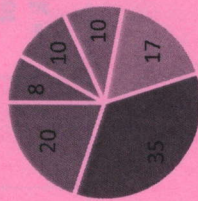


CO1	Apply heat conduction equations to different surface configurations under steady state
CO2	Analysis free and forced convective heat transfer correlations to internal and external flows through/over various surface configurations and solve problems
CO3	Evaluate LMTD and NTU methods of thermal analysis to different types of heat exchanger configurations and solve problems
CO4	Understand basic laws for radiation and apply these principles to radiative heat transfer between different types of surfaces to solve problems.
CO5	Apply phenomena of boiling and condensation, apply diffusive and convective mass transfer equations and correlations to solve problems for different applications.

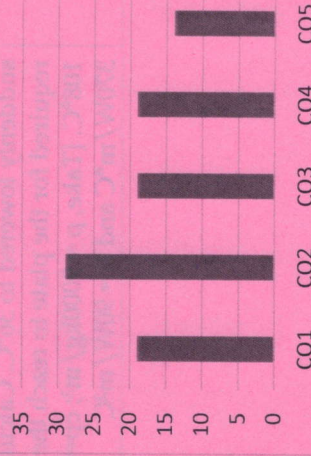
GRAPHICAL REPRESENTATION

Bloom's level wise Marks Distribution



■ K1 ■ K2 ■ K3 ■ K4 ■ K5 ■ K6

Course Outcome wise Marks Distribution



ARKA JAIN University
Jharkhand



[18-11-2025]

END SEM EXAMINATION
School of Engineering & IT

Program	Mechanical Engineering	Branch	B. Tech
Subject Name	Heat & Mass Transfer	Session	Odd, 2025-26
Semester	V	Year	Nov, 2025
Time: 3 Hour Max. Marks : 70	<ul style="list-style-type: none"> Start writing from 2nd page onwards; don't Write on the 1st Page Backside Answer all Questions of Section A (Compulsory) Answer Any Four out of Six of Section B Answer Any Three out of Five of Section C Heat and Mass Transfer Data Book is allowed Possession of Mobile Phone or any kind of Written Material, Arguments with the Invigilator or Discussion with Co-Student will come under Unfair Means and will Result in the Cancellation of the Paper(s). 		
Knowledge Level (KL)	K1 : Remembering K2 : Understanding	K3 : Applying K4 : Analysing	K5 : Evaluating K6 : Creating

Section A (Each question Carry 02 Marks from Q1-i to x - 20 Marks)

Q. N	QUESTIONS	Marks	COs	KL
1				
i	State Fourier's law of conduction	02	CO1	K2
ii	Differentiate between heat transfer and thermodynamics	02	CO1	K1
iii	Define efficiency of the fin.	02	CO2	K2
iv	What is lumped analysis? When it is used.	02	CO2	K1
v	Differentiate between Natural & Forced convection.	02	CO3	K1
vi	Define velocity boundary layer thickness.	02	CO3	K2
vii	What are parallel and counter flow heat exchangers	02	CO4	K2
viii	What are the different types of fouling in heat exchangers?	02	CO4	K1
ix	Define intensity of Radiation.	02	CO5	K4

