PAAVAI ENGINEERING COLLEGE, NAMAKKAL – 637 018

(AUTONOMOUS)

M.E. ENGINEERING DESIGN

REGULATIONS 2016

CURRICULAM

(CHOICE BASED CREDIT SYSTEM)

SEMESTER III

Course Code	Course Title	L	T	P	C
PED1645*	Elective IV	3	0	0	3
PED1655*	Elective V	3	0	0	3
PED1665*	Elective VI	3	0	0	3
PED16301	Project Work (Phase I)	0	0	12	6

SEMESTER IV

Course Code	Course Title	L	T	P	C
PED16401	Project Work (Phase II)	0	0	24	12

ELECTIVE IV

Course Code	Course Title	L	T	P	C
PED16451	Engineering Fracture Mechanics	3	0	0	3
PED16452	Tribology in Design	3	0	0	3
PED16453	Design of Heat exchanger	3	0	0	3
PED16454	Applied Engineering Acoustics	3	0	0	3

ELECTIVE V

Course Code	Course Title	L	T	P	C
PED16551	Productivity Management and Re-Engineering	3	0	0	3
PED16552	Plasticity and Metal Forming	3	0	0	3
PED16553	Reverse Engineering	3	0	0	3
PED16554	Design of Material Handling Equipments	3	0	0	3

ELECTIVE VI

Course Code	Course Title	L	T	P	C
PED16651	Design of Hydraulic and Pneumatic systems	3	0	0	3
PED16652	Theory of Plates and Shells	3	0	0	3
PED16653	Design of Pressure Vessel and Piping	3	0	0	3
PED16654	Modal Analysis of Mechanical Systems	3	0	0	3

ELECTIVE IV

PED16451 ENGINEERING FRACTURE MECHANICS 3 0 0 3

COURSE OBJECTIVES

- To expand student's knowledge in the area of solid mechanics
- To impart knowledge in the area of linear-elastic fracture mechanics and the stress analysis of cracked bodies.
- To learn about energy balance and crack growth
- To understand the fatigue crack growth curve and life calculations
- To know the applications of Fracture Mechanic

UNIT I ELEMENTS OF SOLID MECHANICS 9

The geometry of stress and strain, elastic deformation, plastic and elasto-plastic deformation - limit analysis – Airy's function – field equation for stress intensity factor.

UNIT II STATIONARY CRACK UNDER STATIC LOADING 9

Two dimensional elastic fields – Analytical solutions yielding near a crack front – Irwin's approximation – plastic zone size – Dugdaale model – determination of J integral and its relation to crack opening displacement.

UNIT III ENERGY BALANCE AND CRACK GROWTH 9

Griffith analysis – stable and unstable crack growth –Dynamic energy balance – crack arrest mechanism –K1c test methods - R curves - determination of collapse load.

UNIT IV FATIGUE CRACK GROWTH CURVE 9

Empirical relation describing crack growth law – life calculations for a given load amplitude – effects of changing the load spectrum -- rain flow method– external factors affecting the K1c values.- leak before break analysis.

UNIT V APPLICATIONS OF FRACTURE MECHANICS 9

Crack Initiation under large scale yielding – thickness as a design parameter – mixed mode fractures - crack instability in thermal and residual stress fields – numerical methods.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- define the basics of Solid Mechanics
- appropriately apply fracture mechanics for static loading.
- analyze crack growth mechanisms
- interpret the results of fracture mechanics analysis
- identify the cause of failures of a material based on fracture surface observations.

REFERENCES

1. David Broek, "Elementary Engineering Fracture Mechanics ", Fifthoff and Noerdhoff International, Publisher, 1982.
2. Kare Hellan, "Introduction of Fracture Mechanics", McGraw-Hill Book Company, 1989.
3. Preshant Kumar, "Elements of Fracture Mechanics", Wheeler Publishing, 2009.

