers a current understanding of the techniques and applications of design of experiments in quality engineering design
- To learn a step-by-step process of creating a robust design and use software to facilitate the design

UNIT- I: INTRODUCTION TO ROBUST DESIGN

Robustness Strategy & its primary tools: P-Diagram, Quality Measurement, Quality Loss Function, Signal to Noise (S/N) Ratios, Orthogonal Arrays, Steps in Robust Parameter Design. Robust design and Six-Sigma for Lean Enterprises.

UNIT-II: INTRODUCTION TO TAGUCHI'S EXPERIMENT DESIGN

Criteria for the Use of Experiment Design Methods, Applying Experiment Design Methods According To Situation; Problem Analysis and Empiric Parameter Reduction. Orthogonal Arrays, Graphical representation of factor combinations, linear graphs, Variance Analysis (ANOVA), Inner-Outer arrays Design.

UNIT- III: PARAMETER DESIGN ACCORDING TO TAGUCHI

Direct product design, indirect variance analysis, Product design with characteristic values, taking cost into account, Signal-to-noise ratio according to Taguchi.

UNIT-IV: EXPERIMENT DESIGN ACCORDING TO SHAININ

Multi-variate charts, components search, paired comparisons; Determining decisive parameters (variable search), scatter plots, randomization of experiments, B versus C test, full factorial.

UNIT-V RESPONSE SURFACE METHODOLOGY (RSM)

Linear experiment designs, quadratic experiment designs.

STATE OF ART (Not for Exam)

Relationship between Robust Design and other Quality Processes, Robust Testing

TEXT BOOKS:

1. Phadke S. Madhav, "Introduction to Robust Design (Taguchi Approach)", Phadke Associates Inc., 2006.
2. J. Krottmaier, "Optimizing Engineering Design", McGraw Hill Ltd. England, 1993.

REFERENCES:

1. Philip J. Ross, “Taguchi Techniques for Quality Engineering”, McGraw Hill Ltd.
2. Mitra *A*, “Fundamentals of Quality Control and Improvement”, Pearson Education, New Delhi, 1998.
3. Logothetis. N, “Managing for total quality”, Prentice Hall International, UK, 1992.

14PAE307 / 14PGE204 ADVANCED METROLOGY AND NON DESTRUCTIVE TESTING

L	T	P	C
3	0	0	3

Course Objective

- *To provide exposure to the students on various advanced measuring methods and non-destructive testing techniques.*

ADVANCED MEASURING MACHINES **9**

LASER based measurement– laser interferometer – laser alignment telescope – Laser viewers for production profile checks - Co-ordinate measuring machines - Use of computers - Machine vision technology - Microprocessors in metrology.

VISUAL METHODS AND RADIO GRAPHY **9**

Optical aids, optical holographic methods, dynamic inspection. Principles of radiography-sources of radiation, ionising radiation -x-ray and gamma ray production - properties of x rays and gamma rays - Recording of radiation-film characteristics - exposure charts - contrasts - operational characteristics of x ray equipment -applications.

LIQUID PENETRANT AND MAGNETIC PARTICLE TESTS **9**

Characteristics of liquid penetrants - different washable systems - Developers -applications - Methods of production of magnetic fields - Principles of operation of magnetic particle test – Magnetography- field sensitive probes-Applications - Advantages and limitations.

ULTRASONIC AND ACOUSTIC EMISSION TECHNIQUES **9**

Production of ultrasonic waves - different types of waves - general characteristics of waves - pulse echo method - A, B, C scans - Principles of acoustic emission techniques - Advantages and limitations - Instrumentation - applications.

ELECTRICAL METHODS AND OTHER TECHNIQUES **9**

Eddy current methods- potential-drop methods, applications. Basics of Electromagnetic testing and thermal inspection.

STATE OF ART (Not for Exam)

Application of NDT in automotive and space applications, multi axis inspection by laser and CMM.

Total Hours: 45

TEXT BOOKS:

1. Jain, R.K. “Engineering Metrology ", Khanna Publishers, 1997.
2. Barry Hull and Vernon John, " Non Destructive Testing ", MacMillan, 1988.

