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SPPU B.E./B.Tech MECH Sem 7 syllabus

Hydraulics and Pneumatics

Course Code : 402041

Course Name : Hydraulics and Pneumatics

Credits TH : 03 TH : 03

Unit 1: Basics of Fluid Power and Pumps

Fluid power basics, advantages and limitations, fluid power distribution, standard symbols, energy loss in hydraulic systems. Pumps - types, classification, principle of working and constructional details of vane pumps, gear pumps, radial and axial plunger pumps, screw pumps, power and efficiency calculations, and characteristics curves.

Unit 2: Actuators and Power Unit

Linear and rotary actuators- types, construction and characteristics. Cylinder mountings, cushioning of cylinders. Power units and accessories - types of power units, reservoir assembly, constructional details. Accumulators, Intensifiers, Pressure and Temperature switches /sensors, level sensors.

Unit 3: Fluid Power Control

Direction control valves - center positions, methods of actuation, two stage valves, Flow control valves - pressure and temperature compensated. Pressure control valves - pressure reducing valve, sequence valve, unloading valve, brake valve, back pressure valve, counter balance valve, check valves, prefill valve, servo valves, cartridge valves, proportional valves.

Unit 4: Hydraulic Circuits and Contamination Control

Hydraulic circuits: Simple reciprocating, regenerative, speed control (meter in, meter out and bleed off), sequencing, synchronization,

traverse and feed, automatic reciprocating, fail safe circuit, counter balance circuit, actuator locking, unloading circuit, motor breaking circuit etc.

Contamination control: Contamination, sources of contamination, suction strainer, filters, filtration, filter ratings.

Unit 5: Pneumatics - Components, Control Valves and Circuits

Compressors - Types, principle of working and constructional details. Comparison of pneumatic with hydraulic power transmissions. Types of filters, pressure regulators, lubricators, mufflers, dryers, direction control valves, pneumatic actuators, shuttle valve, two pressure valve, quick exhaust valve and time delay valves, electro-pneumatics. Speed regulating methods, pneumatic circuits, reciprocating, cascading time delay etc. Application of pneumatics in low cost automation and in industrial automation.

Unit 6: System Analysis and Design

Calculation of piston velocity, thrust under static and dynamic applications, considering friction, inertia loads, design considerations for cylinders, Design of hydraulic/pneumatic circuits for practical application, selection of different components such as reservoir, control elements, actuators, accumulator, intensifier, filters, pumps. (Students are advised to refer manufacturers' catalogues for design and use simulation tool like Automation Studio for analysis).

Books

Text :

1. Esposito A, Fluid Power with application, Prentice Hall
2. Majumdar S.R, Oil Hydraulic system- Principle and maintenance ,Tata McGraw Hill
3. Majumdar S.R, Pneumatics Systems Principles and Maintenance ,Tata McGraw Hill
4. Stewart H. L, Hydraulics and Pneumatics , Taraporewala Publication

References :

1. Pipenger J.J, Industrial Hydraulics, McGraw Hill
2. Pinches, Industrial Fluid Power, Prentice Hall
3. Yeaple, Fluid Power Design Handbook
4. Andrew A. Parr, Hydraulics and Pneumatics, Elsevier Science and Technology Books
5. ISO - 1219, Fluid Systems and components, Graphic Symbols
6. Standard Manufacturer's Catalogues

CAD CAM and Automation

Course Code : 402042

Course Name : CAD CAM and Automation

Credits TH : 03 TW : 01

Unit 1: Computer Graphics

Transformations (2D & 3D) : Introduction, Formulation, Translation, Shear, Rotation, Scaling and reflection, Homogeneous representation, Concatenated transformation, Mapping of geometric models, Inverse transformations, Introduction to 3D transformation (Theory + Numerical treatment only for 2D - Max 3 vertices)

Projections : Orthographic, Isometric, Perspective projections (Only theory)

Unit 2: Geometric Modeling

Curves - Introduction, Analytical curves (Line, circle, ellipse, parabola, hyperbola), Synthetic curves (Hermite Cubic Spline, Bezier, B-Spline Curve) [Numerical on Line, Circle, Ellipse, Hermite Cubic Spline, Bezier]

Surfaces - Introduction, Surface representation, Analytic surfaces, Synthetic Surfaces, Hermite bicubic, Bezier, B-Spline, Coons patch surface, Applications in freeform surfaces [only Theory]

