St. PETER'S UNIVERSITY

St. Peter's Institute of Higher Education and Research
(Declared under section 3 of UGC Act 1956)
Avadi, Chennai – 600 054.

M.E. (CAD / CAM) PROGRAMME

(I TO IV SEMESTERS)

REGULATIONS AND SYLLABI

(REGULATIONS – 2008)

M.E. (CAD / CAM) PROGRAMME

Regulations and Syllabi

(Effective from 2008)

1. **Eligibility:** Candidates who passed B.E. / B.Tech.(Mechanical Engineering / Automobile / Manufacturing / Production / Industrial Engineering / Mechatronics) of the University or A.M.I.E. with concerned subject or the equivalent examination thereto are eligible for admission to Two Year M.E.(CAD/CAM) Programme.

2. **Duration:** Two Years Comprising 4 Semesters. Each semester has a minimum 90 working days with a minimum of 5 hours a day.

3. **Medium:** English is the medium of instruction and examination.

4. **Weightage for Internal and End Assessment:** The weightage for Internal Assessment (IA) and End Assessment (EA) be 25:75 unless the ratio is specifically mentioned in the scheme of Examinations.

5. **Credit System:** Credit system be followed with 18 credits for each semester and each credit is equivalent to 25-30 hours of effective study provided in the Time table.

6. **Scheme of Examinations (for I to IV Semesters)**

I Semester

Code No.	Course Title	Credit	Marks		
Theory			**IA**	**EA**	**Total**
108CCPT01	Applied Mathematics	2	25	75	100
108CCPT02	Computer Applications in Design	3	25	75	100
108CCPT03	Finite Elements Analysis	3	25	75	100
108CCPT04	Integrated Mechanical Design	2	25	75	100
108CCPT05	Industrial Robotics and Expert System	3	25	75	100
Electives					
112CCPT06	**Elective I:** Total Quality Management	3	25	75	100
Practical					
108CCPP07	Lab - CAD	2	25	75	100
	Total	**18**	**175**	**525**	**700**

II Semester

Code No.	Course Title	Credit	Marks		
Theory			**IA**	**EA**	**Total**
208CCPT01	Mechanical Vibrations	3	25	75	100
208CCPT02	Integrated Manufacturing Systems	3	25	75	100
208CCPT03	Applied Materials Engineering	3	25	75	100
208CCPT04	Integrated Product and Process Development	3	25	75	100
Electives					
208CCPT05	**Elective II:** Industrial Safety Management	2	25	75	100
208CCPE04	**Elective III:** Metrology and Non Destructive Testing	2	25	75	100
Practical					
208CCPP01	Lab - CAM	2	25	75	100
	Total	**18**	**175**	**525**	**700**

III Semester

Code No.	Course Title	Credit	Marks		
Theory			**IA**	**EA**	**Total**
308CCPT01	**Elective IV**: Computer Aided Process Planning	3	25	75	100
308CCPT02	**Elective V :**Rapid Prototyping and Tooling	3	25	75	100
308CCPT03	**Elective VI** : Design of Hydraulic and Pneumatic Systems	3	25	75	100
Project					
308CCPP01	Project Work (Phase – I)*	9	25	65	100
	Viva voce			10	
	Total	**18**	**100**	**300**	**400**

***** Candidates who have completed Project work (Phase I) successfully are eligible for Project Work (Phase - II) Examination.

IV Semester

Code No.	Course Title	Credit	Marks		
Project			**IA**	**EA**	**Total**
408CCPP01	Project Work (Phase – II)*	18	25	65	100
	Viva voce			10	
	Total	**18**	**25**	**75**	**100**

List of Electives

Course Code	Electives
I Semester	
108CCPE01	Computer Control in Process Planning
108CCPE02	Optimization Techniques in Design
108CCPE03	Advanced Mechanics of Materials
108CCPE04	Design of Material Handling Equipments
II Semester	
208CCPE01	Industrial Safety Management
208CCPE02	Performance Modelling and Analysis of Manufacturing Systems
208CCPE03	Design of Manufacture, Assembly and Environments
208CCPE04	Metrology and Non Destructive Testing
208CCPE05	Design of Materials Handling Equipments
208CCPE06	Reliability Engineering
III Semester	
308CCPE 01	Mechatronics in Manufacturing Systems
308CCPE 02	**Computer Aided Process Planning**
308CCPE 03	Data Communication in CAD / CAM
308CCPE 04	**Rapid Proto typing and Tooling**
308CCPE 05	Tribology in Design
308CCPE 06	**Design of Hydraulic and Pneumatic System**
308CCPE 07	Advanced Tool Design
308CCPE 08	Optimization Techniques in Design
308CCPE 09	Advanced Mechanism Design and Simulation
308CCPE 10	Advanced Strength of Materials
308CCPE 11	Computational Fluid Dynamics

7. **Passing Requirements:** The minimum pass mark (raw score) be 50% in End Assessment (EA) and 50% in Continuous Assessment (CA) and End Assessment (EA) put together. No minimum mark (raw score) in Continuous Assessment (CA) be prescribed unless it is specifically mentioned in the Scheme of Examination.

8. **Grading System:** Grading System on a 10 Point Scale be followed with 1 mark = 0.1 Grade point to successful candidates as given below.

CONVERSION TABLE

(1 mark = 0.1 Grade Point on a 10 Point Scale)

Range of Marks	Grade Point	Letter Grade	Classification
90 to 100	9.0 to 10.0	O	First Class
80 to 89	8.0 to 8.9	A	First Class
70 to 79	7.0 to 7.9	B	First Class
60 to 69	6.0 to 6.9	C	First Class
50 to 59	5.0 to 5.9	D	Second Class
0 to 49	0 to 4.9	**F**	**Reappearance**

Procedure for Calculation

Cumulative Grade Point Average (CGPA) = $\frac{\text{Sum of Weighted Grade Points}}{\text{Total Credits}}$

$= \frac{\sum (CA+EA)\, C}{\sum C}$

Where Weighted Grade Points in each Course = Grade Points (CA+EA) multiplied by Credits

$= (CA+EA)C$

Weighted Cumulative Percentage of Marks(WCPM) = CGPAx10

C- Credit, CA-Continuous Assessment, EA- End Assessment

9. **Pattern of the Question Paper:** The question paper for End Assessment will be set for three hours and for the maximum of 100 marks with following divisions and details.

Part A: 10 questions (with equal distribution to all units in the syllabus). Each question carries 2 marks.

Part B: 5 questions with either or type (with equal distribution to all Units in the syllabus). Each question carries 16 marks.

The total marks scored by the candidates will be reduced to the maximum prescribed in the Regulations.

10. **Effective Period of Operation for the Arrear Candidates :** Two Year grace period is provided for the candidates to complete the arrear examination, if any.

11.Syllabus

108CCPT01 - APPLIED MATHEMATICS

Unit I CALCULUS OF VARIATION

Introduction – Euler's equation – several dependent variables Lagrange's equation of Dynamics – Integrals involving derivatives higher that the first – Problem with constrains – Direct methods and eigen value problems.

Unit II MATRIX THEORY

Eigen values using QR transformations – generalized eigenvectors – canonical forms – singular value decomposition and applications –m pseudo inverse – least square approximations.