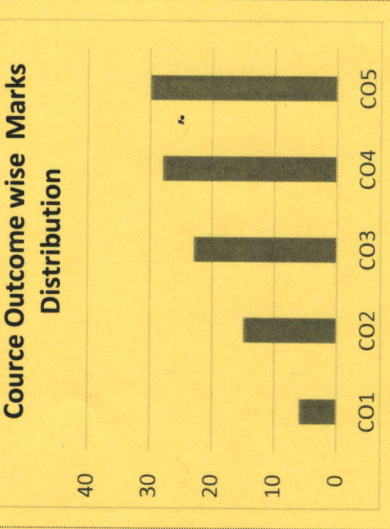
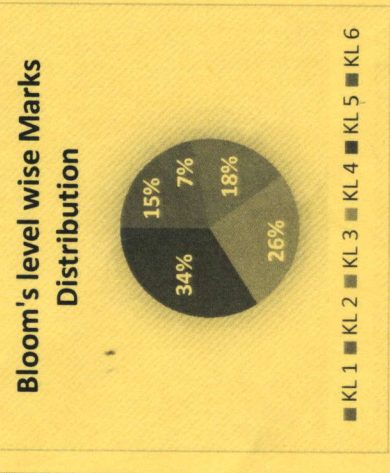
x	What are radiation shields?	02	CO5	K2
Section B (Answer any FOUR out of SIX) – 20 Marks (Each question Carry 05 Marks)				
Q. No.	QUESTIONS	Marks	COs	KL
2	Derive the expression for heat transfer equation for hollow cylinder.	05	CO1	K5
3	Explain the Stefan-Boltzmann law, Planck's law and Wien's displacement law.	05	CO5	K3
4	Derive the expression for lumped heat capacity.	05	CO2	K5
5	Explain the concept of hydrodynamic and thermal boundary layers. Superimpose hydrodynamic and thermal boundary layer profiles for $Pr < 1$, $Pr = 1$ and $Pr > 1$.	05	CO3	K5
6	Derive an expression for LMTD of a parallel and counter flow heat exchanger.	05	CO4	K3
7	State Fick's law of diffusion. Find relation for diffusion of component A into component B.	05	CO5	K4
Section C (Answer any THREE out of FIVE) – 30 Marks (Each question Carry 10 Marks)				
Q. No.	QUESTIONS	Marks	COs	KL
8	A furnace wall consists of three layers. The inner layer of 10 cm thickness is made of firebrick ($k = 1.04$ W/mK). The intermediate layer of 25 cm thickness is made of masonry brick ($k = 0.69$ W/mK) followed by a 5 cm thick concrete wall ($k = 1.37$ W/mK). When the furnace is in continuous operation the inner surface of the furnace is at 800°C while the outer concrete surface is at 50°C . Calculate the rate of heat loss per unit area of the wall, the temperature at the interface of the firebrick and masonry brick and the temperature at the interface of the masonry brick and concrete.	10	CO1	K5
9	An aluminium alloy fin of 7 mm thick and 50 mm long protrudes from a wall, which is maintained at 120°C . The ambient air temperature is 22°C . The heat transfer coefficient and conductivity of the fin material are 140 W/m ² K and 55 W/mK respectively. Determine • Temperature at the end of the fin.	10	CO2	K6

10	<ul style="list-style-type: none"> Temperature at the middle of the fin. Total heat dissipated by the fin. <p>Calculate the average heat transfer coefficient and heat transfer at a distance of 10 cm from the leading edge of an entirely heated plate placed in an air stream. The air velocity is 10 m/sec. Inlet temperature $T = 30^\circ\text{C}$ the surface temperature of plate is 70°C. The plate is 1m wide.</p>	10	CO3	K5
11	<p>The flow rates of hot and cold-water streams running through a parallel flow heat exchanger are 0.2 kg/s and 0.5 kg/s respectively. The inlet temperatures on the hot and cold sides are 75°C and 20°C respectively. The exit temperature of hot water is 45°C. Calculate the outlet temperature of cold fluid. Also, Calculate the area of the heat exchanger if overall heat transfer is 650 W/m²C.</p>	10	CO4	K4
12	<p>A 50 cm \times 50 cm copper slab 6.25 mm thick has a uniform temperature of 300°C. its temperature is suddenly lowered to 36°C. Calculate the time required for the plate to reach the temperature of 108°C. [Take, $\rho = 9000$ kg/m³; $c_p = 0.38$ kJ/kg$^\circ\text{C}$; $k = 370$ W/m$^\circ\text{C}$ and $h = 90$ W/m²C</p>	10	CO2	K6