4. John M.Barson and Stanely T.Rolfe Fatigue and fracture control in structures Prentice hall Inc. Englewood cliffs. 1987.
5. Ashok saxena ,"Non linear Fracture mechanics for engineers"

WEB LINKS

1. textofvideo.nptel.iitm.ac.in/112106065/lec1.pdf
2. freevideolectures.com › Mechanical › IIT Madras
3. nptel.ac.in/courses/112106065/

PED16452 TRIBOLOGY IN DESIGN 3 0 0 3

COURSE OBJECTIVES

- To understand the nature of engineering surfaces, their topography and surface characterization techniques.
- To study the consequences of wear, wear mechanisms, wear theories and analysis of wear problems.
- To know the properties of lubricants and lubrication regimes.
- To gain knowledge on Theory of Hydrodynamic and Hydrostatic Lubrication
- To learn the concept and application of Reynolds Equation

UNIT I SURFACE INTERACTION AND FRICTION 7

Topography of Surfaces – Surface features-Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction –Rolling Friction-Friction properties of metallic and non-metallic materials – friction in extreme conditions –Thermal considerations in sliding contact

UNIT II WEAR AND SURFACE TREATMENT 8

Types of wear – Mechanism of various types of wear – Laws of wear –Theoretical wear models-Wear of Metals and Non metals – Surface treatments – Surface modifications – surface coatings methods- Surface Topography measurements – Laser methods – instrumentation - International standards in friction and wear measurements

UNIT III LUBRICANTS AND LUBRICATION REGIMES 8

Lubricants and their physical properties- Viscosity and other properties of oils – Additives-and selection of Lubricants- Lubricants standards ISO,SAE,AGMA, BIS standards – Lubrication Regimes –Solid Lubrication-Dry and marginally lubricated contacts- Boundary Lubrication- Hydrodynamic lubrication — Elasto and plasto hydrodynamic - Magneto hydrodynamic lubrication – Hydro static lubrication – Gas lubrication.

UNIT IV THEORY OF HYDRODYNAMIC AND HYDROSTATIC LUBRICATION 12

Reynolds Equation,-Assumptions and limitations-One and two dimensional Reynolds Equation-Reynolds and Sommerfeld boundary conditions- Pressure wave, flow, load capacity and friction calculations in Hydrodynamic bearings-Long and short bearings-Pad bearings and Journal bearings-Squeeze film effects-Thermal considerations-Hydrostatic lubrication of Pad bearing- Pressure, flow , load and friction calculations-Stiffness considerations- Various types of flow restrictors in hydrostatic bearings

UNIT -V HIGH PRESSURE CONTACTS AND ELASTO HYDRODYNAMIC LUBRICATION 10

Rolling contacts of Elastic solids- contact stresses – Hertzian stress equation- Spherical and cylindrical contacts-Contact Fatigue life- Oil film effects- Elasto Hydrodynamic lubrication Theory-Soft and hard EHL-Reynolds equation for elasto hydrodynamic lubrication- - Film shape within and outside contact zones-Film thickness and friction calculation- Rolling bearings- Stresses and deflections-Traction drives.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- illustrate knowledge on surface characterization techniques
- use the techniques of Surface Treatment

- apply the principles of lubrication and lubrication regimes.
- practice applications of principles and theories of hydrodynamic, elasto hydrodynamic and mixed / boundary lubrication.
- Solve numerical problems on film thickness with friction.

REFERENCES

1. Rabinowicz.E, “Friction and Wear of materials”, John Willey &Sons ,UK,1995
2. Cameron, A. “Basic Lubrication Theory”, Ellis Herward Ltd., UK, 1981
3. Halling, J. (Editor) “Principles of Tribology “, Macmillian ,2014.
4. Williams J.A. “Engineering Tribology”,Oxford Univ.Press, 2008.
5. G.W.Stachowiak & A.W.Batchelor, Engineering Trobology, Butterworth-Heinemann,UK,2005

WEB LINKS

1. ocw.mit.edu › Courses › Mechanical Engineering › Tribology
2. nptel.ac.in/courses/112102015/
3. nptel.ac.in/courses/112102015/

PED16453 **DESIGN OF HEAT EXCHANGER** **3 0 0 3**

COURSE OBJECTIVES

- To learn thermal analysis of various parts of the heat exchagers
- To synthesis stress analysis in the flow parameters of Heat Exchangers
- To analyse the design aspect of double pipe, finned tube, shell and tube heat exchangers
- To familirise the sizing and rating of the heat exchangers
- To acquire design knowledge on surface and evaporative condensers

UNIT I FUNDAMENTALS OF HEAT EXCHANGER **9**

Temperature distribution and its implications types – shell and tube heat exchangers – regenerators and recuperates – analysis of heat exchangers – LMTD and effectiveness method.

UNIT II FLOW AND STRESS ANALYSIS **9**

Effect of turbulence – friction factor – pressure loss – stress in tubes – header sheets and pressure vessels – thermal stresses, shear stresses, types of failures.

