# MMMD-201- Adv. Machine Design

Gear and Gear Trains:  Synthesis of tooth profile for circular spur gears, noncircular spur gears with constant distance. Generation of logarithmic function, Elliptical gears, equiangular spirals teeth of lion 'circular gears.

Gear trains:  Determination of gear train for a given velocity-ratio upto a desired degree of accuracy.  Method of conjugate fraction, properties of conjugate fraction, Broct's table of fraction and its  application.  Change speed gears. preferred numbers. "three shaft ,step change of speed, arrangement of  change speed gear box.

Cams: Forces in rigid system, Mathematical models, analytica methods, position error, jump, shock,  unbalance, spring, surge and winding.  Synthesis of cams:  High speed can design, kloomoek and Muffley analytical function of cycloid, harmonic and  eigntu power polynomial. Analytical cam design.

Analytical cam design:  Disc cam with radial flat faced follower disc cam with radial roller follower disc cam with oscillating roller follower Linkages:  Number synthesis, type synthesis dimemsional synthesis four bar linkage Freudenstein's Equation.

REFERENCE BOOKS

I. Mechanism and dynamics of machinery)' By M.H.Magic and P.W.Oevirk, J.S. Beggs
2. Mechanisms - Baggs.
3. Gears - Hand book by dudley.
4. Cams - Rothbart.
5. Mechanisms alld Machines - A.Ghosh and Malik

# MMMD 202  FINITE ELEMENT METHOD

**INTRODUCTION:**
Background and application of Finite Element Method, Matrix te,;hniques - solution of larg~ system of algebric equations, inverse of a matrix, eigen value problem.

**THEORY OF FINITE ELEMENT METHOD:**
Calculus of variation, variational principles. weighted residual "approach. The concept of In element, various element shapes, isoperimetric elements. shape functions. A simple structural problem. The F.E.M. solution procedure, plane stress, plane strain body or structure, Mesh refinement, Interelement  compatibility and continuity; convergence criteria. Boundary conditions, Solution of the overall problem, Three dimensional stress analysis using tetrahedral and prismatic elements,

**TECHNIQUES FOR NON LINEAR ANALYSIS:**
Non linear analysis. Basic nonlinear solution techniques, computer aspects of nonlinear techniques, problems involving material and geometric nonlinearity,

**APPLICATION OF FINITE ELEMENT METHOD):**
Introduction to the solution of problems ill theory of elasticity, fluid flow, heat conduction ctc.

**REFERENCE BOOKS RECOMMENDED:**
I. Introduction to finite element Method By : Chandrakant S.Dcsai and Abcl,
2.The finite element Method By : Zienkiewicz
3.Introduction to finite element Analysis (Theory and Application) By: H.C.Martin and Grahm Carey

# MMMD 203  ROBOTICS

UNIT – I

Introduction: Automation and Robotics, CAD/CAM and Robotics – An over view of Robotics – present and future applications – classification by coordinate system and control system. Components of the Industrial Robotics: Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom, Requirements and challenges of end effectors, determination of the end effectors, comparison of Electric, Hydraulic and Pneumatic types of locomotion devices.

UNIT-II

Motion Analysis: Homogeneous transformations as applicable to rotation and translation – problems. Manipulator Kinematics: Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics – problems

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UNIT–III

Differential transformation and manipulators, Jacobians–problems. Dynamics: Lagrange – Euler and Newton – Euler formations – Problems.

UNIT-IV

Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion – straight line motion – Robot programming, languages and software packages.

UNIT-V

Robot actuators and Feed  back components: Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors. Feedback components: position sensors,  potentiometers, resolvers, encoders,  Velocity sensors. Robot Application in Manufacturing: Material Transfer,  Material handling,  loading and unloading- Processing,  spot and continuous arc welding & spray painting , Assembly and Inspection

**REFERENCES :**

1. Industrial Robotics / Groover M P /Pearson Edu.
2. Robotics and Control / Mittal R K & Nagrath I J / TMH.
3. Robotics / Fu K S/ McGraw Hill.
4. An Introduction to Robot Technology, / P. Coiffet and M. Chaironze / Kogam Page Ltd. 1983 London.
5. Robotic Engineering / Richard D. Klafter, Prentice Hall
6. Robot Analysis and Intelligence / Asada and Slow time / Wiley Inter-Science.
7. Introduction to Robotics / John J Craig / Pearson Edu.
8. Robot Dynamics & Control – Mark W. Spong and M. Vidyasagar / John Wiley & Sons (ASIA) Pte Ltd.

# MMMD 204  Industrial  Tribology

UNIT I

Friction and Wear Friction Control and Wear prevention, Boundary Lubrication, Tribological properties of Bearing Materials and Lubricants, Theories of friction and wear, instabilities and stick-slip motion.

