K S INSTITUTE OF TECHNOLOGY
Bangalore – 560109
DEPARTMENT OF MECHANICAL ENGINEERING

CIE Question paper Scrutiny format

Course Name	**Fluid Mechanics**
Course Code	**21ME43**
Course Incharge	**Dr. Saleem Khan**
Academic year	**2022-2023**
Semester	**4th**
CIE #	**IA - 1**
Set	A☑ B ☐
Scrutiny parameters	
Whether questions are according to assessment plan?	Yes ☑ No☐ ; If No, Suggestions:
Whether questions prepared are within the covered syllabus?	Yes ☑ No ☐ ; If No, Suggestions:
Whether all questions are mapped to CO/PO properly?	Yes ☑ No ☐ ; If No, Suggestions:
Whether questions framed are according to Blooms level?	Yes ☑ No ☐ ; If No, Suggestions:
Whether marks distribution for each question are correct?	Yes ☑ No ☐ ; If No, Suggestions:
Whether questions paper follows the format displayed?	Yes ☑ No ☐ ; If No, Suggestions:
Difficulty level	Very High ☐ High ☐ Moderate ☑ Low☐
Percentage of Similarity questions in Set A & B	20%
Final decision	Accepted without corrections☐ Accepted with minor corrections☐ Not accepted☐

22/6/23
Signature with date
of CIE Question paper setter

22/6/2023
Name and Signature with date
of CIE Question paper Scrutiniser
(Dr. Nagaprasad KS)

K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
FIRST INTERNAL TEST QUESTION PAPER 2022-23 EVEN SEMESTER

SET: A

USN										

Degree : B.E | **Semester : IV**
Branch - Stream : ME-ME | **Course Type / Code : Integrated/21ME43**
Course Title : Fluid Mechanics | **Date : 27/06/2023**
Duration : 60 Minutes | **Max Marks : 20**

Note: Answer **ONE full** question from each part.

K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks	CO	K-Level
	PART-A			
1(a)	Define the following terms: i) Absolute pressure ii) Gauge pressure iii) Simple manometer iv) differential manometer.	4	CO1	K2
(b)	Explain briefly the working principle of Bourdon pressure gauge with a neat sketch.	4	CO1	K2
(c)	The left limb of a mercury U-tube manometer is open to atmosphere and the right limb is connected to a pipe carrying water under pressure. The centre of the pipe is at the level of the free surface of mercury. Find the difference in level of mercury limbs of U-tube if the absolute pressure of water in the pipe is 14.5 m of water, atmospheric pressure is 760 mm of Hg.	4	CO1	K3
	OR			
2(a)	Derive an expression for total pressure and centre of pressure on inclined plane surface completely submerged in static mass of fluid.	8	CO1	K3
(b)	An equilateral triangle of side 2.5 m is immersed completely in water with one of its axis of symmetry parallel to the water surface. Its top edge is at 1 m below free surface of water. Determine the total pressure and position of centre of pressure.	4	CO1	K3
	PART –B			
3(a)	Obtain an expression for the force exerted by a jet of water on a fixed vertical plate in the direction of the jet	4	CO2	K3
(b)	A jet of water of diameter 50 mm moving with a velocity of 40 m/s, strikes a curved fixed symmetrical plate at the centre. Find the force exerted by the jet of water in the direction of the jet, if the jet is deflected through an angle of 120^{o} at the outlet of the curved plate.	4	CO2	K3
	OR			
4(a)	Derive an expression for the force exerted by a jet of water on a moving curved plate in the direction of the jet.	4	CO2	K3
(b)	A jet of water of diameter 10 cm strikes a flat plate normally with a velocity of 15 m/s. The plate is moving with a velocity of 6 m/s in the direction of the jet and away from the jet. Find: i) the force exerted by the jet on the plane. ii) work done by the jet on the plate per second.	4	CO2	K3

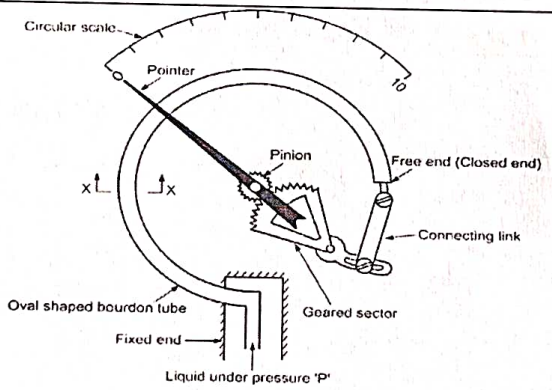
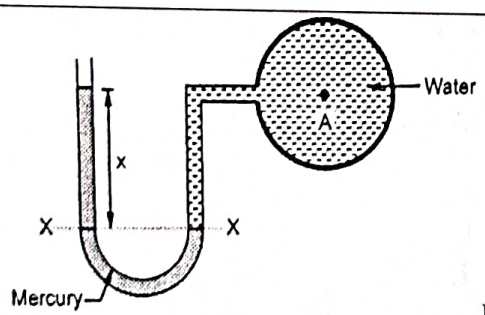
Name & Signature of Course In charge | **Name & Signature of Module Coordinator** (Dr. Nagaprasad KS) | **HOD** | **Principal**

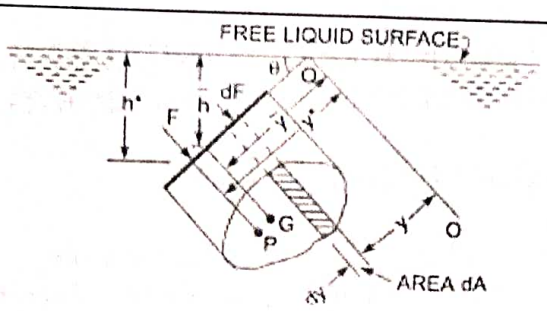
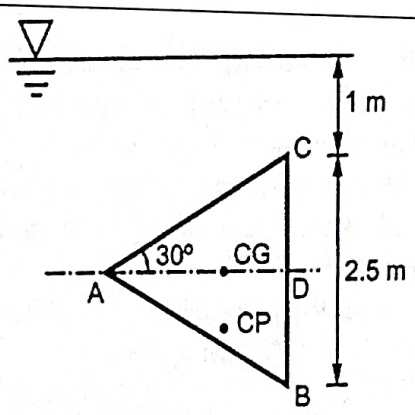
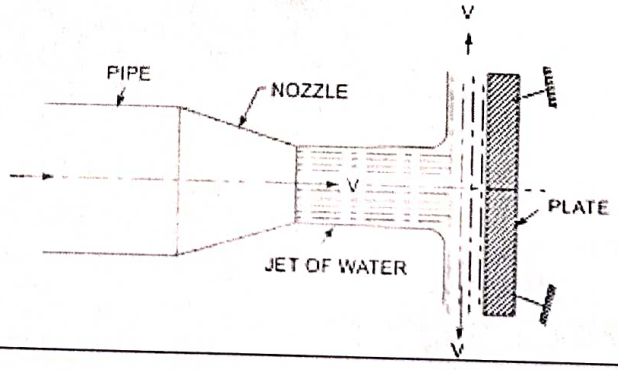
K.S. INSTITUTE OF TECHNOLOGY, BANGALORE - 560109
FIRST SESSIONAL TEST 2022 – 23(EVEN SEMESTER)

SCHEME AND SOLUTION (SET A)

Degree : B.E
Branch-Stream : ME -ME
Course Title : Fluid Mechanics

Semester : IV
Course Type / Code : Integrated/21ME43
Max Marks : 20

Q. No	SOLUTION	MARKS
1(a)	**PART-A** **Absolute pressure** is the pressure of having no matter inside a space, or a perfect vacuum **Gauge pressure** is the pressure relative to atmospheric pressure. For the pressures above atmospheric pressure, gauge pressure is positive. For the pressures below atmospheric pressure, gauge pressure is negative. A **simple manometer** consists of a tubular arrangement where one end of the tube is connected to the point in the fluid, whose pressure is to be determined and the other end is kept open to the atmosphere. **Differential Manometers** are devices used for measuring the difference of pressure between two points in a pipe or in two different pipes	**04X01= 04**
1(b)	 Sketch-02 Explanation-02	**04**
1(c)	 $P_{abs}=9810X14.5=142.245X10^3$ N/m^2--1/2 $P_{atm}=13.6X9810X0.76=101.3961X10^3$ N/m^2--- 1/2 $P_{abs}=P_{gauge}+P_{atm}$ $P_{gauge}=P_A=142.245X10^3-101.3961X10^3=40.8488\ X10^3$ N/m^2---01 X=0.3304 m---02	**04**

2 (a)	 Sketch--- 02 $F = \rho g A \bar{h}$ --- 03 $h^* = \frac{I_G \sin^2\theta}{A\bar{h}} + \bar{h}$ ---03	**08**
2(b)	 Sketch--- 01 P=59.7354X103 N --- 01 $\bar{\square} = 2.3657\ m$ --- 02	**04**
3 (a)	**PART-B** 	04

F_x = Rate of change of momentum in the direction of force

$$= \frac{\text{Initial momentum} - \text{Final momentum}}{\text{Time}}$$

$$= \frac{(\text{Mass} \times \text{Initial velocity} - \text{Mass} \times \text{Final velocity})}{\text{Time}}$$

$$= \frac{\text{Mass}}{\text{Time}} [\text{Initial velocity} - \text{Final velocity}]$$

= (Mass/sec) × (velocity of jet before striking − velocity of jet after striking)

$= \rho a V[V - 0]$ ($\because$ mass/sec = $\rho \times a\ V$)

$= \rho a V^2$

Skech--- 02
Derivation--- 02

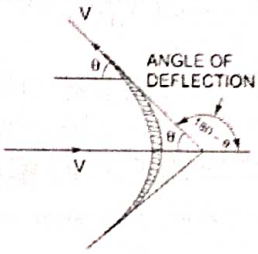
3(b)

Diameter of the jet, $d = 50 \text{ mm} = 0.05 \text{ m}$

$\therefore$ Area, $a = \frac{\pi}{4} (.05)^2 = 0.001963 \text{ m}^2$

Velocity of jet, $V = 40 \text{ m/s}$

Angle of deflection $= 120°$



the angle of deflection $= 180° - \theta$

$\therefore$ $180° - \theta = 120°$ or $\theta = 180° - 120° = 60°$

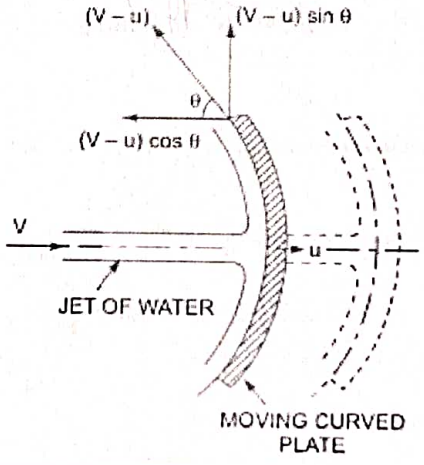
Force exerted by the jet on the curved plate in the direction of the jet is given by

$F_x = \rho a V^2 [1 + \cos \theta]$

$= 1000 \times .001963 \times 40^2 \times [1 + \cos 60°] = \mathbf{4711.15 \text{ N.}}$

04

4(a)



04

	Mass of the water striking the plate = $\rho \times a \times$ Velocity with which jet strikes the plat $= \rho a(V - u)$ $\therefore$ Force exerted by the jet of water on the curved plate in the direction of the jet, F_x = Mass striking per sec × [Initial velocity with which j plate in the direction of jet – Final velocity] $= \rho a(V - u)\ [(V - u) - (-(V - u)\cos\theta)]$ $= \rho a(V - u)\ [(V - u) + (V - u)\cos\theta\ ]$ $= \rho a(V - u)^2\ [1 + \cos\theta\ ]$ Work done by the jet on the plate per second = F_x × Distance travelled per second in the direction $= F_x \times u = \rho a(V - u)^2\ [1 + \cos\theta\ ] \times u$ $= \rho a(V - u)^2 \times u\ [1 + \cos\theta\ ]$ Skech--- 02 Derivation--- 02	
4(b)	d= 10 cm= 0.1 m a=0.007854 m^2 V=15 m/s, u=6 m/s Fx= $\rho a(V-u)^2$= 636.17 N ---- 02 W.D= Fx X u= 3817.02 N-m/s ---- 02	**04**

Signature of Course In-charge **Module In-charge** **Head of the Department**

K S INSTITUTE OF TECHNOLOGY
Bangalore – 560109
DEPARTMENT OF MECHANICAL ENGINEERING

CIE Question paper Scrutiny format

Course Name	**Fluid Mechanics**
Course Code	**21ME43**
Course Incharge	**Dr. Saleem Khan**
Academic year	**2022-2023**
Semester	**4th**
CIE #	**IA - 1**
Set	A☐ B☑
Scrutiny parameters	
Whether questions are according to assessment plan?	Yes ☑ No☐ ; If No, Suggestions:
Whether questions prepared are within the covered syllabus?	Yes ☑ No ☐ ; If No, Suggestions:
Whether all questions are mapped to CO/PO properly?	Yes ☑ No ☐ ; If No, Suggestions:
Whether questions framed are according to Blooms level?	Yes ☑ No ☐ ; If No, Suggestions:
Whether marks distribution for each question are correct?	Yes ☑ No ☐ ; If No, Suggestions:
Whether questions paper follows the format displayed?	Yes ☑ No ☐ ; If No, Suggestions:
Difficulty level	Very High ☐ High ☐ Moderate ☑ Low☐
Percentage of Similarity questions in Set A & B	20%.
Final decision	Accepted without corrections☐ Accepted with minor corrections☐ Not accepted☐

22/6/23

Signature with date
of CIE Question paper setter

22/6/2023

Name and Signature with date
of CIE Question paper Scrutiniser
(Dr Nagaprasad KS)

K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
FIRST INTERNAL TEST QUESTION PAPER 2022-23 EVEN SEMESTER

SET: B

USN										

Degree : B.E
Branch - Stream : ME-ME
Course Title : Fluid Mechanics
Duration : 60 Minutes

Semester : IV
Course Type / Code : Integrated/21ME43
Date : 27/06/2023
Max Marks : 20

Note: Answer **ONE full** question from each part.