UNIT III DESIGN ASPECTS **9**

Heat transfer and pressure loss – flow configuration – effect of baffles – effect of deviations from ideality – design of double pipe, finned tube, shell and tube heat exchangers, simulation of heat exchangers.

UNIT IV COMPACT AND PLATE HEAT EXCHANGERS **9**

Types – merits and demerits – design of compact heat exchangers, plate heat exchangers – performance influencing parameters, limitations.

UNIT V CONDENSERS & COOLING TOWERS **9**

Design of surface and evaporative condensers – cooling tower – performance characteristics.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, the students will be able to:

- carry out thermal analysis of heat exchanger parts
- do stress analysis in the flow parameters of heat exchangers
- analyse the design aspects of heat exchangers
- describe sizing and rating of heat exchangers
- design condensers and cooling towers of heat exchangers

REFERENCES

1. Sadik Kakac, Hongtan Liu,Heat Exchangers Selection, Rating and Thermal Design,CRC Press,2012.
2. P Arthur. Frass, Heat Exchanger Design, John Wiley & Sons, 2011.
3. Taborek.T,Hewitt.G.F and Afgan.N, Heat Exchangers,Theory and Practice,McGraw-Hill Book Co. 1983.
4. Hewitt.G.F, Shires.G.L and Bott.T.R,Process Heat Transfer,CRC Press,1994
5. Holman.J.P,Heat Transfer,Tata Mc Graw Hill, 2008.

WEB LINKS

1. http://nptel.ac.in/courses/103103027/pdf/mod1.pdf
2. nptel.ac.in/courses/103103027/pdf/mod1.pdf
3. www.hrs-heatexchangers.com › Home › Resources

PED16454 APPLIED ENGINEERING ACOUSTICS 3 0 0 3

COURSE OBJECTIVES

- To impart knowledge on the fundamentals of acoustics and its characteristics
- To understand different ways of acuustic control in the Engineering field
- To gain basic knowledge in the trnamission of acoustics in different media
- To learn usage of sound measuring instruments along with their applications
- To familirise students with basic concepts of acoustics like sound intensity, wave equation, transmission phenonmena, measurement of sound and noise control

UNIT I BASIC CONCEPTS OF ACOUSTICS 9

Scope of Acoustics – Sound pressure – Sound intensity – Sound power level Sound power – Wave motion – Alteration of wave paths –Measurement of sound waves –sound spectra – Sound fields – Interference – Standing waves – Acoustic energy density and intensity – Specific acoustic impedance.

UNIT II CHARACTERISTICS OF SOUND 10

One dimensional wave equation – Solution of 1D wave equation – Velocity in gaseous medium – Velocity of plane progressive sound wave through a thin solid rod – Velocity of plane wave in a bulk of solid – Transverse wave propagation along a string stretched under tension – Wave equation in two dimensions.

UNIT III TRANSMISSION PHENOMENA 6

Changes in media – Transmission from one fluid medium to another, normal incidence, oblique incidence - Reflection at the surface of a solid, normal incidence, oblique incidence – Standing wave pattern – Transmission through three media.

UNIT IV INTRODUCTION TO THE ASSESSMENT AND MEASUREMENT OF SOUND 10

Introduction – Decibel scale for the measurement of sound power – Sound level meter – Weighted sound pressure level – Equal Loudness contours – Perceived noisiness – Loudness, Loudness level, perceived noise, perceived noise level –Equivalent sound level – Identified level – Frequency and Amplitude measurement.

UNIT V BASICS OF NOISE CONTROL 10

Noise Control at source, path, and receiver – Noise control by acoustical treatment –Machinery noise – Types of machinery involved – Determination of sound power and sound power level – Noise reduction procedures – Acoustic enclosures.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- show good knowledge of acoustics and noise control to design robust systems.
- become strong in the basics of acoustics, medium of sound, wave equations involved to solve problems in this area.
- comprehend the transmission of sound through different media.
- use decibal scale for measurement of sound.
- demonstrate noise control by acoustical treatment and show good grounding in acoustics.

REFERENCES

1. Lawrence E. Kinsler, Austin R. Frey, "Fundamentals of Acoustics "– John Wiley and Sons Inc., 2009.
2. Bies, David, A. and Hansen, Colin H., "Engineering Noise Control – Theory and Practice", E and FN Spon, Chapman-Hall, Second Edition, 2009.
3. Hansen C.H. and Snyder, S.D., "Active Control of Sound and Vibration", E and FN Spon, London 1997.
4. Peter Haughton, "Acoustics for Audiologist",academic Press, 2002.
5. C.R.Fuller,S.J.Elliott and P.A. Nelson,"Active Control of Vibration", Academic Press,1997.