CO- Course Outcomes, **KL-** Knowledge Level, **PO** – Program Outcome

CO1	Upon completion of this course, students will get an overview of the design methodologies employed for the design of various machine components
CO2	Students will be able to examine the product dimension and meet quality standard of the products.
CO3	Students will be able to work on safety and design features of different parts used in various applications.
CO4	Student will be able to estimate the fatigue strength of the machine components based on their safety features.
CO5	An understanding of the origins, nature and applicability of empirical design principles, based on safety considerations

GRAPHICAL REPRESENTATION



ARKA JAIN University
Jharkhand



[20-11-2025]
END SEM EXAMINATION
School of Engineering & IT

Program	Mechanical Engineering	Branch	B. Tech
Subject Name	Design of Machine Element	Session	Odd, 2025-26
Semester	V	Year	Nov, 2025
Time: 3 Hour Max. Marks : 70	<ul style="list-style-type: none"> Start writing from 2nd page onwards; don't write on the 1st Page * Backside Answer all Questions of Section A (Compulsory) Answer Any Four out of Six of Section B Answer Any Three out of Five of Section C Design Data Book will be allowed. Possession of <u>Mobile Phone</u> or any kind of <u>Written Material, Arguments with the Invigilator or Discussion with Co-Student</u> will come under <u>Unfair Means</u> and will <u>Result in the Cancellation of the Paper(s)</u>. 		
Knowledge Level (KL)	K1 : Remembering	K3 : Applying	K5 : Evaluating
	K2 : Understanding	K4 : Analysing	K6 : Creating

Section A (Each question Carry 02 Marks from Q1-i to x - 20 Marks)

Q. No.	QUESTIONS	Marks	COs	KL
i	How are the plain carbon steels designated in BIS?	2	CO1	K1
ii	State four methods to reduce stress concentration.	2	CO1	K2
iii	Differentiate between hardness and toughness of materials.	2	CO2	K2
iv	List the important factors that influence the magnitude of factor of safety?	2	CO2	K1
v	What are the applications of a Knuckle Joint?	2	CO3	K1
vi	What is the function of a spring?	2	CO1	K2
vii	Which theory of failure is suitable for the design of brittle materials?	2	CO4	K3
viii	Differentiate between repeated stress and reversed stress.	2	CO3	K3
ix	Discuss the various types of shafts and the standard sizes of transmissions shafts.	2	CO3	K3
x	List out types of stresses are induced in shafts.	2	CO3	K1

Section B (Answer any FOUR out of SIX) – 20 Marks (Each question Carry 05 Marks)				
Q. No.	QUESTIONS	Marks	COs	KL
2	Distinguish between cotter joint and knuckle joint.	5	CO5	K2
3	What is power screw? State its applications and advantages.	5	CO5	K3
4	Distinguish clearly, giving examples between pin, axle and shaft.	5	CO5	K2
5	What is herringbone gear? Where they are used, explain with neat sketch.	5	CO5	K3
6	Define the terms spring index, stress factor, spring rate, active number of coils and free length in springs.	5	CO5	K3
7	Distinguish between full and partial bearings. What is the preferred angle of contact for partial journal bearings?	5	CO5	K4
Section C (Answer any THREE out of FIVE) – 30 Marks (Each question Carry 10 Marks)				
Q. No.	QUESTIONS	Marks	COs	KL
8	A plate 100mm wide and 12.5 mm thick is to be welded to another plate by means of parallel fillet welds. The plates are subjected to a load of 50KN. Find the length of the welds so that the maximum stress does not exceed 56MPa.	10	CO4	K4
9	A solid shaft is to transmit 1000kW and 120rpm. Find the shaft diameter if the shear stress is 80N/mm ² . If the shaft is made hollow with internal diameter is 0.6 times the outer diameter. Find the percentage of saving in material.	10	CO5	K5
10	Design a leaf spring for the following specification: Total load = 140kN; Number of springs supporting the load = 4; maximum number of leaves = 10; span of the spring = 1000 mm; permissible deflections = 80mm, take young's modulus E = 200 kN/mm ² and allowable stress in the spring material as 600 MPa.	10	CO5	K5
11	A pair of 20° Involute straight tooth spur gears to transmit 50kW and reduce the speed from 720 rpm to 180 rpm. The pinion and gear are made from phosphor bronze and cast steel with allowable static stresses 50 N/mm ² and 70 N/mm ² respectively. Assuming medium shock conditions design drive completely.	10	CO5	K5