K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks	CO	K-Level
	PART-A			
1(a)	Define the following terms: i) Buoyancy ii) Centre of buoyancy iii) Meta-centre iv) Meta-centric height.	4	CO1	K2
(b)	Explain the stability of floating bodies.	4	CO1	K2
(c)	The left limb of a mercury U-tube manometer is open to atmosphere and the right limb is connected to a pipe carrying water under pressure. The centre of the pipe is at the level of the free surface of mercury. Find the difference in level of mercury limbs of U-tube if the absolute pressure of water in the pipe is 14.5 m of water, atmospheric pressure is 760 mm of Hg.	4	CO1	K3
	OR			
2(a)	Derive an expression for total pressure and centre of pressure for a vertically immersed surface.	8	CO1	K3
(b)	A triangular plate of 1 m base and 1.5 m altitude is immersed in water. The plane of the plate is 30° with free water surface and base is parallel to and at a depth of 2 m from water surface. Find the total pressure on the plate and the position of centre of pressure.	4	CO1	K3
	PART –B			
3(a)	Derive an expression for the force exerted by a jet of water on a fixed curved plate in the direction of the jet	4	CO2	K3
(b)	A jet of water of diameter 50 mm moving with a velocity of 40 m/s, strikes a curved fixed symmetrical plate at the centre. Find the force exerted by the jet of water in the direction of the jet, if the jet is deflected through an angle of 120° at the outlet of the curved plate.	4	CO2	K3
	OR			
4(a)	Obtain an expression for the force exerted by a jet of water on a moving flat plate in the direction of the jet.	4	CO2	K3
(b)	A jet of water of diameter 10 cm strikes a flat plate normally with a velocity of 15 m/s. The plate is moving with a velocity of 6 m/s in the direction of the jet and away from the jet. Find: i) the force exerted by the jet on the plane. ii) work done by the jet on the plate per second.	4	CO2	K3

Name & Signature of Course In charge

Name & Signature of Module Coordinator
CD. Nagaprasad KS

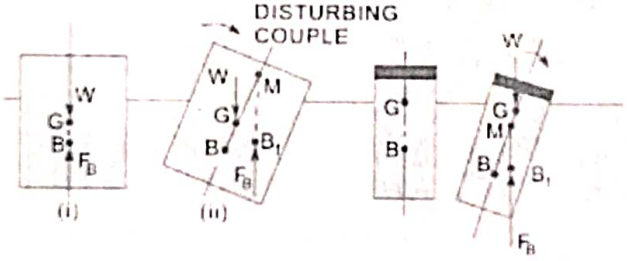
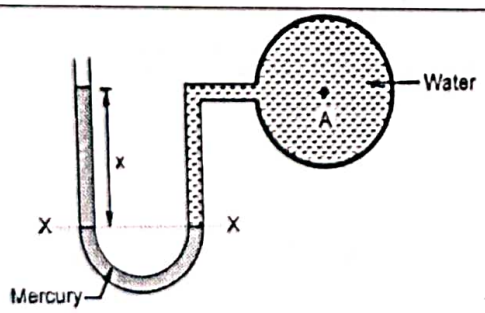
HOD

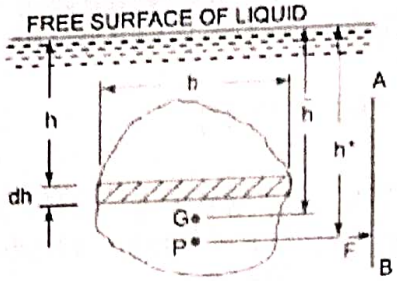
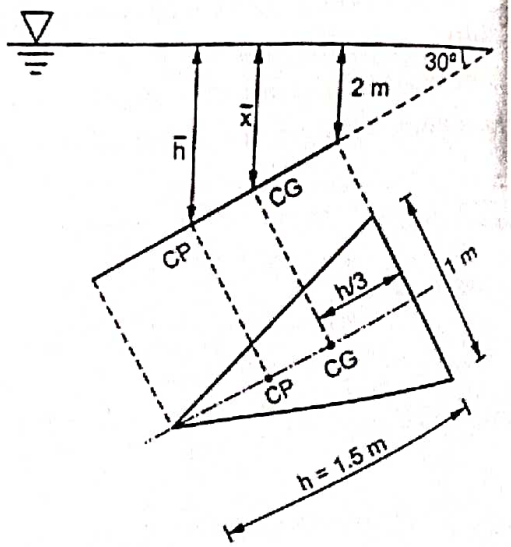
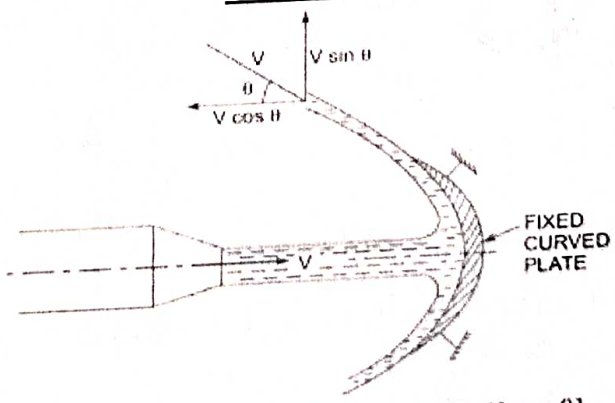
Principal
Selected

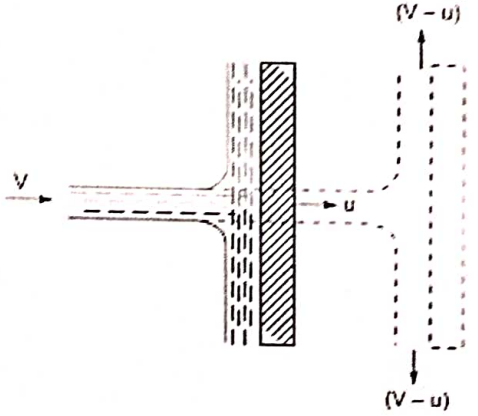
K.S. INSTITUTE OF TECHNOLOGY, BANGALORE - 560109
FIRST SESSIONAL TEST 2022 – 23(EVEN SEMESTER)

SCHEME AND SOLUTION (SET B)

Degree : **B.E** **Semester** : **IV**
Branch-Stream : **ME -ME** **Course Type / Code** : **Integrated/21ME43**
Course Title : **Fluid Mechanics** **Max Marks** : **20**

Q. No	SOLUTION	MARKS
1(a)	**PART-A** **Buoyancy** is the tendency of an object to float in a fluid The **centre of buoyancy** is the centre of gravity of the volume of water displaces by the body when immersed in the water. The **metacentre** remains directly above the centre of buoyancy regardless of the tilt of a floating body, such as a ship The **meta-centric height** is a measurement of the initial static stability of a floating body. It is calculated as the distance between the centre of gravity of a ship and its metacentre.	**04X01= 04**
1(b)	 (a) Stable equilibrium *M* is above *G* (b) Unstable equilibrium *M* is below *G*. Sketch-02 Explanation-02	**04**
1(c)	 P_{abs}=9810X14.5=142.245X10^3 N/m^2--1/2 P_{atm}=13.6X9810X0.76=101.3961X10^3 N/m^2--- 1/2 $P_{abs}=P_{gauge}+P_{atm}$ $P_{gauge}=P_A$=142.245X10^3-101.3961X10^3=40.8488 X10^3 N/m^2---01 X=0.3304 m---02	**04**

2 (a)	 Sketch--- 02 $F = \rho g A \bar{h}$ --- 03 $h^* = \frac{I_G + A\bar{h}^2}{A\bar{h}} = \frac{I_G}{A\bar{h}} + \bar{h}$ ---03	08
2(b)	 Sketch--- 01 P=16.5543X103 N --- 01 $\bar{h} = 2.2638\ m$ --- 02	04
3 (a)	**PART-B**  $F_x = \rho a V[V - (-V\cos\theta)] = \rho a V[V + V\cos\theta]$ $= \rho a V^2[1 + \cos\theta]$ Skech--- 02 Derivation--- 02	04

3(b)	Diameter of the jet, $d = 50 \text{ mm} = 0.05 \text{ m}$ $\therefore$ Area, $a = \frac{\pi}{4}(.05)^2 = 0.001963 \text{ m}^2$ Velocity of jet, $V = 40 \text{ m/s}$ Angle of deflection $= 120°$ the angle of deflection $= 180° - \theta$ $\therefore$ $180° - \theta = 120°$ or $\theta = 180° - 120° = 60°$ Force exerted by the jet on the curved plate in the direction of the jet is given by $F_x = \rho a V^2 [1 + \cos \theta]$ $= 1000 \times .001963 \times 40^2 \times [1 + \cos 60°] = 4711.15 \text{ N}$.	04
4(a)	 Mass of water striking the plate per sec $= \rho \times$ Area of jet $\times$ Velocity with which jet strikes the plate $= \rho a \times [V - u]$ $\therefore$ Force exerted by the jet on the moving plate in the direction of the jet, F_x = Mass of water striking per sec $\times$ [Initial velocity with which water strikes – Final velocity] $= \rho a(V - u)[(V - u) - 0]$ ($\because$ Final velocity in the direction of jet is zero) $= \rho a(V - u)^2$ Skech--- 02 Derivation--- 02	04
4(b)	d= 10 cm= 0.1 m a=0.007854 m^2 V=15 m/s, u=6 m/s Fx= $\rho a(V-u)^2$= 636.17 N ---- 02 W.D= Fx X u= 3817.02 N-m/s ---- 02	04

Signature of Course In-charge

Module In-charge

Head of the Department

K S INSTITUTE OF TECHNOLOGY
Bangalore – 560109

DEPARTMENT OF MECHANICAL ENGINEERING

CIE Question paper Scrutiny format

Course Name	**Fluid Mechanics**
Course Code	**21ME43**
Course Incharge	**Dr. Saleem Khan**
Academic year	**2022-2023**
Semester	**4th**
CIE #	**IA - 2**
Set	A☑ B ☐
Scrutiny parameters	
Whether questions are according to assessment plan?	Yes ☑ No☐ ; If No, Suggestions:
Whether questions prepared are within the covered syllabus?	Yes ☑ No ☐ ; If No, Suggestions:
Whether all questions are mapped to CO/PO properly?	Yes ☑ No ☐ ; If No, Suggestions:
Whether questions framed are according to Blooms level?	Yes ☑ No ☐ ; If No, Suggestions:
Whether marks distribution for each question are correct?	Yes ☑ No ☐ ; If No, Suggestions:
Whether questions paper follows the format displayed?	Yes ☑ No ☐ ; If No, Suggestions:
Difficulty level	Very High ☐ High ☐ Moderate ☑ Low☐
Percentage of Similarity questions in Set A & B	30%
Final decision	Accepted without corrections☑ Accepted with minor corrections☐ Not accepted☐

26/7/2023

Signature with date
of CIE Question paper setter

26/7/2023

Name and Signature with date
of CIE Question paper Scrutiniser
(Dr. Nagaprasad KS)

K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
SECOND INTERNAL TEST QUESTION PAPER 2022-23 EVEN SEMESTER

SET: A

USN										

Degree : **B.E** | **Semester** : **IV**
Branch - Stream : **ME-ME** | **Course Type / Code** : **Integrated/21ME43**
Course Title : **Fluid Mechanics** | **Date** : **01/08/2023**
Duration : **60 Minutes** | **Max Marks** : **20**

Note: Answer **ONE full** question from each part.

K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks	CO	K-Level
	PART-A			
1(a)	Derive Darcy's equation for head losses due to friction in a circular pipe.	8	CO3	K3
(b)	A horizontal circular pipe is of 50 mm diameter and 750 m long maintains water flow rate of 0.03 m^3/min. Calculate the head loss due to friction and the power required to maintain the flow if $\mu=1.14X10^{-3}$ N-s/m^2 and f= 0.008.	4	CO3	K3
	OR			
2(a)	What are the losses that occur in pipes. Give the expressions for different minor energy losses.	4	CO3	K3
(b)	A horizontal pipeline, 50 m long, is connected to a reservoir at one end and discharges freely in to the atmosphere at the other end. For the first 25 m length from the reservoir the pipe has a diameter of 15 cm and it has a square entrance at the reservoir. The remaining 25 m length of pipe has a diameter of 30 cm. the junction of the two pipes is in the form of a sudden expansion. The 15 cm has a gate valve (K=0.2) in fully open condition. If the height of water surface in the tank is 10 m above the centerline of the pipe, estimate the discharge in the pipe by considering the Darcy's Weisbach factor f=0.02 for both the pipes (Include all minor losses in the calculations)	8	CO3	K3
	PART –B			
3(a)	Obtain Bernoulli's equation from Euler's equation of motion.	4	CO2	K3
(b)	Check whether the following equations (with their usual notations) are dimensionally homogeneous or not. i) $h_f= 4flV^2/2gd$ ii) $P= \gamma QH$	4	CO4	K3
	OR			
4(a)	A pipe 5 m long is inclined at an angle of 15^0 with the horizontal. The smaller section of the pipe which is at a lower level is of 80 mm diameter and the larger section of the pipe is of 240 mm diameter. Determine the difference of pressure between the two sections, if the pipe is uniformly tapering and the velocity of water at the smaller section is 1 m/s.	4	CO2	K3
(b)	Using Rayleigh's method find the expression for power P, developed by a pump when P depends upon the head H, the discharge Q and specific weight w of the fluid.	4	CO4	K3

Name & Signature of Course In charge

Name & Signature of Module Coordinator

(Dr. Nagaprasad KS)

HOD 26/7/23

Principal

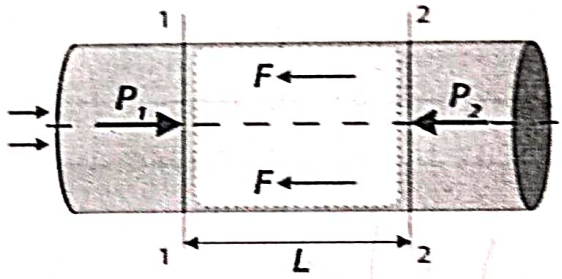
Selected

K.S. INSTITUTE OF TECHNOLOGY, BANGALORE - 560109
SECOND SESSIONAL TEST 2022 – 23 (EVEN SEMESTER)

SCHEME AND SOLUTION (SET A)

