**Course Syllabus**

Academic year: 2020-2021

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| Institution | University of Petroşani |
| Faculty | Mechanical and Electrical Engineering |
| Field of study | Mechanical Engineering |
| Level | Bachelor |
| Program of study | Mining Machinery and Equipment |

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| Course | **Fluid Mechanics and Hydraulic Machines** |
| Code | 2MM5OD37 |
| Year of study (semester) | III (I) |
| Number of hours | 70 |
| Number of credits | 5 |
| Professor | Assoc. Prof., Ph.D. DOSA Ion |

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| **No.** | **Topic** |
|  | Introduction. The concept of fluid. Continuity hypothesis. Units. Dimensional analysis and similitude (Buckingham π theorem, The Rayleigh method, Dimensionless parameters). |
|  | The physical properties of fluid (density and specific weight, specific volume, compressibility, thermal expansion, equation of state, cavitation). |
|  | Physical properties of the fluid (surface tension, Laplace equation, capillarity, the formation of droplets). Transport phenomena. |
|  | Fluid statics. Principle of solidification. Euler's equation. Static pressure head. General equation for variation of pressure in a static fluid. Consequences of equilibrium equations. Variation of pressure vertically in a fluid under gravity. |
|  | Consequences of hydrostatic law. The variation of pressure in a gas located in the gravitational field. The variation in atmospheric temperature with altitude. The energetic interpretation of hydrostatic law. Geometric and graphical interpretation of the law of hydrostatics. Pressure diagrams. Problems |
|  | Forces on planar bodies. Forces on curved bodies. Buoyant forces on submerged bodies. Determination of the volume of a body by weighing. |
|  | Floating bodies. Initial stability of floating and submerged bodies. Relative location of reference points. Meta-centre. Meta-centric height. Methods of improving initial stability. Densitometry. |
|  | Relative equilibrium of fluids. Relative equilibrium of a liquid in a vessel rotating around a vertical axis. Relative equilibrium of a liquid in a vessel involved in a translational movement. Problems. |
|  | Kinematics of fluid. Kinematic parameters. Lagrangian and Eulerian specifications. The particle derivative. Streamline, path line and streak line. Linear and shear strain rate. Vorticity and circulation. Stokes's theorem. Flow rate, the average speed. Continuity equation. |
|  | Fluid dynamics. Euler's equation. Bernoulli's equation for an ideal fluid. Geometric explanation of Bernoulli's equation. The fundamental equation of the turbo-machines. Applications of Bernoulli's equation for incompressible ideal fluid (orifice in a tank, Pitot tube, Pitot-Prandtl tube, Venturi tube, ejector). Problems |
|  | Momentum theorem. Conservation of momentum. Momentum principle for a fixed volume. Angular momentum principle for a fixed volume. Applications: jet action on walls, Euler's equations for turbines. Navier-Stokes equation. |
|  | Viscous Fluid Flows (Couette and Poiseuille flows, Rotational viscous flows). |
|  | Laminar Pipe Flow (Equations of motion, The Moody diagram, Minor losses, Energy equation for real fluid flow in a pipe, The siphon, Pipes in series, Flow in parallel pipes). |
|  | Turbulent Pipe Flow (Role of vorticity in the origin of turbulence, The equations of motion for turbulent flow, Zero-equation model for fully turbulent flow, The mixing length hypothesis, Fully turbulent flow in a pipe). |
|  | Boundary Layer Flows (Reynolds’ Experiment, Prandtl boundary layer equations, Blasius solution foe laminar boundary layer flow over a flat plate, Boundary layer thicknesses of displacement and momentum, Integral momentum, Mechanics of boundary layer transition, Turbulent boundary layers). |
|  | Potential Flow (Laplace’s equation, The complex potential and velocity, Conservation of circulation, Equation of the body, Blasius’ theorem for forces, Combined flows, Lift and drag, Potential and stream functions in real fluids) |
|  | One Dimensional Compressible Flow (Perfect gas, Second law of thermodynamics, Equations of a process, The compressible flow energy equations, Normal shock waves, Mach number relationships, Mass rate through an isentropic nozzle, , The Prandtl relation, Thickness of the normal shock, Isothermal gas flow in a pipe, Drag coefficient for compressible flow). |
|  | Introduction to hydraulic machines. Energy equation of pumps. Diagram of pumping. Centrifugal and axial pumps. Components and construction types. Single-stage centrifugal pump. Multi-stage centrifugal pump. |
|  | The basic equation of the turbo-machines. Power and efficiency. Curves at constant speed. Similarity of pumps. Specific speed of pumps. |
|  | Operation of pumps in the network. Operating point.  Connecting pumps. Pumps connected in parallel.  Pumps connected in series. Positive Displacement Pumps. Centrifugal Pumps. Alternating Pumps. Airlift pumps. Ejectors. |
|  | Hydraulic Turbines. Pelton Wheel. Francis Turbine. Kaplan Turbine. Bulb turbine. Deriaz-Kviatkovski turbine. Regulation of a hydraulic turbine. |