19ME3301 – ENGINEERING MECHANICS

Offering Branches	ME		
Course Category	Program Core	Credits	3
Course Type	Theory	Lecture-Tutorial-Practical	2-1-0
Prerequisites	Engineering Mathematics	Continuous Evaluation	30 + 70 = 100
Course Outcomes			
Upon successful completion of the course, the student will be able to			
CO1	Determine the resultant force, moment and static equilibrium of a rigid body subjected to a force system.		L3
CO2	Analyse planar force systems to determine the forces in the members of trusses and solve friction related problems.		L4
CO3	Determine centroids and moment of inertia for simple and composite areas		L3
CO4	Apply kinematic principles to the rigid bodies under translation and rotation motion.		L3
CO5	Determine the motion parameters for a body subjected to a given force system.		L3
Course Content			
Unit-1	**Introduction**: Significance of Engineering Mechanics, Composition and resolution of forces, parallelogram law, principle of transmissibility, types of force systems - concurrent and non-concurrent, coplanar forces, resultant of coplanar force systems, couple, moment of a force, Varignon's theorem, concept of free body diagrams, concept of equilibrium of coplanar force systems.		CO1
Unit-2	**Friction:** Laws of friction, types of friction, equilibrium of force systems involving frictional forces, ladder and wedge friction **Analysis of Structures:** Introduction to plane trusses, Types of trusses, Assumptions in analysis of truss, analysis of plane trusses by method of joints.		CO2
Unit-3	**Centroid:** Centroid and centre of gravity, derivation of centroids of rectangle, triangle, circle, semi-circle from first principles, centroid of composite areas. **Moment of Inertia:** Area moment of inertia of plane and composite figures, parallel axis theorem, perpendicular axis theorem, polar moment of inertia.		CO3
Unit-4	**Kinematics:** Equations of motion for rigid bodies under constant and variable acceleration, rectilinear and curvilinear motion, Rotation of a rigid body about a fixed axis- Rotation under the action of constant moment.		CO4
Unit-5	**Kinetics:** Principles of dynamics - Newton's Laws of motion, D'Alembert's principle in rectilinear translation, principle of work and energy. **Ideal Systems:** Principle of conservation of energy, conservation of linear momentum, principle of momentum and impulse, impact – Direct central impact		CO5

Learning Resources		
Text Books	1. S. Timoshenko, D.H. Young, J.V. Rao, Sukumar Pati, Engineering Mechanics (in SI units), 5/e, McGraw Hill, 2013. 2. Engineering Mechanics Statics and dynamics, by A.K.Tayal, Umesh Publication, Delhi, 14e, 2010.	
Reference Books	1. Irving Shames, G.K.M. Rao, Engineering Mechanics: Statics and Dynam-ics, 4/e, Pearson, 2009. 2. K.L. Kumar, Veenu Kumar, Engineering Mechanics, 4/e, Tata McGraw Hill, 2010. 3. N.H. Dubey, Engineering Mechanics: Statics and Dynamics,TataMcGrawHill,2014	
e-Resources & other digital material	1. https://nptel.ac.in/courses/112/103/112103108/ 2. https://www.coursera.org/learn/engineering-mechanics-statics	

Course Coordinator HOD

Code No: **19ME3301**

PVP SIDDHARTHA INSTITUTE OF TECHNOLOGY
(Autonomous)

II B.Tech – I Semester Regular Examinations, May-2020

ENGINEERING MECHANICS

Duration: 3 Hours **Max. Marks: 70**

Note:
1. This question paper contains two Parts A and B.
2. Part A is compulsory which carries 10 marks. Answer all questions in Part A.
3. Part B consists of 5 units. Answer any one full question from each unit. Each question carries 12 marks and may have a, b, c as sub questions.
4. All parts of Question paper must be answered in one place

PART – A

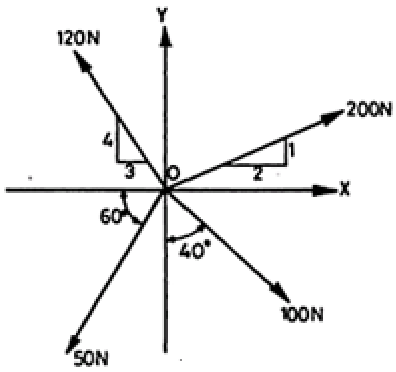
5 x 2 = 10 marks

		Blooms Level	CO
1. a)	Discuss about principle of transmissibility.	L2	CO1
1. b)	Differentiate static friction and dynamic friction.	L2	CO2
1. c)	Define the term polar moment of inertia.	L1	CO3
1. d)	Explain the terms kinematics and kinetics.	L2	CO4
1. e)	State impulse-momenutum priniciple.	L1	CO5

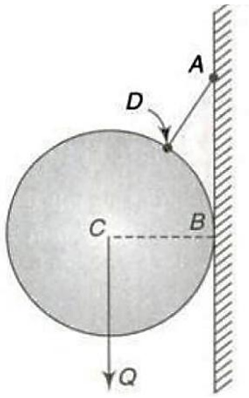
PART – B

5 x 12 = 60 marks

			Blooms Level	CO	Max. Marks
		UNIT-I			
2	(a)	A system of four forces acting on a body is as shown in Fig. Determine the resultant.	3	CO1	6