Solids - Introduction, Geometry and Topology, Solid Representation, Boundary Representation, Euler's equation, Constructive Solid Geometry (CSG), Boolean operation for CSG [only Theory]

Unit 3: Finite Element Analysis (FEA)

Introduction : Brief History of FEM, Finite Element Terminology (nodes, elements, domain, continuum, Degrees of freedom, loads and constraints), General FEM procedure, Applications of FEM in various fields, meshing, p and h formulation, Advantages and disadvantages of FEM [Only theory]

One Dimensional Problem: Finite element modeling, coordinate and linear shape function, Assembly of Global Stiffness Matrix and Load Vector, Properties of Stiffness Matrix, Finite Element Equations, Temperature Effects. [Theory + Numerical - composite shaft, spring elements in series and parallel]

Trusses : Introduction, 2D Trusses, Assembly of Global Stiffness Matrix [Numerical limited to 4X4 matrix]

Unit 4: Computer Aided Manufacturing (CAM)

Introduction to Computer Aided Manufacturing (CAM), Coordinate system, Working principal of CNC Lathe, Turning Centers, Milling Machine, Steps in developing CNC part program, Tool and geometric compensations, subroutine and Do loop using canned cycle. [Only theory - 2 hrs]

CNC Lathe part programming (FANUC) : Linear and circular interpolation, Canned cycles for facing, threading, grooving, etc. [Theory + Program]

CNC Milling part programming (FANUC): Linear and circular interpolation, Pocketing, contouring and drilling cycles. [Theory + Program]

Unit 5: Advanced Manufacturing Method

Product Life Cycle: Introduction, Need, Components/Elements of PLM, Collaborative Engineering. [Only theory]

Rapid Prototyping : Introduction, classification of RP Processes (SLA, LOM, SLS, FDM, 3D printing), Working principle, features, models & specification of process, application, advantages and disadvantages, Rapid Tooling and STL format, Concept of 4D Rapid Prototyping. [Only theory]

Unit 6: Automation

Automation : Introduction, Automation strategies, Types of Automation - Hard and Soft Automation, Flexible Manufacturing System - Types, Advantages, Limitations, AGVs and AS/RS [Only theory]

Group Technology: Introduction, Coding Methods, Concepts of Computer Integrated Manufacturing (CIM) and Computer Aided Process Planning (CAPP), Variant & Generative methods of CAPP, advantages of CAPP. [Only theory]

Robotics: RIA definition of Robot, Laws of robotics, Classification of robots, robot anatomy, Point to point and continuous path robotic systems, Joints, End Effectors, Grippers - Mechanical, Magnetic and Pneumatic, Applications. [Only theory]

Books

Text :

1. Ibrahim Zeid and R. Sivasubramanian - CAD/CAM - Theory and Practice Tata McGraw Hill Publishing Co. 2009
2. Chandrupatla T. R. and Belegunda A. D. -Introduction to Finite Elements in Engineering - Prentice Hall India.

3. Nitin S. Gokhale, Practical Finite Element Analysis, Finite To Infinite; First Edition edition, ISBN-10: 8190619500 ISBN-13: 978-8190619509
4. S. K. Sinha, CNC Programming using Fanuc Custom Macro B, McGraw-Hill Professional
5. S. R. Deb, Robotics Technology and Flexible Automation, Tata McGraw Hill.

References :

1. Ibraim Zeid, Mastering CAD/CAM - Tata McGraw Hill Publishing Co. 2000
2. Segerling L. J. - Applied Finite Elements Analysis, John Wiley and Sons
3. Seshu P. Text book of Finite Element Analysis, PHI Learning Private Ltd. New Delhi, 2010
4. Rao P. N., Introduction to CAD/CAM Tata McGraw Hill Publishing Co.
5. B. S. Pabla, M. Adithan, CNC Machines, New Age International, 1994
6. Groover M.P.-Automation, production systems and computer integrated manufacturing' - Prentice Hall of India
7. Ian Gibson, David W. Rosen, Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer
8. Geoffrey Boothroyd, Peter Dewhurst, Winston A. Knight, Product Design for Manufacture and Assembly, Third Edition ,CRC Press
9. Antti Saaksvuori, Anselmi Immonen, Product Life Cycle Management -Springer, 1st Edition, 2003

Dynamics of Machinery

Course Code : 402043

Course Name : Dynamics of Machinery

Credits TH : 04 TW : 01

UNIT 1: Single Degree of Freedom Systems - Free Vibration

Fundamentals of Vibration : Elements of a vibratory system, vector representation of S.H.M., degrees of freedom, Introduction to Physical and Mathematical modeling of vibratory systems : Bicycle, Motor bike and Quarter Car. types of vibration, equivalent stiffness and damping, formulation of differential equation of motion (Newton, D'Alembert and energy method)

Undamped free vibrations: Natural frequency for longitudinal, transverse and torsional vibratory systems.