12	A journal bearing of 50 mm diameter and 80 mm long has a bearing pressure of 6MPa. The speed of the journal is 1000 r.p.m. and the ratio of journal diameter to the diametral clearance is 800. The bearing is lubricated with oil whose absolute viscosity at the operating temperature of 75°C may be taken as 0.015 kg/m-s. The room temperature is 25°C. Find: (i) Amount of heat generated (ii) Amount of heat dissipated through the bearing. The specific heat of the oil as 1900 J/kg /°C. Heat dissipation Coefficient = 490 W/m ² /°C	10	CO4	K4
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**ARKA JAIN
University**
Jharkhand



[22-11-2025]

END SEM EXAMINATION
School of Engineering & IT

Program	Mechanical Engineering		Branch	B. Tech
Subject Name	Essence Of Indian Knowledge Tradition		Session	Odd, 2025-26
Semester	V		Year	Nov, 2025
Time: 1.5 Hour Max. Marks : 35	<ul style="list-style-type: none"> Start writing from 2nd page onwards; don't Write on the 1st Page Backside Answer all Questions of Section A (Compulsory) Answer Any Five out of Six of Section B Answer Any Two out of Four of Section C Possession of Mobile Phones or any kind of Written Material <u>Arguments with the Invigilator or Discussing with Co-Student</u> will come under <u>Unfair Means</u> and will <u>Result in the Cancellation of the Papers.</u> 			
Knowledge Level (KL)	K1 : Remembering K2 : Understanding	K3 : Applying K4 : Analysing	K5 : Evaluating K6 : Creating	

Section A (Each question Carry 01 Mark from Q1-i to v) – 05 Marks

Q. N	QUESTIONS	Marks	COs	KL
1				
i	Name the compiler of Veda.	01	CO1	KL1
ii	Name the agricultural head of Indian Government.	01	CO2	KL4
iii	Mention the language in which all the Vedas are written.	01	CO1	KL2
iv	Sama Veda is a _____ text.	01	CO3	KL5
v	State Newtons 1 st law.	01	CO1	KL3

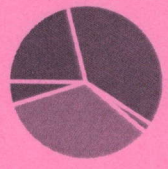
Section B (Answer any FIVE out of SIX) – 10 Marks
(Each question Carry 02 Marks)

Q. No.	QUESTIONS	Marks	COs	KL
2	Name the two 'Epics'.	02	CO1	KL2
3	Mention all the 4 castes.	02	CO2	KL1
4	Ashtadasa Vidya is known as _____ & _____.	02	CO3	KL3
5	Name all the 4 Veda's.	02	CO3	KL2

Course Outcomes	CO1	Basic principles of thought process, reasoning and differencing.
	CO2	Introduction to the Indian Knowledge Systems, Indian perspective of modern scientific world-view and basic principles of Yoga and holistic health care systems.
	CO3	Focus on Indian philosophical traditions, Indian linguistic tradition and Indian artistic tradition.

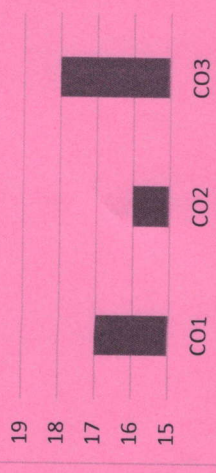
GRAPHICAL REPRESENTATION

Bloom's Level wise Marks Distribution



■ K1 ■ K2 ■ K3 ■ K4 ■ K5 ■ K6

Course Outcome Wise Marks Distribution



6	Name the Indian Musical Rag.	02	CO2	KL5
7	State down the 4 weapons of ancient times.	02	CO3	KL4
Section C (Answer any TWO out of FOUR) – 20 Marks (Each question Carry 10 Marks)				
Q. No.	QUESTIONS	Marks	COs	KL
8	Name any 10 eighteen sciences.	10	CO2	KL2
9	Explain Holistic Development of India.	10	CO1	KL5
10	Explain all the 3 laws of Newton.	10	CO2	KL5
11	Explain Sati Paratha.	10	CO3	KL3