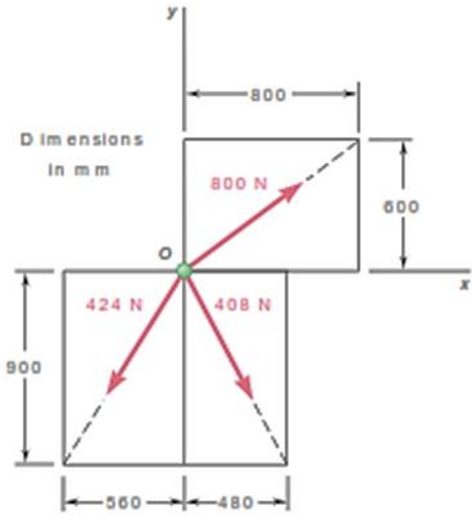


	(b)	A ball of weight Q and radius r is attached by a string AD to a vertical wall AB, as shown in Fig. Determine the tensile force S in the string and the pressure R_b against the wall at B if Q = 35.6 N, r = 75 mm, AB = 100 mm. Neglect friction at wall.	3	CO1	6

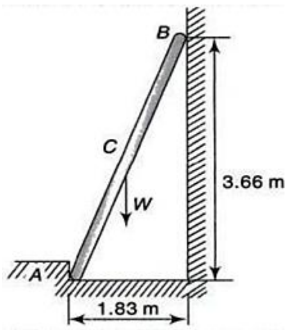


OR

3	(a)	Determine the **x** and **y** components of each of the forces shown.	3	CO1	6



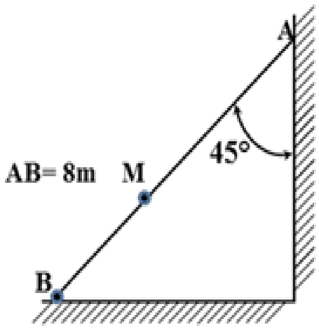
	(b)	A 667.5 N man stands on the middle rung of a 222.5 N ladder, as shown in Fig. Assuming a smooth wall at B and a stop at A to prevent slipping, find the reactions at A and B.	3	CO1	6



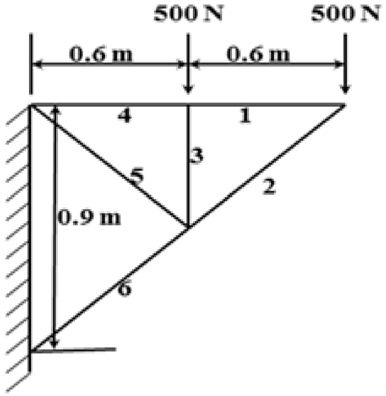
UNIT-II

4	(a)	A 8m long ladder rests against a vertical wall as shown in figure, with which it makes an angle of 45° with the vertical wall. If a man of 800 N weight climbing up the ladder. At what distance from B along the ladder will he	4	CO2	6

be when the ladder is about to slip. The coefficient of friction between the ladder and the wall is 1/3 and between the ladder and the floor is ½. Neglect the weight of the ladder.

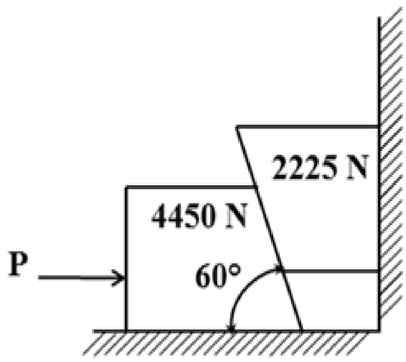


	(b)	Determine the axial force in each bar of the plane truss loaded as shown in the figure.	4	CO2	6

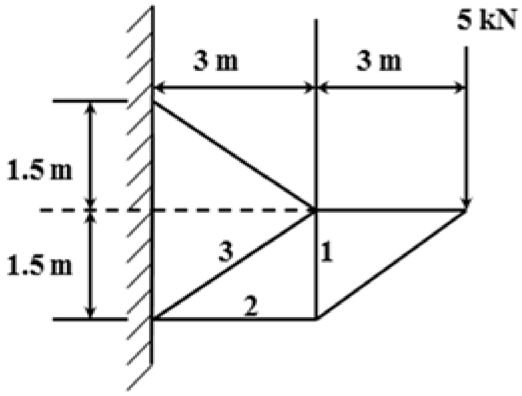


OR

5	(a)	Referring to the figure the coefficient of friction are as follows: 0.25 at the floor, 0.30 at the wall, 0.20 between the blocks. Find the minimum value of a horizontal force P applied to the lower block that will hold the system in equilibrium.	4	CO2	6