Damped free vibrations: Different types of damping, Viscous damping - over damped, critically damped and under damped systems, initial conditions, logarithmic decrement, Dry friction or coulomb damping - frequency and rate of decay of oscillations.

UNIT 2: Single Degree of Freedom Systems - Forced Vibrations

Forced vibrations of longitudinal and torsional systems, Frequency Response to harmonic excitation, excitation due to rotating and reciprocating unbalance, base excitation, magnification factor, Force and Motion transmissibility, Quality Factor. Half power bandwidth method, Critical speed of shaft having single rotor of undamped systems.

UNIT 3: Two Degree of Freedom Systems - Undamped Vibrations

Free vibration of spring coupled systems - longitudinal and torsional, torsionally equivalent shafts, natural frequency and mode shapes, Eigen value and Eigen vector by Matrix method, Combined rectilinear and angular motion, Vibrations of Geared systems.

UNIT 4: Balancing

Static and dynamic balancing, balancing of rotating masses in single and several planes, primary and secondary balancing of reciprocating masses, balancing in single cylinder engines, balancing in multi-cylinder in-line engines, direct and reverse cranks method -radial and V engines.

UNIT 5: Measurement and Control of Vibration

A) Measurement: Vibration Measuring Instruments, Accelerometers, Impact hammer, Vibration shakers, Vibration Analyzer, Vibration based condition monitoring, Analysis of Vibration Spectrum, Standards related to measurement of vibration, Human response to vibrations.

B) Control : Vibration control methods, passive, semi active (Introduction to Electro-Rheological & Magneto-Rheological dampers) and active vibration control, control of excitation at the source, control of natural frequency, Vibration isolators, Tuned Dynamic Vibration Absorbers, Introduction to Torsional Damper

UNIT 6: Introduction to Noise

Fundamentals of noise Sound concepts, Decibel Level, white noise,

weighted sound pressure level, Logarithmic addition, subtraction and averaging, sound intensity, noise measurement, sound fields, octave band, sound reflection, absorption and transmission, acoustic material & its characteristics, Noise control at the Source, along the path and at the receiver, pass-by-noise, Reverberation chamber, Anechoic Chamber, Human Exposure to Noise and Noise standards.

Books

Text :

1. S. S. Rao, Mechanical Vibrations, Pearson Education Inc. New Delhi.
2. G. K. Grover, Mechanical Vibrations, New Chand and Bros., Roorkee
3. William J Palm III, Mechanical Vibration, Wiley India Pvt. Ltd, New Delhi
4. Uicker J. John, Jr, Pennock Gordon R, Shigley Joseph E., Theory of Machines and Mechanisms, International Version, OXFORD University Press, New Delhi.
5. M L Munjal, Noise and Vibration Control, Cambridge University Press India

References :

1. Weaver, Vibration Problems in Engineering, 5th Edition Wiley India Pvt. Ltd, New Delhi.
2. Bell, L. H. and Bell, D. H., Industrial Noise Control - Fundamentals and Applications||, Marcel Dekker Inc.
3. Alok Sinha, Vibration of Mechanical System, Cambridge university Press , India
4. Debabrata Nag, Mechanical Vibrations, Wiley India Pvt. Ltd, New Delhi.
5. Kelly S. G., Mechanical Vibrations, Schaums outlines, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
6. Meirovitch, L., Elements of Mechanical Vibrations||, McGraw Hill.
7. Ver, Noise and Vibration Control Engineering, Wiley India Pvt. Ltd, New Delhi.
8. Bies, D. and Hansen, C., Engineering Noise Control - Theory and Practice, Taylor and Francis.
9. Shrikant Bhave, Mechanical Vibrations Theory and Practice, Pearson, New Delhi

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