ARKA JAIN
University
Jharkhand



[29-11-2025]
END SEM EXAMINATION
School of Engineering & IT

Program	Mechanical Engineering	Branch	B. Tech
Subject Name	Professional Practices Laws and Ethics	Session	Odd, 2025-26
Semester	V	Year	Nov, 2025
Time: 3 Hour Max. Marks : 70	<ul style="list-style-type: none"> Start writing from 2nd page onwards; don't Write on the 1st Page Backside Answer all Questions of Section A (Compulsory) Answer Any Four out of Six of Section B Answer Any Three out of Five of Section C Possession of Mobile Phone or any kind of Written Material, Arguments with the Invigilator or Discussion with Co-Student will comes under Unfair Means and will Result in the Cancellation of the Paper(s). 		
Knowledge Level (KL)	K1 : Remembering	K3 : Applying	K5 : Evaluating
	K2 : Understanding	K4 : Analysing	K6 : Creating

Section A (Each question Carry 02 Marks from Q1-i to x - 20 Marks)

Q. N	QUESTIONS	Marks	COs	KL
1				
i	List any six basic ethical principles.	2	CO1	K2
ii	What is intellectual property? *	2	CO3	K3
iii	Who are the main stakeholders in an infrastructure project?	2	CO2	K1
iv	Write down any two ethical principles to a situation involving conflict of interest in a construction project.	2	CO1	K2
v	Write down about the five moral values	2	CO2	K3
vi	Explain the meaning of arbitration scope and types.	2	CO4	K2
vii	List two types of arbitration.	2	CO6	K1
viii	What is the objective of the Workmen's Compensation Act, 1923?	2	CO4	K2
ix	What is collective bargaining?	2	CO6	K3
x	List any three rights of a patentee.	2	CO5	K1

Section B (Answer any FOUR out of SIX) – 20 Marks
(Each question Carry 05 Marks)

Q. No.	QUESTIONS	Marks	COs	KL
2	Describe the importance of engineering ethics in project execution.	05	CO1	K4
3	Define arbitration.	05	CO3	K3
4	Write down the advantages of Contract	05	CO4	K2
5	What are the key features of the Indian Copyright Act, 1957?	05	CO3	K2
6	Discuss about collective bargaining	05	CO2	K3
7	Explain the key distinction between arbitration and mediation.	05	CO5	K4

Section C (Answer any THREE out of FIVE) – 30 Marks-
(Each question Carry 10 Marks)

Q. No.	QUESTIONS	Marks	COs	KL
8	Summarize the provisions of the Standing Orders Act, 1946 related to misconduct.	10	CO3	K4
9	a) Evaluate the impact of intellectual property rights on research and development. b) Apply the patent law to assess whether an invention is patentable	10	CO6	K5
10	Discuss about Goal of Ethics. Differentiate between Moral and Ethics	10	CO2	K5
11	Should Lok Adalats be given more powers similar to regular courts? Justify your answer	10	CO4	K4
12	a) How Government bodies involved in Professional Ethics? b) Discuss the objectives of IRC.	10	CO1	K3

CO- Course Outcomes,

KL- Knowledge Level,

PO – Program Outcome

Course Outcomes	CO1	CO2	CO3	CO4	CO5	CO6
	Understand what constitutes professional practice, introduction of various stakeholders and their respective roles; understanding the fundamental ethics governing the profession.	Compare into contracts and contracts management in engineering, dispute resolution mechanisms; laws governing engagement of labor	Apply the understanding of Intellectual Property Rights, Patents	Distinguish various constitutional laws & ethics	Justify the types of roles they are expected to play in the society as practitioners of the engineering profession	Build good ideas of the legal and practical aspects of their profession