Unit III LINEAR PROGRAMMING PROBLEM

Graphical method – simplex method – Big M Technique – Integer programming.

Unit IV TESTING OF HYPOTHESIS

Sampling distributions – Test based on Normal t-distribution. Chi-square and F-distributions – analysis of variance – One way and Two way classifications.

Unit V TIME SERIES

Characteristics and Representation – Moving Averages – Exponential smoothing – Auto Regressive Process.

REFERENCES:

1. Gupta, A.S., Calculus of Variations with Applications, Prentice – Hall of India, New Delhi, 1997.
2. Bronson R, :Matrix Operation" Schaums Outline Series, Mc Graw Hill, New York, 1989.
3. Taha H.A., "Operation Research an Introduction", Prentice Hall of India, 2001.
4. Anderson O.D., "Time Series Analysis theory and practice", I. North – Holland, Amsterdam, 1982.
5. Gupta, S.C. and Kapur, V.K. "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, New Delhi, 1999.

108CCPT02 – COMPUTER APPLICATIONS IN DESIGN

Unit I INTRODUCTION TO COMPUTER GRAPHICS AND FUNDAMENTALS

Output primitives (points, lines, curves, etc.,), 2-D & 3-D transformation (translation, scaling, rotators) windowing, view ports clipping transformation.

Unit II INTRODUCTION TO CAD SOFTWARE

Writing interactive programs to solve design problems and production of drawing, using any languages like Auto LISP/C/FORTRAN etc., creation of surfaces, solids etc., using solid modeling pack (prismatic and revolved parts).

Unit III VISUAL REALISM

Hidden – Line – Surface – solid removal algorithms shading – coloring. Introduction to parametric and variational geometry based software's and their principles creation of prismatic and lofted parts using these packages.

Unit IV ASSEMBLY OF PARTS

Assembly of parts, tolerances analysis mass property calculations, mechanism simulation.

Unit V SOLID MODELING

Rapid prototyping – Data exchange – documentation – customizing solid modeling system.

REFERENCES:

1. William M. Neumann and Robert F. Sproul "Principles of Computer Graphics", Mc. Graw Hill Book Co. Singapore, 1989.
2. Donald Hearn and M. Pauline Baker "Computer Graphics", Prentice Hall, Inc., 1992.
3. Mikell, P. Grooves and Emory W. Zimmers Jr. "CAD / CAM Computer – Aided Design and Manufacturing: Prentice Hall Inc., 1995.
4. Ibrahim Zeid "CAD / CAM – Theory and Practice" – McGraw Hill, International Edition, 1998.

108CCPT03 – FINITE ELEMENT ANALYSIS

Unit I INTRODUCTION

Relevance of finite element analysis in design – Modeling and discretization, Interpolation, elements, nodes and degrees-of-freedom-application of FEA.

One-Dimensional Elements and Computational Procedures: Bar element – beam element – bar and beam elements of arbitrary orientation – assembly of elements – properties of stiffness matrices - boundary conditions – solution of equations – mechanical loads and stresses – thermal loads and stresses – example problems.

Unit II BASIC ELEMENTS

Interpolation and shape functions – elements matrices – liner triangular elements (CST) – quadratic triangular elements – bilinear rectangular elements – quadratic rectangular elements – solid elements – higher order elements – nodal loads – stress calculations – example problems.

Unit III ISOPERIMETRIC ELEMENTS

Introduction – bilinear quadrilateral elements – quadratic quadrilaterals – hexahedral elements – Numerical Integration – quadrature – static condensation – load considerations – stress calculations – example of 2D and 3D applications.

Unit IV FINITE ELEMENTS IN STRUCTURAL DYNAMICS APPLICATIONS

Dynamic equations – mass and damping matrices – natural frequencies and modes – damping – reduction of number of degrees-of-freedom – response history – model methods – Ritz vectors – component mode synthesis – harmonic response – direct integration techniques – explicit and implicit methods – analysis by response spectra – example problems.

Unit V HEAT TRANSFER AND FLUID MECHANICS APPLICATIONS

Heat transfer – elements formulation – reduction – nonlinear problems – transient thermal analysis – acoustic frequencies and modes – fluid structure interaction problems – plane incompressible and rotational flows – example problems.

108CCPT04 – INTEGRATED MECHANICAL DESIGN

Unit I INTRODUCTION

Phases of design – Standardization and interchangeability of machine elements – Tolerances from process and function – Individual and group tolerances – Selection of fits for different design situations – Design for assembly and modular constructions – Concepts of integration.

Unit II SHAFTING

Analysis and Design of shafts for different applications – detailed design – preparation of production drawings – integrated design of shaft, bearing and casing – design for rigidity.

Unit III GEARS AND GEAR BOXES

Principles of gear tooth action – Gear correction – Gear tooth failure modes – Stresses and loads – Component design of spur, helical, bevel and worn gears – Design for sub assembly – Integrated design of speed reducers and multispeed gear boxes – application of software packages.

Unit IV CLUTCHES

Integrated design of automobile clutches and over running clutches.

Unit V BRAKES

Dynamics and thermal aspects of vehicle braking – Integrated design of brakes for machine tools, automobile and mechanical handling equipments.

REFERENCES:

1. Newcomb, T.P. and Spur, R.T., "Automobile Brakes and Braking Systems", Chapman and Hall, 2nd Edition, 1975.
2. Juvinall, RL.C., "Fundamentals of Machine Component Design", John Wiley, 1983.
3. Maitra G.M., "Hand Book of Gear Design", Tata McGraw Hill, 1985.
4. Shigley, J.E., "Mechanical Engineering Design", McGraw Hill, 1986.
5. Lingaiah K. and Narayana Iyengar, "Machine Design Data Hand Book", Vol. 1 & @, Suma Publishers, Bangalore, 1983.

WEB REFERENCE:

1. http://agma.org/

108CCPT05 – INDUSTRIAL ROBOTICS AND EXPERT SYSTEMS

Unit I INTRODUCTION AND ROBOT KINEMATICS

Definition need and scope of Individual robots – Robot anatomy – Work volume – Precision movement – End effectors – Sensors.

Robot Kinematics – Direct and inverse kinematics – Robot trajectories – Control of robot manipulators – Robot dynamics – Methods for orientation and location of objects.

Unit II ROBOT DRIVES AND CONTROL

Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.

Unit III ROBOT SENSORS

Transducers and Sensors – Sensors in Robot – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Gribbing – Image processing and analysis – Image segmentation – Pattern recognition – Training of vision system.

Unit IV ROBOT CELL DESIGN AND APPLICATION

Robot work cell design and control – Safety in Robotics – Robot cell layouts – Multiple Robots and machine interface – Robot cycle time analysis. Industrial application of robots.

Unit V ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPORT SYSTEMS

Methods of Robots Programming – Characteristics of task level languages lead through programming methods – Motion interpolation. Artificial intelligence – Basics – Goals of artificial intelligence – AI techniques – problem representation in AI – Problem reduction and solution techniques – Application of AI and KBES in Robots.

TEXT BOOK:

1. K.S. Fu, R.C. Gonzalez and C.S.G. Lee, "Robotics Control, Sensing, Vision and Intelligence", Mc Graw Hill, 1987.

108CCPP07 – CAD LAB

Exercises in Modeling and Analysis of Mechanical Components and assembly using Parametric and feature based Packages like PRO-E / SOLID WORKS / CATIA / NX / ANSYS / NASTRAN etc.

