Hall Ticket No | | | | | | | | | | | Question Paper Code: AMEB03

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER

B.Tech III Semester End Examinations, November - 2019

Regulations: R18

ENGINEERING MECHANICS

(Common to MECH/CIVIL)

Time: 3 hours **Max. Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

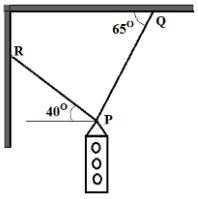
MODULE – I

1. a) Explain the procedure to find the resultant of several forces acting at a point. **[7M]**

   b) The following forces act at a point **[7M]**
   a. 30kN inclined at 35^0 towards North to East.
   b. 22kN towards North
   c. 30kN inclined at 30^0 towards North to West
   d. 35kN inclined at 25^0 towards South to West.
   Find the magnitude and direction of the resultant force.

2. a) State and prove Lami's theorem with a neat sketch? **[7M]**

   b) A traffic signal of mass 50kg is hung with the help of two strings, as shown in figure. Find the forces induced in the strings. **[7M]**

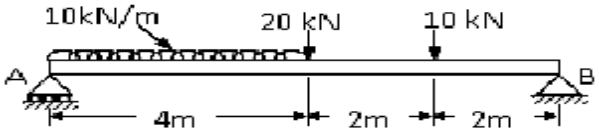


MODULE – II

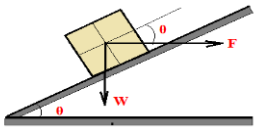
3. a) Derive an expression for the minimum effort required along the inclined plane to keep a body in equilibrium position when it is at point of sliding downwards on a inclined plane. **[7M]**

   b) A screw jack has mean diameter of 50mm and pitch 10mm. if the coefficient of friction between its screw and nut is 0.15, find the effort required at the end of the 700mm long handle to raise a load of 10KN. **[7M]**

4. a) A beam AB is supported and loaded as shown in fig.1. Find the reactions at the supports. **[7M]**



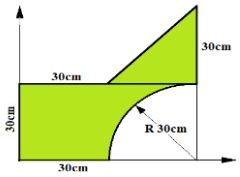
b) A horizontal force F is applied to a block which rests on an inclined plane, as shown in figure. Find the force required to initiate motion up the plane. **[7M]**



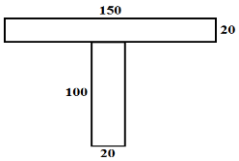
MODULE – III

5. a) State and prove the parallel axis theorem. **[7M]**

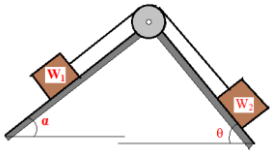
b) Determine the coordinates of centroid of the shaded area shown in figure. **[7M]**



6. a) Find the moment of inertia of the "T " section as shown in figure about centroidal x-axis. All dimensions are in mm. **[7M]**



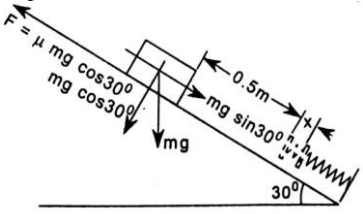
b) Two blocks are placed on two smooth inclined planes as shown in figure. The string connecting the blocks passing over a smooth pulley is inextensible. If W_1 = 75N, W_2 = 65N and $\alpha = 37^0$ determine using the method of virtual work, the angle θ. **[7M]**



MODULE – IV

7. a) A particle starts from rest and moves along a straight line with constant acceleration a. If it acquires a velocity v=3 mm/s^2, after having travelled a distance S=7.5m, find the magnitude of the acceleration. **[7M]**

b) A block of mass 5kg resting a 30^o inclined plane is released. The block after travelling a distance of 0.5m along inclined plane hits a spring of stiffness 15N/cm as shown in figure given below. Find the maximum compression of spring. Assume coefficient of friction between block and the inclined plane as 0.2. **[7M]**