UNIT-II

Lubrication of Bearings:- Mechanics of Fluid Flow, Reynold's Equation and its limitations, idealized bearings, infinitely long plane pivoted and fixed show sliders, infinitely long and infinitely short (narrow) journal bearings, lightly loaded infinitely long journal bearing (Petroff's solution).

UNIT-III

Finite Bearings Hydrostatic, Hydrodynamic and thrust oil bearings, heat in bearings. Hydrostatic squeeze film:-Circular and rectangular flat plates, variable and alternating loads, piston pin lubrications, application to journal bearings.

UNIT IV

Elasto-hydrodynamic Lubrication:-Pressure-viscosity term in Reynold's Equation, Hertz theory, Ertel-Grubin Equation, lubrication of spheres. Air lubricated bearings:-Tilting pad bearings, hydrostatic, hydrodynamic and thrust bearings with air lubrication.

UNIT V

Tribological aspects of rolling motion:- The mechanics of tyre-road interaction, road grip and rolling resistance, Tribological aspects of wheel on rail contact, Tribological aspects of metal rolling, drawing and extrusion. Tribo characteristics of different materials, Evaluation of friction & wear through experiments under influencing parameters, pV value of materials.

**Reference Books**

1. Basic Lubrication Theory- A Camaron
2. Integral Approaches to Tribo-testing in Mechanical Engineering – Dr H. Prashad
3. Principles of Lubrication – A Camaron, Longman's Green Co. Ltd.
4. Theory and Practice for Engineers – D. D. Fuller, John Wiley and sons.
5. Fundamental of Friction and Wear of Metals – ASM
6. The Design of Aerostatic Bearings – J. W. Powell
7. Gas Bearings – Grassam and Powell
8. Theory Hydrodynamic Lubrication Pinkush and Sterrolicht
9. Tribology in Machine Design – T. A. Stolarski

# MMMD/MMPD  205  Vibration & Noise Control

Unit 1

(A) Multi Degree Freedom System:-Free Vibration equation of motion. Influence Coefficient i) Stiffness Coeff. ii)Flexibility Coeff. Generalized coordinates, and Coordinate couplings. Langranges Equations Matrix Method Eigen Values Eigen Vector problems. Modal Analysis. Forced Vibrations of undamped system and modal analysis.

(B) Multi Degree System Numerical Methods:- (i)Rayleigh`s Method, (ii)Rayleigh-Ritz Method (iii) Holzer`s Method (iv)Methods of Matrix iterations (v) Transfer Matrix Method, Impulse response and frequency response functions.

Unit 2

Continuous System: -   Vibrations of String, Bars, Shafts and beams, free and forced vibration of continuous systems. Vibration Measurement:- FFT analyzer, vibration exciters, signal analysis. Time domain & Frequency domain analysis of signals. Experimental modal analysis, Machine Conditioning and Monitoring, fault diagnosis.

 Unit 3

Transient vibrations:- Response of a single degree of freedom system to step and any arbitrary excitation, convolution (Duhamel's) integral, impulse response functions. Vibration Control:- Balancing of rotating machine, In-situ balancing of rotors, control of natural frequency introduction of damping, vibration isolation & vibration absorbers.

Unit 4

Random Vibrations:- Expected values auto and cross correlation function, Spectral density, response of linear systems, analysis of narrow band systems. Non Linear Vibrations:-Systems with non-linear elastic properties, free vibrations of system with non-linear elasticity and damping, phase-plane technique, Duffing's equation, jump phenomenon, Limit cycle, perturbation method.

Unit 5

Noise and Its Measurement:- Sound waves, governing equation its propagation, Fundamentals of Noise , Decibel, Sound Pressure level, Sound Intensity, Sound fields, reflection, absorption and transmission .Noise measurement , Sound meter , Allowed exposure levels and time limit by B.I.S., Octave Band analysis of sound, Fundamentals of Noise control, source control, path control ,enclosures, noise absorbers, noise control at receiver.

Reference Books

1       Theory of Vibrations with Applications: W T Thomson CBS Publishers,

         Delhi.

2       Mechanical Vibrations : S S Rao Addison-Wesley Publishing Co.
3       Fundamentals of Vibration: Leonard Meirovitch, McGraw Hill International Edison.

4       Principles of Vibration Control: Asok Kumar Mallik, Affiliated East-West Press.

5       Mechanical Vibrations A H Church ,John Wiley & Sons Inc

6       Mechanical Vibrations J P Den Hartog ,McGraw Hill.

7       Mechanical Vibration Analysis : Srinivasan ,McGraw Hill.
8       Mechanical Vibrations : G K Groover. Vibration and Noise for Engineers:

         Kewal Pujara , Dhanpat Rai & co.