Title of Subject	**:**	**Railways and Waterways Engineering (Th)**
Code	**:**	CE207
Discipline	**:**	Civil Engineering (3rd Semester)
Effective	**:**	20-Batch and onwards
Pre-requisite	**:**	Nil **Co-requisite:** Nil
Assessment	**:**	20% Sessional, 80% Written Semester Examination (20% Mid, 60% Final)
Credit Hours	**:**	03 + 00 **Marks :** 100 + 00
Minimum Contact Hours:		45 + 00

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	DISCUSS concepts of transportation systems and its planning in solving unban transportation problems.	C2	1
2	APPLY the principles of transportation engineering to solve the problems that are most likely to be encountered in the planning and design of railways and coastal structures based on best practices and guidelines.	C3	3

Course outline:

- **Introduction to Transportation Systems and Planning**

  Comparison of different modes of transportation, Phases of planning, Planning process and mode choice decisions, Urban transportation problems: Transportation and urban growth, Mass transit system, Comparison of different transit modes, Transit and environment, Transit and urban sustainability.

- **Railway Engineering**

  Introduction, planning, routes of railways, crossings and transfer, passengers' traffic and stations, planning of stations / platforms for passengers, Railway Track, gauge, Track components, Rail, rail fittings, fixtures, Sleepers and ballast requirements and specification per kilometre of track, Formation and cross- section details, drainage, track defects, signals, branching, classification and Marshall signals, other signals, maintenance and adjustment of railway.

  Design analysis: Geometric design of track, Points and Crossing, Station and Yards, Level crossing, Signalling and control, Suburban Railways, Metro railways system, Modernization of railways, Underground Railways.

- **Ports and Harbour Engineering**

  Water Transportation: Sea Port, Harbours, Ports and harbours of Pakistan Types and selection of site, Breakwaters, Jetties, Wharves, Navigation aids: Buoys and light houses, Inland water transportation. Components and classification, site investigation, waterway design. Design principles and requirements of harbours, and their construction, Transit sheds and warehouses.

Recommended Books:

- Transportation Engineering Introduction to Planning, Design and Operations, Jason C. Yu, Elsevier Science Ltd. Latest Edition
- Port Engineering Planning Construction Maintenance and Security, Gregory P. Tsinker, John Wiley, Latest Edition
- Urban Mass Transportation Planning, A. Black, McGraw Hill.
- Railway Engineering by Chandra and Agarwal, Oxford University Press
- Dock and Harbour Engineering, Oza and Oza, Charotar Publisher.

Approval:

Board of Studies: 33	**Resolution No. 33.3**	**Dated: 30-11-2021**
Board of Faculty: 23	**Resolution No. 23.09**	**Dated: 09-12-2021**
Academic Council:	**Resolution No.**	**Dated:**

Title of Subject	**:**	**Mechanics of Solids-I (Th +Pr)**
Code	**:**	CE212
Discipline	**:**	Civil Engineering (3rd Semester)
Effective	**:**	20-Batch and onwards
Pre-requisite	**:**	Engineering Mechanics **Co-requisite:** Nil
Assessment	**:**	Theory: 20% Sessional, 80% Written Semester Examination (20% Mid, 60% Final) Practical: 40% Sessional, 60% Final Semester Examination
Credit Hours	**:**	02 + 01 **Marks :** 50 + 50
Minimum Contact Hours:		30 + 45

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	SOLVE problems related to simple stress and strain in materials subjected to axial forces.	C3	1
2	ANALYZE simple beams subjected to simple bending and explain torsion and energy theory.	C4	2
3	PRACTICE various laboratory tests to determine various properties of materials.	P3	4

Course outline:

- **Simple Stress and Strain**
  Types of stresses and strains, Stress-stain diagrams of different materials, Elastic constants, Load-deflection relation with respect to length, area of cross-section and Young's modulus of elasticity, Thermal stresses in restraint and compound bars.

- **Stresses in Beams**
  Centroid of general cross-section, second moment of area/Moment of inertia and Product of inertia, Theory of simple bending: position of neutral axis, Moment of resistance and section modulus, Application of flexural formula.

- **Strain Energy**
  Theory of torsion of solids and hollow circular shafts, Strain energy due to direct loads, Stresses due to gradual, sudden and impact loads.