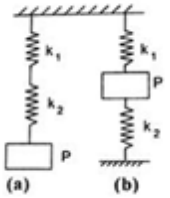


8. a) A ball is thrown vertically upwards at 20m/s from a window 50m above the ground. Determine the (i) maximum rise of the ball from ground and (ii) time and velocity of the ball hitting the ground. **[7M]**

b) An elevator weighing 4900N is ascending with an acceleration of 3 m/s2. During the ascent its operator whose weight is 686N is standing on the scales placed on the floor. What is the scale reading? What will be total tension in the cable of the elevator during this motion? **[7M]**

MODULE – V

9. a) Determine the period of vibration of a weight P attached to springs of stiffness k1 and k2 in two different cases as shown in figure 10 given below. **[7M]**



b) A body performing simple harmonic motion has a velocity 12m/s when the displacement is 50mm and 3m/s when the displacement is 100mm, the displacement measured from the midpoint. Calculate the frequency and amplitude of the motion. What is the acceleration when the displacement is 75mm. **[7M]**

10. a) A pendulum having a time period of 1s is installed in a lift. Determine its time period when **[7M]**
a The lift is moving upwards with an acceleration of $g=10m/s^2$
b The lift is moving downwards with an acceleration of $g=10m/s^2$

b) A weight of 10N attached to a spring oscillates at a frequency of 60 oscillations per minute. If the maximum amplitude is 30mm, find the tension induced in the spring. Also find the spring constant and the maximum velocity in the spring **[7M]**

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COURSE OBJECTIVES:

The course should enable the students to:

I	Students should develop the ability to work comfortably with basic engineering mechanics concepts required for analyzing static structures.
II	Identify an appropriate structural system to studying a given problem and isolate it from its environment, model the problem using good free-body diagrams and accurate equilibrium equations
III	Understand the meaning of centre of gravity (mass)/centroid and moment of Inertia using integration methods and method of moments
IV	To solve the problem of equilibrium by using the principle of work and energy, impulse momentum and vibrations for preparing the students for higher level courses such as Mechanics of Solids, Mechanics of Fluids, Mechanical Design and Structural Analysis etc...

COURSE OUTCOMES (COs):

CO 1	Develop the ability to work comfortably with basic engineering mechanics concepts required for analysing rigid bodies and structures. Identify an appropriate structural system for studying a given problem and isolate it from its environment, model the problem using free body diagrams and accurate equilibrium equations.
CO 2	Understand laws of friction and advantages of friction. Can be able to use this knowledge for various engineering applications. Can be able to analyse simple pin-jointed frames under different load conditions.
CO 3	Can be able to locate the centroids and calculate the moments of inertia for various simple cross-sections such as I section, T-scetion, Channel section etc., and composite sections. Mass moments of inertia can also be determined. Can apply the, principle of virtual work for the analysis of structures.
CO 4	Understand the principles(Laws of rigid body motion, Work-energy principle and Impulse-momentum principle etc.,), for analysing the problems related to the motion of rigid bodies with and without considering the forces which causes motion.
CO 5	Understands the concepts related to the free and forced vibrations and can be able to apply the same to real world problems. Also understands the simple harmonic motion of simple pendulum.

COURSE LEARNING OUTCOMES (CLOs):

AMEB03.01	A basic understanding of the laws and principle of mechanics.
AMEB03.02	The ability to solve simple force system problems in mechanics
AMEB03.03	Determine the resultant and apply conditions of static equilibrium to a plane force system
AMEB03.04	Can be able to apply the knowledge of forces and force systems in the analysis of more complex problems.
AMEB03.05	Understands the concepts of static and dynamic friction, advantages and disadvantages of friction.
AMEB03.06	Solve the problems of simple systems with friction effect. Calculate the linear moving bodies ingeneral plane motion and applications of friction.
AMEB03.07	Analyze planar and spatial systems to determine the force in the members of truss and frames.
AMEB03.08	Solve the problems on different types of beams.

