Enrolment No/Seat No.: _____

R.N.G.PATEL INSTITUTE OF TECHNOLOGY-RNGPIT

(An Autonomous College U/s UGC Act 1956)

B.Tech. SEMESTER-I, SEMESTER END EXAMINATION - WINTER 2024

Subject Code: 1ME102 **Date: 21-12-2024**

Subject Name: ENGINEERING MECHANICS

Time: 11:00 AM to 01:30 PM **Total Marks: 70**

Instructions

1. It is **compulsory** for students to write **Enrolment No. /Seat No.** on the question paper.
2. Write answers of **Section A** and **Section B** in **separate answer books**.
3. Attempt all questions from both **Section A** and **Section B**.
4. Each section carries **35 marks**, with a total of **70 marks** for the examination.
5. The figures to the right of each question indicate full marks, make suitable assumptions with justification.
6. BL - Bloom's Taxonomy Levels (R-Remember, U-Understanding, A –Application, N –Analyze, E – Evaluate, C -Create), CO - Course Outcomes.

SECTION A

		Marks	BL	CO
Q.1	**Objective-Type Questions**	**[05]**		
(a)	A self-locking machine is also known as a:	**1**	**R**	**2**
	(i) Reversible machine **(ii)** Irreversible machine			
	(iii) Frictionless machine **(iv)** Lever machine			
(b)	In a truss, a zero-force member is:	**1**	**U**	**4**
	(i) A member carrying maximum force **(ii)** A member carrying no force			
	(iii) A member with unknown force **(iv)** A member always under compression			
(c)	Which of the following types of trusses is most commonly used for roof structures?	**1**	**R**	**4**
	(i) Howe Truss **(ii)** Pratt Truss			
	(iii) Warren Truss **(iv)** King Post Truss			
(d)	If the coefficient of static friction between two surfaces is 0.4, what is the angle of repose?	**1**	**A**	**5**
	(i) 21.8° **(ii)** 30°			
	(iii) 45° **(iv)** 53.1°			

(e) What is the primary advantage of friction in practical applications? **1** **R** **5**

(i) Causes wear and tear **(ii)** Reduces energy efficiency

(iii) Provides grip and prevents slipping **(iv)** Requires more effort to move objects

Q.2 Attempt Any Two **[10]**

(a) With a differential wheel and axle, an effort of 6 N raised a load of 60 N. If the efficiency at this load is 80%, find the velocity ratio of the machine. If the diameter of the effort wheel is 300 mm, determine the difference between the diameters of the axles. If the sum of the diameters of the axles is 280 mm, determine the diameter of each axle. **5** **A** **2**

(b) In a differential wheel and axel, the diameter of the effort wheel is 400 mm. The radii of the axels are 150 mm and 100 mm respectively. The diameter of the rope is 10 mm. Find the load which can be lifted by an effort of 25 N. assuming the efficiency of the machine to be 84%. **5** **A** **2**

(c) What is truss? Write assumption made in analysis of truss. **5** **U** **4**

Q.3 Attempt Any Two **[10]**

(a) Explain different types of trusses with applications. **5** **U** **4**

(b) Determine the force in each member of the loaded truss shown in figure 1. **5** **A** **4**

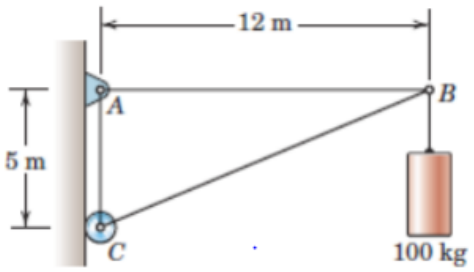
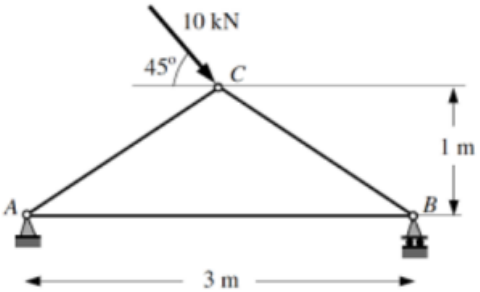


Figure 1

(c) Find the internal forces in members AB, AC, BC shown in figure 2 by using the method of joints. **5** **A** **4**



(d) Figure 2

Q.4 Attempt Any Two **[10]**

(a) Define friction and state the laws of dry friction. **5** **R** **5**

(b) An 8 m long ladder rests against a vertical wall with which it makes an angle of 45°. A man whose weight is one half of that ladder, climbs it. Determine the distance of the man from the wall when the ladder just start to slip. The coefficient of friction is 0.3 between ladder and wall & 0.5 between ladder and floor. **5** **A** **5**

(c) A block is lying on an inclined plane shown in figure 3, determine whether the block will slide or remains at rest. Also, determine the frictional force developed. **5** **A** **5**

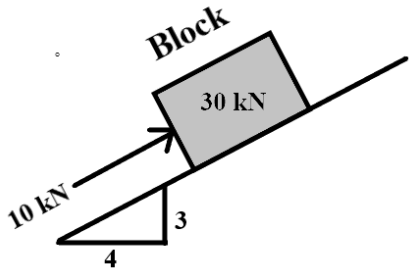


Figure 3

SECTION B

Marks BL CO

Q.5 Objective-Type Questions **[05]**

(a) If the center of gravity of a body is not within the material of the body, the body is: **1** **R** **3**

(i) Unstable. **(ii)** Stable.