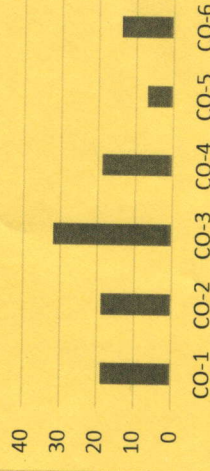
GRAPHICAL REPRESENTATION

Bloom's level wise Marks Distribution



■ K1 ■ K2 ■ K3 ■ K4 ■ K5

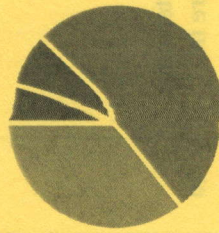
Course Outcome wise Marks Distribution



CO1	Describe the fundamental concepts and principles of elasticity, stress-strain relationships, Hooke's law, and perform basic calculations related to the strength and stability of structures and mechanical components.
CO2	Define the characteristics and calculate magnitudes of combined stresses in members and complete structures, and analyze solid mechanics problems using classical and energy methods.
CO3	Analyze structural members under combined stresses using Mohr's circle of stress and determine the shear center of thin-walled beams.
CO4	Calculate deflections of beams subjected to various loadings, including unsymmetrical bending, and apply energy methods to solve deflection problems.
CO5	Apply torsion theory and different failure criteria to analyze stresses and deflections in bars and thin-walled members subjected to complex loading.

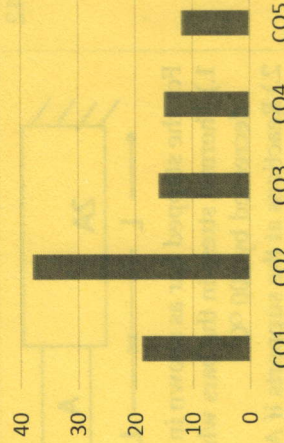
GRAPHICAL REPRESENTATION

Bloom's level wise Marks Distribution



■ KL1 ■ KL2 ■ KL3 ■ KL4 ■ KL5 ■ KL6

Course Outcome wise Marks Distribution



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[25-11-2025]
END SEM EXAMINATION
School of Engineering & IT

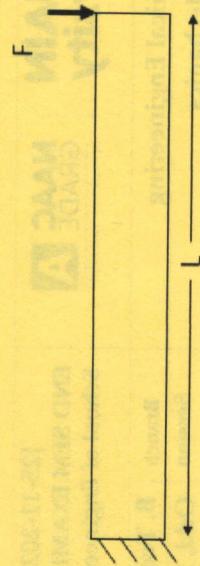
Program	Mechanical Engineering	Branch	B. Tech
Subject Name	Solid Mechanics	Session	Odd, 2025-26
Semester	V	Year	Nov, 2025
Time: 3 Hour Max. Marks : 70	<ul style="list-style-type: none"> Start writing from 2nd page onwards; don't write on the 1st Page Backside Answer all Questions of Section A (Compulsory) Answer Any Four out of Six of Section B Answer Any Three out of Five of Section C Possession of Mobile Phone or any kind of Written Material, Arguments with the Invigilator or Discussion with Co-Student will come under <u>Unfair Means</u> and will <u>Result in the Cancellation of the Paper(s)</u>. 		
Knowledge Level (KL)	K1 : Remembering K2 : Understanding	K3 : Applying K4 : Analysing	K5 : Evaluating K6 : Creating

Section A (Each question Carry 02 Marks from Q1-i to x – 20 Marks)