Degree : B.E
Branch-Stream : ME -ME
Course Title : Fluid Mechanics

Semester : IV
Course Type / Code : Integrated/21ME43
Max Marks : 20

Q. No	SOLUTION	MARKS
1(a)	**PART-A**  Fig: uniform horizontal pipe with a steady flow of fluid Sketch-02 $h_f=4fLV^2/2gd$ Derivation- 06	08
1(b)	Q=AV ∴ V= 0.2546 m/s --01 $Re=\rho Vd/\mu$, ∴ Re= $11.1667X10^3$ --01 $h_f=4fLV^2/2gd$, ∴ h_f= 1.5858 m --01 $P=\gamma Qh_f$=7.7783 W --01	04
2 (a)	Major and Minor head losses in pipes Major head losses in pipes- i) Darcy's and ($h_f=4fLV^2/2gd$) ii) Chezy's equation ($V= C\sqrt{mi}$) Minor head losses in pipes- i) $he=(V_1-V_2)^2/2g$ ii) $hc= 0.375\ V_2)^2/2g$ iii) $h_i=0.5\ V^2/2g$ iv) $ho=V^2/2g$	02+02= 04
2(b)	$V_1=4V_2$ --01 $h_i= 8(V_2)^2/2g$, $h_{fittings}= 3.2(V_2)^2/2g$, $h_{\Omega}= 213.33(V_2)^2/2g$, $he=9(V_2)^2/2g$ --05 $h_{\Omega}= 6.66(V_2)^2/2g$ V_2= 0.9 m/sec --01 Q= 0.0636 m^3/sec-- 01	08
3 (a)	**PART-B** dp/p+gdz+vdv=0 ------ Euler's equation ----01 $p/\rho g+v^2/2g+Z$=Constant ------- Bernoulli's equation----03	04

3(b)	$h_f = 4flV^2/2gd$ [L]=[L] LHS=RHS ∎ Equation is dimensionally homogeneous. $P = \gamma QH$ $[ML^2T^{-3}]=[ML^2T^{-3}]$ LHS=RHS ∎ Equation is dimensionally homogeneous.	02+02 04
4(a)	$A_1=5.026X10^{-3}\ m^2$ $A_2=0.045\ m^2$ $V_2= 0.11$ m/sec ----- 01 $Z_2=5Sin15^0=1.294$ m ------ 01 $P_1-P_2= 12209.69\ N/m^2$ or $12.20\ KN/m^2$ ------- 02	04
4(b)	$P=K\ H^a\ Q^b\ w^c$ $[ML^2T^{-3}]= K\ [L]^a\ [L^3T^{-1}]^b\ [ML^{-2}T^{-2}]^c$ ------ 02 c=1, a=1, b=1 $P=K\ H^1\ Q^1\ w^1$ --------- 02	04

Signature of Course In-charge **Module In-charge** **Head of the Department**

K S INSTITUTE OF TECHNOLOGY
Bangalore – 560109

DEPARTMENT OF MECHANICAL ENGINEERING

CIE Question paper Scrutiny format

Course Name	**Fluid Mechanics**
Course Code	**21ME43**
Course Incharge	**Dr. Saleem Khan**
Academic year	**2022-2023**
Semester	**4th**
CIE #	**IA - 2**
Set	A☐ B☑
Scrutiny parameters	
Whether questions are according to assessment plan?	Yes ☑ No☐ ; If No, Suggestions:
Whether questions prepared are within the covered syllabus?	Yes ☑ No ☐ ; If No, Suggestions:
Whether all questions are mapped to CO/PO properly?	Yes ☑ No ☐ ; If No, Suggestions:
Whether questions framed are according to Blooms level?	Yes ☑ No ☐ ; If No, Suggestions:
Whether marks distribution for each question are correct?	Yes ☐ No ☐ ; If No, Suggestions:
Whether questions paper follows the format displayed?	Yes ☐ No ☐ ; If No, Suggestions:
Difficulty level	Very High ☐ High ☐ Moderate ☑ Low☐
Percentage of Similarity questions in Set A & B	30%
Final decision	Accepted without corrections☑ Accepted with minor corrections☐ Not accepted☐

26/7/2023
Signature with date
of CIE Question paper setter

26/7/2023
Name and Signature with date
of CIE Question paper Scrutiniser
(Dr. Nagaprasad KS)

K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
SECOND INTERNAL TEST QUESTION PAPER 2022-23 EVEN SEMESTER

SET: B

USN										

Degree : **B.E** | **Semester** : **IV**
Branch - Stream : **ME-ME** | **Course Type / Code** : **Integrated/21ME43**
Course Title : **Fluid Mechanics** | **Date** : **01/08/2023**
Duration : **60 Minutes** | **Max Marks** : **20**

Note: Answer **ONE full** question from each part.

K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks	CO	K-Level
	PART-A			
1(a)	Derive Chezy's equation for loss of head due to friction in pipes.	4	CO3	K3
(b)	Two reservoirs are connected by a pipeline consisting of two pipes, one of 15 cm diameter and length 6 m and other of diameter 22.5 cm and 16 m length. If difference of water levels in the two reservoirs is 6 m, calculate the discharge. Take coefficient of friction f= 0.04.	8	CO3	K3
	OR			
2(a)	For a flow through pipe, derive Darcy-Weisbach equation.	8	CO3	K3
(b)	A 5 cm diameter pipe takes off abruptly from a large tank and run 8 m, then expands abruptly to 10 cm diameter and runs 45 m and next discharge directly into open air with a velocity of 1.5 m/s. Compute the necessary height of water surface above the point discharge. Take f=0.0065 in the Darcy equation.	4	CO3	K3
	PART –B			
3(a)	A pipe 5 m long is inclined at an angle of 15^0 with the horizontal. The smaller section of the pipe which is at a lower level is of 80 mm diameter and the larger section of the pipe is of 240 mm diameter. Determine the difference of pressure between the two sections, if the pipe is uniformly tapering and the velocity of water at the smaller section is 1 m/s.	4	CO2	K3
(b)	The time period (t) of a pendulum depends upon the length (L) of the pendulum and acceleration due to gravity (g). Derive an expression for the time period using Rayleigh's method.	4	CO4	K3
	OR			
4(a)	Obtain Bernoulli's equation from Euler's equation of motion.	4	CO2	K3
(b)	Explain dimensional homogeneity with two examples.	4	CO4	K3

Name & Signature of Course In charge

Name & Signature of Module Coordinator
(Dr. Nagaprasad KS)

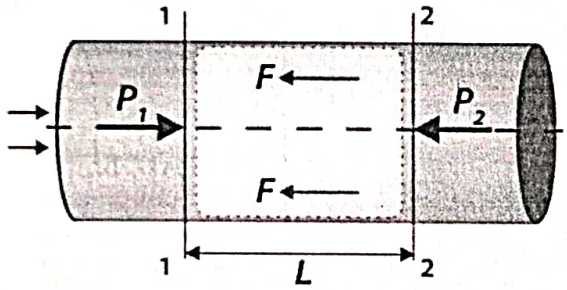
HOD 26/7/23

Principal

K.S. INSTITUTE OF TECHNOLOGY, BANGALORE - 560109
SECOND SESSIONAL TEST 2022 – 23(EVEN SEMESTER)

SCHEME AND SOLUTION (SET B)

Degree : B.E | **Semester : IV**
Branch-Stream : ME -ME | **Course Type / Code : Integrated/21ME43**
Course Title : Fluid Mechanics | **Max Marks : 20**

Q. No	SOLUTION	MARKS
	PART-A	
1(a)	Derivation of Chezy's equation ($V= C \sqrt{mi}$)	04
1(b)	$Q=A_1V_1=A_2V_2$ $V_1= 2.25\ V_2 =3.492$ m/sec --- 01 $h_i= 0.3107$ m, $h_{f1}= 3.9774$ m, $he=0.1918$ m, $h_{f2}= 1.3968$ m $ho=0.1228$ m -- 05 $V_2= 1.552$ m/sec --- 01 $Q= 0.0617\ m^3$/sec --- 01	08
2 (a)	 Fig: uniform horizontal pipe with a steady flow of fluid Sketch-02 $h_f=4fLV^2/2gd$ Derivation- 06	08
2(b)	$V_1=6$ m/s--01 $h_i= 0.9174$ m, $h_{f1}= 7.6330$ m, $he=1.0321$ m, $h_{f2}= 1.3417$ m – 02 $H= 11.0388$ m --- 01	04
	PART-B	
3 (a)	$A_1=5.026X10^{-3}\ m^2$ $A_2=0.045\ m^2$ $V_2= 0.11$ m/sec ----- 01 $Z_2=5Sin15^0=1.294$ m ------ 01 $P_1-P_2= 12209.69\ N/m^2$ or $12.20\ KN/m^2$ ------- 02	04

3(b)	$t = K L^a g^b$ --- 01 $T = K [L]^a [LT^{-2}]^b$ --- 01 $a = 1/2, b = -1/2$ ---- 01 $\therefore t = K L^{1/2} g^{-1/2}$ ---- 01	**04**
4(a)	$dp/p + gdz + vdv = 0$ ------ Euler's equation ----01 $p/\rho g + v^2/2g + Z = \text{Constant}$ ------- Bernoulli's equation----03	**04**
4(b)	$h_f = 4flV^2/2gd$ $[L] = [L]$ LHS=RHS $\therefore$ Equation is dimensionally homogeneous. $P = \gamma QH$ $[ML^2T^{-3}] = [ML^2T^{-3}]$ LHS=RHS $\therefore$ Equation is dimensionally homogeneous.	**02+02= 04**

Signature of Course In-charge **Module In-charge** **Head of the Department**

26/7/23

K S INSTITUTE OF TECHNOLOGY
Bangalore – 560109

DEPARTMENT OF MECHANICAL ENGINEERING

CIE Question paper Scrutiny format

Course Name	**Fluid Mechanics**
Course Code	**21ME43**
Course Incharge	**Dr. Saleem Khan**
Academic year	**2022-2023**
Semester	**IV**
CIE #	**IA - 3**
Set	A☑ B ☐
Scrutiny parameters	
Whether questions are according to assessment plan?	Yes ☑ No☐ ; If No, Suggestions:
Whether questions prepared are within the covered syllabus?	Yes ☑ No ☐ ; If No, Suggestions:
Whether all questions are mapped to CO/PO properly?	Yes ☑ No ☐ ; If No, Suggestions:
Whether questions framed are according to Blooms level?	Yes ☑ No ☐ ; If No, Suggestions:
Whether marks distribution for each question are correct?	Yes ☑ No ☐ ; If No, Suggestions:
Whether questions paper follows the format displayed?	Yes ☑ No ☐ ; If No, Suggestions:
Difficulty level	Very High ☐ High ☐ Moderate ☑ Low☐
Percentage of Similarity questions in Set A & B	20%
Final decision	Accepted without corrections☑ Accepted with minor corrections☐ Not accepted☐

2/9/23
Signature with date
of CIE Question paper setter

2/9/2023
Name and Signature with date
of CIE Question paper Scrutiniser
(Dr. Nagaprasad KS)

K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
THIRD INTERNAL TEST QUESTION PAPER 2022-23 EVEN SEMESTER

SET: A

USN										

Degree : B.E | **Semester : IV**
Branch - Stream : ME-ME | **Course Type / Code : Integrated/21ME43**
Course Title : Fluid Mechanics | **Date : 07/09/2023**
Duration : 60 Minutes | **Max Marks : 20**

Note: Answer **ONE full** question from each part.

K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks	CO	K-Level
	PART-A			
1(a)	Derive an expression for velocity of sound wave in a fluid.	8	CO5	K3
(b)	A projectile travels in air of pressure 8.829 N/cm^2 at -10^{0}C at a speed of 1200 km/hr. Find the Mach number and Mach angle. Take k=1.4 and R=287 j/kg K.	4	CO5	K3
	OR			
2(a)	What do you understand by stagnation pressure? Obtain an expression for stagnation pressure of a compressible fluid in terms of approaching Mach number and pressure.	8	CO5	K3
(b)	Find the velocity of air flowing at the outlet of a nozzle, fitted to a large vessel which contains air at a pressure of 294.3 N/cm^2(abs) and at a temperature of 30^{0}C. The pressure at the outlet of the nozzle is 137.34 N/cm^2(abs). Take k=1.4 and R=287 j/kg K.	4	CO5	K3
	PART –B			
3(a)	Using Buckingham's π-theorem, show that the velocity through a circular orifice is given by $V = \sqrt{2gH}\,\emptyset\left[\frac{D}{H}, \frac{\mu}{\rho VH}\right]$. Where H is the head causing flow, D is the diameter of the orifice, μ is the co-efficient of viscosity, ρ is the mass density and g is the acceleration due to gravity.	8	CO4	K3
	OR			
4(a)	Explain the different types of hydraulic similarities that must exist between a prototype and its model.	4	CO4	K3
(b)	Define the following non-dimensional numbers: (i) Reynold's number and (ii) Mach's number. What are their significances for fluid flow problems?	4	CO4	K3

2/9/23

Name & Signature of Course In charge

Name & Signature of Module Coordinator

(Dr. Nagaprasad KS)

HOD

Principal

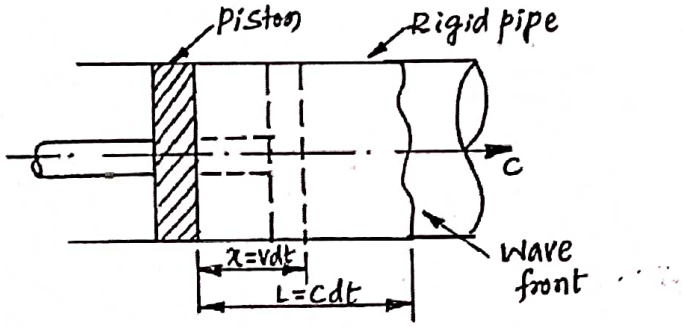
Selected

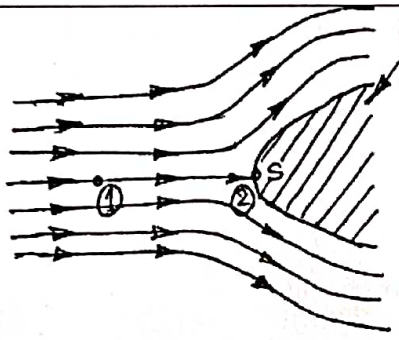
K.S. INSTITUTE OF TECHNOLOGY, BANGALORE - 560109

THIRD SESSIONAL TEST 2022 – 23(EVEN SEMESTER)

SCHEME AND SOLUTION (SET A)

Degree	**:**	**B.E**	**Semester**	**:**	**IV**
Branch-Stream	**:**	**ME -ME**	**Course Type / Code**	**:**	**Integrated/21ME43**
Course Title	**:**	**Fluid Mechanics**	**Max Marks**	**:**	**20**

Q. No	SOLUTION	MARKS
1(a)	**PART-A**  Mass of fluid before compression = Mass of fluid after compression. $\rho A c dt = (\rho + d\rho) A \times (c dt - v dt)$ $\div$ by $A dt$ $\rho c = (\rho + d\rho)(c - v)$ On Simplification $c d\rho = \rho v + v d\rho$ $d\rho$ is very small, $\therefore$ neglected, $c d\rho = \rho v$ — (A) From momentum equation $(P + dP)A - P \times A = \frac{\rho A L}{dt}(v - 0) = \frac{\rho A c dt}{dt}(v - 0) = \rho A c v$ $dP A = \rho A c v \quad \therefore c = \frac{dP}{\rho v}$ — (B) $\times$ly (A) & (B) $c^2 d\rho = \rho v \frac{dP}{\rho v}$, $c = \sqrt{dP/d\rho}$	02 02 02 02