Equipments for CAD Lab

1. CAD Workstations : 10 Nos
2. CAD, 3D Modeling Software with assembly : 10 Nos

ANALYSIS AND SIMULATION LAB

Analysis of Mechanical Components – Use of FEA packages, like ANSYS NASTRON etc., Excesses shell include FEA analysis of

(i) Machine elements under static loads
(ii) Heat transfer in mechanical systems
(iii) Determination of natural frequency
(iv) Axi-Symmetric
(v) Non-linear systems

Use of kinematics and dynamics simulation software like ADAMS software. Analysis of velocity acceleration for mechanical linkages of different mechanisms.

ELECTIVES

108CCPE01 – FLEXIBLE COMPETITIVE MANUFACTURING SYSTEM

Unit I MANUFACTURING IN A COMPETITIVE ENVIRONMENT

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

Unit II GROUP TECHNOLOGY

Part families – classification and coding – Production flow analysis – Machine cell design – Benefits.

Unit III FLEXIBLE MANUFACTURING SYSTEMS

Introduction – Components of FMS – Application workstations – Computer control and functions – Planning, scheduling and control of FMS – Scheduling – Knowledge based scheduling – Hierarchy of computer control – Supervisory.

Unit IV COMPUTER SOFTWARE, SIMULATION AND DATABASE OF FMS

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 V JUST IN TIME

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

REFERENCES:

1. Groover M.P., "Automation, Production Systems and Computer Integrated Manufacturing", Prentice-Hall of India Pvt. Ltd., New Delhi, 1996.
2. Jha, N.K. "Handbook of Flexible Manufacturing Systems", Academic Press Inc., 1991.
3. Kalpakjian, "Manufacturing Engineering and Technology", Addison-Wesley Publishing Co., 1995.
4. Taiichi Ohno, Toyota, "Production System Beyond Large-Scale Production", Productivity Press (India) Pvt Ltd., 1992.

WEB REFERENCE:

1. http://www.engineeringtalk.com/news/lvd103.htm

108CCPE02 – TOTAL QUALITY MANAGEMENT

Unit I CONCEPT OF TQM

Philosophy of TQM, Customer focus, organization, top management commitment, teamwork, Quality philosophies of Deming, Crossby and Muller.

Unit II TQM PROCESS

QC tools, problem solving methodologies, new management tools, work habits, quality circles, bench marking, strategic quality planning.

Unit III TQM SYSTEMS

Quality policy deployment, quality function deployment, standardization, designing for quality, manufacturing for quality.

Unit IV QUALITY SYSTEM

Need for ISO 9000 system, advantages, clauses of ISO 9000, Implementation of ISO 9000, quality costs, quality auditing, case studies.

Unit V IMPLEMENTATION OF TQM

Steps in KAIZEN, 5S, JIT, POKAYOKE, Taguchi methods, case studies.

REFERENCES:

1. Rose., J.E. "Total Quality Management". Kogan Page Ltd., 1993.
2. John Bank, "The Essence of Total Quality Management", PHI 1993.
3. Greg Bounds, Lyle Yorks et al, "Beyond Total Quality Management", McGraw Hill, 1994.
4. Takashi Osada, The 5S's The Asian Productivity Organizations, 1991.
5. Masaki Imami, KAIZEN, McGraw Hill, 1986.

108CCPE03 – MAINTENANCE MANAGEMENT

Unit I INTRODUCTION

Maintenance functions – Tero technology – Maintenance costs – Organization for maintenance – Japanese concept.

Unit II RELIABILITY ANALYSIS

Reliability function – useful life – repair time distribution – Weibull application – Standby systems – Maintainability and availability – RCM.

Unit III MAINTENANCE POLICIES

Maintenance types – Preventive maintenance – PM for functional characteristics and large scale systems – repair policy – PM and break down maintenance – Statistical applications – replacement models.

Unit IV LOGISTICS

Spare parts control – overall/optimum availability – Maintenance planning – priority rules – Maintenance staffing – UMS – Maintenance manual.

Unit V ADVANCED TECHNIQUES

Condition monitoring – WDM, SPM, Vibration monitoring – Maintenance information system – TPM – Maximize equipment effectiveness.

REFERENCES:

1. Edward Hartman, "Maintenance Management", Productivity and Quality Publishing Pvt. Ltd., Madras, 1995.
2. Smith D.J. "Reliability and Maintainability in perspective", Mac Millan Ltd, London, 1985.
3. Seiichi Nakagrima, "Introduction to Total Productive Maintenance", Productivity Press (India) Pvt. Ltd., 1993.

SECOND SEMESTER

208CCPT01 – MECHANICAL VIBRATIONS

Unit I FUNDAMENTALS OF VIBRATIONS

Review of single freedom systems – Response to arbitrary periodic Excitations – Duhamel's Integral – Impulse Response function – Virtual work – Lagrange's equation – Single degree freedom forced vibration with elastically coupled viscous dampers – System Identification from frequency response – Transient Vibration – Laplace transformation formulation.

Unit II TWO DEGREE FREEDOM SYSTEM

Free vibration of spring-coupled system – mass coupled system – Vibration of two degree freedom system – Forced vibration – Vibration Absorber – Vibration isolation.

Unit III MULTI-DEGREE FREEDOM SYSTEM

Normal mode of vibration – Flexibility Matrix and Stiffness matrix – Eigen values and Eigen vectors – orthogonal properties – Modal matrix – Modal Analysis – Forced Vibration by matrix inversion – Modal damping in forced vibration – Numerical methods for fundamental frequencies.

Unit IV VIBRATION OF CONTINUOUS SYSTEMS

Systems governed by wave equations – Vibration of strings – vibration of rods – Euler Equation for Beams – Effect of Rotary inertia and shear deformation – Vibration of plates.

Unit V EXPERIMENTAL METHIODS IN VIBRATION ANALYSIS

Vibration instruments – Vibration exciters Measuring Devices – Analysis – Vibration Tests – Free and Forced Vibration tests. Examples of Vibration tests – Industrial, case studies.

REFERENCES:

1. Thomson, W.T. – "Theory of Vibration with Applications", CBS Publishers and Distributors, New Delhi, 1990.
2. Rao, J.S., & Gupta, K. – "Ind. Course on Theory and Practice Mechanical Vibration", New Age International (P) Ltd., 1984.
3. Den Hartog, J.P., "Mechanical Vibrations", Dover Publications, 1990.
4. Rao, S.S., "Mechanical Vibrations", Addison Wesley Longman, 1995.

WEB REFERENCES:

1. http://www.ecgcorp.com/velav/
2. http://www.auburn.edu/isvd/

3. www.vibetech.com/techpaper.htm

208CCPT02 – INTEGRATED MANUFACTURING SYSTEM

Unit I INTRODUCTION

Objectives of a manufacturing system-identifying business opportunities and problems classification production system-linking manufacturing strategy and systems analysis of manufacturing operations.

Unit II GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING

Introduction-part families-parts classification and cooling – group technology machine cells – benefits of group technology. Process planning function CAPP – Computer generated time standards.

Unit III COMPUTER AIDED PLANNING AND CONTROL

Production planning and control-cost planning and control-inventory management – Material requirements planning (MRP) – shop floor control – Factory data collection system – Automatic identification system – barcode technology – automated data collection system.