Practical Work to be carried out:

1. Introduction to Laboratory and HSE Measures.
2. To determine the diameter and unit weight of metallic bar.
3. To determine the yield strength, proportional limit, ultimate strength of steel bars and develop stress-strain relationship.
4. To determine the percentage elongation and percentage reduction in area of steel bar.
5. To perform the bend test of steel bar.
6. To determine the shear strength of steel bar
7. To determine shear modulus and Poisson's ratio for metals
8. To determine the location of neutral axis in the beam cross-section and compare it with the theoretical value
9. To determine the bending stress and deflection of simply supported beams
10. To determine the bending stress and deflection of cantilever beams
11. To perform torsional test on steel bars and determine modulus of rigidity

12. To perform hardness/toughness test on steel bars
13. To determine impact strength of steel bars
14. To determine the stiffness of the spring
15. To perform an open-ended lab.

Recommended Books:

- Strength of Materials, F.L Singer, Harper and Row Publisher New York, Latest Edition
- Elements of Strength of Materials, S. Timoshenko, D. Van Nostrand Company New Jersy, Latest Edition
- Strength of Materials, R. L Ryder, McMillan education limited, Latest Edition

Approval:

Board of Studies: 33	**Resolution No. 33.3**	**Dated: 30-11-2021**
Board of Faculty: 23	**Resolution No. 23.09**	**Dated: 09-12-2021**
Academic Council:	**Resolution No.**	**Dated:**

Title of Subject	**:**	**Fluid Mechanics and Hydraulics (Th + Pr)**	
Code	**:**	CE227	
Discipline	**:**	Civil Engineering (3rd Semester)	
Effective	**:**	19-Batch and onwards	
Pre-requisite	**:**	Engineering Mechanics	**Co-requisite:** Nil
Assessment	**:**	Theory: 20% Sessional, 80% Written Semester Examination (20% Mid, 60% Final) Practical: 40% Sessional, 60% Final Examination	
Credit Hours	**:**	03 + 01	**Marks :** 100 + 50
Minimum Contact Hours:		45 + 45	

Course Learning Outcomes (CLOs):

Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	DESCRIBE the concepts related to fluid statics, kinematics, dynamics and simulation model of a real hydraulic structure.	C2	1
2	SOLVE problems related to various open channel x-sections and flow based on hydraulic energy & momentum principles.	C3	2
3	PRACTICE experiments to verify the theoretical principles of fluid mechanics & hydraulics engineering.	P3	4

Course outline:

- **Properties of Fluid**
  Density, Specific weight, Specific volume, Specific gravity, Viscosity and Newton's law of viscosity, Bulk modulus of elasticity, Surface tension, Capillarity, Dimensions and Systems of units.

- **Fluid Statics**
  Pressure; Pressure head, Pressure-head relationship, Atmospheric pressure, Absolute pressure, Gauge pressure and Pascal's law. Equipment's for measurement of pressure, Piezometer, Manometers, Bourdon gauge and Mechanical gauges. Hydrostatic pressure, Buoyancy and stability of floatation.

- **Fluid Kinematics**
  Basic concepts of uniform and non-uniform, Flow rate and mean velocity, Acceleration in fluid flow.

- **Fluid Dynamics**
  Continuity equation in differential form for steady and unsteady flows, Continuity equation's integral form, Total head or energy (Bernoulli's) equation and its applications.

- **Hydraulic Similitude**
  Dimensions analysis of physical quantities (FLT or MLT system of measurement) by Releigh's or Buckingham's π-Theorem and its applications, Model analysis, Model and its prototype's geometric, kinematic, dynamic and hydraulic similarities, Dimension less number and their significance.

- **Open Channel Flow and its Classifications**
  Types of open channel and flow. States of flow and Regimes of flow, uniform flow (Chezys's and Manning's velocity equations) through various channel sections.

- **Design of Open Channels and Their Properties**

Open channels Channel geometry, Design of most efficient, effective and economical open channel sections.

- **Energy and Momentum Principles**
  Non-uniform flow, Energy in open channels, Specific energy, Critical flow, Momentum principle and its applications, Hydraulic jump and its applications.