1(b)	$P = 8.829\ N/cm^2 = 8.829 \times 10^4\ N/m^2$ $T = -10^\circ C = -10 + 273 = 263\ K$ $V = 1200\ km/hr = \frac{1200 \times 1000}{60 \times 60} = 333.34\ m/s$ $k = 1.4$ $R = 287\ J/kg'K$ $C = \sqrt{KRT} = \sqrt{1.4 \times 287 \times 263} = 325.07\ m/s$ $M = \frac{V}{C} = \frac{333.34}{325.07} = 1.02$ $\sin\alpha = \frac{C}{V} = \frac{1}{M} = \frac{1}{1.02} = 0.98$ $\alpha = \sin^{-1}(0.98) = 78.52^\circ$	01 01 01 01
2 (a)	 $\left[\frac{k}{k-1}\right]\frac{P_1}{\rho_1 g} + \frac{V_1^2}{2g} + Z_1 = \left[\frac{k}{k-1}\right]\frac{P_2}{\rho_2 g} + \frac{V_2^2}{2g} + Z_2$ $Z_1 = Z_2,\ P_2 = P_S,\ \rho_2 = \rho_S$ $\left[\frac{k}{k-1}\right]\frac{P_1}{\rho_1}\left[1 - \frac{P_S}{P_1} \times \frac{\rho_1}{\rho_S}\right] = -\frac{V_1^2}{2}$ For Adiabatic process $\frac{P_1}{\rho_1^k} = \frac{P_2}{\rho_2^k} = \frac{P_S}{\rho_S^k}$ $\frac{\rho_1}{\rho_S} = \left[\frac{P_1}{P_S}\right]^{1/k}$ $\left[\frac{k}{k-1}\right]\frac{P_1}{\rho_1}\left[1 - \frac{P_S}{P_1} \times \left(\frac{P_1}{P_S}\right)^{1/k}\right] = -\frac{V_1^2}{2}$ on Simplification $1 + \frac{V_1^2}{2}\left[\frac{k-1}{k}\right]\frac{\rho_1}{P_1} = \left[\frac{P_S}{P_1}\right]^{\frac{k-1}{k}}$ For adiabatic process, velocity of Sound is $C = \sqrt{KRT} = \sqrt{k\frac{P}{\rho}},\ C_1 = \sqrt{k\frac{P_1}{\rho_1}}$ or $C_1^2 = k\frac{P_1}{\rho_1}$ $1 + \frac{V_1^2}{2}(k-1) \times \frac{1}{C_1^2} = \left[\frac{P_S}{P_1}\right]^{\frac{k-1}{k}}$ $1 + \frac{M_1^2}{2}(k-1) = \left[\frac{P_S}{P_1}\right]^{\frac{k-1}{k}}$ $\therefore P_S = P_1\left[1 + \frac{k-1}{2}M_1^2\right]^{\frac{k}{k-1}}$	04 04

2(b)	$P_1 = 294.3\ N/cm^2 = 294.3\times10^4\ N/m^2$ $T_1 = 30+273 = 303\ K$ $P_2 = 137.34\ N/cm^2 = 137.34\times10^4\ N/m^2$ $R = 287\ J/kg\,k$ $k = 1.4$ $\frac{P_1}{\rho_1} = RT_1,\ \rho_1 = \frac{P_1}{RT_1} = \frac{294.3\times10^4}{287\times303} = 33.84\ kg/m^3$ $V_2 = \sqrt{\left[\frac{2k}{k-1}\right]\frac{P_1}{\rho_1}\left[1-\left(\frac{P_2}{P_1}\right)^{\frac{k-1}{k}}\right]} = \sqrt{\left[\frac{2\times1.4}{1.4-1}\right]\frac{294.3\times10^4}{33.84}\left[1-\left(\frac{137.34\times10^4}{294.3\times10^4}\right)^{\frac{1.4-1}{1.4}}\right]}$ $V_2 = 344.54\ m/sec$	02 02
3 (a)	**PART-B** $V = f(H, D, \mu, \rho, g)$ $f(V, H, D, \mu, \rho, g) = 0$ $n = 6,\ m = 3,\ (n-m) = 6-3 = 3\ \pi$'s $f_1(\pi_1, \pi_2, \pi_3) = 0$ $\pi_1 = H^{a_1} g^{b_1} \rho^{c_1} V$ $\pi_2 = H^{a_2} g^{b_2} \rho^{c_2} D$ $\pi_3 = H^{a_3} g^{b_3} \rho^{c_3} \mu$ For first π-term : $a_1 = -\frac{1}{2},\ b_1 = -\frac{1}{2},\ c_1 = 0,\ \therefore \pi_1 = H^{-\frac{1}{2}} g^{-\frac{1}{2}} \rho^0$ $\pi_1 = \frac{V}{H^{1/2} g^{1/2}} \Rightarrow \boxed{\pi_1 = \frac{V}{\sqrt{gH}}}$ For Second π-term : $a_2 = -1,\ b_2 = 0,\ c_2 = 0,\ \therefore \pi_2 = H^{-1} g^0 \rho^0 D$ $\boxed{\pi_2 = \frac{D}{H}}$ For Third π-term : $a_3 = -\frac{3}{2},\ b_3 = -\frac{1}{2},\ c_3 = -1,\ \pi_3 = H^{-3/2} g^{-1/2} \rho^{-1} \mu$ on Simplification, $\boxed{\pi_3 = \frac{\mu}{\rho V H}}$ $f_1\left(\frac{V}{\sqrt{gH}}, \frac{D}{H}, \frac{\mu}{\rho V H}\right) = 0$ $\frac{V}{\sqrt{gH}} = \phi\left[\frac{D}{H}, \frac{\mu}{\rho V H}\right]$ or $\boxed{V = \sqrt{2gH}\,\phi\left[\frac{D}{H}, \frac{\mu}{\rho V H}\right]}$	02 02 02 02
4(a)	✓ Geometric Similarity ✓ Kinematic Similarity ✓ Dynamic Similarity	04

4(b)	i) Reynold's Number is defined as the ratio of inertia force of a flowing fluid and the viscous force of the fluid $Re = \frac{\rho V d}{\mu}$ Significance : The Reynold's number is used to study fluids as they flow. The Reynold's number determines whether a fluid flow is laminar or turbulent. ii) Mach Number is defined as the square root of the ratio of the inertia force to elastic force. $M = \frac{V}{C}$ Significance : The Mach number provides a comparison between fluid flow rate and the speed of sound	04

Signature of Course In-charge 2/9/23

Module In-charge

Head of the Department

K S INSTITUTE OF TECHNOLOGY
Bangalore – 560109

DEPARTMENT OF MECHANICAL ENGINEERING

CIE Question paper Scrutiny format

Course Name	**Fluid Mechanics**
Course Code	**21ME43**
Course Incharge	**Dr. Saleem Khan**
Academic year	**2022-2023**
Semester	**IV**
CIE #	**IA - 3**
Set	A☐ B☑
Scrutiny parameters	
Whether questions are according to assessment plan?	Yes ☑ No☐ ; If No, Suggestions:
Whether questions prepared are within the covered syllabus?	Yes ☑ No ☐ ; If No, Suggestions:
Whether all questions are mapped to CO/PO properly?	Yes ☑ No ☐ ; If No, Suggestions:
Whether questions framed are according to Blooms level?	Yes ☑ No ☐ ; If No, Suggestions:
Whether marks distribution for each question are correct?	Yes ☑ No ☐ ; If No, Suggestions:
Whether questions paper follows the format displayed?	Yes ☑ No ☐ ; If No, Suggestions:
Difficulty level	Very High ☐ High ☐ Moderate ☑ Low☐
Percentage of Similarity questions in Set A & B	20%
Final decision	Accepted without corrections☑ Accepted with minor corrections☐ Not accepted☐

Signature with date 2/9/23
of CIE Question paper setter

2/9/2023
Name and Signature with date
of CIE Question paper Scrutiniser
(Dr. Nagaprasad KS)

K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
THIRD INTERNAL TEST QUESTION PAPER 2022-23 EVEN SEMESTER

SET: B

USN										

Degree : **B.E**
Branch - Stream : **ME-ME**
Course Title : **Fluid Mechanics**
Duration : **60 Minutes**

Semester : **IV**
Course Type / Code : **Integrated/21ME43**
Date : **07/09/2023**
Max Marks : **20**

Note: Answer **ONE full** question from each part.

K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks	CO	K-Level
	PART-A			
1(a)	Obtain an expression for stagnation pressure of a compressible fluid in terms of approaching Mach number and pressure.	8	CO5	K3
(b)	Find the Mach number when an aeroplane is flying at 1000 km/hr through still air having pressure of 7 N/cm^2 and temperature of -5^{0}C. Take R= 287.14 j/kg K. Calculate the pressure and temperature of air at stagnation point. Take k=1.4.	4	CO5	K3
	OR			
2(a)	Derive an expression for velocity of sound wave in a fluid.	8	CO5	K3
(b)	Define Computational fluid dynamics (CFD). Mention the applications and limitations of CFD.	4	CO5	K3
	PART –B			
3(a)	Using Buckingham's π-theorem, show that the discharge Q consumed by an oil ring is given by $Q = Nd^3\emptyset\left[\frac{\mu}{\rho Nd^2}, \frac{\sigma}{\rho N^2 d^3}, \frac{w}{\rho N^2 d}\right]$ Where d is the internal diameter of the ring, N is the rotational speed, ρ is density, μ is viscosity, σ is surface tension and w is the specific weight of oil.	8	CO4	K3
	OR			
4(a)	What are repeating variables? How are the repeating variables selected for dimensional analysis	4	CO4	K3
(b)	A 7.2 m height and 15 m long spillway discharges 94 m^3/s discharge under a head of 2 m. If a 1:9 scale model of this spillway is to be constructed, determine model dimensions, head over spillway model and the model discharge. If model experiences a force of 7500 N, determine force on the prototype.	4	CO4	K3

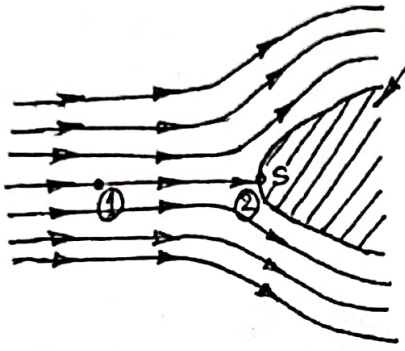
Name & Signature of Course In charge	Name & Signature of Module Coordinator	HOD	Principal
7/9/23	(Dr. Nagaprasad KS)		

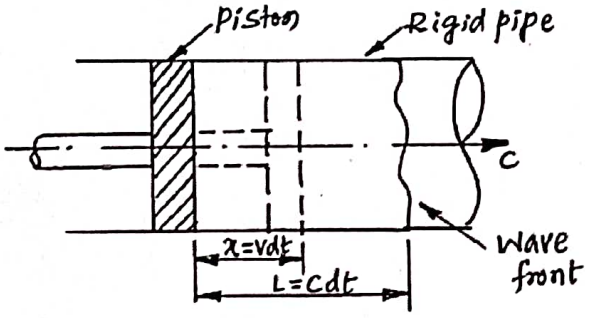
K.S. INSTITUTE OF TECHNOLOGY, BANGALORE - 560109

THIRD SESSIONAL TEST 2022 – 23(EVEN SEMESTER)

SCHEME AND SOLUTION (SET B)

Degree	**: B.E**	**Semester**	**: IV**
Branch-Stream	**: ME -ME**	**Course Type / Code**	**: Integrated/21ME43**
Course Title	**: Fluid Mechanics**	**Max Marks**	**: 20**

Q. No	SOLUTION	MARKS
1(a)	**PART-A**  $\left[\frac{k}{k-1}\right]\frac{P_1}{\rho_1 g}+\frac{V_1^2}{2g}+Z_1=\left[\frac{k}{k-1}\right]\frac{P_2}{\rho_2 g}+\frac{V_2^2}{2g}+Z_2$ $Z_1=Z_2,\ P_2=P_S,\ \rho_2=\rho_S$ $\left[\frac{k}{k-1}\right]\frac{P_1}{\rho_1}\left[1-\frac{P_S}{P_1}\times\frac{\rho_1}{\rho_S}\right]=-\frac{V_1^2}{2}$ For Adiabatic process $\frac{P_1}{\rho_1^k}=\frac{P_2}{\rho_2^k}=\frac{P_S}{\rho_S^k}$ $\frac{\rho_1}{\rho_S}=\left[\frac{P_1}{P_S}\right]^{1/k}$ $\left[\frac{k}{k-1}\right]\frac{P_1}{\rho_1}\left[1-\frac{P_S}{P_1}\times\left(\frac{P_1}{P_S}\right)^{1/k}\right]=-\frac{V_1^2}{2}$	02
	On Simplification $1+\frac{V_1^2}{2}\left[\frac{k-1}{k}\right]\frac{\rho_1}{P_1}=\left[\frac{P_S}{P_1}\right]^{\frac{k-1}{k}}$	02
	For adiabatic process, velocity of Sound is $C=\sqrt{kRT}=\sqrt{k\frac{P}{\rho}}$, $C_1=\sqrt{k\frac{P_1}{\rho_1}}$ or $C_1^2=k\frac{P_1}{\rho_1}$ $1+\frac{V_1^2}{2}(k-1)\times\frac{1}{C_1^2}=\left[\frac{P_S}{P_1}\right]^{\frac{k-1}{k}}$ $1+\frac{M_1^2}{2}(k-1)=\left[\frac{P_S}{P_1}\right]^{\frac{k-1}{k}}$	02
	$\therefore P_S=P_1\left[1+\frac{k-1}{2}M_1^2\right]^{\frac{k}{k-1}}$	02