(iii) Neutral. **(iv)** Immovable.

(b) Which of the following sections has the highest area moment of inertia for the same cross-sectional area? **1** **U** **3**

(i) Circular section. **(ii)** Rectangular section.

(iii) I-section. **(iv)** Hollow circular section.

(c) The resultant of two concurrent forces can be determined using: **1** **R** **1**

(i) Varignon's theorem **(ii)** Law of polygon of forces

(iii) Law of triangle of forces **(iv)** Lami's theorem

(d) Newton's first law of motion is also called: **1 R 1**

(i) Law of action and reaction **(ii)** Law of acceleration

(iii) Law of inertia **(iv)** Law of momentum

(e) A simple machine is a device that: **1 R 2**

(i) Multiplies force and changes direction of force **(ii)** Converts mechanical energy into electrical energy

(iii) Reduces energy consumption **(iv)** Stores energy

Q.6 Attempt Any Two [10]

(a) Discuss the importance of the center of gravity in the design of mechanical components. **5 U 3**

(b) Find the CG of plane lamina shown in figure 1. **5 A 3**

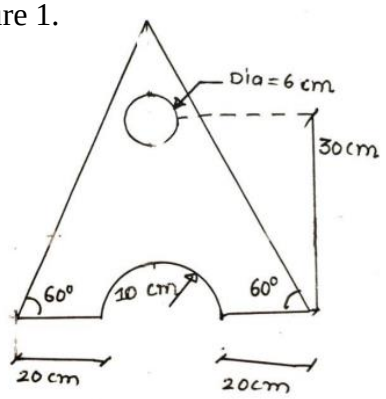


Figure 1

(c) Determine moments of inertia of a section shown in figure 2 about horizontal centroidal axis. **5 A 3**

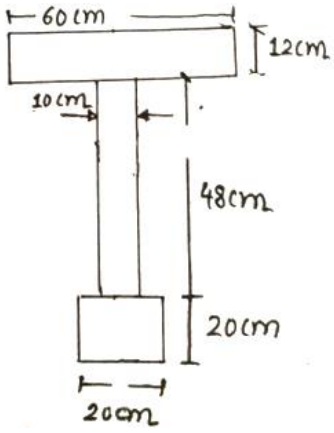


Figure 2

Q.7 Attempt Any Two **[10]**

(a) In a certain weight lifting machine, a weight of 1 kN is lifted by an effort of 25 N. While the weight moves up by 100 mm, the point of application of effort moves by 8 m. Find mechanical advantage, velocity ratio and efficiency of the machine. **5 A 2**

(b) State lami's theorem and explain its significance is mechanics. **5 U 1**

(c) In a simple wheel and axle, the diameter of the wheel is 150 mm and that of the axle is 30 mm. If efficiency of the machine is 60%, determine the effort required to lift a load of 500 N. **5 N 2**

Q.8 Attempt Any Two **[10]**

(a) Using analytical method find the resultant of two forces 30 N and 40 N acting at a point as shown in figure 3. The forces are acting away from the point and make an angle 60° with one another. **5 A 1**

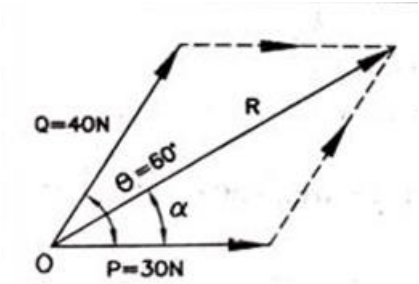


Figure 3

(b) A weight of 100 kN is hung by means of two strings from ceiling as shown in figure 4, find tensions T1 and T2 in two strings. **5 A 1**

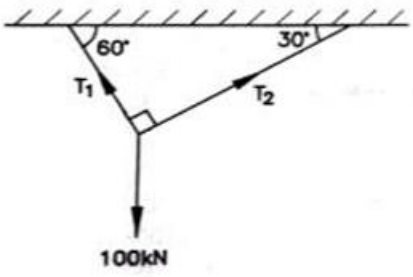


Figure 4

(c) State the parallelogram law of forces and derived its expression **5 A 1**

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