- **Flow Rate Measurement in Open Channels**
  Measurement of discharge through weirs, modular and non-modular venturi-flumes.
- **Introduction to subject relevant software's**

Practical Work to be carried out:

1. Introduction to Practical contents, Equipment's, and HSE (Health, Safety and Environment) measures.
2. To determine errors in the readings of a Bourdon pressure gauge.
3. To determine the metacentric height of floating body.
4. To investigate the validity of the formulas for resultant force on, and position of center of pressure of, a vertical rectangular surface.
5. To prove validity of Bernoulli's Theorem.
6. To determine coefficient of discharge for Venturimeter and Orifice meter.
7. To find the coefficient of velocity for a small orifice.
8. To find the coefficient of discharge for a small orifice.
9. To investigate relation between head over sill of a rectangular notch and flow rate through the notch.
10. To investigate relation between head over vertex of a Vee-notch and flow rate through the notch.
11. To determine Chezy's and Manning's coefficients for a rectangular smooth open channel.
12. To examine the quantitative characteristics of hydraulic jump formation on a horizontal floor of a rectangular channel.
13. To determine coefficient of discharge for a Venturi flume.
14. To draw specific energy curve for open channel with subcritical and super critical flow.
15. To perform an open-ended lab.

Recommended Books:

- Fluid Mechanics with Engineering Applications, Daugherty, Franzini and Finnemore, McGraw Hill Book Company, Latest Edition.
- Applied Fluid Mechanics, Robert L. Mott and Jaseph A. Untener, Pearson Education Inc, Latest Edition.
- A Textbook of Fluid Mechanics and Hydraulics Machines, Er. R.K. Rajput. S. Chand & Company Ltd, Latest Edition.
- A Textbook of Hydraulics, Fluid Mechanics and Hydraulic Machines, R.S. Khurmi, Latest Edition.

Approval:

Board of Studies:	**Resolution No. 32.3**	**Dated: 03-10-2020**
Board of Faculty:	**Resolution No. 20.11**	**Dated: 07-10-2020**
Academic Council:	**Resolution No. 98.7(ii)**	**Dated: 22-10-2020**

Title of Subject	**:**	**Theory of Structures (Th)**
Code	**:**	CE222
Discipline	**:**	Civil Engineering (3rd Semester)
Effective	**:**	20-Batch and onwards
Pre-requisite	**:**	Engineering Mechanics **Co-requisite:** Nil
Assessment	**:**	20% Sessional, 80% Written Semester Examination (20% Mid, 60% Final)
Credit Hours	**:**	02 + 00 **Marks :** 50 + 00
Minimum Contact Hours:		30 + 00

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	ANALYZE shear force and bending moment in beams and frames.	C4	2
2	EVALUATE axial forces in Trusses; axial force, shear force and bending moment in arches; buckling of columns and influence lines and moving loads.	C5	2

Course outline:

1. **Introduction**
   Definition of types of structures, Loads on structures, serviceability and safety of structures.

2. **Reactions, Shear and Bending Moments**
   Concept of bending and shear, Shear force and bending moment diagrams in determinate beams, Relation between loading intensity, Shear force and bending moment, Symbols and conventions.

3. **Determinate Plane Frames**
   Analysis of normal force, shear force and bending moment diagrams of determinate plane frames.

4. **Trusses**
   Analysis of forces in the trusses by the method of joints and method of sections.

5. **Arches**
   Analysis of three hinged parabolic and circular arches

6. **Columns and Struts**
   Axial loading, Simple strut theory, Long columns, Empirical formula for long columns, combined direct and bending stresses.

7. **Influence Lines and Moving Loads**
   Influence lines for statically determinate beams and girders, Influence lines for shear, Reaction, shear and bending moment for beams. Calculation of maximum reaction, shear and bending moment in a simply supported beam due to series of moving loads, Absolute maximum bending moment and its evaluation.

Recommended Books:

1. Mechanics of Structures Vol-I & Vol-II, Junarkar JB, Vivek Publication Mumbai. Latest Edition
2. Elementary Theory of Structures, Wang CK & Eckel CL McGraw Hill Book Company, Singapore. Latest Edition
3. Theory of Structures, Timoshenko SP and Young DH, McGraw Hill Book Company, Singapore. Latest Edition

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Approval:

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