WEB LINKS

1. *www.ljudlandskap.acoustics.nu/downloads/ljudbok/.../1Introduction.pdf*
2. www.appliedacoustics.com
3. www.journals.elsevier.com/applied-acoustics

ELECTIVE V

PED16551 PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING 3 0 0 3

COURSE OBJECTIVES

- To understand the concepts of productivity and analyze its factors and models.
- To learn the concepts of management by objectives (MBO) and performance objective Productivity (POP).
- To study the elements of organizational transformation, reengineering principles and models.
- To familiarize the reengineering process improvement and its models like LMICIP and NPRDC
- To gain knowledge on reengineering tools, techniques and its implementation.

UNIT I PRODUCTIVITY 9

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

UNIT II SYSTEMS APPROACH TO PRODUCTIVITY MEASUREMENT 9

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

UNIT III ORGANIZATIONAL TRANSFORMATION 9

Elements of Organizational Transformation and Reengineering-Principles of organizational transformation andre-engineering, fundamentals of process reengineering, preparing the workforce for transformation and re-engineering, methodology, guidelines, LMI CIP Model – DSMC Q & PMP model.

UNIT IV RE-ENGINEERING PROCESS IMPROVEMENT MODELS 9

PMI models, PASIM Model, Moen and Nolan Strategy for process improvement, LMICIP Model, NPRDC Model.

UNIT V RE-ENGINEERING TOOLS AND IMPLEMENTATION 9

Analytical and process tools and techniques – Information and Communication Technology – Implementation of Reengineering Projects – Success Factors and common implementation Problem – Cases.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- distinguish between macro and micro factors of productivity and describe measurement models.
- comprehend the system approach to productivity measurement.
- analyse the process of organizational transformations .
- express in-depth knowledge on re-engineering process improvement models.
- use re-engineering tools ,implementation techniques and analyze the problems involved.

REFERENCES

1. Sumanth, D.J., 'Productivity Engineering and Management', TMH, New Delhi,1990.
2. Edosomwan, J.A., "Organisational Transformation and Process Re-engineering",Library Cataloging in Pub. Data, 1996.
3. Rastogi, P.N., "Re-engineering and Re-inventing the Enterprise", Wheeler Pub.New Delhi, 1995.
4. Premvrat, Sardana, G.D. and Sahay, B.S., "Productivity Management – ASystems Approach", Narosa Publishing House. New Delhi, 1998.
5. Giles Johnston, "Business process Reengineering" 2017.

WEB LINKS

1. http://ebookdig.biz/ebook/q/pdf/productivity-management-and-re-engineering.html
2. https://totalqualitymanagement.wordpress.com/.../productivity-quality-an
3. https://en.wikipedia.org/wiki/Business_process_reengineering

PED16552 PLASTICITY AND METAL FORMING 3 0 0 3

COURSE OBJECTIVES

- To study the theory of plasticity and its behavior.
- To familiarize the concepts of constitutive relationships and plastic instability.
- To learn to analyse problems of metal forming.
- To know thoroughly about sheet metal forming process and the theories involved.
- To acquire knowledge of various advancements in metal forming processes

UNIT I THEORY OF PLASTICITY 9

Theory of plastic deformation - Engineering stress and strain relationship – Stress tensor - Strain tensor – Yield criteria's - Plastic stress strain relationship – Plastic work - Equilibrium conditions - Incremental plastic strain

UNIT II CONSTITUTIVE RELATIONSHIPS AND INSTABILITY 7

Uniaxial tension test - Mechanical properties - Work hardening, Compression test, bulge test, plane strain compression stress, plastic instability in uniaxial tension stress, plastic instability in biaxial tension stress

UNIT III ANALYSIS OF METAL FORMING PROBLEMS 12

Slab analysis - Slip line method, upper bound solutions, statistically admissible stress field, numerical methods, contact problems, effect of friction, thermo elastic Elasto plasticity, Elasto visco plasticity - Thermo mechanical coupling – Analysis of forging, rolling, extrusion and wire drawing processes - Experimental techniques of the evaluation of metal forming.

UNIT IV ANALYSIS OF SHEET METAL FORMING 8

Bending theory - Cold rolling theory - Hill's anisotropic theory, Hill's general yield theory - Sheet metal forming - Elements used - Mesh generation and formulation -Equilibrium equations - Consistent full set algorithm - Numerical solutions procedures - examples of simulation of simple parts - Bench mark tests – Forming limit Diagrams.

