NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

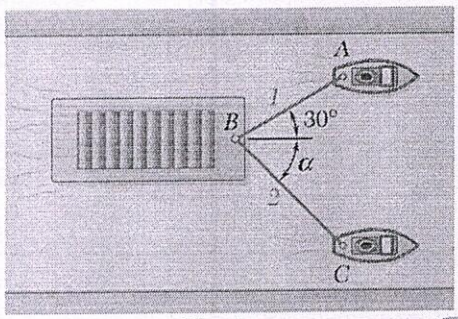
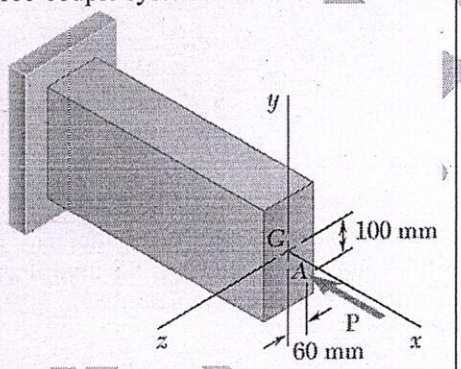
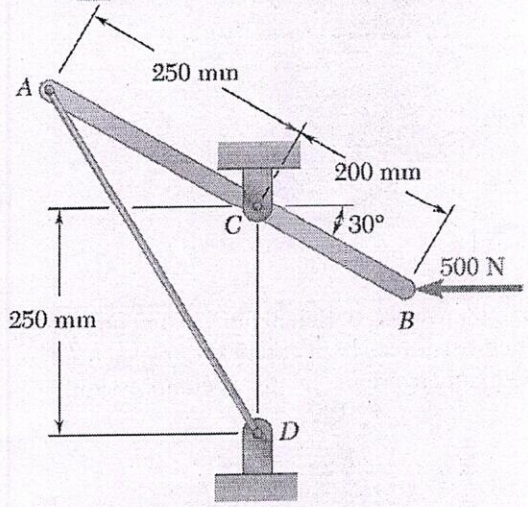
Odd Semester Mid-term Examination, 2023-24

Course Code: XEC01 Full Marks: 25

Course Name: Engineering Mechanics Time: 90 Mins

Question Paper No.: NITDGP/XEC01/ Date of Exam: 16/10/2023

Instructions: Answer any three questions. One mark is reserved for neatness.
Materials to be supplied: Graph paper shall be supplied, if required.
Attempt all parts of a question together.

	Body of the Question	Marks	Mapped CO
1a.	A barge is pulled by two tugboats as shown in Fig. 1a. If the resultant of the forces exerted by the tugboats is a 20 kN force directed along the axis of the barge, determine (a) the tension in each of the ropes knowing that a $\alpha = 45^{O}$, (b) the value of α for which the tension in rope 2 is minimum.	5	CO1
1b.	Refer to Fig. 1b. An eccentric, compressive 1220 N force ***P*** is applied to the end of a column. Replace ***P*** with an equivalent force-couple system at *G*.	3	
	 Fig. 1a  Fig. 1b		
2a.	State and prove the principle of transmissibility of a force.	3	CO1
2b.	A lever *AB* is hinged at *C* and attached to a control cable at *A* as shown in Fig. 2b. If the lever is subjected to a 500 N horizontal force at *B*, determine (a) the tension in the cable, (b) the reaction at *C*.	5	
	 Fig. 2b		
3.	The boom *AB* lies in the vertical *y-z* plane and is supported by a ball-and-socket joint at *B* and by the two cables at *A* (Fig. 3). Calculate the tension in each cable resulting from the 20 kN force acting in the horizontal plane and applied at the midpoint *M* of the boom. Neglect the weight of the boom.	8	CO1

Course Outcomes
CO1: Acquire knowledge of mechanics and ability to draw free body diagrams.
CO2: Apply knowledge of mechanics for solving special problems like truss and frame analysis

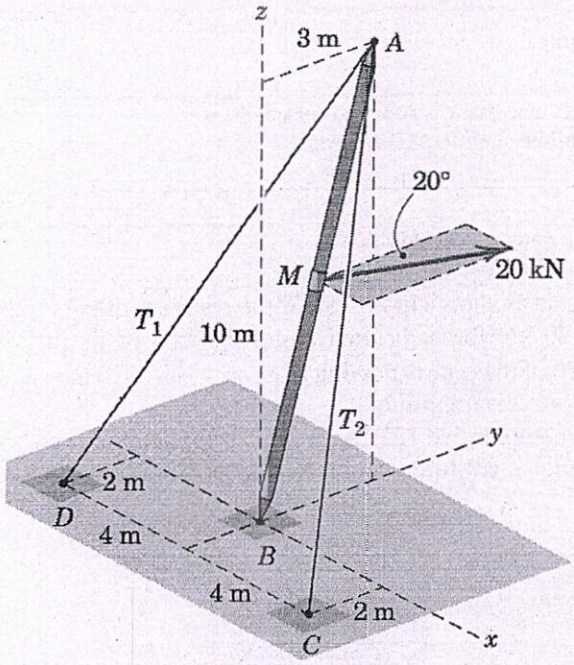


Fig. 3

4a.	The 30 kg homogeneous cylinder of 40 cm diameter rests against the vertical and inclined surfaces as shown in Fig. 4a. If the coefficient of static friction between the cylinder and surfaces is 0.3, calculate the applied clockwise couple *M* which would cause the cylinder to slip.	4	CO1
4b.	A single square-threaded screw jack has a pitch of 16 mm and a mean radius of 50 mm. The coefficient of friction between threads is 0.3. Determine the force that must be applied at the end of a 60 cm lever to raise a weight of 100 kN and the efficiency of the jack. State whether it is self-locking or not?	4	