REFERENCES:

1. American Society for Metals, " Metals Hand Book ", Vol.II, 1976.
2. Progress in Acoustic Emission, " Proceedings of 10th International Acoustic Emission Symposium ", Japanese Society for NDI, 1990.
3. Halmshaw, R., "Non-destructive testing**"**, 2nd edition, Edward Arnold, 1991.

14PAE308 SUPPLY CHAIN MANAGEMENT

L	T	P	C
3	0	0	3

Course Objectives

- *To understand the fundamentals of logistics management*
- *To understand the concepts of the different types of supply chain networks*
- *To understand the role of Information Technology in supply chain management*

UNIT – I LOGISTICS AND CUSTOMER SERVICE DIMENSION 9

Mission of logistics management, logistics environment, Customer service and retention, Setting customer service priorities and service standards. Measuring logistics – logistics costing – customer profitability analysis

UNIT – II STRATEGIC FRAMEWORK AND SUPPLY CHAIN NETWORKS 9

Objective, decision phases, process views, examples, strategic fit, supply chain drivers and metrics. Distribution networks, Facility networks and design options, Factors influencing, Models for facility location and capacity allocation, Transportation networks and design options, Evaluating network design decisions

UNIT – III MANAGING DEMAND AND SUPPLY IN A SUPPLY CHAIN 9

Predictable variability in a supply chain, Economies of scale and uncertainty in a supply chain – Cycle and safety Inventory, Optimum level of product availability, Forward Buying, Multiecheloncycle inventory

UNIT – IV SOURCING AND PRICING IN A SUPPLY CHAIN 9

Cross-Functional drivers, Role of sourcing in a supply chain, Logistics providers, Procurement process, Supplier selection, Design collaboration, Role of Pricing and Revenue Management in a supply chain

UNIT – V INFORMATION TECHNOLOGY AND COORDINATION IN A SUPPLY CHAIN 9

The role of IT in supply chain, The supply chain IT frame work, Customer Relationship Management, Supplier relationship management, Future of IT in supply chain, E-Business in supply chain, Bullwhip effect – Effect of lack of co-ordination in supply chain, Building strategic partnerships, CPFR

START OF ART (Not for Exam)

Study about the software used in SCM and logistics providers. Cause study of SCM: millrun, auto, spares, etc.,

Total Hours: 45

TEXT BOOKS:

1. Sunil Chopra and Peter meindl, "Supply Chain Management, Strategy, Planning, and Operation", PHI, Third edition, 2007.
2. Martin Christopher, "Logistics and supply chain management", Pearson Education, 2001

REFERENCES:

1. Jeremy F.Shapiro, "Modeling the supply chain", Thomson Duxbury, 2002.
2. James B.Ayers, "Handbook of Supply chain management", St.Lucle press, 2000.
3. Agrawal, D K, "Logistics and supply chain management" Macmillan India, 2003

14PAE309 INDUSTRIAL SAFETY ENGINEERING

L	T	P	C
3	0	0	3

Course Objectives

- *To understand the basic concepts of safety engineering*
- *To understand the principles of fire and explosive control*
- *To understand the methods of safety training*

UNIT – I INTRODUCTION TO SAFETY MANAGEMENT 9

Introduction, Principles of accident Prevention, Planning for Safety, Organising for safety, Directing for Safety, Safety Education & Training, Employee Participation in Safety, Human behaviour & safety, Financial aspects of Safety, Safety Management Information System, Introduction to national & international SHE Management Systems

UNIT – II SAFETY MANAGEMENT SYSTEM AND LAW 9

Legislative measures in industrial safety, Occupational Safety, Health and Environment Management, Safety Management, Directing safety.

UNIT – III FIRE ENGINEERING AND EXPLOSIVE CONTROL 9

Fire properties of solid, liquid and gases – fire triangle – principles of fire extinguishing – active and passivefie protection systems – various classes of fires – A, B, C, D, E – types of fire extinguishers –Principles of explosion – Explosion Protection – Electrical Safety. Electrical Hazards – Primary and Secondary hazards – concept of earthing – protection systems – fuses, circuit breakers and over load relays – first aid.