UNIT V ADVANCES IN METAL FORMING 9

Orbital forging, Isothermal forging, Warm forging, Hot and Cold isotropic pressing, high speed extrusion, rubber pad forming, micro blanking –Super plastic forming -Overview of Powder Metal techniques - Powder rolling - Tooling and process parameters.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course ,the students will be able to

- explain the concepts of plasticity and its behavior.
- analyse the mechanical properties of plastics and their instability.
- solve the metal forming problems for different shapes using different methods.
- demonstrate knowledge of sheet metal forming and various theories associated with it.
- update with various advancements in metal forming processes and their techniques.

REFERENCES

1. Wagoner. R H., and Chenot. J.J., Metal Forming analysis,Cambridge University Press, 2005.
2. Slater. R A. C., Engineering Plasticity - Theory & Applications to Metal Forming,John Wiely and Sons, 2001.
3. Shiro Kobayashi, Altan. T, Metal Forming and Finite Element Method, Oxford University Press, 1989.
4. Narayanaswamy. R, Theory of Metal Forming Plasticity, Narosa Publishers, 1999.
5. Surender Kumar, "Technology of Metal Forming Processes", Prentice Hall of India, New Delhi, 2008.

WEB LINKS

1. www.vgu.edu.vn/fileadmin/pictures/studies/master/.../tp/plastice.pdf
2. web.itu.edu.tr/~livatyali/dersler/mak645e/ICTP08_history.pdf
3. www.ntnu.edu/studies/courses/TMT4266

PED16553 **REVERSE ENGINEERING** **3 0 0 3**

COURSE OBJECTIVES

- To introduce the basic concepts, tools, data management and integration process of re-engineering
- To know different types of Reverse Engineering tools.
- To study the reverse engineering concepts and their implementations.
- To understand the strategies, software components and evaluation models of data management.
- To learn about the reuse tools, coordinate measurement and feature capturing for integration of reverse engineering.

UNIT I INTRODUCTION **5**

Scope and tasks of RE - Domain analysis- process of duplicating.

UNIT II TOOLS FOR RE **8**

Functionality- dimensional- developing technical data - digitizing techniques -construction of surface model - solid-part material- characteristics evaluation -software and application- prototyping – verification

UNIT III CONCEPTS **12**

History of Reverse Engineering – Preserving and preparation for the four stage process – Evaluation and Verification- Technical Data Generation, Data Verification, Project Implementation

UNIT IV DATA MANAGEMENT **10**

Data reverse engineering – Three data Reverse engineering strategies – Definition –organization data issues - Software application – Finding reusable software components – Recycling real-time embedded software – Design experiments to evaluate a Reverse Engineering tool – Rule based detection for reverse Engineering user interfaces – Reverse Engineering of assembly programs: A model based approach and its logical basics.

UNIT V INTEGRATION **10**

Cognitive approach to program understated – Integrating formal and structured methods in reverse engineering – Integrating reverse engineering, reuse and specification tool environments to reverse engineering -–coordinate measurement –feature capturing – surface and solid members.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course ,the students will be able to

- explain the scope and tasks of re-engineering
- employ Re-digitisation tools and software for analysis
- evaluate the process of RE, data generation ,verification and project implementation.
- find suitable reusable software components.
- recognize different integrating methods of RE.

REFERENCES

1. Design Recovery for Maintenance and Reuse, T J Biggerstaff, IEEE Corp. July1991
2. White paper on RE, S. Rugaban, Technical Report, Georgia Instt. of Technology,1994
3. Reverse Engineering, Katheryn, A. Ingle, McGraw-Hill, 1994

4. Data Reverse Engineering, Aiken, Peter, McGraw-Hill, 1996

5.Reverse Engineering, Linda Wills, Kluiver Academic Publishers, 2013.

WEB LINKS

1. people.auc.ca/xu/present/reverse.ppt
2. https://www.classle.net/#!/classle/videolink/lec-52-reverse-engineering/
3. https://en.wikipedia.org/wiki/Reverse_engineering

PED16554 DESIGN OF MATERIAL HANDLING EQUIPMENTS 3 0 0 3

COURSE OBJECTIVES

- To learn the types, selection and applications of materials handling equipment.
- To familiarize the applications of the chain drives, ropes and pulleys.
- To identify the handling mechanisms which are appropriate to different types of material handling.
- To acquire knowledge about various types of conveyors and its application based on the purpose.
- To know the design details of elevators and safety while handling various types of materials.

