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)

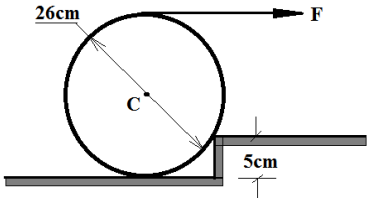
Time: 3 hours **Max. Marks: 70**

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

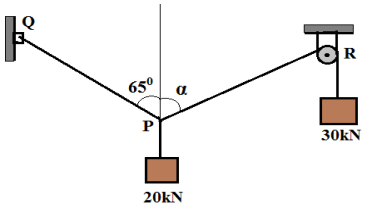
1. a) Explain free body diagram with neat sketches. **[7M]**

   b) A heavy cylinder of mass 280kg is to be pulled over a curb of height 5cm by a horizontal force F applied by means of a rope wound around the cylinder as shown in figure. Determine the magnitude of pull for impending motion over the curb, while the radius of the cylinder is 13cm.. **[7M]**



2. a) State and prove the Parallelogram law of forces? **[7M]**

   b) Two weights are suspended as shown in figure. Determine the tension in String PQ. Pulley is assumed smooth. **[7M]**

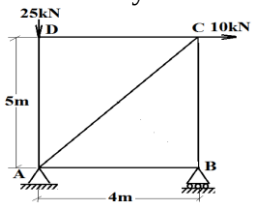


MODULE – II

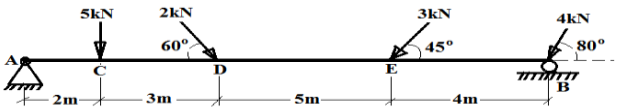
3. a) Explain Cone of friction. **[7M]**

   b) A screw thread of a screw jack has a mean diameter of 10cm and a pitch of 1.25cm. The coefficient of friction between the screw and its nut housing is 0.25. Determine the force F that must be applied at the end of a 50cm lever arm to raise a mass of 5000kg. Is the device self-locking? Also determine its efficiency. **[7M]**

4. a) Find the forces in the members AB and BD by method of sections. **[7M]**

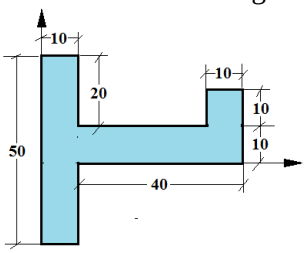


b) Determine the support reactions at points A & B for the simply supported beam shown in figure. **[7M]**

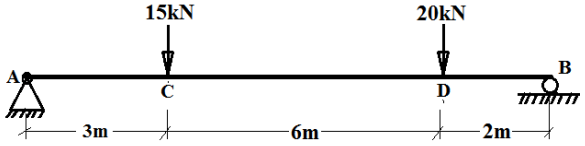


MODULE – III

5. a) Derive an expression for centroid of semi-circle. **[7M]**
b) Locate the centroid of the composite area shown in figure. **[7M]**

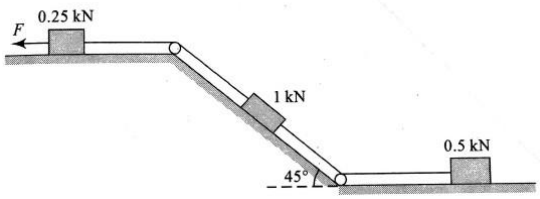


6. a) State Pappus-Guldinus theorems. Illustrate it with the determination of **[7M]**
(a) Surface area of a cylinder of radius 'r' and length 'l' and
(b) Volume of a sphere of radius 'r'.
b) Using the method of virtual work, determine the reaction at supports A and B of the transversely loaded beam shown in figure. **[7M]**



MODULE – IV

7. a) The position of a particle moving along a straight line is defined by the relation $x = t^3-9t^2+15t+18$ where x is expressed in metres m and t in seconds. Determine the time, position and acceleration of the particle when its velocity becomes zero. **[7M]**
b) For the system of connected bodies as shown in the figure given below, calculate the force F required to make the motion impending to the left. Use the method of virtual work and take coefficient of friction for all contiguous surfaces except pulleys as 0.25. **[7M]**



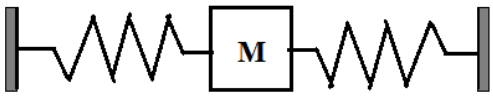
8. a) The rectilinear motion of a particle is defined by the displacement time equation as $x=x_0+v_0t+(1/2)at^2$. Find the displacement and velocity at time t=2s while x_0=250mm, v_0=125mm/s and a=0.5mm/s^2. **[7M]**

b) A mass of 5kg is dropped from a height of 2 metres upon a spring whose stiffness is 10N/mm. Calculate the speed of the mass when a spring is compressed through a distance of 100mm. **[7M]**

MODULE – V

9. a) A simple pendulum swings 5 oscillations in the same time as another 0.48m longer swings 3 oscillations. Determine their lengths. **[7M]**

b) A spring of stiffness 10N/m is cut into two halves and fixed with a mass M, so that the system can vibrate, as shown in figure. If the cyclic frequency of the system is 7 cps, determine the magnitude of M. **[7M]**



10. a) A body moving with SHM has amplitude of 1m and period of oscillation of 2 seconds. What will be its velocity and acceleration at 0.4s after passing an extreme position? **[7M]**

b) A conical pendulum rotates at 100 rev/min. The cord is 150mm long and the mass of bob1.35Kg. **[7M]**

Find

i. The amount of which the bob rises above its lowest position

ii. The period

iii. The tension in the cord.

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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 in general 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	AMEB03.07	Analyze planar and spatial systems to determine the force in the members of truss and frames.	CO 2	Understand
	b	AMEB03.08	Solve the problems on different types of beams	CO 2	Understand

5	a	AMEB03.9	Obtain the centroid, center of gravity and centre of mass for simple and composite objects	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	AMEB03.18	Derive the expressions for the concepts of simple, compound and torsional pendulums.	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**