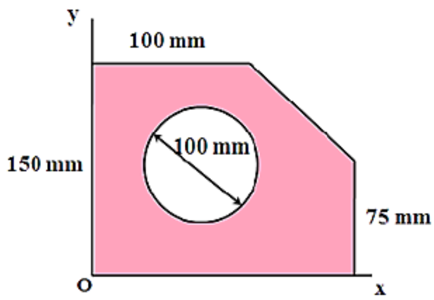


	(b)	Find the axial force in each of bars 1,2,3 of the plane truss in the figure.	4	CO2	6

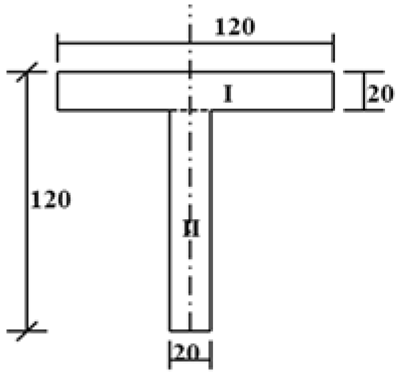


UNIT-III

6	(a)	Referring to the figure , determine the coordinates x_c and y_c of the center of a 100mm diameter, circular hole cut in a 150x200mm thin plate so that this point will be the centroid of the remaining shaded area.	3	CO3	6

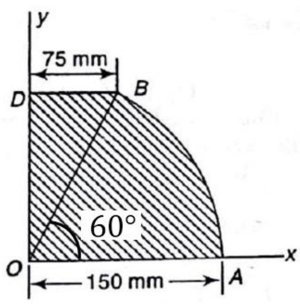


	(b)	Find the second moments of area of a T – section 120x120x20 about its centroidal axes as shown in figure.	3	CO3	6

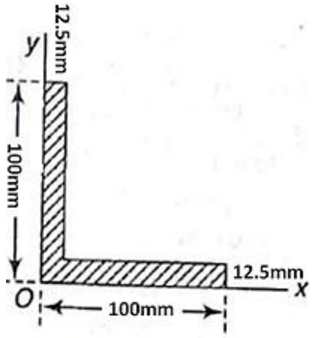


OR

7	(a)	Locate the centroid C of the shaded area OABD shown in the Figure.	3	CO3	6



	(b)	Calculate the Moment of Inertia of angle section about x – axis.	3	CO3	6



UNIT-IV

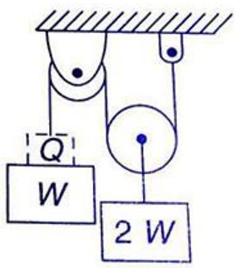
8	(a)	A small steel ball is shot vertically upwards from the top of a building 25m above the ground with an initial velocity of 18m/s. (i) In what time, it will reach the maximum height (ii) How high above the building will ball rise (iii) Compute the velocity with which it will strike the ground and the total time it is in motion.	3	CO4	6
	(b)	Derive kinematic equations of motion for a particle rotating about a fixed axis.	3	CO4	6

OR

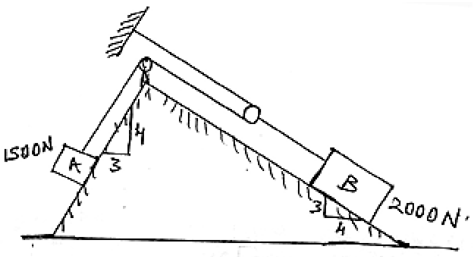
9	(a)	A body starting from rest moves in a straight line with its equation of motion being $S=2t^3-3t^2+2t+1$ where, S is displacement in *metre* and t is time in *second*. What is its acceleration after one second?	3	CO4	6
	(b)	Starting from rest, a particle moves along a circular path of radius ‘r’ so that the distance travelled is given by the expression $s = ct^2$, where ‘c’ is a constant. Find the tangential and normal components of acceleration of the particle.	3	CO4	6

UNIT-V

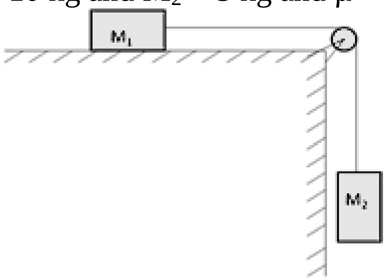
10	(a)	Weight W and 2W are supported in a vertical plane by a string and pulleys arranged as shown in Fig.2. Find the magnitude of an additional weight Q applied on the left which will give a download acceleration a=0.1*g* to the weight *W*. Neglect friction and inertia of pulleys.	3	CO5	6



	(b)	In what distance will body A of figure attain a velocity of 3 m/s starting from rest? Use work-energy method to solve the problem.	3	CO5	6



OR

11	(a)	Two blocks of masses M_1 and M_2 are connected by a flexible but inextensible string as shown in figure. Assuming the coefficient of friction between the block M1 and the horizontal surface to the μ find the acceleration of the masses and tension in the string. Assume M_1 = 10 kg and M_2 = 5 kg and μ = 0.25. 	3	CO5	6
	(b)	A vehicle of mass 600 kg and moving with a velocity of 12 m/s strikes another vehicle of mass 400 kg, moving at 9 m/s in the same direction. Both the vehicles get coupled together due to impact. Find the common velocity with which the two vehicles will move. Also find the loss of kinetic energy due to impact.	3	CO5	6