UNIT I MATERIALS HANDLING EQUIPMENT 5

Types, selection and applications

UNIT II DESIGN OF HOISTS 10

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 10

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 10

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

UNIT V ELEVATORS 10

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

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course ,the students will be able to

- select appropriate types of materials handling equipment for different.
- design various hoisting elements like chain drive, ropes and pulley.
- review hand and power drives of hoisting gear and their mechanisms for appropriate use.
- demonstrate knowledge on different types of conveyors and their applications.
- identify different types of elevators for suitable application and design fork lift trucks.

REFERENCES

1. Rudenko, N., Materials handling equipment, ELnvee Publishers, 1970.
2. Spivakovsy, A.O. and Dyachkov, V.K., Conveying Machines, Volumes I and II, MIR Publishers, 1985.
3. Alexandrov, M., Materials Handling Equipments, MIR Publishers, 1981.
4. Boltzharol, A., Materials Handling Handbook, the Ronald Press Company, 1958.
5. P.S.G. Tech., “Design Data Book”, Kalaikathir Achchagam, Coimbatore, 2003.

WEB LINKS

- nptel.ac.in/courses/112107142/part2/material%20handling/lecture1.htm
- www.managementstudyguide.com/material-handling.htm
- www.ehow.com › Business

ELECTIVE VI

PED16651 DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS 3 0 0 3

COURSE OBJECTIVES

- To familiarize the students with various hydraulic systems and hydraulic actuators.
- To understand the control elements and actuation systems.
- To learn to design Hydraulic circuits effectively.
- To acquire knowledge to design the pneumatic systems and circuits.
- To know about pneumatic equipments, design calculation and use of microprocessors.

UNIT I OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS 5

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

UNIT II CONTROL AND REGULATION ELEMENTS 12

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

UNIT III HYDRAULIC CIRCUITS 5

Reciprocation, 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 16

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 7

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

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course ,the students will be able to

- demonstrate knowledge on hydraulic power generator, pumps and various actuators.
- identify proper control and regulation elements.
- design appropriate hydraulic circuits for various Engineering applications.
- describe design procedure for pneumatic circuits.
- select suitable components for designing hydro pneumatic circuits.

REFERENCES

1. Antony Espossito, “Fluid Power with Applications”, Prentice Hall, 2013.
2. Dudleyt, A. Pease and John J. Pippenger, “Basic fluid power”, Prentice Hall,1987.
3. Andrew Parr, “Hydraulic and Pneumatics” (HB), Jaico Publishing House, 2011.
4. Bolton. W., “Pneumatic and Hydraulic Systems “, Butterworth –Heinemann, 1997.

5. K.Shanmuga Sundaram, “Hydraulic and Pneumatic Controls: Understanding made Easy" S.Chand & Co Book publishers, New Delhi, 2006 (Reprint 2009).

WEB LINKS

1. nptel.ac.in/courses/112106175/Module%201/Lecture%201.pdf
2. www.nitc.ac.in/.../Chapter2_Hydraulics_control_in_machine_tools.pdf
3. newengineeringpractice.blogspot.com/.../pneumatic-complete-lecture

PED16652 THEORY OF PLATES AND SHELLS 3 0 0 3

COURSE OBJECTIVES

- To acquire thorough knowledge in structural mechanics, approximations of membranes, plates and shells and principles of elasticity.
- To become familiar with the concepts of classical theories, equilibrium in different coordinates, bending of plates.
- To focus on buckling analysis of plates under different compressive and boundary conditions.
- To know about the various vibrating conditions of plates under different loads conditions.
- To analyse the shells of revolution and various aspects of cylindrical and spherical shells.

UNIT I GENERAL INTRODUCTION 7

Review of equations of elasticity- kinematics, compatibility equations, stress measures- equations of motions- constitutive relations- transformation of stresses, strains and stiffness-energy principles and variation methods in elasticity- virtual work-external and internal virtual work- variation operator- functional- Euler Lagrange equations- energy principles- Hamilton's principle- principle of minimum total potential- applications.