Q. N1	QUESTIONS	Marks	COs	KL
i	Define Hooke's Law and explain its significance in elastic deformation.	2	CO1	KL1
ii	A solid circular shaft of 50 mm diameter transmits a torque of 5 kNm. Calculate the maximum shear stress.	2	CO5	KL3
iii	Explain the different types of loads with respect to cross sectional area.	2	CO1	KL2
iv	Define principal stresses and write expressions for them in a 2D stress element.	2	CO2	KL3
v	What is Mohr's circle? Draw it for a general state of plane stress and explain its applications.	2	CO2	KL3
vi	Write the differential relationship between load, shear, and bending moment.	2	CO2	KL2
vii	Explain the significance of the neutral axis in bending. How is it located for a symmetrical beam section?	2	CO2	KL2
viii	Write the expressions for section modulus and moment of inertia for a rectangular section.	2	CO3	KL2
ix	Derive the formula for shear stress distribution in a rectangular beam subjected to transverse loading.	2	CO3	KL3

Q. No.	QUESTIONS	Marks	COs	KL
2	A steel rod of 25 mm diameter and 1.5 m length is subjected to a tensile load of 50 kN. Calculate the normal stress, elongation, and strain. Take $E = 2 \times 10^5$ N/mm ² .	5	CO1	KL3
3	At a point in a material, the stresses are $\sigma_x = 60$ MPa, $\sigma_y = 40$ MPa, $\tau_{xy} = 25$ MPa. Determine the principal stresses and their orientation using equations.	5	CO2	KL3
4	A solid circular shaft of 60 mm diameter transmits a torque of 8 kNm. Calculate the maximum shear stress and the angle of twist for a 1.5 m length. Take $G = 0.8 \times 10^5$ N/mm ² .	5	CO5	KL3
5	A rectangular beam section 300 mm \times 450 mm is subjected to a maximum bending moment of 80 kNm. Find the maximum bending stress in the beam.	5	CO1	KL3
6	A simply supported beam of span 5 m carries a point load of 12 kN at mid-span. Using the moment-area method, determine the slope at the supports. Take $E = 2 \times 10^5$ N/mm ² , $I = 1 \times 10^7$ mm ⁴ .	5	CO4	KL3
7	At a point, the stresses are $\sigma_x = 70$ MPa, $\sigma_y = 50$ MPa, $\tau_{xy} = 30$ MPa. Using Mohr's circle, find the principal stresses and the maximum shear stress.	5	CO2	KL4
Section C (Answer any THREE out of FIVE) – 30 Marks (Each question Carry 10 Marks)				
Q. No.	QUESTIONS	Marks	COs	KL
8	A simply supported beam of span 6 m carries a uniformly distributed load of 4 kN/m over its entire length. Using the moment-area method, calculate: a) The slope at the supports.	10	CO4	KL3

9	b) The maximum deflection of the beam. Take $E = 2 \times 10^5$ N/mm ² and $I = 1 \times 10^7$ mm ⁴ . Draw the bending moment diagram to aid your solution. Derive the expressions for normal and shear stress on an inclined plane subjected to plane stress. Show how principal stresses and their planes are determined.	10	CO2	KL4
10	Derive the expressions for shear force and bending moment at a section of a simply supported beam subjected to a triangular load. Sketch the corresponding SF and BM diagrams. Assume the data wherever possible.	10	CO3	KL4
11	A hollow circular beam has an external diameter of 180 mm and internal diameter of 100 mm. If it is subjected to a maximum bending moment of 50 kNm, and a maximum twisting moment of 35 kNm. Calculate the maximum bending stress, shear stress and the section modulus.	10	CO5	KL3
12	For the stepped bar as shown in the figure, determine 1.) Thermal stress in the bars when temperature in decreased by 100 °C. 2.) Reactions at the supports if $A = 100$ mm ² . Assume coefficient of thermal expansion is 12×10^{-6} /C. 3.) Deformation at the joint if $L = 500$ mm. Young's Modulus = 200 GPa.	10	CO2	KL4



Draw the Shear force, Bending Moment, Twisting Moment and Axial Load Diagrams for the rod subjected to a transverse load shown in figure.