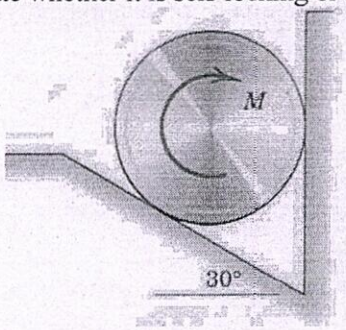


Fig. 4a

5a.	Define a truss and differentiate among perfect, deficient, and redundant truss.	3	CO2
5b.	Refer to Fig. 5b. Determine the member forces in the members, *CD* and *DF* of the truss and comment whether these members are in tension or compression.	5	

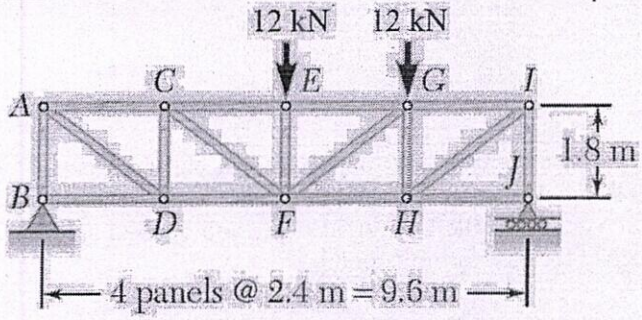


Fig. 5b

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

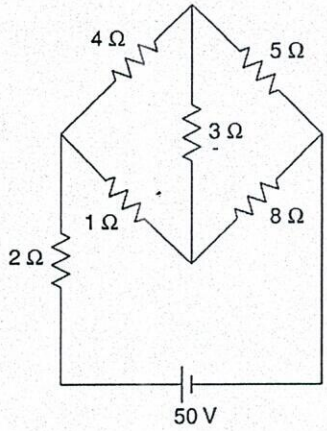
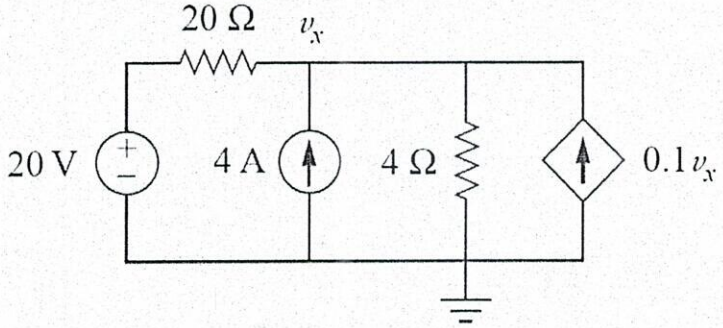
Odd Semester Mid-Term Examination, 2023-2024

Course Code: XEC02 **Full Marks: 25**

Course Name: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING **Time: 90 Minutes**

Instructions: Answer all questions.
Answer SECTION - A and SECTION - B questions separately in your answer script.
Materials to be supplied: Graph paper shall be supplied, if required.

SECTION - A

Question No.	Part No.	Body of the Question	Marks	Mapped CO
1	A	State Thevenin's Theorem.	1	CO1
	B	In the following circuit, determine the current through 3 Ω resistor using Thevenin's Theorem. 	4	CO1
2	A	State and prove maximum power transfer theorem for DC circuits.	3	CO1
	B	In the following circuit, determine the value of v_X 	2	CO1
3	A	Write down the similarities between magnetic circuit and electrical circuit.	2	CO2
	B	A steel ring has a mean diameter of 20 cm, a cross-section of 25 cm^2 and a radial air-gap of 0.8 mm cut across it. When excited by a current of 1 A through a coil of 1000 turns wound on the ring core, it produces an air-gap flux of 1 mWb. Neglecting leakage and fringing, calculate (a) relative permeability of steel and (b) total reluctance of the magnetic circuit.	3	CO2

Course Outcomes
CO1: Learn the fundamentals of electric circuits and analyze the circuits using laws and network theorems.
CO2: Gain the knowledge about magnetic circuits, electromagnetism and the basics of generation of alternating voltage.
CO3: Understand the behaviour of single phase and poly-phase AC circuits.
CO4: Understand the fundamentals of semiconductor devices.
CO5: Analyze the design and characteristics of transistor-based electronic circuits.
CO6: Evaluate operational amplifier-based circuits and logic gates.

SECTION – B				
Question No.	Part No.	Body of the Question	Marks	Mapped CO
4	A	Explain reverse breakdown in a diode.	2	CO4
	B	A germanium diode for which the reverse saturation current is 5 μA has a forward current of 1 A at 27 degree centigrade. Calculate the forward voltage drop across it.	3	CO4
5	A	Write in short how a Zener diode acts as a voltage regulator.	2	CO4
	B	Design a Zener regulator for the following specifications: Input voltage = minimum 9 volt, maximum 15 volt. Output voltage is 5 volt. Load current is 20 mA. Zener power dissipation is 500 mW and Zener voltage is 5V.	3	CO4