Unit IV COMPUTER MONITORING

Types of production monitoring systems-structure model of manufacturing process – process control & strategies – direct digital control-supervisory computer control-computer in QC – contact inspection methods non-contact inspection method – computer-aided testing – integration of CAQC with CAD / CAM.

Unit V INTEGRATED MANUFACTURING SYSTEM

Definition – application – features – types of manufacturing systems – machine tools – materials handling system – computer control system – DNC systems manufacturing cell.
Flexible manufacturing systems (FMS) – the FMS concept – transfer systems – head changing FMS – variable mission manufacturing system – CAD/CAM system – human labor in the manufacturing system – computer integrated manufacturing system benefits.
Rapid prototyping – Artificial Intelligence and Expert system in CIM.

TEXT BOOKS:

1. Groover, M.P., "Automation, Production System and CIM", Prentice-Hall of India, 1998.

REFERENCES:

1. David Bedworth, "Computer Integrated Design and Manufacturing", TMH, New Delhi, 1998.
2. Yorem Koren, "Computer Integrated Manufacturing Systems", McGraw Hill, 1983.

3. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International 1986.
4. R.W. Yeomamas, A. Choudry and P.J.W. Ten Hagen, "Design rules for a CIM system", North Holland Amsterdam, 1985.

208CCPT03 - APPLIED MATERIALS ENGINEERING

Unit I ELASTIC AND PLASTIC BEHAVIOUR

Elasticity in metals and polymers – Mechanism of plastic deformation, role of dislocation, yield stress, shear strength of perfect and real crystals – Strengthening mechanisms, work hardening, solid sectioning, grain boundary strengthening, poly phase mixture, precipitation, particle, fiber and dispersion strengthening, Effect of temperature, strain and strain rate on plastic behaviors – Super plasticity – Deformation of non – crystalline material.

Unit II FRACTURE BEHAVIOUR

Griffith theory, stress intensity factor and fracture toughness – Toughening mechanisms – Ductile, brittle transition in steel – High temperature fracture, creep – Larison – 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

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 MODERN METALLIC MATERIALS

Dual phase steels, Micro alloyed, High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) steel, Maraging steel – Intermetallics, Ni and Ti aluminides – Smart materials, shape memory alloys – Metallic glass – Quasi crystal and nano crystalline materials.

Unit V NON METALLIC MATERIALS

Polymeric materials – Formation of polymer structure – Production techniques of fibers, foams, adhesives and coatings – Structure, properties and applications of engineering polymers – Advanced structural ceramics, WC, TIC, Tac, AI2O3, SiC, Si3N4, CBN and diamond – properties, processing and applications.

REFERENCES:

1. Thomas H.Courtney, "Mechanical Behaviour of Materials", (2nd Edition), McGraw-Hill, 2000.
2. Charles J.A., Crane, F.A.A and Furness, J.A.G., "Selection and use of Engineering Materials", (3rd Edition), Butterworth-Heiremann, 1977.

3. Flinn, R.A. and Trojan, P.K., "Engineering Materials and their Applications", (4th Edition), Jaico, 1999.
4. George E. Dieter, "Mechanical Metallurgy", McGraw Hill, 1988.
5. Metals Hand Book, Vol. 10, "Failure Analysis and Prevention", (10th Edition), 1994.

WEB REFERENCES:

1. www.astm.org/labs/pages/13150.htm
2. www.applied materials.com/carrers/agu-ei.html.

208CCPT04 – INTEGRATED PRODUCT AND PROCESSES DEVELOPMENT

Unit I INTRODUCTION

Characteristics of Successful Product Development-Who Designs and Develops Products-Duration and Costs of Product Development – Challenges of Product Development – Development Processes and Organizations – A Generic Development Process – Concept Development: The Front-End Process Adapting the Genetic Product Development Process – Product Development Process Flows – The AMF Development Process – Product Development Organizations – The AMF Organization.

Unit II PRODUCT PLANNING

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.

Unit III PRODUCT SPECIFICATIONS

What Are Specifications – When Are Specifications Established-Establishing Target Specifications – Setting the Final Specifications – Concept Generation – The Activity of Concept Generation – Clarify the Problem – Search Externally – Search Internally – Explore Systematically – Reflect on the Results and the Process.

Unit IV CONCEPT SELECTION

Concept Selection – Overview of Methodology – Concept Screening – Concept Testing – Define the Purpose of the Concept Test – Choose a Survey Population – Choose a Survey Format – Communicate the Concept – Measure Customer Response – Interpret the Results – Reflect on the Results and the Process.

Unit V PRODUCT ARCHITECTURE

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

208CCPP01 – CAM LAB

Simulation and Machining using CNC / DNC Machine Tools – Use of FEM Packages – Relational Data Base – Networking – Practice on Computer Aided Measuring Instruments – Image Processing – Software Development for Manufacturing – CNC Controllers – Use of advanced CNC Machining Packages – Business Data Processing.

EQUIPMENTS FOR CAM LAB

1. CAM Software for tool path generation for planer machining, contour machining, drilling, turning etc. & post processing modulus for different CNC controllers.
2. Medium production type CNC turning center with popular industrial type controller.
3. Medium production type CNC machining center with popular industrial type controller.
4. Bench Model CMM.
5. Vision & image processing software.
6. Data Processing Software.

ELECTIVES

208CCPE01 – INDUSTRIAL SAFETY MANAGEMENT

Unit I SAFETY MANAGEMENT

Evaluation of modern safety concepts – Safety management functions – safety organization, safety department – safety committee, safety audit – performance measurements and motivation – employee participation in safety – safety and productivity.

Unit II OPERATIONAL SAFETY

Hot metal Operation – Boiler, pressure vessels – heat treatment shop – gas furnace operation – electroplating – hot bending pipes – Safety in welding and cutting Cold – metal Operation – Safety in Machine shop – Cold bending and chamfering of pipes – metal cutting – shot blasting, grinding, painting – power press and other machines.

Unit III SAFETY MEASURES

Layout design and material handling – Use of electricity – Management of toxic gases and chemicals – Industrial fires and prevention – Road safety – highway and urban safety – Safety of sewage disposal and cleaning – Control of environmental pollution – Managing emergencies in Industries – planning, security and risk assessments, on-site and off-site. Control of major industrial hazards.

Unit IV ACCIDENT PREVENTION

Human side of safety – personal protective equipment – Causes and cost of accidents. Accident prevention programmes – Specific hazard control strategies – HAZOP – Training and development of employees – First Aid – Fire fighting devices – Accident reporting, investigation.

Unit V SAFETY, HEALTH, WELFARE & LAWS

Safety and health standards – Industrial hygiene – occupational diseases prevention – Welfare facilities – History of legislations related to Safety – pressure vessel act-Indian boiler act – The environmental protection act – Electricity act – Explosive act.

TEXT BOOKS

1. John V. Grimaldi and Rollin H. Simonds, "Safety Management", All India Travellers bookseller, New Delhi-1989.
2. Krishnan N.V., "Safety in Industry", Jaico Publisher House, 1996.

