| Name of Faculty: Prof. Rashid Mustafa |
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| Discipline: Civil Engineering(4th Semester) |
| Subject: Introduction to Solid Mechanics (PCC-CE 205) |
| Course Credit : 03 |

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| **Course Objective** | The objective of this Course is to introduce to continuum mechanics and material modelling of engineering materials based on first energy principles: deformation and strain; momentum balance, stress and stress states; elasticity and elasticity bounds; plasticity and yield design. The subject of mechanics of materials involves analytical methods for determining the strength, stiffness (deformation characteristics), and stability of the various members in a structural system. The behaviour of a member depends not only on the fundamental laws that govern the equilibrium of forces, but also on the mechanical characteristics of the material. These mechanical characteristics come from the laboratory, where materials are tested under accurately known forces and their behaviour is carefully observed and measured. For this reason, mechanics of materials is a blended science of experiment and Newtonian postulates of analytical mechanics. |
| **Subject Synopsis/ Indicative Syllabus** | **Module1:** Simple Stresses and Strains: Concept of stress and strain, St.Venant's principle, stress and strain diagram, Elasticity and plasticity Types of stresses and strains, Hooke's law stress strain diagram for mild steel, Working stress, Factor of safety, Lateral strain, Poisson's ratio and volumetric strain, Elastic moduli and the relationship between them, Bars of varying section, composite bars, Temperature stresses. Strain Energy, Resilience, Gradual, sudden, impact and shock loadings simple applications.<br>**Module2:** Compound Stresses and Strains: Two dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr circle of stress, ellipse of stress and their applications. Two dimensional stress-strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain. Relationship between elastic constants.<br>**Module3:** Bending moment and Shear Force Diagrams: Bending moment (BM) and shear force (SF) diagrams.BM and SF diagrams for cantilevers simply supported and fixed beams with or without overhangs. Calculation of maximum BM and SF and the point of contra flexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, Uniformly varying loads, application of moments.<br>**Module4:** Flexural Stresses: Theory of simple bending, Assumptions, Derivation of bending equation: M/I = f/y = E/R Neutral axis, Determination of bending stresses Section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections, Design of simple beam sections.<br>**Module5:** Shear Stresses Derivation of formula Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T, angle sections.<br>**Module6:** Slope and deflection: Relationship between moment, slope and deflection, Moment area method, Macaulay's method. Use of these methods to calculate slope and deflection for determinant beams.<br>**Module7:** Torsion: Derivation of torsion equation and its assumptions. |

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| | Applications of the equation of the hollow and solid circular shafts, torsional rigidity, Combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion. Analysis of close coiled helical springs.<br>**Module 8:** Thin Cylinders and Spheres: Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder, and sphere subjected to internal pressures. |
| **Gate Syllabus of Solid Mechanics** | Bending moment and shear force in statically determinate beams; Simple stress and strain relationships; Theories of failures, Simple bending theory, flexural and shear stresses, shear centre, Uniform torsion, buckling of column, combined and direct bending stresses. |
| **Reading List and References** | ➢ Timoshenko, S. and Young, D. H., Elements of Strength of Materials‖, DVNC, NewYork, USA.<br>➢ Kazmi, S. M. A., Solid Mechanics‖ TMH, Delhi, India.<br>➢ Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004<br>➢ Crandall, S. H., N. C. Dahl, and T. J. Lardner. An Introduction to the Mechanics of Solids. 2nd ed. New York, NY: McGraw Hill, 1979<br>➢ Mechanics of Materials - Ferdinand P. Beer, E. Russel Jhonston Jr., John T. D Ewolf, TMH 2002.<br>➢ Strength of Materials by R. Subramanian, Oxford University Press, New Delhi. |