1(b)	V=1000X1000/60X60= 277.78 m/s C=√KRT= √1.4X287.14X268=328.2 m/s $M_1=V_1/C_1$= 277.78/328.2=0.846 Ps=11.18X10^4 N/m^2 Ts=306.36^{0}K	**01** **01** **01** **01**
2 (a)	 Mass of fluid before compression = Mass of fluid after compression $\rho AC dt = (\rho+d\rho)A \times (cdt - vdt)$ ÷ by Adt $\rho C = (\rho+d\rho)(C-V)$ On Simplification $Cd\rho = \rho V + Vd\rho$ $d\rho$ is very small, ∴ neglected, $cd\rho = \rho V$ — (A) From momentum equation $(P+dP)A - P \times A = \frac{\rho AL}{dt}(V-0) = \frac{\rho ACdt}{dt}(V-0) = \rho ACV$ $dPA = \rho ACV \quad \therefore C = \frac{dP}{\rho V}$ — (B) $\times$ (A) & (B) $C^2 d\rho = \rho V \frac{dP}{\rho V}$, $C = \sqrt{dP/d\rho}$	**02** **02** **02** **02**
2(b)	**Computational fluid dynamics (CFD)** is a science that, with the help of digital computers, produces quantitative predictions of fluid-flow phenomena based on the conservation laws (conservation of mass, momentum, and energy) governing fluid motion. **Applications of CFD Engineering in Different Fields** Turbomachinery, Electronics Cooling Simulation, Heat Transfer and Thermal Management, Rotating Machinery Simulation, CFD Analysis for Cavitation, CFD Simulation in Aerodynamics, CFD Simulation for Batteries. **Limitations of CFD** ▪ Cost of tool or software is very high ▪ Solutions are not reliable ▪ Require large number of input data	**01** **03**

PART-B

3 (a)

Solution. Given : $Q = f(d, N, \rho, \mu, \sigma, w)$ or $f_1(Q, d, N, \rho, \mu, \sigma, w) = 0$

$\therefore$ Total number of variables, $n = 7$

Dimensions of each variables are

$$Q = L^3T^{-1},\ d = L,\ N = T^{-1},\ \rho = ML^{-3},\ \mu = ML^{-1}T^{-1},\ \sigma = MT^{-2}$$

and $w = ML^{-2}T^{-2}$

$\therefore$ Total number of fundamental dimensions, $m = 3$

$\therefore$ Total number of π-terms $= n - m = 7 - 3 = 4$

$\therefore$ Equation (i) becomes as $f_1(\pi_1, \pi_2, \pi_3, \pi_4) = 0$

Choosing d, N, ρ as repeating variables, the π-terms are

$$\pi_1 = d^{a_1} \cdot N^{b_1} \cdot \rho^{c_1} \cdot Q$$
$$\pi_2 = d^{a_2} \cdot N^{b_2} \cdot \rho^{c_2} \cdot \mu$$
$$\pi_3 = d^{a_3} \cdot N^{b_3} \cdot \rho^{c_3} \cdot \sigma$$
$$\pi_4 = d^{a_4} \cdot N^{b_4} \cdot \rho^{c_4} \cdot w.$$

First π-term $\pi_1 = d^{a_1} \cdot N^{b_1} \cdot \rho^{c_1} \cdot Q.$

Substituting dimensions on both sides,

$$M^0L^0T^0 = L^{a_1} \cdot (T^{-1})^{b_1} \cdot (ML^{-3})^{c_1} \cdot L^3T^{-1}.$$

Equating the powers of M, L, T on both sides,

Power of M, $0 = c_1$, $\therefore$ $c_1 = 0$

Power of L, $0 = a_1 - 3c_1 + 3$, $\therefore$ $a_1 = 3c_1 - 3 = 0 - 3 = -3$

Power of T, $0 = -b_1 - 1$, $\therefore$ $b_1 = -1$

Substituting a_1, b_1, c_1 in π_1, $\pi_1 = d^{-3} \cdot N^{-1} \cdot \rho^0 \cdot Q = \dfrac{Q}{d^3N}$ **02**

Second π-term $\pi_2 = d^{a_2} \cdot N^{b_2} \cdot \rho^{c_2} \cdot \mu.$

Substituting the dimensions on both sides,

$$M^0L^0T^0 = L^{a_2} \cdot (T^{-1})^{b_2} \cdot (ML^{-3})^{c_2} \cdot ML^{-1}T^{-1}$$

Equating the powers of M, L, T on both sides,

Power of M, $0 = c_2 + 1$, $\therefore$ $c_2 = -1$

Power of L, $0 = a_2 - 3c_2 - 1$,

$\therefore$ $a_2 = 3c_2 + 1 = -3 + 1 = -2$

Power of T, $0 = -b_2 - 1$, $\therefore$ $b_2 = -1$

Substituting the values of a_2, b_2, c_2 in π_2,

$$\pi_2 = d^{-2} \cdot N^{-1} \cdot \rho^{-1} \cdot \mu = \frac{\mu}{d^2N\rho} \quad \text{or} \quad \frac{\mu}{\rho Nd^2}.$$ **02**

Third π-term $\pi_3 = d^{a_3} \cdot N^{b_3} \cdot \rho^{c_3} \cdot \sigma.$

Substituting dimensions on both sides,

$$M^0L^0T^0 = L^{a_3} \cdot (T^{-1})^{b_3} \cdot (ML^{-3})^{c_3} \cdot MT^{-2}.$$

Equating the powers of M, L, T on the sides,

Power of M, $0 = c_3 + 1$, $\therefore$ $c_3 = -1$

Power of L, $0 = a_3 - 3c_3$, $\therefore$ $a_3 = 3c_3 = -3$

Power of T, $0 = -b_3 - 2$, $\therefore$ $b_3 = -2$

Substituting the values of a_3, b_3, c_3 in π_3,

$$\pi_3 = d^{-3} \cdot N^{-2} \cdot \rho^{-1} \cdot \sigma = \frac{\sigma}{d^3N^2\rho}.$$

Fourth π-term $\pi_4 = d^{a_4} \cdot N^{b_4} \cdot \rho^{c_4} \cdot w$

Substituting dimensions on both sides, **02**

$$M^0L^0T^0 = L^{a_4} \cdot (T^{-1})^{b_4} \cdot (ML^{-3})^{c_4} \cdot ML^{-2}T^{-2}.$$

Equating the powers of M, L, T on both sides,

Power of M, $0 = c_4 + 1$, $\therefore$ $c_4 = -1$

Power of L, $0 = a_4 - 3c_4 - 2$, $\therefore$ $a_4 = 3c_4 + 2 = -3 + 2 = -1$

Power of T, $0 = -b_4 - 2$, $\therefore$ $b_4 = -2$

Substituting the values of a_4, b_4 and c_4 in π_4,

$$\pi_4 = d^{-1} \cdot N^{-2} \cdot \rho^{-1} \cdot w = \frac{w}{dN^2\rho}.$$

Now substituting the values of $\pi_1, \pi_2, \pi_3, \pi_4$ in (ii),

$$f\left(\frac{Q}{d^3N}, \frac{\mu}{\rho Nd^2}, \frac{\sigma}{d^3N^2\rho}, \frac{w}{dN^2\rho}\right) = 0 \quad \text{or} \quad \frac{Q}{d^3N} = f_1\left[\frac{\mu}{\rho Nd^2}, \frac{\sigma}{d^3N^2\rho}, \frac{w}{dN^2\rho}\right]$$ **02**

or $$Q = d^3N\phi\left[\frac{\mu}{\rho Nd^2}, \frac{\sigma}{d^3N^2d}, \frac{w}{dN^2\rho}\right].$$ Ans.

4(a)	**Method of Selecting Repeating Variables.** The number of repeating variables are equal to the number of fundamental dimensions of the problem. The choice of repeating variables is governed by the following considerations : 1. As far as possible, the dependent variable should not be selected as repeating variable. 2. The repeating variables should be choosen in such a way that one variable contains geometric property, other variable contains flow property and third variable contains fluid property. Variables with Geometric Property are (*i*) Length, l (*ii*) d (*iii*) Height, H etc. Variables with flow property are (*i*) Velocity, V (*ii*) Acceleration etc. Variables with fluid property : (*i*) μ, (*ii*) ρ, (*iii*) ω etc. 3. The repeating variables selected should not form a dimensionless group. 4. The repeating variables together must have the same number of fundamental dimensions. 5. No two repeating variables should have the same dimensions. In most of fluid mechanics problems, the choice of repeating variables may be (*i*) d, v, ρ (*ii*) l, v, ρ or (*iii*) l, v, μ or (*iv*) d, v, μ.	**04**
4(b)	(*i*) *Model dimensions (h_m and L_m)* $$\frac{h_p}{h_m} = \frac{L_p}{L_m} = L_r = 9$$ $$\therefore \quad h_m = \frac{h_p}{9} = \frac{7.2}{9} = 0.8 \text{ m. Ans.}$$ And $$L_m = \frac{L_p}{9} = \frac{15}{9} = 1.67 \text{ m. Ans.}$$ (*ii*) *Head over model (H_m)* $$\frac{H_p}{H_m} = L_r = 9$$ $$\therefore \quad H_m = \frac{H_p}{9} = \frac{2}{9} = 0.222 \text{ m. Ans.}$$ (*iii*) *Discharge through model (Q_m)* Using equation (12.23), we get $\frac{Q_p}{Q_m} = L_r^{2.5}$ $$\therefore \quad Q_m = \frac{Q_p}{L_r^{2.5}} = \frac{94}{9^{2.5}} = \frac{94}{243} = 0.387 \text{ m}^3\text{/s. Ans.}$$ (*iv*) *Force on the Prototype (F_p)* Using equation (12.24), we get $F_r = \frac{F_p}{F_m} = L_r^3$ $$\therefore \quad F_p = F_m \times L_r^3 = 7500 \times 9^3 = 5467500 \text{ N. Ans.}$$	**01** **01** **01** **01**

Signature of Course In-charge **Module In-charge** **Head of the Department**

K S INSTITUTE OF TECHNOLOGY
Bangalore – 560109

DEPARTMENT OF MECHANICAL ENGINEERING

CIE Question paper Scrutiny format

Course Name	Design of Machine Elements-I
Course Code	18ME52
Course Incharge	Anilkumar A
Academic year	2022-2023
Semester	V
CIE	1st
Set	A☑ B ☐
Scrutiny parameters	
Whether questions are according to assessment plan?	Yes ☑ No☐ ; If No, Suggestions:
Whether questions prepared are within the covered syllabus?	Yes ☑ No ☐ ; If No, Suggestions:
Whether all questions are mapped to CO/PO properly?	Yes ☑ No ☐ ; If No, Suggestions:
Whether questions framed are according to Blooms level?	Yes ☑ No ☐ ; If No, Suggestions:
Whether marks distribution for each question are correct?	Yes ☑ No ☐ ; If No, Suggestions:
Whether questions paper follows the format displayed?	Yes ☑ No ☐ ; If No, Suggestions:
Difficulty level	Very High ☐ High ☑ Moderate ☐ Low☐
Percentage of Similarity questions in Set A & B	30-1.
Final decision	Accepted without corrections☑ Accepted with minor corrections☐ Not accepted☐

04/11/2022

Signature with date
of CIE Question paper setter

H. Nagaraj
CIE. NAGARAJ (HOD) 04/11/2022

Name and Signature with date
of CIE Question paper Scrutiniser

K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
FIRST INTERNAL TEST QUESTION PAPER 2022-23 ODD SEMESTER

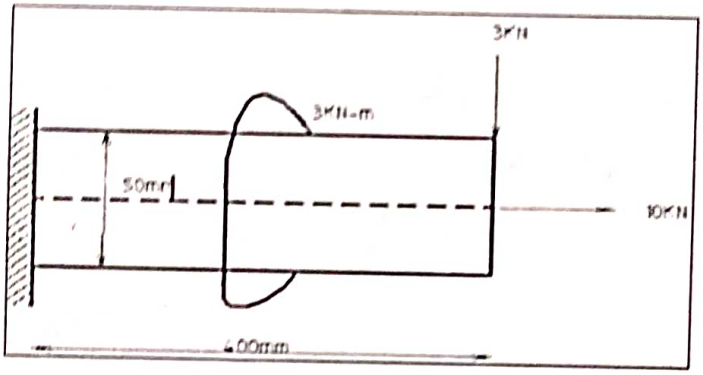
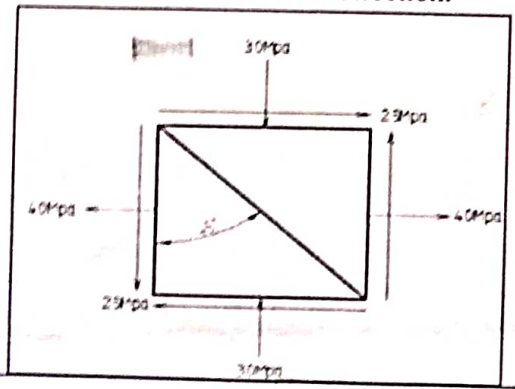
SET: A

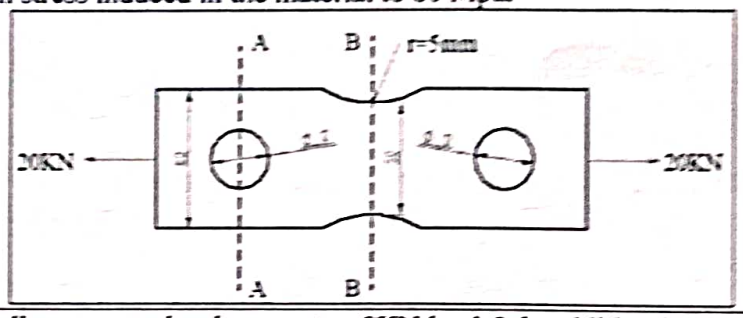
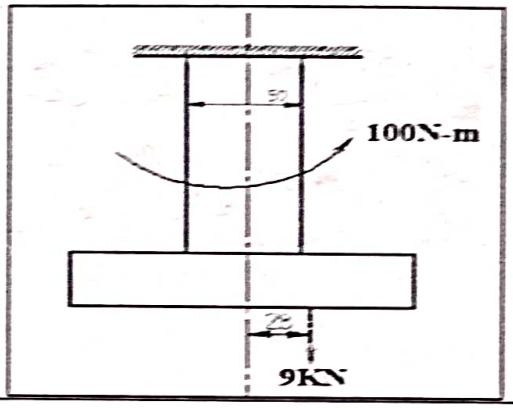
USN										

Degree : B.E
Branch : MECHANICAL ENGINEERING
Course Title : DESIGN OF MACHINE ELEMENTS-I
Duration : 90 Minutes

Semester : V
Course Code : 18ME52
Date : 14-11-2022
Max Marks : 30

Note: Answer **ONE full** question from each part.
K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks	CO	K-Level
	PART-A			
1(a)	Briefly Explain the phases of Engineering Design.	6	CO1	K2
(b)	A shaft of 50mm diameter is subjected to a tensile load of 10KN, bending load of 3KN & a torque of 3KN-m as shown in figure, **determine** the stresses at points A & B. 	6	CO1	K3
(c)	A point in a structural member is subjected to plane stress as shown in figure. **Determine** the following. (i) Normal and Tangential Stress on a plane inclined at 45^0 with respect to vertical. (ii) The principal stresses. (iii) The orientation of principal stresses. (iv) The maximum shear stress and its direction. 	6	CO1	K3
	OR			
2(a)	State and **explain** the following theories of failures (a) Rankin's Theory, (b) Tresca's Theory, (c) Distortion Energy Theory	6	CO1	K2