REFERENCES

1. Occupational Safety Manual BHEL.

2. Industrial safety and the law by P.M.C. Nair Publisher's, Trivandrum.
3. Managing emergencies in industries, Loss Prevention of India Ltd., Proceedings, 1999.
4. Safety security and risk management by U.K. Singh & J.M. Dewan, A.P.H. Publishing company, New Delhi, 1996.
5. Singh, U.K. and Dewan, J.M., "Safety, Security and risk management", APH Publishing Company, New Delhi, 1996.

208CCPE02 – PERFORMANCE MODELLING AND ANALYSIS OF MANUFACTURING SYSTEM

Unit I MANUFACTURING SYSTEMS & CONTROL

Automated Manufacturing Systems – Modelling – Role of performance modeling – simulation models – Analytical models.
Product cycle – Manufacturing lead – time – Work in process – Machine utilization – Throughput – Capacity – Flexibility – performability – Quality.
Control Systems – Control system architecture – Factory communications – Local area networks – Factory net works – Open systems interconnection model – Net work to network interconnections – Manufacturing automation protocol – Database management system.

Unit II MANUFACTURING PROCESSES

Examples of stochastic processes – Poisson process Discrete time Markov chain models – Definition and notation – Sojoum times in states – Examples of DTMCs in manufacturing – Chapman – Kolmogorov equation – Steady – state analysis.
Continuous Time Markov Chain Models – Definitions and notation – Sojourn times in states – examples of CTMCs in manufacturing – Equations for CTMC evolution – Markov model of a transfer line.
Birth and Death Processes in Manufacturing – Steady state analysis of BD Processes – Typical BD processes in manufacturing.

Unit III QUEUING MODELS

Notation for queues – Examples of queues in manufacturing system – Performance measures – Little's result – Steady state analysis of M/M/m queue, queues with general distributions and queues with breakdowns - Analysis of a flexible machine center.

Unit IV QUEUING NETWORKS

Examples of QN models in manufacturing – Little's law in queuing networks – Tandem queue – An open queuing network with feed back – An open central server model for FMS – Closed transfer line - Closed server model – Garden Newell networks.

Unit V PETRI NETS

Classical Petri Nets – Definitions – Transition firing and reachability – Representational power – properties – Manufacturing models. Stochastic Petri Nets – Exponential timed Petri Nets – Generalized Stochastic Petri Nets – modeling of KANBAN systems – Manufacturing models.

REFERENCES

1. Viswanadham, N and Narahari, Y. "Performance Modelling of Automated Manufacturing Systems", Prentice Hall of India, New Delhi, 1994.

2. Trivedi, K.S., "Probability and Statistics with Reliability, Queuing and Computer Science Applications", Prentice Hall, New Jersey, 1982.
3. Gupta S.C., & Kapoor V.K., "Fundamentals of Mathematical Statistics", 3rd Edition, Sultan Chand and Sons, New Delhi, 1988.

208CCPE03 – DESIGN FOR MANUFACTURE, ASSEMBLY AND ENVIRONMENTS

Unit I INTRODUCTION

General design principles for manufacturability – strength and mechanical factors, mechanisms selection, evaluation method, Process capability – Feature tolerances – Geometric tolerances – Assembly limits – Datum features – Tolerance stacks.

Unit II FACTORS INFLUENCING FORM DESIGN

Working principle, Material, Manufacture, Design – Possible solutions – Materials choice – influence of materials on form design – form design of welded members, forgings and castings.

Unit III COMPONENT DESIGN – MACHINING CONSIDERATION

Design features to facilitate machining – drills – milling cutters – keyways – Doweling procedures, counter sunk screws – Reduction of machined area – simplification by separation – simplification by amalgamation – Design for machinability – Design for economy – Design for clampability – Design for accessibility – Design for assembly.

Unit IV COMPONENT DESIGN – CASTING CONSIDERATION

Redesign of castings based on Parting line considerations – Minimizing core requirements, machined holes, redesign of cast members to obviate cores.
Identification of uneconomical design – Modifying the design – group technology – Computer Applications for DFMA.

Unit V DESIGN FOR THE ENVIRONMENT

Introduction – Environmental objectives – Global issues – Regional and local issues – Basic DFE methods – Design guide lines – Example application – Lifecycle assessment – Basic method – AT&T's environmentally responsible product assessment – Weighted sum assessment method – Lifescycle assessement method – Techniques to reduce environmental impact – Design to minimize material usage – Design for disassembly – Design for ecyclability – Design for remanufacture – Design for energy efficiency – Design to regulations and standards.

REFERENCES:

1. Boothroyd, G, 1980 Design for Assembly Automation and Product Design, New York, Marcel Dekker.
2. Bralla, Design for Manufacture handbook, McGraw hill, 1999.
3. Boothroyd, G, Heartz and Nike, Product Design for Manufacture, Marcel Dekker, 1994.
4. Dickson, John. R, and Corroda Poly, Engineering Design and Design for Manufacture and Structural Approach, Field Stone Publisher, USA, 1995.
5. Fixel, J. Design for the Environment McGraw hill., 1996.
6. Graedel T. Allen By. B. Design for the Environment Angle Wood Cliff, Prentice Hall. Reason Pub., 1996.
7. Kevien Otto and Kristin Wood, Product Design, Pearson Publication, 2004.

WEBSITE

1. www,Ulrich – Epingar.Net
2. www.dfma.com

208CCPE04 – METROLOGY AND NON DESTRUCTIVE TESTING

Unit I MEASURING MACHINES

Tool Maker's microscope – Co-ordinate measuring machines – Universal measuring machine – Laser viewers for production profile checks – Image shearing microscope – Use of computers – Machine vision technology – Microprocessors in metrology.

Unit II STATISTICAL QUALITY CONTROL

Data presentation – Statistical measures and tools – Process capability – Confidence and tolerance limits – Control charts for variables and for fraction defectives – Theory of probability – Sampling – ABC standard - Reliability and life testing.

Unit III LIQUID PENETRANT AND MAGNETIC PARTICLE TESTS

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

Unit IV RADIO GRAPHY

Sources of ray-x-ray production – properties of d and x rays – film characteristics – exposure charts – contrasts – operational characteristics of x ray equipment – applications.

Unit V ULTRASONIC AND ACOUSTIC EMISSION TECHNIQUES

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.

REFERENCES:

1. JAIN,R.K. "Engineering Metrology", Khanna Publishers, 1997.
2. Barry Hull and Vernon John, "Non Destructive Testing", MacMillan, 1988.
3. American Society for Metals, "Metals Hand Book", Vol II, 1976.
4. Progress in Acoustic Emission, "Proceedings of 10th International Acoustic Emission Symposium", Japanese Society for NDI, 1990.

WEB REFERENCES

1. www.metrologytooling.com
2. www.sisndt.com
3. www.iuk'tu-harburg.de

208CCPE05 – DESIGN OF MATERIAL HANDLING EQUIPMENTS

(Use of Approved Data Book Is Permitted)

Unit I MATERIALS HANDLING EQUIPMENT

Types, selection and applications

Unit II DESIGN OF HOISTS

Design of hoisting elements: Welded and roller chains – Hemp and wire ropes – Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks – crane grabs – lifting magnets – Grabbing attachments – Design of arresting gear – Brakes: shoe, band and cone types.

Unit III DRIVES OF HOISTING GEAR

Hand and power drives – Traveling gear – Rail traveling mechanism – cantilever and monorail cranes – slewing, jib and luffing gear – cogwheel drive – selecting the motor ratings.

