15MH202J	Mechanics of Solids and Fluids			L	T	P	C
				3	0	2	4
Co-requisite:	Nil						
Prerequisite:	15ME102						
Data Book / Codes/Standards	Nil						
Course Category	P	Professional Core	Mechanical Engineering				
Course designed by	Department of Mechatronics Engineering						
Approval	32nd Academic Council Meeting held on 23.07.2016.						

Purpose	To impart the knowledge of fundamental behavior of structural members under loads and also the basic concepts of fluids.							
Instructional Objectives		**Student Outcomes**						
At the end of the course, student will be able to								
1.	Analyze the stress, strain in the structural members subjected to different types of loading.	a	b	e				
2.	Construct Mohr's circle and determine the stress components associated with different planes at a point.	a		e				
3.	Analyze the buckling load for columns with different support conditions.	a	b	e				
4.	Analyze the physical behavior of fluids using the concepts of continuity equation and Bernoulli's theorem.	a	b	e				
5.	Explain the basic idea of dimensional analysis.	a		e				

Session	Description of Topics	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Stress, Strain and Deformation of Solids	**8**			
1.	Concept of stress-strain and its types, Hooke's law, modulus of elasticity, factor of safety, Poisson's ratio, elastic constants and their relationship.	1	C	1	1,2
2.	Analysis of bars of uniform and varying cross sections subjected to different loads.	1	C	1	1,2
3.	Principle of superposition, analysis of bars of composite sections.	1	D	1	1,2
4.	Analysis of stress in composite bars due to temperature difference.	1	C,D	1	1,2
5.	Principal plane and principal stresses, analysis of direct stresses in one plane and two mutually perpendicular planes.	1	C,D	1,2	1,2
6.	Analysis of direct stresses in two mutually perpendicular planes using Mohr's circle.	1	C,D	1,2	1,2
7.	Analysis of direct stresses in two mutually perpendicular planes with simple shear stress using Mohr's circle.	2	C,D	1,2	1,2
	Unit II: Transverse Loading on Beams, Shear Force and Bending Moment	**8**			
8.	Types of beams and loadings, shear force and bending moments, sign convention for shear force and bending moments.	1	C	1	1,2
9.	Analysis of shear force and bending moment for cantilever beam with point load at free end, different loads at different points.	1	C,D	1	1,2
10.	Analysis of shear force and bending moment for cantilever beam with Uniformly Distributed Load (UDL).	1	C,D	1	1,2
11.	Analysis of shear force and bending moment for simply supported beam with point loads and UDL.	1	C,D	1	1,2
12.	Analysis of shear force and bending moment for overhanging beam with point loads and UDL.	1	C,D	1	1,2
13.	Analysis of maximum bending moment and point of contraflexure in overhanging beam.	1	C,D	1	1,2
14.	Theory of simple bending in beam, expression for bending stress equation.	1	C,D	1	1,2