UNIT – IV SAFETY EDUCATION AND TRAINING 9

Importance of training – identification of training needs – training methods – programmes, seminars, conferences, competitions – method of promoting safe practice – motivation – communication – role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

UNIT – V SAFETY AT WORKPLACE 9

Safe use of machines and tools,Plant design and Housekeeping, Industrial Lighting, Ventilation & heat control, Electrical Hazards, Noise and Vibration, Fire & Explosion.

MINI PROJECT (Internal assessment Only)

In-plant training of 10 days is compulsory to study the Safety practices in the industry and a Report to be submitted to the Department with due Certification of the industry where training is sought.

STATE OF ART (Not for Exam)

Fire hazards and disaster management

Total Hours: 45

TEXT BOOKS:

1. Krishnan N.V., "Safety Management in Industry", Jaico Publishing House, Bombay, 1997.
2. Hand book of "Occupational Safety and Health", National Safety Council, Chicago, 1982.
3. R.K.Jain and Sunil S.Rao , Industrial Safety , Health and Environment Management Systems, Khanna publishers , New Delhi, 2006.

REFERENCES:

1. Grimaldi and Simonds , Safety Management, AITBS Publishers , New Delhi (2001).
2. Guidelines for Hazard Evaluation Procedures, Centre for Chemical Process Safety, AICHE 1992
3. Frank P Lees - Loss of prevention in Process Industries , Vol. 1 and 2, Butterworth-Heinemann Ltd., London (1991).
4. Industrial Safety -National Safety Council Of India.

14PAE310 PRECISION ENGINEERING

L	T	P	C
3	0	0	3

Course Objective

- *To give an insight into the subject of precision engineering in general and to here an understanding of precision machining tools, material processing, ultra precision machine elements, MEMS and rolling, hydrodynamic and hydrostatic bearings*

UNIT I BASICS AND TOOL MATERIALS FOR PRECISION ENGINEERING 9

Introduction to precision engineering: Need for high precision – Accuracy and precision – Achievable Machining Accuracy- Precision Machining. Tool based Micro & Ultra precision Machining grinding – Thermal effects – Materials for tools and machine elements – carbides – ceramic, CBN & diamond.

UNIT II LIMITS, FITS, TOLERANCE AND GEOMETRIC DIMENSIONING 9

Tolerance zone-fits- Hole & shaft system- Limits- selective assembly- Geometric tolerance terms and definitions- datum reference frames- datum elements - Form, orientation, profile and position tolerances

UNIT III ULTRA PRECISION MACHINE ELEMENTS 9

Guide ways – drive system – Spindle drive- preferred numbers – Rolling elements – hydrodynamic & hydrostatic bearings – pneumatic bearings.

UNIT IV MICRO ELECTRO MECHANICAL SYSTEMS (MEMS) 9

Characteristics and principles of MEMS, Design of MEMS – Application of MEMS – Materials for MEMS – Fabrication and micro manufacturing processes – Future of MEMS – Clean rooms

UNIT V FUNDAMENTALS OF NANO TECHNOLOGY AND MEASURING SYSTEMS PROCESSING 9

Systems of nanometer accuracies – Mechanism of metal Processing – Nano physical processing of atomic bit units. Nanotechnology and Electrochemical atomic bit processing. In processing or in-situ measurements of position of processing point-Post process and on-machine measurement of dimensional features and surface-mechanical and optical measuring systems.

START OF ART (Not for Exam)

Micro finishing processes - Reliability Simulation: Reliability Evaluation using Parts Court and Parts Stress Methods, Network Reliability Simulation.

Total Hours: 45

TEXT BOOKS:

1. V.C.Venkatesh&S.Izman, "Precision Engineering" Tata McGraw-Hill Publishing Company, 2007.
2. Murthy.R.L. "Precision Engineering in Manufacturing" New Age international Publishers, 1996.

REFERENCES:

1. Mark J. Madon" Fundamentals of Micro Fabrication" CRC Press, 2002.
2. Nano Taniguchi"Nano Technology" oxford university press, New York, 2003.