Unit IV CONVEYORS

Types – description – design and applications of Belt conveyors, apron conveyors and escalators Pneumatic conveyors, Screw conveyors and vibratory conveyors.

Unit V ELEVATORS

Bucket elevators: design – loading and bucket arrangements – Cage elevators – shaft way, guides, counter weights, hoisting machine, safety devices – Design of form lift trucks.

TEXT BOOKS

1. Rudenko. N., Materials handling equipment, Elnvee Publishers, 1970.
2. Spivakovsy, A.O. and Dyachkov, V.K., L Conveying Machines, Volumes I and II, MIR Publishers, 1985.

REFERENCES

1. Alexandrov, M., Materials Handling Equipments, MIR Publishers, 1981.
2. Bolyzharol, A., Materials Handling Handbook, The Ronald Press Company, 1958.
3. Tech, P.lS.G., "Design Data Book", Kalaikathir Achchagam, Coimbatore, 2003.
4. Lingaiah. K. and Narayana Iyengar, "Machine Design Data Hand Book", Vol. 1 & 2, Suma Publishers, Bangalore, 1983.

208CCPE06 – RELIABILITY ENGINEERING

Unit I RELIABILITY CONCEPT

Reliability function – failure rate – Mean time between failures (MTBF) – Mean time to failure (MTTF) – a priori and a posteriori concept – mortality curve – useful life availability – maintainability – system effectiveness.

Unit II RELIABILITY DATA ANALYSIS

Time to failure distributions – Exponential, normal, Gamma, Weibull, ranking of data – probability plotting techniques – Hazard plotting.

Unit III RELIABILITY PREDICTION MODELS

Series and parallel systems – RBD approach – Standby systems –m/n configuration – Application of Baye's theorem – cut and tie set method – Markov analysis – FTA – Limitations.

Unit IV RELIABILITY PREDICTION MODELS

Reliability testing – Reliability growth monitoring – Non-parametric methods – Reliability and life cycle costs – Reliability allocation – Replacement model.

Unit V RISK ASSESSMENT

Definition and measurement of risk – risk analysis techniques – risk reduction resources – industrial safety and risk assessment.

REFERENCES:

1. Modarres. "Reliability and Risk analysis", Mara Dekker Inc, 1993.
2. John Davidson, "The Reliability of Mechanical system", published by the Institution of Mechanical Engineers, London, 1988.
3. Smith C.O. "Introduction to Reliability in Design", McGraw Hill, London, 1976.

THIRD SEMESTER

308CCPE01 – MECHATRONICS IN MANUFACTURING SYSTEMS

Unit I INTRODUCTION

Introduction to Mechatronics – Systems – Mechatronics in Products – Measurement Systems – Control Systems – Traditional design and Mechatronics Design.

Unit II SENSORS AND TRANSDUCERS

Introduction – Performance Terminology – Displacement, Position and Proximity – Velocity and Motion – Fluid pressure – Temperature sensors – Light sensors – Selection of sensors – Signal processing – Servo systems.

Unit III MICROPROCESSORS IN MECHATRONICS

Introduction – Architecture – Pin configuration – Instruction set – Programming of Microprocessors using 8085 instructions – Interfacing input and output devices – Interfacing D/A converters and A/D converters – Applications – Temperature control – Stepper motor control – Traffic light controller.

Unit IV PROGRAMMABLE LOGIC CONTROLLERS

Introduction – Basic structure – Input / Output processing – Programming – Mnemonics Timers, Internal relays and counters – Data handling – Analog input / output – Selection of PLC.

Unit V DESIGN AND MECHATRONICS

Designing – Possible design solutions – Case studies of Mechatronics systems.

TEXT BOOKS

1. Michael B. Histand and David G Alciatore, "Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 1999.
2. Bradley, D.A., Dawson, D, Buru, N.C. and Loader, AJ, "Mechatronics", Chapman and Hall, 1993.
3. Ramesh.S, Gaonkar, "Microprocessor Architecture, Programming and Applications", Wiley Eastern, 1998.
4. Lawrence J.Kamm, "Understanding Electro-Mechanical Engineering, An Introduction to Mechaatronics", Prentice-Hall, 2000.
5. Ghosh, P.K. and Sridhar, P.R., 0000 to 8085, "Introduction to Microprocessors for Engineers and Scientists", Second Edition, Prentice Hall, 1995.

WEB REFERENCE:

1. www.cs.Indiana.edu

308CCPE02 – COMPUTER AIDED PROCESS PLANNING

Unit I INTRODUCTION

The Place of Process Planning in the Manufacturing cycle – Process Planning and Production Planning – Process Planning and Concurrent Engineering, CAPP, Group Technology.

Unit II PART DESIGN REPRESENTATION

Design Drafting – Dimensioning – Conventional tolerance – Geometric tolerance – CAD – input / output devices – topology – Geometric transformation – Perspective transformation – Data structure – Geometric modeling for process planning – GT coding – The optiz system – The MICLASS system.

Unit III PROCESS ENGINEERING AND PROCESS SYSTEMS

Experienced, based planning – Decision table and decision trees – Process capability analysis – Process Planning – Variant process planning – Generative approach – Forward and Backward planning, Input format, AI.

Unit IV COMPUTER AIDED PROCESS PLANNING SYSTEMS

Logical Design of a Process Planning – Implementation considerations – manufacturing system components, production Volume, No. of production families – CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP.

Unit V AN INTERGRADED PROCESS PLANNING SYSTEMS

Totally integrated process planning systems – An Overview – Modulus structure – Data Structure, operation – Report Generation, Expert process planning.

REFERENCES

1. Gideon Halevi and Ronald D. Weill, "Principles of Process Planning", A logical approach, Chapman & Hall, 1995.
2. Tien-Chien chang, Richard A. Wysk, "An Introduction to automated process planning systems", Prentice Hall, 1985.
3. Chang, T.C., "An Expert Process Planning System", Prentice Hall, 1985.
4. Nanua Singh, "Systems Approach to Computer Integrated Design and Manufacturing", John Wiley & Sons, 1996.
5. Rao, "Computer Aided Manufacturing", Tata McGraw Hill Publishing Co., 2000.

WEB REFERENCES:

1. http://claymore.engineer.gusu.edu/jackh/eod/automate/capp/capp.htm
2. http://Estraj.ute.sk/journal/engl/027/027.htm

308CCPE03 – DATA COMMUNICATION IN CAD / CAM

Unit I DIGITAL COMPUTERS & MICRO PROCESSORS

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 × 86 and modes of operation. Features of Pentium Processors.

Unit II OPERATING SYSTEM & ENVIRONMENTS

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

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

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

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

REFERENCES

1. Morris Mano. M., "Computer System Architecture", Prentice Hall of India, 1996.
2. Gaonkar R.S., "Microprocessor Architecture, Programming and Applications of 8085", Penram International, 1997.
3. Peterson J.L., Galvin P. and Silberschaz, A., "Operating Systems Concepts", Addison Wesley, 1997.
4. Alfred V. Aho, Ravi Setjhi, Jeffrey D Ullman, "Compilers Principles Techniques and Tools", Addison Wesley, 1986.
5. William Stallings, "Data of Computer Communications" Prentice Hall of India, 1997.
6. Andrew S. Tanenbanum "Computer Networks", Prentice Hall of India 3rd Edition, 1996.
7. Christian Crumlish, "The ABC's of the Internet", BPB Publication, 1996.