(b)	**Determine** the thickness of a flat plate loaded as shown in figure. Limiting the maximum stress induced in the material to 80 Mpa. 	6	CO1	K3
(c)	A 50mm diameter steel rod supports a 9KN load & in addition is subjected to a Torsional moment of 100N-m as shown in figure. **Determine** the maximum tensile & maximum sear stress. 	6	CO1	K3
	PART –B			
3(a)	**Show that** the maximum stress induced in axial impact loading is given by $\sigma' = \sigma\left[1+\sqrt{1+\frac{2h}{\delta_{st}}}\right]$	6	CO2	K3
(b)	An unknown weight falls through 100mm on a collar rigidly attached to the lower end of a vertical bar of 3m long and 600mm^2 cross section. The maximum instantaneous extension is 2mm. **Determine** the corresponding Stress and value of unknown weight. Take E=206Gpa.	6	CO2	K3
	OR			
4(a)	A weight of 1.5KN is dropped on to a collar at the lower end of the vertical bar of length 3m and a diameter 25mm. **Calculate** the height of drop, if the maximum stress induced is not to exceed 120Mpa, take E=210Gpa.	6	CO2	K3
(b)	A weight of 1KN is dropped from a height of 50mm at the free end of a cantilever beam of effective length 300mm. **Determine** the square cross section of the cantilever beam. I f the allowable stress for the material is 80Mpa.	6	CO2	K3

4/11/2022

(ANILKUMAR.K)
Name & Signature of Course In charge:

Name & Signature of Module Coordinator:

HOD ME 4/11/22

Principal

Selected

SET A

K S INSTITUTE OF TECHNOLOGY, BENGALURU-560109

DEPARTMENT OF MECHANICAL ENGINEERING

I Internal Assessment test ODD Semester

SCHEME OF VALUATION 2022-23

Course Title: Design of Machine Elements - I Course Code: 18ME52 Date: 14/11/2022

Q. No.	Solution	Marks Division	Total Marks
(1a)	Statement of problem → Analysis of problem → Synthesis → Analysis & optimization → Evaluation presentation & Explanation →	- 03 - - 03 -	- 06 -
(1b)	Tensile stress $\sigma_t = 5.09\ N/mm^2$ Bending stress $\sigma_b = 97.78\ N/mm^2$ Shear stress $\tau = 12.22\ N/mm^2$ →	- 03 -	- 06 -
	Stresses at point 'A': $\sigma_{max} = 104.3\ N/mm^2$; $\tau_{max} = 60.86$ MPa	- 03 -	
	Stresses at point 'B': $\sigma_{max} = 1.58\ N/mm^2$; $\tau_{max} = 47.49\ N/mm^2$	1.5	
(1c)	Normal & Tangential stress → $\sigma_\theta = 30\ N/mm^2$; $\tau_\theta = 35\ N/mm^2$	1.5	- 06 -
	Principle stress → $\sigma_1 = 48$ MPa; $\sigma_2 = -38.31$ MPa	1.5	
	Orientation of stresses → $\theta_1 = 17.767°$; $\theta_2 = 107.76°$	1.5	
	Maximum shear stress → $\tau_{max} = 43.01$ MPa; $\theta = 27.22°$	2	
(2a)	Rankine Theory & Definition →	2	- 06 -
	Tresca Theory & Definition →	2	
	Distortion Theory & Definition →	2	
(2b)	Considering Section A-A Thickness $h = 13.02$mm	3	- 06 -
	Considering Section B-B Thickness $h = 11.401$mm	3	
(2c)	Maximum Tensile Stress $\sigma_{max} = \left(\frac{\sigma}{2}\right) + \sqrt{\left(\frac{\sigma}{2}\right)^2 + \tau^2} = 25.754\ N/mm^2$	03	- 06 -
	Maximum Shear Stress: $\tau_{max} = \sqrt{\left(\frac{\sigma}{2}\right)^2 + \tau^2} = 13.00\ N/mm^2$	03	

(3a)	Deriving Till $\sigma'^2 = \left(\frac{A}{\delta t}\right) \cdot \sigma' \left(\frac{Wh}{E}\right) - Wh = 0$	-03-	-06-
	Impact Stress: $\sigma' = \sigma \left\{ 1 + \sqrt{1 + \frac{2h}{\delta t}} \right\}$ →	-03-	
(3b)	Instantaneous Stress $\sigma' = \frac{\delta' E}{L} = 137.34 \text{ N/mm}^2$	-02-	-06-
	$\sigma' = \sigma \left\{ 1 + \sqrt{1 + \frac{2h}{\delta t}} \right\}$ $W = 807.03 \text{ N}$ →	-04-	
(4a)	$\sigma = \frac{F}{A} = 3.00 \text{ N/mm}^2$; $\delta_{st} = \frac{Wl}{AE} = 0.0465 \text{ mm}$	-03-	06.
	$\sigma' = \sigma \left\{ 1 + \sqrt{1 + \frac{2h}{\delta t}} \right\} = h = 39.0665 \text{ mm}$	-03-	
(4b)	$\sigma_b = \frac{My}{I} = \frac{1.8 \times 10^6}{b^3}$; $y = \frac{1}{3} \frac{FL^3}{EI} = \frac{514.285 \times 10^3}{b^4}$ →	-03-	-06-
	$b = h = 313.2 \text{ mm}$ →	-03-	

04/11/2022
COURSE INCHARGE

04/11/2022
MODULE CO ORDINATOR

4/11/22
SIGNATURE OF HOD

K S INSTITUTE OF TECHNOLOGY
Bangalore – 560109

DEPARTMENT OF MECHANICAL ENGINEERING

CIE Question paper Scrutiny format

Course Name	Design of Machine Elements-I
Course Code	18ME52
Course Incharge	Anilkumar A
Academic year	2022-2023
Semester	V
CIE	1st
Set	A☐ B☑
Scrutiny parameters	
Whether questions are according to assessment plan?	Yes ☑ No☐ ; If No, Suggestions:
Whether questions prepared are within the covered syllabus?	Yes ☑ No ☐ ; If No, Suggestions:
Whether all questions are mapped to CO/PO properly?	Yes ☑ No ☐ ; If No, Suggestions:
Whether questions framed are according to Blooms level?	Yes ☑ No ☐ ; If No, Suggestions:
Whether marks distribution for each question are correct?	Yes ☑ No ☐ ; If No, Suggestions:
Whether questions paper follows the format displayed?	Yes ☑ No ☐ ; If No, Suggestions:
Difficulty level	Very High ☐ High ☑ Moderate ☐ Low☐
Percentage of Similarity questions in Set A & B	30%.
Final decision	Accepted without corrections☑ Accepted with minor corrections☐ Not accepted☐

04/11/2022
Signature with date
of CIE Question paper setter

Name and Signature with date
of CIE Question paper Scrutiniser

K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
FIRST INTERNAL TEST QUESTION PAPER 2022-23 ODD SEMESTER

SEC.E

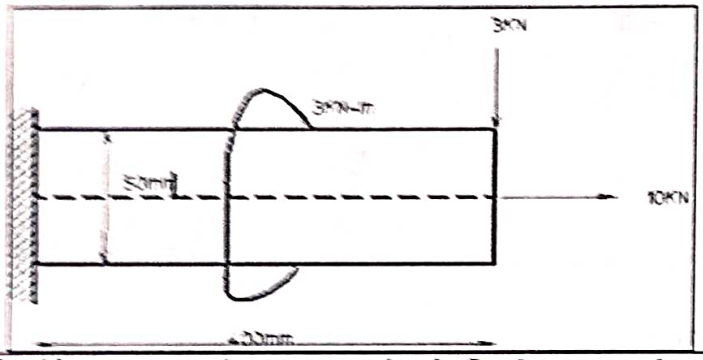
USN | | | | | | | | | | |

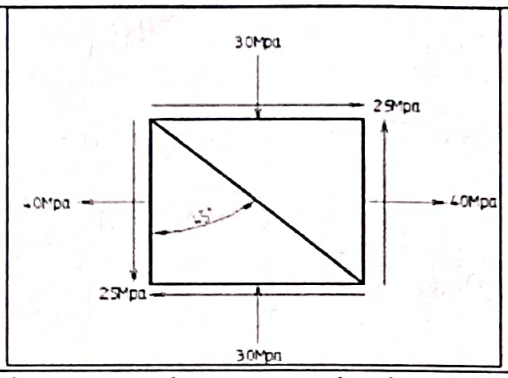
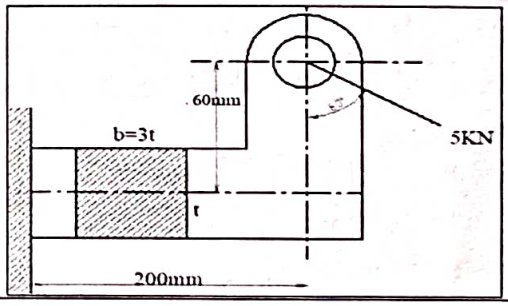
Degree : B.E
Branch : MECHANICAL ENGINEERING
Course Title : DESIGN OF MACHINE ELEMENTS-I
Duration : 90 Minutes

Semester : V
Course Code : 18ME52
Date : 14-11-2022
Max Marks : 30

Note: Answer **ONE full** question from each part.

K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks	CO	K-Level
	PART-A			
1(a)	Explain the codes and standards used in machine design.	6	CO1	K2
(b)	A shaft of 50mm diameter is subjected to a tensile load of 10KN, bending load of 3KN & a torque of 3KN-m as shown in figure, **determine** the stresses at points A & B. 	6	CO1	K3
(c)	A beam of uniform rectangular cross section is fixed at one end and carries a load of 1000N at a distance of 300mm from the fixed end. The maximum bending stress in the beam is 80MPa. **Find** the width and depth of the beam. If the depth is twice that of width.	6	CO1	K3
	OR			
2(a)	Explain the factors which influence the selection of engineering materials.	6	CO1	K2
(b)	A point in a structural member is subjected to plane stress as shown in figure. **Determine** the following. (i) Normal and Tangential Stress on a plane inclined at 45^0 with respect to vertical. (ii) The principal stresses. (iii) The orientation of principal stresses. (iv) The maximum shear stress and its direction.	6	CO1	K3

				
(c)	A wall bracket with a rectangular cross section is as shown in figure . The force 'P' acting on the bracket at 60^0 to the vertical is 5 kN. The material of the bracket is grey cast iron and FOS is 2. **Determine** the cross section of the bracket for maximum normal stress. 	6	CO1	K3
	PART –B			
3(a)	A machine element in the form of a cantilever beam of 800mm span has a rectangular cross section of depth 200mm. The free end of a beam is subjected to an impact from a transverse load of 1KN, that drops on to it from a height of 40mm. Selecting carbon-steel C-30, with yield strength of 294.2Mpa and factor of safety as 2.5. **Determine** the width of rectangular cross section.	6	CO2	K3
(b)	A steel bar of 50mm diameter and 1m long is subjected to an axial impact load caused by weight of 200N under gravity, with a velocity of 5m/sec. **Determine** maximum stress induced in the bar. Take E=210 X 10^3 N /mm^2	6	CO2	K3
	OR			
4(a)	Obtain an expression for impact stress induced in a member subjected to an axial load.	6	CO2	K3
(b)	An unknown weight falls through 100mm on a collar rigidly attached to the lower end of a vertical bar of 3m long and 600mm^2 cross section. The maximum instantaneous extension is 2mm. **Determine** the corresponding Stress and value of unknown weight. Take E=206Gpa.	6	CO2	K3

04/11/2022

Name & Signature of Course In charge:

Name & Signature of Module Coordinator:

HOD ME 4/11/22

Principal

SET B

K S INSTITUTE OF TECHNOLOGY, BENGALURU-560109

DEPARTMENT OF MECHANICAL ENGINEERING

I Internal Assessment test ODD Semester

SCHEME OF VALUATION 2022-23

Course Title: Design of Machine Elements - I Course Code: 18ME52 Date: 14/11/2022

Q. No.	Solution	Marks Division	Total Marks
(1a)	Defn of Standards with examples	-03-	-06-
(1b)	Defn of Codes with examples	-03-	
	Tensile Stress: $\sigma_t = 5.09$ Mpa Bending Stress: $\sigma_b = 47.78$ N/mm^2 Shear Stress: $\tau = 12.2$ N/mm^2	-03-	-06-
	Stress at A: $\sigma_{max} = 104.3$ MPa; $\tau_{max} = 52.8$ MPa Stress at B: $\sigma_{max} = 1.58$ MPa; $\tau_{max} = 47.92$ MPa	-03-	
(1c)	$M_b = F \times L = 3 \times 10^5$ N-mm; $I = \frac{bh^3}{12} = \frac{8b^4}{12}$ → $y = h/2$.	-03-	-06-
	$b = 17.784$ mm; $h = 35.586$ mm	-03-	
(2a)	Normal & Tangential Stress $\sigma_\theta = 30$ MPa; $\tau_\theta = 35$ MPa	-1.5-	-06-
	The Principal Stress $\sigma_1 = 48.01$ MPa; $\sigma_2 = -38.31$ MPa	-1.5-	
	orientation of Principal Stress $\theta_1 = 17.67°$; $\theta_2 = 107.76°$	-1.5-	
	Shear Stress & Direction: $\tau_{max} = 43.011$ MPa; $\theta = 27.23°$	-1.5-	
(2b)	Horizontal Component $F_H = 4330.127$ N Vertical Component $F_V = 2500$ N. →	-02-	-06-
	Direct Stress $\sigma_d = \frac{1444.37}{t^2}$ Bending Stress $\sigma_b = \frac{519615.24}{t^4}$ →	-02-	
	$t = 29.275$ mm; $b = 87.825$ mm →	-02-	
(2c)	Strength; Rigidity; Wear Resistance; minimum Dimensions & weight; Safety; Reliability; Cost; Maintainability; manufacturability	-06-	-06-

(3a) $\sigma' = 117.7 MPa$; $Y = \frac{FL^3}{3EI} = \frac{1.919}{b}$ — -03-

$\sigma' = \sigma\left\{1+\sqrt{1+\frac{2h}{y}}\right\} = b = 69.64mm$ — -03- — -06-

(3b) $\sigma = \frac{F}{A} = 0.101 N/mm^2$; $v = \sqrt{2gh}$. $h = 1.85 \times 10^{-3} m$ — -03-