14PAE311 / 14PGK105 DESIGN FOR MANUFACTURING AND ASSEMBLY

L	T	P	C
3	1	0	4

Course Objectives

- *To understand the concept of tolerance analysis.*
- *To enable the students to understand and appreciate better design and manufacturing methodologies that facilitates easier assembly of complex equipment.*

UNIT I SELECTION OF MATERIALS AND PROCESSES 9

Phases of design – General requirements for material and process selection, effect of material properties and manufacturing process on design – DFM approach - DFM Guidelines – Product design for manual assembly, automatic assembly and robotic assembly – Computer aided DFMA.

UNIT II TOLERANCE ANALYSIS 9

Process capability – metrics – costs aspects – Feature tolerance – geometric tolerance – surface finish, review of relationship between attainable tolerance grades and difference machining process – Cumulative effect of tolerances; sure fit law , normal law and truncated normal law. Tolerance charting technique**:** Tolerance worksheets and centrality analysis, examples – Computer aided tolerance charting.

UNIT III SELECTIVE ASSEMBLY AND DATUM SYSTEMS 9

Interchangeable selective assembly – Control and axial play; introducing secondary machining operations, laminated shims, examples. Datum systems : Degrees of freedom, grouped datum systems different types, two and three mutually perpendicular grouped datum planes; Grouped datum system with spigot and recess pair and tongue – slot pair – computation of translational and rotational accuracy, geometric analyses and applications.

UNIT IV TRUE POSITION THEORY 9

Comparison between co-ordinate and convention method of feature location, tolerance and true position tolerance, virtual size concept, floating and fixed fasteners, projected tolerance zone, assembly with gasket, zero true position tolerance, functional gauges, paper layout gauging, compound assembly, examples.

UNIT V DESIGN FOR MACHINING 9

Design features to facilitate machining – Functional and manufacturing datum features, component design, machining considerations, redesign for manufacture, examples. Form design**:** Form design of castings and weldments – Redesign of castings based on parting line considerations, minimizing core requirements – redesigning case members using weldments.

STATE OF ART (Not for Exam)

Case studies- Tolerance Technique, Design for Machining.

Theory: 45 Tutorial: 15 Total Hours: 60

TEXT BOOKS:

1. Boothroyd, G, “Design for Assembly Automation and Product Design”. New York, Marcel Dekker. 1980.
2. Bralla, “Design for Manufacture handbook”, McGraw hill, 1999.

REFERENCES:

1. Boothroyd, G, Heartz and Nike, Product Design for Manufacture, Marcel Dekker, 1994.
2. Dickson, John. R, and Corroda Poly, Engineering Design and Design for Manufacture and Structural Approach, Field Stone Publisher, USA, 1995.

14PAE312 / 14PGE312 ADVANCED OPTIMIZATION TECHNIQUES

L	T	P	C
3	1	0	4

Course Objective

- *To provide knowledge on different types of optimization and its applications in various fields.*

UNIT I LINEAR AND NONLINEAR OPTIMIZATION 9

Introduction to optimization, Linear programming problem (LPP) - Graphical solution- Simplex method. Non Linear programming problem (NLPP) - unconstrained optimization, one dimensional optimization, elimination methods, fibonacci method, golden section methods, Hooks and Jeeves method.

UNIT II UNCONSTRAINED AND CONSTRAINED OPTIMIZATION 9

Single variable and multivariable optimization, Techniques of unconstrained minimization – Golden search– Interpolation methods. Optimization with equality and inequality constraints - Indirect methods using penalty functions, Lagrange multipliers; Geometric programming- Constrained, mixed inequality and unconstrained minimization.

UNIT III INTEGER AND DYNAMIC PROGRAMMING 9

Introduction to Integer Programming – Solution Techniques, Graphical method, the branch and bound technique, Gomary's cutting plane method, Examples on the application in manufacturing / design systems. Introduction to Dynamic Programming, Bellman's principle of optimality, examples on the application on cutting stock problem and inventory problem.

UNIT IV NETWORK OPTIMIZATION MODELS 9

Terminology of Networks – the shortest route problem – the minimum spanning tree problem – the maximum flow problem – the minimum cost flow problem – the network simplex method.