308CCPE04 - RAPID PROTOTYPING AND TOOLING

(Common for M.E. CAD/CAM and Engineering Design)

UNIT – I

Introduction: Need for time compression in product development, Product development – conceptual design – development – detail design – prototype – tooling.

UNIT – II

Classification of RP systems, Stereo lithography systems – Principle – process parameters – process details – machine details, Applications.
Direct Metal Laser Sintering (DMLS) system – Principle – process parameters – process details – machine details, Applications.

UNIT – III

Fusion Deposition Modeling – Principle – process parameters – process details – machine details, Applications.
Laminated Object Manufacturing – Principle – process parameters – process details – machine details, Applications.

UNIT – IV

Solid Ground Curing – Principle – process parameters – process details – machine details, Applications, 3-Dimensional printers – Principle – process parameters – process details – machine details, Applications, and other concept modelers like thermo jet printers, Sander's model maker, JP system 5, Object Quadra system.

UNIT – V

Laser Engineering Net Shaping (LENS), Ballistic Particle Manufacturing (BPM) – Principle, Introduction to rapid tooling – direct and indirect method, software for RP – STL files, Magics, Mimics, Application of Rapid prototyping in Medical field.

TEXT BOOK:

1. Pham, D.T. & Dimov. S.S., Rapid manufacturing, Springer-Verlag, London, 2001.

REFERENCE:

1. Terry wohlers, Wohlers Report 2000, Wohlers Associates, USA, 2000.

308CCPE05 – TRIBOLOGY IN DESIGN

Unit I SURFACES, FRICTION AND WEAR

Topography of Surfaces – Surface features – Surface interaction – Theory of Friction – Sliding and Rolling Friction, Friction properties of metallic and non-metallic materials - friction in extreme conditions – wear, types of wear – mechanism of wear – wear resistance materials – surface treatment – Surface modifications – surface coatings.

Unit II LUBRICATION THEORY

Lubricants and their physical properties lubricants standards – Lubrication Regimes Hydrodynamic lubrication – Reynolds Equation, Thermal, inertia and turbulent effects – Elasto hydrodynamic and plasto hydrodynamic and magneto hydrodynamic lubrication – Hydro static lubrication – Gas lubrication.

Unit III DESIGN OF FLUID FILM BEARINGS

Design and performance analysis of thrust and journal bearings – Full, partial, fixed and pivoted journal bearings design – lubricant flow and delivery – power loss, Heat and temperature rotating loads and dynamic loads in journal bearings – special bearings – Hydrostatic Bearing design.

Unit IV ROLLING ELEMENT BEARINGS

Geometry and kinematics – Materials and manufacturing processes – contact stresses – Hertzian stress equation – Load divisions – Stresses and deflection – Axial loads and rotational effects, Bearing life capacity and variable loads – ISO standards – Oil films and their effects – Rolling Bearings Failures.

Unit V TRIBO MEASUREMENT IN INSTRUMENTATION

Surface Topography measurements – Election microscope and friction and wear measurements – Laser method – instrumentation – International standards – bearings performance measurements – bearing vibration measurement.

REFERENCES:

1. Cameron, A. "Basic Lubrication Theory", Ellis Herward Ltd., OK, 1981.
2. Hulling, J. (Editor) – "Principles of Tribology", Macmillian – 1984.
3. Williams J.A. "Engineering Tribology", Oxford Univ. Press, 1994.
4. Neale, M.J. "Tribology Hand Book", Butterworth Heinemann, 1995.

WEB REFERENCES:

1. http://www.csetr.org/link.htm
2. http://www.me.psu.edu/research/tribology.html

308CCPE06 – DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS

Unit I OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS

Hydraulic Power Generators – Selection and specification of pumps, pump characteristics, Linear and Rotary Actuators – selection, specification and characteristics.

Unit II CONTROL AND REGULATION ELEMENTS

Pressure – direction and flow control valves – relief valves, non-return and safety valves – actuation systems.

Unit III HYDRAULIC CIRCUITS

Peciprocation, quick return, sequencing, synchronizing circuits – accumulator circuits – industrial circuits – press circuits – hydraulic milling machine – grinding, planning, copying, - forklift, earth mover circuits – design and selection of components – safety and emergency mandrels.

Unit IV PNEUMATIC SYSTEMS AND CIRCUITS

Pneumatic fundamentals – control elements, position and pressure sensing – logic circuits – switching circuits – fringe conditions modules and these integration – sequential circuits – cascade methods – mapping methods – step counter method – compound circuit design – combination circuit design.

Unit V INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS

Pneumatic equipments – selection of components – design calculations – application – fault finding – hydro pneumatic circuits – use of microprocessors for sequencing – PLC, Low cost automation – Robotic circuits.

REFERENCES:

1. Antony Espossito, "Fluid Power with Applications", Prentice Hall, 1980.
2. Dudleyt, A. Pease and John J. Pippenger, "Basic fluid power", Prentice Hall, 1987.
3. Andrew Parr, "Hydraulic and Pneumatics" (HB), Jaico Publishing House, 1999.
4. Bolton. W., "Pneumatic and Hydraulic Systems", Butterworth – Heinemann, 1997.

WEB REFERENCES:

1. www.pneumatics.com/
2. www.fluidpower.com/

308CCPE07 – ADVANCED TOOL DESIGN

Unit I TOOL-DESIGN METHODS

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 – Electro – discharge machining for cavity.

Unit II TOOLING MATERIALS AND HEAT TREATMENT

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

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

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 – Formating dies – Drawing operations.

Unit V TOOL DESIGN FOR NUMERICALLY CONTROLLED MACHINE TOOLS

Introduction – The need for numerical control – A basic explanation of numeric control – Numerical control systems in use today – Fixture design for numerically controlled machine tools – Cutting tools for numerical control – 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.

REFERENCES:

1. Cyrll Donaldson, George H.LeCain, V.C. Goold, "Tool Design", Tata McGraw Hill publishing Company Ltd., 2000.
2. Prkash Hiralal Joshi, "Tooling data", Wheeler Publishing, 2000.

WEB REFERENCES:

1. www.irdi.on.ca/irdi/front.htm
2. www.techsolve.org/flashhome.htm

308CCPE08 – OPTIMIZATION TECHNIQUES IN DESIGN

Unit I INTRODUCTION

General Characteristics of mechanical elements, adequate and optimum design, principles of optimization, formulation of objective function, design constraints – Classification of optimization problem.

Unit II OPTIMIZATION TECHNIQUES

Single variable and multivariable optimization, Techniques of unconstrained minimization – Golden section, Random, pattern and gradient search methods – Interpolation methods; Optimization with equality and inequality constraints.

Unit III MULTI OBJECTIVE OPTIMIZATION

Direct methods – Indirect methods using penalty functions, Lagrange multipliers; Geometric programming and stochastic programming; Multi objective optimization, Genetic algorithms and Simulated Annealing techniques.

Unit IV STATIC APPLICATIONS

Structural applications – Design of simple truss members. Design applications – Design of simple axial, transverse loaded members for minimum cost, maximum weight – Design of shafts and torsionally loaded members – Design of springs.