UNIT II CLASSICAL THEORY OF PLATES 10

Plates as structural elements- stress and moment resultants- assumptions made in the classical theory- displacement fields and strains- equations of equilibrium in Cartesian coordinates and in polar coordinates- boundary conditions – bending of rectangular plates with various boundary conditions and loading- symmetrical and asymmetrical bending of circular plates-limitations of classical theory- finite element analysis(elementary treatment only; discussion of various elements used and their capabilities- not for examination)

UNIT III BUCKLING ANALYSIS OF RECTANGULAR PLATES 10

Buckling of simply supported plates under compressive forces- governing equations the Navier solution- biaxial compression of a plate- uniaxial compression of a plate buckling of plates simply supported on two opposite edges- Levy's solution- buckling of plates with various boundary conditions- general formulation- finite element analysis(elementary treatment only; discussion of various elements used and their capabilities- not for examination)

UNIT IV VIBRATION OF PLATES 9

Governing equations for natural flexural vibrations of rectangular plates- natural vibrations of plates simply supported on all edges- vibration of plates with two parallel sides simply supported- Levy's solution- vibration of plates with different boundary conditions- Rayleigh-Ritz method- Natural vibration of plates with general boundary conditions- transient analysis of rectangular plates- finite element analysis (elementary treatment only; discussion of various elements used and their Capabilities- not for examination)

UNIT V ANALYSIS OF THIN ELASTIC SHELLS OF REVOLUTION 9

Classification of shell surfaces- geometric properties of shells of revolution- general strain displacement relations for shells of revolution- stress resultants- equations of motion of thin shells- analytical solution for thin cylindrical shells- membrane theory flexure under ax symmetric loads- shells with double curvature- geometric considerations- equations of equilibrium- bending of spherical shells- vibration of cylindrical shells- finite element analysis(elementary treatment only; discussion of various elements used and their capabilities- not for examination)

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course ,the students will be able to

- compute structural mechanic approximations of membrane, plates and shells.
- derive equations of membrane plate and shell for analysis.
- demonstrate knowledge on the consistent derivation of approximate boundary conditions and edge effects.
- analyse and determine the static, dynamic, non-linear motion of membrane, plate and shell structures.
- perform numerical approximations of all types of shells.

REFERENCES

1. Reddy,J.N., “Theory and Analysis of Elastic Plates & Shells”,C.R.C.Press,NY,USA, 2nd Edition 2006
2. Szilard, R., Theory and Analysis of Plates, Prentice Hall Inc., 2004
3. S.Timoshenko.,”Theory of plates and shells” McGraw Hill company
4. Eduard Ventsel Theodor Krauthammer.,” Thin Plates and Shells Theory, Analysis, and Applications”. Marcel Dekker, 2001.
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PED16653 DESIGN OF PRESSURE VESSELS AND PIPING 3 0 0 3

COURSE OBJECTIVES

- To give exposure to engineering problems involved in the design of pressure vessel.
- To learn about the tests and analysis for various components of pressure vessels.
- To know the procedure to design pressure vessels.
- To familiarize the buckling and fracture analysis of pressure vessels under various load conditions.
- To acquire knowledge of piping, piping layout and designing of pipes

UNIT I INTRODUCTION 3

Methods for determining stresses – Terminology and Ligament Efficiency –Applications

UNIT II STRESSES IN PRESSURE VESSELS 15

Introduction – Stresses in a circular ring, cylinder – Membrane stress Analysis of Vessel Shell components – Cylindrical shells, spherical Heads, conical heads –Thermal Stresses – Discontinuity stresses in pressure vessels.

UNIT III DESIGN OF VESSELS 15

Design of Tall cylindrical self supporting process columns – supports for short vertical vessels – stress concentration – at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement – pressure vessel Design.

UNIT IV BUCKLING AND FRACTURE ANALYSIS IN VESSELS 8

Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure –Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.

UNIT V PIPING 4

Introduction – Flow diagram – piping layout and piping stress Analysis.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course ,the students will be able to

- explain the concepts of various types of pressure vessels and their applications
- identify various stresses in different components of pressure vessels.
- design different types of pressure vessels.
- carry out fracture analysis of pressure vessels and their components
- perform stress analysis of piping.

