



M.E.- (MECHANICAL ENGG). -II

5. Elective –II

ELECTIVE-I: PROCESS EQUIPMENT DESIGN

Teaching Scheme:

3 Lectures (60 min) per week
1 Pract./Tut. (60 min) per week

Examination Scheme:

Uni. Exam: 100Marks
Term work: 25 Marks

1. Process Design Parameters:

Basic concepts in process design, block diagrams for flow of processes, material flow balance. Design pressures -temperatures, design stresses, factor of safety, minimum shell thickness and corrosion allowance, weld joints efficiency, design loading, stress concentration and thermal stresses, failure criteria, optimization technique such as Lagrange's multiplier and golden section method, cost and profitability estimation. Introduction to design codes like IS-2825, ASME-SECT, EIGHT-DIV-II TEMA.API-650, BS-1500 & 1515.

2. Design of Cylindrical and Spherical Vessels:

Thin and thick walled cylinder analysis, design of end closers, local stresses due to discontinuity or change of shape of vessel, vessel opening compensation, design of standard and non-standard flanges, design of vessels and pipes under external pressure, design of supports for process vessels.

3. Design of Tall Vessels and Large Storage Tanks:

Determination of equivalent stress under combined loadings including seismic and wind loads application of it to vertical equipment like distillation column.

4. Design of Thick Walled High Pressure Vessels:

Design by various theories of failure, construction of these vessels with high strength steel and other special methods.



5. Process Equipment Design:

Storage vessels, reaction vessels, agitation and mixers, heat exchangers, filters and driers, centrifuges. Code practices, selection and specification procedures used in design. Selection of pumps, compressors, electrical equipments and auxiliary services, safety, etc.

6. Process Piping Design:

Flow diagrams and pipe work symbols, design of layout of water, steam and compressed air pipes work, pipe fitting, linings and flanged connections. Types of valves used on pipe line. Fabrication of pipe lines, expansion joints and pipe supports.

7. Planning, manufacture, inspection and erection of process equipment like pressure vessels, chimneys, ducting, heat exchangers, pulverizing equipment, etc. protective coatings, lining of vessels.

8. Process Control:

Fundamentals of process measurements and control modern control devices and other controls of major unit operation and processes.

9. Applications of CAD to process Equipment Design.

Term Work:

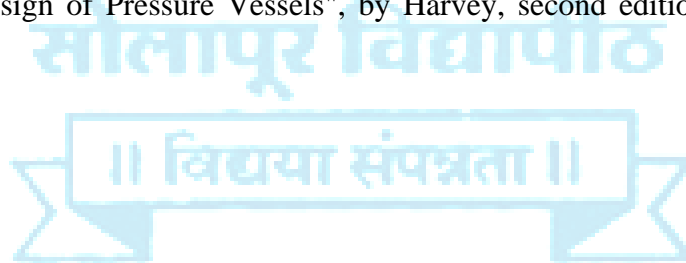
Following assignments / experiments comprise the laboratory practice :-

- 1) Design and optimization of tall vessels and large tanks.
- 2) Design of Heat exchangers used in industries.
- 3) Design of crystallizers.
- 4) Design and development of equipment useful to process industries such as sugar, cement, Chemical industries.
- 5) Preparing flow diagrams of processes, piping layout, etc.
- 6) Report based on visit to industries such as sugar, cement, chemical industries.



Reference Books:

- 1) Process Equipment Design : By Dr. M.V. Joshi, Mc-Millan.
- 2) Process Equipment Design : By Browell and Young, John Wiley.
- 3) Plant Design and Economics : Max and Timasulaus Kalus – McGraw Hill.
- 4) Industrial Instrumentation servicing Hand Book : Cannel Grady, McGraw Hill.
- 5) Handbook of Instrumentation and Control : Kellen Heward, McGraw Hill.
- 6) Chemical Engineering Handbook : Perry John, McGraw Hill.
- 7) Chemical Equipment Design : B.C. Bhattacharya.
- 8) Industrial Pipe Work : D.N.W. Kentish, McGraw Hill.
- 9) Chemical Engineering : J.M. Coulson, Richardson, Sinnott Vol. VII, Maxwell, McMillan.
- 10) Pressure Vessel Design Hand Book : H. Bedna.
- 11) Process System Analysis and Control: By D.R. Coughanowr, McGraw Hill, New York.
- 12) Engineering Optimization: Theory and Practice : By Rao S.S., New Age Publishing Co., New Delhi.
- 13) Theory and Design of Pressure Vessels", by Harvey, second edition, CBS publishers and distribution