$\delta_{st} = \frac{WL}{AE} = 4.85 \times 10^{-4} mm$. — -06-

$\sigma' = \sigma\left\{1+\sqrt{1+\frac{2h}{\delta st}}\right\} = 229.77 N/mm^2$ — -03-

(4a) Deriving till: $\sigma'^2\left(\frac{AL}{2E}\right) - \sigma'\left(\frac{WL}{E}\right) - Wh = 0$ — -03- — -06-

Deriving till: $\sigma' = \sigma\left\{1+\sqrt{1+\frac{2h}{\delta st}}\right\}$ — -03-

(4b) $\sigma' = \frac{\delta' E}{L} = 137.34 N/mm^2$ — -02- — -06-

$\sigma' = \sigma\left\{1+\sqrt{1+\frac{2h}{\delta st}}\right\}$. — -04-

$W = 807.03N$

04/11/2022

COURSE INCHARGE

MODULE CO ORDINATOR

4/11/22

SIGNATURE OF HOD

K S INSTITUTE OF TECHNOLOGY
Bangalore – 560109

DEPARTMENT OF MECHANICAL ENGINEERING

CIE Question paper Scrutiny format

Course Name	**Design of Machine Elements-I**
Course Code	**17ME54**
Course Incharge	**Anilkumar A**
Academic year	**2022-2023**
Semester	**V**
CIE	**2nd**
Set	A☑ B ☐
Scrutiny parameters	
Whether questions are according to assessment plan?	Yes ☑ No☐ ; If No, Suggestions:
Whether questions prepared are within the covered syllabus?	Yes ☑ No ☐ ; If No, Suggestions:
Whether all questions are mapped to CO/PO properly?	Yes ☑ No ☐ ; If No, Suggestions:
Whether questions framed are according to Blooms level?	Yes ☑ No ☐ ; If No, Suggestions:
Whether marks distribution for each question are correct?	Yes ☑ No ☐ ; If No, Suggestions:
Whether questions paper follows the format displayed?	Yes ☑ No ☐ ; If No, Suggestions:
Difficulty level	Very High ☐ High ☑ Moderate ☐ Low☐
Percentage of Similarity questions in Set A & B	12·1·
Final decision	Accepted without corrections☑ Accepted with minor corrections☐ Not accepted☐

15/02/2022

Signature with date
of CIE Question paper setter

(M-NAGARAJ NAIK)

Name and Signature with date
of CIE Question paper Scrutiniser

K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
SECOND INTERNAL TEST QUESTION PAPER 2022-23 ODD SEMESTER

SET: A

USN | | | | | | | | | | |

Degree	:	**B. E.,**	**Semester**	:	**V**
Branch	:	**Mechanical Engineering**	**Course Code**	:	**18ME52**
Course Title	:	**Design of Machine Elements-I**	**Date**	:	**22/12/2022**
Duration	:	**90 Minutes**	**Max Marks**	:	**30**

Note: Answer **ONE full** question from each part.

K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks	CO	K-Level
	PART-A			
1(a)	**Prove that** a square has equal strength in both compression as well as in shear. Key	6	CO3	K3
(b)	**Design** a flange coupling to connect to a motor with following specification. Take pump output = 3000Ltrs/min, Total head =20m, Pump speed = 600rpm, Efficiency = 70%. Select C40 steel for shaft, C35 steel for key with factor of safety 2. Assume allowable stress in Cast Iron flange as 15Mpa.	12	CO3	K3
	OR			
2(a)	A rectangular key of 15mm width and 12mm thickness is required to transmit a torque of 800N-m from a shaft of 40mm diameter. Taking allowable values of stress in shear and compression as 58Mpa and 110Mpa respectively. **Find** the length of the key required.	6	CO3	K3
(b)	**Design** a pin type flexible coupling to transmit 10KW at 500rpm. Assume C40 steel for shaft, pin, keys with σ_y=328.6Mpa & FOS=2. Flange is made up of Cast iron with σ_{ut}=124.5Mpa	12	CO3	K3
	PART –B			
3(a)	**Derive** an expression for Impact stress induced due to Impact bending load.	6	CO2	K3
(b)	A simply supported beam of 5m span has to resist an impact of 6KN falling under gravity with a velocity of 30m/min at its center. The beam is of box section of 40mm depth. The moment of inertia of box section is $10^8 mm^4$, the modulus of elasticity is 210Gpa. **Determine** the maximum stress induced in the beam and compare that with static stress.	6	CO2	K3
	OR			
4(a)	A machine element in the form of a cantilever beam of span 800mm has a rectangular cross section of depth 200mm. The free end of a beam is subjected to an impact from a transverse load of 1KN, that drops on to it from a height of 40mm. Selecting C-30 steel with yield strength σ_y=294.2Mpa and choosing Factor of Safety as 2.5,	6	CO2	K3

	determine the width of rectangular cross section.			
(b)	A stainless steel beam of span 1000mm is subjected to central load of 20KN, that falls from a height of 20mm. The beam has a rectangular cross section of 60mm X 200mm. The material of the beam has a modulus of elasticity of 207Gpa. **Determine** Maximum normal stress, Maximum static deflection, Impact factor, Maximum Impact normal stress, Maximum Impact deflection..	6	CO2	K3

15/12/2022.

(ANILKUMAR.A)

Name & Signature of Course In charge

Name & Signature of Module Coordinator

HOD ME

Principal

K S INSTITUTE OF TECHNOLOGY, BANGALORE-109

DEPARTMENT OF MECHANICAL ENGINEERING

ACADEMIC YEAR-2022-23

SCHEME OF EVALUATION

Internal: II
Subject: DME-I
Subject code: 18ME52

Sem & Section: V
Date: 22/12/2022

Max. Marks: 30
Duration: 90 MINS

Question No:	Points to be Covered	Marks Split	Total Marks
(1a)	$T_{HC} = \frac{\pi c h l d}{4}$ → (1) $T_{HS} = \frac{\pi b h d}{2}$ → (2) (1) ÷ (2) $\frac{T_{HC}}{T_{HS}} = \frac{\frac{\pi c h l d}{4}}{\frac{\pi b h d}{2}}$ $\frac{T_{HC}}{T_{HS}} = \frac{\pi c l}{2 b}$ $\frac{T_{HC}}{T_{HS}} = \frac{\tau_c}{\tau_s} =$ $\boxed{T_{HC} = T_{HS}}$	03M. 03M	06M.
(1b)	$P = \frac{2\pi NT}{1000} = 9.81$ KW; $P_{total} = \frac{P}{\eta} = \frac{9.81}{0.7} = 14$ KW $T_H = \frac{9550N}{n} = 222.833 \times 10^3$ N mm $T_H = \frac{\pi d^3}{16} n \tau_s =$ dst = 28mm // Key => b = 8mm; h = 7mm; L = 29.91mm. Bolts => i = 4; D_1 = 106mm; d_1 = 7mm Stresses in Bolts: $\tau_b = 27.311 N/mm^2$ Hub :- D_2 = 67mm; L = 53.7mm; D = 145mm; t = 7mm. Check for stresses = $\tau_s = 4.51 N/mm^2$	03M. 09M. 04M 03M.	12M.
(2a)	$T_{HC} = \frac{\pi c h l d}{4}$ => L = 60.606mm; $T_{HS} = \frac{\tau_c b h d}{2}$ => L = 57.471mm.	03M 03M	06M
(2b)	$T_H = \frac{9550 \times N}{n} = 191000$ N-mm; $T_H = \frac{\pi d^3}{16} \times n \times \tau_s =$ dstd = 36mm Key: b = 8mm; h = 7mm; L = 35.54mm. Pin dia: i = 4; D_1 = 102mm Pin: L = 46.25mm; F = 936.2N; d' = 58mm; d_2 = 41mm; d_1 = 38mm. Stresses in pin: $\tau_p = 1.58 N/mm^2$; $\sigma_b = 4.65 N/mm^2$; $\sigma_{max} = 5.10$ $\tau_{max} = 2.77$ Flange: D = 150N/mm²; D_2 = 45.5mm; t = 9.75mm Stresses in flange: $\tau_f = 6.02 N/mm^2$	02M. 02M. 04M. 04M	12M.

Question No:	Points to be Covered	Marks Split	Total Marks
(3a)	Work done = force × Distance $\Rightarrow W = \frac{1}{2}(h+y')$ work done by equivalent static weight $= \frac{1}{2} w e y'$ $\frac{1}{2} w e y' = W(h+y') \Rightarrow y' = \frac{w l^3}{48EI} \Rightarrow y' = \frac{2(h+y')}{y'} \times \frac{Wl^3}{48EI}$ $y' = \frac{2(h+y')y}{y'} \Rightarrow y'^2 - (2y)y' - 2hy = 0.$ $y' \times \frac{8Ey}{l^2} = y \times \frac{8Ey}{l^2}\left\{1+\sqrt{1+\frac{2h}{y}}\right\} \Rightarrow$ $\sigma_b' = \sigma_b\left\{1+\sqrt{1+\frac{2h}{y}}\right\}$	02M 02M 02M.	06M
(3b)	$\sigma_b' = \sigma_b\left\{1+\sqrt{1+\frac{2h}{y}}\right\} \Rightarrow h = \frac{v^2}{2g} = 12.7mm;$ $\sigma_b = \frac{M_b y}{I} \Rightarrow 1.5 N/mm^2;$ $y = \frac{Wl^3}{48EI} \Rightarrow 0.744 mm.$ $\sigma_b' = 10.405 N/mm^2;$ IF = 6.9367.	03M 03M.	06M
(4a)	$\sigma_b = \frac{M_b y}{I} \Rightarrow \frac{120}{b}; y = \frac{Fl^3}{3EI} = \frac{1.219}{b}.$ ⟶ $\sigma_b' = \sigma_b\left\{1+\sqrt{1+\frac{2h}{y}}\right\} \Rightarrow (0.9808b-1) = \sqrt{1+65.03b}$ $b = 69.64mm$	03M 03M.	06M
(4b)	$\sigma_b = \frac{M_b y}{I} \Rightarrow 12.5 N/mm^2$ ⟶ $y = \frac{Wl^3}{48EI} \Rightarrow 0.050 mm.$ ⟶ $\sigma_b' = \sigma\left\{1+\sqrt{1+\frac{2h}{y}}\right\} \Rightarrow 366.27 N/mm^2.$ ⟶ $IF = \frac{\sigma_b'}{\sigma_b} = 89.3016$ // ⟶ $y' = y\left\{1+\sqrt{1+\frac{2h}{y}}\right\} = 1.4650 mm.$ ⟶	02M. 01M. 01M. 01M 01M	06M

15/12/2022

Signature of Course Incharge

Signature of HOD/MED

K S INSTITUTE OF TECHNOLOGY
Bangalore – 560109

DEPARTMENT OF MECHANICAL ENGINEERING

CIE Question paper Scrutiny format

Course Name	**Design of Machine Elements-I**
Course Code	**18ME52**
Course Incharge	**Anilkumar A**
Academic year	**2022-2023**
Semester	**V**
CIE	**2nd**
Set	A☐ B☑
Scrutiny parameters	
Whether questions are according to assessment plan?	Yes ☑ No☐ ; If No, Suggestions:
Whether questions prepared are within the covered syllabus?	Yes ☑ No ☐ ; If No, Suggestions:
Whether all questions are mapped to CO/PO properly?	Yes ☑ No ☐ ; If No, Suggestions:
Whether questions framed are according to Blooms level?	Yes ☑ No ☐ ; If No, Suggestions:
Whether marks distribution for each question are correct?	Yes ☑ No ☐ ; If No, Suggestions:
Whether questions paper follows the format displayed?	Yes ☑ No ☐ ; If No, Suggestions:
Difficulty level	Very High ☐ High ☑ Moderate ☐ Low☐
Percentage of Similarity questions in Set A & B	12%
Final decision	Accepted without corrections☑ Accepted with minor corrections☐ Not accepted☐

15/12/2022.

Signature with date
of CIE Question paper setter

Name and Signature with date
of CIE Question paper Scrutiniser

K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
SECOND INTERNAL TEST QUESTION PAPER 2022-23 ODD SEMESTER

SET: B

USN | | | | | | | | | | |

Degree	:	B. E.,	Semester	:	V
Branch	:	Mechanical Engineering	Course Code	:	18ME52
Course Title	:	Design of Machine Elements-I	Date	:	22/12/2022
Duration	:	90 Minutes	Max Marks	:	30

Note: Answer **ONE full** question from each part.

K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks	CO	K-Level
	PART-A			
1(a)	**Find** the dimensions of a square tapered key to transmit 20KW at 1800rpm. Allowable shear and compressive stresses are 80Mpa and 170Mpa. Also calculate the axial force required to drive the keyway.	6	CO3	K3
(b)	**Design** a flexible flanged coupling to transmit a power of 25KW at speed of 500rpm. Assume Shaft, Keys, Pins are made of C40 steel with FOS=2 and flanges are made of Cast iron with FOS=6. Assume bearing pressure=0.5Mpa.	12	CO3	K3
	OR			
2(a)	**Derive** the equation for torque transmitted by the key in compression and shear.	6	CO3	K3
(b)	It is required to **design** a protected type rigid flange coupling to connect two shafts. The shaft transmits 37.5KW at 180rpm to the output shaft through coupling. Starting torque is 15 times the rated torque. The shaft and key are made of steel wit yield strength 380Mpa and FOS=2.5. Flanges are made of Cast Iron FG200 with FOS=6. Assume ultimate shear as on half of the ultimate tensile strength.	12	CO3	K3
	PART –B			
3(a)	A weight of 1KN is dropped from a height of 50mm at the free end of a cantilever beam of effective length 300mm. **Determine** the square cross section of the cantilever beam if the allowable stress for the material is 80Mpa.	6	CO2	K3
(b)	A power hammer of mass 500Kg strikes the angle supported at the midpoint of the beam simply supported at its ends 5m apart, the height through which the angle falls is 10cm. **Determine** the width of the rectangular cross section of beam if the depth of the cross section is 200mm. Take E=210 X 10^3Mpa and C-30 steel with FOS=2.5.	6	CO2	K3
	OR			
4(a)	**Derive** an expression for Impact stress induced due to Impact bending load.	6	CO2	K3
(b)	A beam of 40mm depth and I cross section is resting on two supports	6	CO2	K3

	that are 6m apart. It is loaded by a weight of 5000N falling through a height of 10mm and striking the beam at mid point. The moment of Inertia of the I section is 12 X 10^7mm^4. Take E = 210 X 10^3Mpa. **Determine**: (i) Impact factor, (ii) Instantaneous maximum deflection, (iii) Instantaneous maximum stress, (iv) Instantaneous maximum load.			