UNIT V META HEURISTIC APPROACHES 9

Introduction to nontraditional(MHA)optimization, Computational Complexity – NP-Hard, NP-Complete, No free lunch theorem. Working principles of Genetic Algorithm, Simulated Annealing, Particle Swarm Optimization and Neural Networks - Simple applications.

STATE OF ART (Not for Exam)

Software in Optimization - Study and practice in Optimization solvers- Lingo and CPLEX.

Theory: 45 Tutorial: 15 Total Hours: 60

TEXT BOOKS:

1. Singiresu S Rao, “Engineering Optimization: Theory and Practice”, Wiley,Interscience, 3rd Edition, 1996.
2. Kalyanmoy Deb, “Optimization for engineering design”, Prentice Hall India (Pvt) Ltd., New Delhi, 2000.

REFERENCES:

1. R.Saravanan, “Manufacturing optimization through intelligent techniques”, Taylor and Francis Publications, CRC Press, 2006.
2. David E Goldberg, “Genetic Algorithms in Search, Optimization and Machine Learning”, Addison, Wesley Pub Co., 1989.
3. Cihan H Dagli**,** “Artificial Neural Networks for Intelligent Manufacturing”, Chapman and Hall, London, 1994.

14PAE313 SENSOR INTERFACE AND SYSTEM INTEGRATION

L	T	P	C
3	0	0	3

Course objective:

- *To understand the concept of sensors, DAQ and Virtual Instrumentation systems.*

UNIT – I INTRODUCTION TO MEASUREMENT SYSTEM 9

General principle of measurement system- Force measurement- Equal arm balance, Unequal arm balance, Pendulum scale, Elastic force meter, Hydraulic load cell, Pneumatic load cell. Pressure measurement- Bourdon tube pressure gauge, Elastic diaphragm gauge Mechanical/Electronic, Bellowgauges. Temperature measurement- Bimetallic strips, pressure thermo meter.

UNIT – II SENSORS AND APPLICATIONS 9

General principle- Sensor for motion and position measurement- Force sensor- Pressure sensor- Torque sensor – Tactile sensor - Temperature sensor- Ultrasonic sensor- Piezoelectric sensor. Application of sensors in modern industry.

UNIT – III DATA ACQUISITION SYSTEM 9

DAQ system overview and configuration, Signal conditioning, DAQ hardware, Counters\Timers, Wireless communication, DAQ software, Instrument Control, Control system, A/D converter, D/A converter.

UNIT – IV INTERFACE STANDARDS AND PC BUSES 9

RS232, GPIB- IEEE488, USB, Fire wire, Backplane buses- PCI, Ethernet- TCP\IP Protocols, Networktopologies- Star, ring, bus and tree, Repeaters, Bridges, Routers, Gateways, Hubs and Switches.

UNIT – V VIRTUAL INSTRUMENTATION SYSTEMS 9

General Functional description of a digital instrument- Block diagram of a Virtual Instrument- Userinterfaces- Advantages of Virtual instruments over conventional instruments- Machine visiontechniques- serial communication.

STATE OF ART (Not for Exam)

Image processing and analysis, flow measurement using ultrasonic sensor, advanced safety concepts using sensors.

Total Hours: 45

TEXT BOOKS:

1. Garry W Johnson, “LabVIEW Graphical Programming”, Tata McGraw Hill, 3rd Edition, 2001.
2. Barry Paron, “Sensors, Transducers and LabVIEW” Prentice Hall,2000

REFERENCES:

1. Dick Caro, “Automation Network Selection- The instrumentation Systems and Automation Society”, 2004.
2. William Buchanan, “Computer Buses Design and Application”, CRC Press, 2000.
3. Clyde F Coombs, “Electronic Instruments Handbook”, McGraw Hill Inc., Third Edition, 1999.

14PAE314 / 14PGE317 FIELD WORK

Fieldwork is the systematic collection of information, samples, data or other specific source material, or the carrying out of research, or practical work, such as surveying and specimen collecting, undertaken at an external location.

The student has to visit industries related to the subject of his/her field work.

The student has to submit a report at the end of the semester which will be evaluated by the appointed examiner.