Session	Description of Topics	Contact hours	C-D-I-O	IOs	Reference
	Unit III: Torsion and Columns	**8**			
16.	Theory of torsion, derivation of torsional equation.	1	C	1	1,2
17.	Analysis of torque transmitted by a solid and hollow shaft.	2	C,D	1	1,2
18.	Analysis of strength of varying cross sections of shafts.	1	C,D	1	1,2
19.	Types of columns, applications, expression for buckling load of columns with different support conditions.	1	C,D	1	1,2
20.	Determination of buckling load for columns with different support conditions using Euler's formula.	2	C,D	1,3	1,2
21.	Determination of buckling load for columns with different support conditions using Rankine's formula.	1	C,D	1,3	1,2
	Unit IV: Fluid Flow Concepts and Dynamics of Fluids	**8**			
22.	Fluids and their properties, determination of fluid properties.	1	C	4	3,4
23.	Basics of continuity equation, determination of velocity and discharge of fluids in pipe using continuity equation.	2	C	4	3,4
24.	Equations of motion, derivation of Euler's equation and Bernoulli's equation.	1	C,D	4	3,4
25.	Assumptions: Determination of velocity, pressure and discharge of fluids in pipe using Bernoulli's equation.	2	C,D	4	3,4
26.	Applications of Bernoulli's equation, determination of rate of flow of fluids in pipe using venturimeter in horizontal position.	1	C,D	4	3,4
27.	Determination of rate of flow of fluids in pipe using orificemeter.	1	C,D	4	3,4
	Unit V: Dimensional Analysis and Flow Through Pipes	**9**			
28.	Dimensions and units, dimensional homogeneity, Rayleigh method.	1	C	4,5	3,4
29.	Buckingham's Π theorem, dimensional analysis using Buckingham's Π theorem.	1	C,D	4,5	3,4
30.	Losses in pipes, types of losses, analysis of minor losses in pipes.	1	C,D	4,5	3,4
31.	Analysis of major losses in pipes using Darcy Weisbach and Chezy formula.	1	C,D	4,5	3,4
32.	Analysis of discharge, velocity of fluids flows through pipes in series.	1	C,D	4,5	3,4
33.	Analysis of discharge, velocity of fluids flows through pipes in parallel.	2	C,D	4,5	3,4
34.	Construction and working principle of centrifugal pump.	1	C,D	4	3
35.	Construction and working principle of reciprocating pump.	1	C,D	4	3
	Assessment	**4**			
36.	Cycle test – I	1			
37.	Cycle test – II	2			
38.	Surprise test / Assignment and Quiz	1			
	Total contact hours	**45**			

Sl. No.	Description of Experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Tensile test on mild steel.	2	I,O	1	7
2.	Deflection test on different beams.	2	I,O	3	
3.	Charpy and Izod impact test on steel specimen.	2	I,O	1	
4.	Double shear and (or) Compression test.	2	I,O	1	
5.	Torsional test on mild steel.	2	I,O	1	
6.	Fatigue test.	2	I,O	1	
7.	Determination of coefficient of discharge of orificemeter.	2	I,O	4	8
8.	Determination of coefficient of discharge of venturimeter.	2	I,O	4	
9.	Determination of major losses in pipe flow.	2	I,O	4	
10.	Verification of Bernoulli's theorem.	2	I,O	4	

11.	Determination of minor losses: Expansion and contraction losses in pipes.	2	I,O	4	8
12.	Performance test on Centrifugal pump / Reciprocating pump.	2	I,O	4	
13.	Extra practice session.	2			7,8
14.	Extra practice session.	2			
15.	Model Examination.	2			
	Total contact hours	**30**			

Learning Resources	
Sl. No.	**Text Books**
1.	Bansal.R.K, "*Strength of Materials*", 5th edition Lakshmi publications Pvt. Ltd., New Delhi, 2014.
2.	Ramamurtham.S and Narayanan.R, "*Strength of Materials*", 14th edition, DhanpatRai Pvt. Ltd., New Delhi, 2011.
3.	Bansal.R.K, "*Fluid Mechanics and Hydraulic Machines*", 9th edition, Laxmi publications (P) Ltd., New Delhi, 2005.
4.	Kumar.K.L, "*Engineering Fluid Mechanics*", 8th edition, Chand and co limited, New Delhi, 2012.
	Reference Books/Other Reading Materials
5.	Timoshenko.S.P and Gere .M.J, "*Mechanics of Materials*", 5th edition, Stanley Thornes (PUB) Ltd, 1999.
6.	Ferdinand P. Beer and Russell Johnston.E, "*Mechanics of Materials*", SI metric edition McGraw Hill, 1992.
7.	Strength of Material Laboratory Manual.
8.	Fluid Mechanics Laboratory Manual.

Course nature				**Theory + Practical**			
Assessment Method – Theory Component (Weightage 50%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination weightage:							**50%**
Assessment Method – Practical Component (Weightage 50%)							
In-semester	**Assessment tool**	Experiments	Record	MCQ/Quiz/Viva Voce	Model examination		**Total**
	Weightage	**40%**	**5%**	**5%**	**10%**		**60%**
End semester examination weightage:							**40%**