AMEB03.09	Obtain the centroid, center of gravity and centre of mass for simple and composite objects.
AMEB03.10	Understand the concept of moment of inertia and can calculate second moment of area for simple and composite sections..
AMEB03.11	Can apply the knowledge of first and second moments of area in the analysis and design of complex structures.
AMEB03.12	Understand the concept of virtual work and an ability to solve practical problems using the principle of virtual work.
AMEB03.13	Understand the concepts of kinematics of the particles and rectilinear motion.
AMEB03.14	Explore knowledge & ability to solve various particle motion problems.
AMEB03.15	Derive the D' Alembert's principle and apply it to various field problems of kinetic motion.
AMEB03.16	Determine the impact, impulse and impulsive forces occurring in the system and able to solve the problems.
AMEB03.17	Understands the concepts of vibration and explain the relation between simple harmonic motion and the equilibrium systems.
AMEB03.18	Derive the expressions for the concepts of simple, compound and torsional pendulums.
AMEB03.19	Applies the knowledge of vibrations in the analysis and design of various machine foundations.
AMEB03.20	Explore the use of modern engineering tools, software and equipment to prepare for competitive exams, higher studies etc

MAPPING OF SEMESTER END EXAMINATION - COURSE OUTCOMES

SEE Question No		Course Learning Outcomes		Course Outcomes	Blooms Taxonomy Level
1	a	AMEB03.02	The ability to solve simple force system problems in mechanics	CO 1	Understand
	b	AMEB03.02	The ability to solve simple force system problems in mechanics	CO 1	Understand
2	a	AMEB03.01	A basic understanding of the laws and principle of mechanics.	CO 1	Understand
	b	AMEB03.03	Determine the resultant and apply conditions of static equilibrium to a plane force system	CO 1	Understand
3	a	AMEB03.05	Understands the concepts of static and dynamic friction, advantages and disadvantages of friction.	CO 2	Understand
	b	AMEB03.06	Solve the problems of simple systems with friction effect. Calculate the linear moving bodies in general plane motion and applications of friction.	CO 2	Remember
4	a	AMEB03.08	Solve the problems on different types of beams	CO 2	Understand
	b	AMEB03.06	Solve the problems of simple systems with friction effect. Calculate the linear moving bodies in general plane motion and applications of friction.	CO 2	Understand
5	a	AMEB03.10	Understand the concept of moment of inertia and can calculate second moment of area for simple and composite sections..	CO 3	Understand
	b	AMEB03.09	Obtain the centroid, center of gravity and centre of mass for simple and composite objects.	CO 3	Understand
6	a	AMEB03.11	Can apply the knowledge of first and second moments of area in the analysis and design of complex structures.	CO 3	Understand

	b	AMEB03.12	Understand the concept of virtual work and an ability to solve practical problems using the principle of virtual work.	CO 3	Understand
7	a	AMEB03.13	Understand the concepts of kinematics of the particles and rectilinear motion	CO 4	Understand
	b	AMEB03.15	Derive the D' Alembert's principle and apply it to various field problems of kinetic motion.	CO 4	Understand
8	a	AMEB03.13	Understand the concepts of kinematics of the particles and rectilinear motion	CO 4	Understand
	b	AMEB03.16	Determine the impact, impulse and impulsive forces occurring in the system and able to solve the problems.	CO 4	Understand
9	a	AMEB03.17	Understands the concepts of vibration and explain the relation between simple harmonic motion and the equilibrium systems.	CO 5	Understand
	b	AMEB03.18	Derive the expressions for the concepts of simple, compound and torsional pendulums.	CO 5	Understand
10	a	AMEB03.18	Derive the expressions for the concepts of simple, compound and torsional pendulums.	CO 5	Understand
	b	AMEB03.19	Applies the knowledge of vibrations in the analysis and design of various machine foundations.	CO 5	Understand

Signature of Course Coordinator **HOD, CE**