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5. Elective –II

ROBOTICS

Teaching Scheme:

3 Lectures (60 min) per week

1 Pract./Tut. (60 min) per week

Examination Scheme:

Uni. Exam: 100Marks

Term work: 25 Marks

1. Robot Fundamentals

Definitions, History of robots, present and future trends in robotics, Robot classifications, Robot configurations, Point to Point robots, Continuous Path robots, Work volume, Issues in design and controlling robots Repeatability, Control resolution, spatial resolution, Precision, Accuracy, Robot configurations, Point to Point robots, Continuous Path robots, Work volume, Applications of robots. Drives used in robots- Hydraulic, Pneumatic and Electric drives, Comparison of drive systems and their relative merits and demerits.

2. Manipulator Kinematics:-

Matrix Algebra, Inverse of matrices, rotational groups, matrix representations of coordinate transformation, transformation about reference frame and moving frame Forward & Inverse Kinematics examples of 2R, 3R & 3P manipulators, Specifying position and orientation of rigid bodies Euler's angle and fixed rotation for specifying position and orientation Homogeneous coordinate transformation and examples D-H representation of kinematics linkages Forward kinematics of 6R manipulators using D-H representations Inverse kinematics of 6R manipulators using D-H representations, Inverse Kinematics geometric and algebraic methods.

3. Robotics Dynamics:-

Velocity Kinematics, Acceleration of rigid body, mass distribution Newton's equation, Euler's equation, Iterative Newton –Euler's dynamic formulation, closed dynamic, Lagrangian formulation of manipulator dynamics, dynamic simulation, computational consideration.



4. Trajectory planning:-

Introduction, general considerations in path description and generation, joint space schemes, Cartesian space schemes, path generation in runtime, planning path using dynamic model point to point and continuous trajectory , 4-3-4 & trapezoidal velocity strategy for robots.

5. Robot Sensors:-

Internal and external sensors, position- potentiometric, optical sensors ,encoders - absolute, incremental ,touch and slip sensors velocity and acceleration sensors, proximity sensors, force & torque sensors, laser range finder, camera. Micro-controllers, DSP, centralized controllers, real time operating systems.

6. Robot Controllers:-

Essential components-Drive for Hydraulic and Pneumatic actuators, H-bridge drives for Dc motor Overload over current and stall detection methods, example of a micro-controller/ microprocessor based robot Controller.

7. Robot Vision:-

Introduction, Image acquisition, Illumination Techniques, Image conversion, Cameras, sensors, Camera and system interface, Frame buffers and Grabbers, Image processing, low level & high level machine vision systems.

8. Robot Programming languages:-

Introduction the three level of robot programming, requirements of a robot programming language, problems peculiar to robot programming languages.

9. Futuristic topics in Robotics:-

Micro-robotics and MEMS (Microelectro mechanical systems), fabrication technology for Micro-robotics, stability issue in legged robots, under-actuated manipulators, telecheirs.

Term Work:

Minimum TEN assignments based on the above topics.



References:

- 1) S.R.Deb, “Robotics Technology and Flexible Automation “, Tata Mc Graw Hill 1994.
- 2) M.P.Groover, M. Weiss R.N. Nagel, N.G. Odrey “ Industrial Robotics (Technology , Programming and application s) , McGraw, Hill 1996
- 3) K.S.Fu, R.C.Gonzalez and C.S.G.Lee, “Robotics: Control , sensors , vision and inintlligence “, MCGraw-Hill.1987.
- 4) J.J.Craig , introduction to Robotics , Addison-wesely 1989.
- 5) Klafter , Richard D., et al “ Robotics Engineering” ,PhI,1996.
- 6) Zuech,Nello,”Applying Machine Vision “,john Wiley and sons, 1988.