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1. John F. Harvey, Theory and Design of Pressure Vessels, CBS Publishers and Distributors, 2001.
2. Henry H. Bedner, “Pressure Vessels, Design Hand Book, CBS publishers and Distributors, 1986.
3. Stanley, M. Wales, “Chemical process equipment, selection and Design.Buterworths series in Chemical Engineering, 1988.
4. William. J., Bees, “Approximate Methods in the Design and Analysis of Pressure Vessels and Piping”, e ASME Pressure Vessels and Piping Conference, 1997

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2. http://strathprints.strath.ac.uk/7495/
3. ed.iitm.ac.in/course/design-of-heat-exchangers-pressure-vessels-and-piping/

PED16654 MODAL ANALYSIS OF MECHANICAL SYSTEMS 3 0 0 3

COURSE OBJECTIVES

- To impart knowledge on modal testing to perform model analysis and their applications.
- To apply the DOF in single and Multi systems and to study various dampings, vibrations for analysis.
- To understand the concepts behind the mobility measurement techniques, selection and mounting of transducers, amplifiers.
- To know the concept of peak amplitude details and get an idea to draw the time domain curve.
- To gain the analytical knowledge of different modal models for display, response, spatial and system.

UNIT I OVERVIEW 3

Introduction to Modal Testing – Applications of Modal Testing – Philosophy of Modal Testing – Summary of Theory – Summary of Measurement Methods – Summary of Analysis – Review of Test Procedure.

UNIT II THEORETICAL BASIS 15

Introduction – Single Degree of Freedom (SDOF) System Theory – Presentation and Properties of FRF Data for SDOP System – Undamped Multi-degree of freedom (MDOF) system – Proportional Damping – Hysteretic Damping – General Case – Viscous Damping – General Case – Characteristics and presentation of MDOF – FRF Data – Complete and incomplete models - Non-sinusoidal vibration and FRF Properties – Analysis of Weakly Nonlinear Structures.

UNIT III MOBILITY MEASUREMENT TECHNIQUES 15

Introduction – Basic Measurement System – Structure preparation – Excitation of the Structure – Transducers and Amplifiers – Analyzers – Digital Signal Processing –Use of Different Excitation types – Calibration – Mass Cancellation – Rotational Mobility Measurement – Measurement on Non linear structures – Multi point excitation methods.

UNIT IV MODAL PARAMETER EXTRACTION METHODS 8

Introduction – Preliminary checks of FRF Data – SDOF Modal Analysis-I – Peak amplitude – SDOF Modal. Analysis-II – Circle Fit Method – SDOF Modal Analysis III –Inverse Method – Residuals – MDOF curve-fitting procedures – MDOF curve fitting in the Time Domain – Global or Multi-Curve fitting – Non linear systems

UNIT V DERIVATION OF MATHEMATICAL MODELS 4

Introduction – Modal Models – Display of Modal Model – Response Models – Spatial Models – Mobility Skeletons and SystemModels .

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course ,the students will be able to

- perform modal analysis and apply for dynamic structures.
- consider DOF in single and multi systems and to analyse various dampings, vibrations for different models.
- apply the concepts of mobility measurement techniques in modal tests
- utilize modal parameter extraction methods for modal analysis.

- drive mathematical models of modal analysis for display, response, spatial and system models.

REFERENCES

1. Ewins D J, “Modal Testing: Theory and Practice “, John Wiley & Sons Inc., 1984.
2. Gaetan.Kerchen, “Modal analysis of non linear mechanical system”, CISM International system,2014
3. Singiresu S.RAO, “Vibration of Continuous System”,2007
4. S.K.Dwivedy, “Analysis of mechanical System”, 2008
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2. www.springer.com/gp/book/9783709117903
3. https://hal.inria.fr/docs/00/56/17/57/PDF/paper.pdf

PED16301 **PROJECT WORK (PHASE I)** **0 0 12 6**

COURSE OBJECTIVES

- To develop the ability to solve a specific problem right from its identification, literature review and analysis till finding a successful solution for the same.
- To train the students in preparing project reports and to face reviews and viva voce examination and develop presentation skills

The student works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

COURSE OUTCOMES

At the end of this course ,the students will be able to

- take up any challenging practical problems and find solution by formulating proper methodology, using the technical knowledge and professional approach.

PED16401 **PROJECT WORK (PHASE II)** **0 0 24 12**

COURSE OBJECTIVES

- The project work shall be based on the knowledge acquired by the student during the course and preferably it should meet and contribute towards the needs of the society. The project aims to provide an opportunity of designing and building complete system or subsystems based on area where the student likes to acquire specialized skills.
- In Project Work Phase –II, the student shall complete the balance part of the Project that will consist of fabrication of set up required for the project, conducting experiments and taking results, analysis & validationof results and conclusions.The student shall prepare the final report of Project work in standard format dulycertified for satisfactory completion of the work by the concerned guide and head of the department/Institute.

COURSE OUTCOMES

At the end of this course ,the students will be able to

- on completion of the project work, the students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.