Unit V DYNAMIC APPLICATIONS

Dynamic Applications – Optimum design of single, two degree of freedom systems, vibration absorbers. Application in Mechanisms – Optimum design of simple linkage mechanisms.

REFERENCES:

1. Johnson Ray, C., "Optimum design of mechanical elements", Wiley, John & Sons, 1990.
2. Goldberg, D.E., "Genetic algorithms in search, optimization and machine", Barnen, Addison-Wesley, New York, 1989.
3. Kalyanamoy Deb, "Optimization for Engineering design algorithms and Examples", Prentice Hall of India Pvt. 1995.

308CCPE09 – ADVANCED MECHANISM DESIGN AND SIMULATION

Unit I INTRODUCTION

Review of fundamentals of kinematics – mobility analysis – formation of one D.O.F. multi loop kinematic chains, Network formula – Gross motion concepts.

Unit II KINEMATIC ANALYSIS

Position Analysis – Vector loop equations for four bar, slider crank, inverted slider crank, geared five bar and six bar linkages. Analytical methods for velocity and acceleration Analysis – four bar linkage jerk analysis. Plane complex mechanisms.

Unit III PATH CURVATURE THEORY

Fixed and moving centrodes, iinflection points and inflection circle. Euler Savary equation, graphical constructions – cubic of stationary curvature.

Unit IV SYNTHESIS OF MECHANISMS

Type synthesis – Number synthesis – Associated Linkage Concept. Dimensional synthesis – function generation, path generation, motion generation, Graphical methods. Cognate linkages – Coupler linkages – Coupler curve synthesis, design of six-bar mechanisms. Algebraic methods. Application of instant center in linkage design. Cam Mechanisms – determination of optimum size of Cams.

Unit V DYNAMICS OF MECHANISMS AND SPATIAL MECHANISMS AND ROBOTICS

Static force analysis with friction – Inertia force analysis – combined static and inertia force analysis, shaking force, Kinetostatic analysis. Introduction to force and moment balancing of linkages.
Kinematic Analysis of Spatial RSSR mechanism – Denavit – Hartenberg Parameters, Forward and inverse Kinematics of Robotic Manipulators.
Study and use of Mechanism using Simulation Soft-ware packages.

REFERENCES:

1. Sandor G.N., and Erdman A.G., "Advanced Mechanism Design Analysis and Synthesis", Prentice Hall, 1984.
2. Shigley, J.E., and Uicker, J.J., "Theory of Machines and Mechanisms", McGraw Hill, 1995.
3. Amitabha Ghosh and Asok Kumar Mallik, "Theory of Mechanism and Machines", EWLP, Delhi, 1999.

4. Nortron R.L., "Design of Machinery", McGraw Hill, 1999.
5. Kenneth J, Waldron, Gary L. Kinzel, "Kinematics, Dynamics and Design of Machinery", John Wiley-sons, 1999.

WEB REFERENCES:

1. http://www.machinedesign.com/

308CCPE10 – ADVANCED STRENGTH OF MATERIALS

Unit I ELASTICITY

Stress-Strain relations and general equations of elasticity in Cartesian, Polar and spherical coordinates differential equations of equilibrium – compatibility-boundary conditions-representation of three-dimensional stress of a tension generalized hook's law-St. Venant's principle-plane stress-Airy's stress function.

Unit II SHEAR CENTER AND UNSYMMETRICAL BENDING

Location of shear center for various sections - shear flows.
Stresses and deflections in beams subjected to unsymmetrical loading-kern of a section.

Unit III CURVED FLEXIBLE MEMBERS AND STRESSES IN FLAT PLATES

Circumference and radial stresses-deflections-curved beam with restrained ends-closed ring subjected to concentrated load and uniform load-chain links and crane hooks.
Stresses in circular and rectangular plates due to various types of loading and end conditions buckling of plates.

Unit IV TORSION OF NON-CIRCULAR SECTIONS

Torsion of rectangular cross section – S.Venants theory – elastic membrane analogy Prandtl's stress function torsional stress in hollow thin walled tubes.

Unit V STRESSES DUE TO ROTARY SECTIONS AND CONTACT STRESSES

Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness allowable speeds.
Methods of computing contact stress-deflection of bodies in point and line contact applications.

REFERENCES:

1. Seely and Smith, "Advanced Mechanics of Materials", John Wiley International Edn, 1952.
2. Rimoahwnko, "Strength of Materials", Van Nostrand.
3. Timoshenko and Goodier, "Theory of Elasticity", McGraw Hill.
4. Wang, "Applied Elasticity", McGraw Hill.
5. Cas, "Strength of Materials", Edward Arnold, London 1957.
6. Robert D. Cook, Warren C. Young, "Advanced Mechanics of Materials", Mc-millan pub. Co., 1985.

308CCPE11 – COMPUTATIONAL FLUID DYNAMICS

Unit I GOVERNING DIFFERENTIAL EQUATION AND FINITE DIFFERENCE METHOD

Classification, Initial and Boundary conditions, Initial and Boundary value problems. Finite difference method, Central, Forward, Backward difference. Uniform and non-uniform Grids. Numerical Errors. Grid Independence Test.

Unit II CONDUCTION HEAT TRANSFER

Steady one-dimensional conduction. Two and Three-diemensional steady state problems. Transient one-dimensional problem. Two-dimensional Transient Problems.

Unit III INCOMPRESSIBLE FLUID FLOW

Coverning Equations, Stream Function – Verticity method, Determination of pressure for viscous flow, SIMPLE Procedure of Patankar and spalding, Computation of Boundary layer flow, Finite difference approach.

Unit IV CONVECTION HEAT TRANSFER AND FEM

Steady One-Dimensional and Two-Dimensional Convection – Diffusion, Unsteady one- dimensional convection – Diffusion, Unsteady two-dimensional convection – Diffusion – Introduction to finite element method – Solution of steady heat conduction by FEM – Incompressible flow – Simulation by FEM.

Unit V TURBULENCE MODELS

Algebraic Models – One equation model, K – ϵ Models, Standard and High and Low Reynolds number models, Prediction of fluid flow and heat transfer using standard codes.

REFERENCES:

1. Muralidhar, K, and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 1995.
2. Ghoshdasdidar, P.S., "Computer Simulation of flow and heat transfer" Tata McGraw-Hill Publishing Company Ltd., 1998.
3. Subas, V. Patankar "Numerical heat transfer fluid flow", Hemisphere Publishing Corporation, 1980.
4. Taylor, C and Hughes, J.B. "Finite Element Programming of the Navier Stock Equation., Pineridge Press Limited, U.K., 1981.
5. Anderson, D.A., Tannehill, J.I., and Pletcher, R.H., "Computational fluid Mechanics and Heat Transfer", Hemiphere Publishing Corporation, New York, USA, 1984.
6. Fletcher, C.A.J. "Computational Techniques for Fluid Dynamics 1", Fundamental and General Techniques, Springer – Verlag, 1987.
7. Fletcher, C.A.J. "Computational Techniques for Fluid Dynamics 2", Specific Techniques for Different Flow Categories, Springer – Verlag, 1987.

8. Bose, T.X., "Numerical Fluid Dynamics", Narosa Publishing House, 1997.

Registrar