15/12/2022.

(ADILKUMAR.A)

Name & Signature of Course In charge

Name & Signature of Module Coordinator

HOD ME

Principal

Selected.

K S INSTITUTE OF TECHNOLOGY, BANGALORE-109

DEPARTMENT OF MECHANICAL ENGINEERING

ACADEMIC YEAR-2022-23

SCHEME OF EVALUATION

Internal: II | **Sem & Section: V** | **Max. Marks: 30**
Subject: DME-I | **Date: 22/12/2022** | **Duration: 90 MINS**
Subject code: 18ME52

Question No:	Points to be Covered	Marks Split	Total Marks
(10a)	$M_t = \frac{9550 \times N}{n} = 106.11 \times 10^3$ N-mm. $\Rightarrow$ $M_t = \frac{\pi d^3}{16} \eta \tau_s \Rightarrow d = 20.806$mm ; $d_{std} = 22$mm. $\Rightarrow$ From T-17.4 $\Rightarrow$ $b = h = 6$mm. $\Rightarrow$ $M_{tb} = \frac{\tau_s b h l d}{2} \Rightarrow L = 20.09$mm. $\Rightarrow$ Axial force $\Rightarrow F_a = 2M_t F + F \tan\beta = 6765.31$N. $\Rightarrow$	02M 02M 02M	06M
(10b)	$M_t = \frac{9550 \times N}{n} = 477.8 \times 10^3$ N-mm. $\rightarrow$ $M_t = \frac{\pi d^3}{16} \eta \tau_s \Rightarrow d_{std} = 32$mm $\rightarrow$ Key $b = h = 10$mm ; $L = 60$mm. $\rightarrow$ Check for stresses. $\rightarrow \tau = 49.74$MPa ; $\sigma_b = 99.48$MPa $\rightarrow$ Pitch: $i = 4$; $d_p = 16$mm ; PCD = 125mm. $\rightarrow$ Bolt: $d' = 36$mm; $F = 18$kN ; $L_b = 70.74$mm; $\rightarrow$ Flange: $D_3 = 170$mm ; $t = 21$mm ; $\rightarrow$	01M. 02M. 02M 01M. 02M 02M 02M	12M.
(20a)	Compression $M_{tc} = F_c \times$ Radius $\Rightarrow \sigma_c \times A \times \frac{d}{2} = \tau_c \frac{h}{2} L \frac{d}{2}$ $M_{tc} = \frac{\tau_c h l d}{4}$ Shear: $M_{ts} = F_s \times$ Radius $\Rightarrow \tau_s A \frac{d}{2} \Rightarrow \tau_s b h \frac{d}{2}$ $M_t = \frac{\tau_s b h l d}{2}$	03M. 03M	06M.
(20b)	$M_t = \frac{9550 \times N}{n} \Rightarrow 1989583.34$N-mm $M_{t\max} = 2984375.01$ N-mm $M_t = \frac{\pi d^3}{16} \eta \tau \Rightarrow \boxed{d_{std} = 65}$ Key: $b = 18$mm ; $h = 11$mm ; $L = 109.6408$mm. $\rightarrow$ Bolts: $i = 6$; $D_1 = 2d + 50$mm $= 180$mm ; $d_1 = \frac{0.5d}{0.7} = 14$mm Stresses $\tau_b = 35.901$ N/mm^2 Hub Dia: $D_8 = 122.5$mm ; $h = 100$mm ; $D = 237.5$mm ; $t = 16.25$mm Stresses: $\tau_g = 7.79$ N/mm^2	02M 02M 04M 04M	12M.

Question No:	Points to be Covered	Marks Split	Total Marks
(4a)	Work Done = Force × Distance $\Rightarrow W(h+y')$ Work Done by Equivalent weight $\Rightarrow \frac{1}{2}We y'$ $\frac{1}{2}We y' = W(h+y') \Rightarrow We = \frac{2W(h+y')}{y'} \Rightarrow y' = \frac{We l^3}{48EI}$ $y' = \frac{2W(h+y')}{y'} \times \frac{l^3}{48EI} \Rightarrow y' = \frac{2(h+y')y}{y'}$ $y'^2 - 2hy - (2y^2) = 0 \Rightarrow y' \times \frac{8Ey}{l^2} = \frac{8Ey}{l^2}\left\{1+\sqrt{1+\frac{2h}{y}}\right\}$ $\sigma_b' = \sigma\left\{1+\sqrt{1+\frac{2h}{y}}\right\}$.	02M. 02M 02M	6M.
(4b)	$\sigma_b' = \sigma_b\left[1+\sqrt{1+\frac{2h}{y}}\right] = 7.89 N/mm^2$; $\sigma_b = \frac{Mby}{I} = 1.25 N/mm^2$ $IF = \frac{\sigma_b'}{\sigma_b} = 6.83$; $y' = y\left\{1+\sqrt{1+\frac{2h}{y}}\right\} = 5.8116 mm$ $IF = \frac{w'}{w} = 29187 N$.	02M. 03M. 01M	6M.
(3a)	$\sigma_b' = \sigma_b\left[1+\sqrt{1+\frac{2h}{y}}\right] \Rightarrow \sigma_b = \frac{Mby}{I} = \frac{1.8\times10^6}{b^3}$ $y = \frac{1}{3}\frac{Fl^3}{3EI} = \frac{514.285\times10^3}{b^4}$ $b = h = 313.2mm$.	02M. 02M 02M	6M.
(3b)	$\sigma = \frac{Mby}{I} \Rightarrow \frac{919.04}{b}$ $y = \frac{Fl^3}{48EI} \Rightarrow \frac{91.443}{b}$. $\sigma_b' = \sigma_b\left\{1+\sqrt{1+\frac{2h}{y}}\right\}$. $0.127b - 1 = \sqrt{1+2.19b}$ $b = 151.8012 mm$.		

15/12/2022

Signature of Course Incharge

Signature of HOD/MED

K S INSTITUTE OF TECHNOLOGY
Bangalore – 560109

DEPARTMENT OF MECHANICAL ENGINEERING

CIE Question paper Scrutiny format

Course Name	**Design of Machine Elements-I**
Course Code	**18ME52**
Course Incharge	**Anilkumar A**
Academic year	**2022-2023**
Semester	**V**
CIE	**3RD**
Set	A☑ B☐
Scrutiny parameters	
Whether questions are according to assessment plan?	Yes ☑ No☐ ; If No, Suggestions:
Whether questions prepared are within the covered syllabus?	Yes ☑ No ☐ ; If No, Suggestions:
Whether all questions are mapped to CO/PO properly?	Yes ☑ No ☐ ; If No, Suggestions:
Whether questions framed are according to Blooms level?	Yes ☑ No ☐ ; If No, Suggestions:
Whether marks distribution for each question are correct?	Yes ☑ No ☐ ; If No, Suggestions:
Whether questions paper follows the format displayed?	Yes ☑ No ☐ ; If No, Suggestions:
Difficulty level	Very High ☐ High ☐ Moderate ☑ Low☐
Percentage of Similarity questions in Set A & B	40%
Final decision	Accepted without corrections☑ Accepted with minor corrections☐ Not accepted☐

13/01/2023

Signature with date
of CIE Question paper setter

13/1/23

Name and Signature with date
of CIE Question paper Scrutiniser

K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
THIRD INTERNAL TEST QUESTION PAPER 2022-23 ODD SEMESTER

SET: A

USN | | | | | | | | | | |

Degree	:	**B. E.,**	**Semester**	:	**V**
Branch	:	**Mechanical Engineering**	**Course Code**	:	**18ME52**
Course Title	:	**Design of Machine Elements-I**	**Date**	:	**18/01/2023**
Duration	:	**90 Minutes**	**Max Marks**	:	**30**

Note: Answer **ONE full** question from each part.

K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks	CO	K-Level
	PART-A			
1(a)	**Explain** Caulking & Fullering with a neat sketch.	5	CO4	K2
(b)	Design a triple riveted longitudinal double strap butt joint with unequal strap for a boiler. The inside diameter of the longest course of the drum is 1.3m. The joint is to be designed for a steam pressure of 2.4N/mm^2. The working stresses to be used are σ_t=77Mpa for plate material in tension, τ =62Mpa for rivet material in shear, σ_c=120Mpa for rivet material in compression. Assume joint efficiency of 81%.	10	CO4	K4
	OR			
2(a)	**Explain** in brief types of failures in riveted joints.	5	CO4	K2
2(b)	An air vessel of 1m diameter has triple riveted lap joint (Zig-Zag type), the maximum air pressure in the vessel is 2Mpa. Design the riveted joint if the safe working stress in tension, Shear and compression are 125Mpa, 90Mpa & 165Mpa.	10	CO4	K4
	PART –B			
3(a)	**Derive** the Expression for Torque required to lift the load on a square threaded screw.	7	CO5	K3
(b)	A weight of 500KN is raised at a speed of 6m/min by two screw rods with square threads of 50X8 cut by them. The two screw rods are driven through bevel gear driven by a motor, **Calculate,** i) The torque required to raise the load ii) The speed of rotation of the screw rod assuming the threads are of double start. iii) The maximum stresses induced on the cross-section of the screw rod. iv) The efficiency of screw drive. v) The length of nuts for the purpose of supporting the load vi) Check for overhaul.	8	CO5	K4
	OR			

4(a)	**Design** a screw jack with a lift of 300mm to lift a load of 50KN. Select C40 steel ($\sigma_y = 328.6MPa$) for screw and soft phosphor bronze ($\sigma_{ut} = 345MPa, \sigma_y = 138MPa$) for nut.	**15**	**CO5**	**K4**

13/01/2023

(Anilkumar. A)

Name & Signature of Course In charge

13/1/23

Name & Signature of Module Coordinator

HOD ME

Principal

K S INSTITUTE OF TECHNOLOGY, BANGALORE-109

DEPARTMENT OF MECHANICAL ENGINEERING

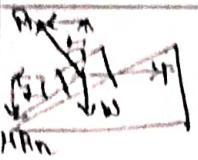
ACADEMIC YEAR-2022-2023

SET-A

SCHEME OF EVALUATION

Internal: III
Subject: DME-I | **Sem & Section:V** | **Max. Marks:30**
Subject code: 18ME52 | **Date:18/01/2023** | **Duration: 90 M**

Question No:	Points to be Covered	Marks Split	Total Marks
(1a)	Caulking  * used to get leak proof joint * cross point edge of top plate	2.5M	05M.
	Fullering  * cross the tool curved to the thickness of plate.	2.5M	
(1b)	Finding thickness & sketch →	2M	10M.
	Finding - Coverplate thickness, length & dia of rivet →	2M.	
	Finding Pitch, transverse pitch & margin →	3M	
	Finding efficiency →	3M	
(2a)	Tearing of plate →  hole is placed to close to plate.	2M	05M.
	Shearing of rivet →  failure because of shear.	1.5M	
	Crushing of rivets  failure because of compressive load.	1.5M	
(2b)	Finding thickness & sketching a joint →	2M.	10M.
	Finding length, Dia of rivet & rivet hole dia →	2M.	
	Finding Longitudinal Pitch, transverse pitch & margin →	3M.	
	Finding efficiency →	2M.	

Question No:	Points to be Covered	Marks Split	Total Marks
(3a)	 Horizontal component: $F = \mu R_n \cos\alpha + R_n \sin\alpha$ Vertical component $W = R_n \cos\alpha - \mu R_n \sin\alpha$ $\frac{F}{W} = \left\{\frac{\mu + \tan\alpha}{1-\mu\tan\alpha}\right\} \Rightarrow M_{ts} = F \times \frac{d}{2}$; $\mu = \tan\phi$ $M_{ts} = W \frac{d}{2} \tan(\phi - \alpha)$	04M 03M	07M
(3b)	Torque => $M_t = W\left[\frac{d_2}{2}\left[\frac{\mu + \tan\alpha}{1-\mu\tan\alpha}\right] + \frac{\mu_c d_c}{2}\right] = 264750$ N-mm Speed => $n = \frac{V}{L} = \frac{6000}{2\times 12}$ Efficiency => $\eta = \frac{d_2 \tan\alpha}{d_2\left\{\frac{\mu+\tan\alpha}{1-\mu\tan\alpha}\right\} + \mu_c d_c} = 20.8\%$ Length of nut: $L_n = lP = \frac{4WP}{\pi_b \pi (d^2 - d_1^2)} = 156$ mm Condition for over hauling $\tan\alpha > \mu$	02M 01M 02M 02M 01M	08M
(4)	Designed Screw: $A_c = 707\text{mm}^2$; $d = 36$mm; $d_1 = 30$mm; $d_2 = 33$mm; $d_{nut} = 36.5$mm. Stresses in Screw: $\tau_{max} = 82.41 N/mm^2$; $\sigma_{max} = 47.05 N/mm^2$ Screw head: $H_1 = 54$mm; $d_{c0} = 72$mm; $d_c = 51$mm; $\mu_c = 0.14$ Nut: $L_n = 72$mm; $D_1 = 55$mm; $D_2 = 65$mm; $H = 15$mm. Buckling $F_{cr} = 157048.4552$ N Handle: $L_h = 1769$mm; $d_h = 33$mm; Cup: $D_3 = 72$mm; $D_4 = 144$mm; $H_3 = 60$mm; $t = 6$mm Efficiency: $\eta = 13.55\%$ Overhauling: Self Locking Screw. Body: $H = 450$mm; $D_5 = 100$mm; $D_6 = 150$mm; $D_7 = 225$mm; $t_1 = 30$mm; $t_2 = 10$mm	03M 03M 02M 02M 03M 02M	15M

Signature of Staff

Signature of HOD

K S INSTITUTE OF TECHNOLOGY
Bangalore – 560109

DEPARTMENT OF MECHANICAL ENGINEERING

CIE Question paper Scrutiny format

Course Name	**Design of Machine Elements-I**
Course Code	**18ME52**
Course Incharge	**Anilkumar A**
Academic year	**2022-2023**
Semester	**V**
CIE	**3RD**
Set	A☐ B☑
Scrutiny parameters	
Whether questions are according to assessment plan?	Yes ☑ No☐ ; If No, Suggestions:
Whether questions prepared are within the covered syllabus?	Yes ☑ No ☐ ; If No, Suggestions:
Whether all questions are mapped to CO/PO properly?	Yes ☑ No ☐ ; If No, Suggestions:
Whether questions framed are according to Blooms level?	Yes ☑ No ☐ ; If No, Suggestions:
Whether marks distribution for each question are correct?	Yes ☑ No ☐ ; If No, Suggestions:
Whether questions paper follows the format displayed?	Yes ☑ No ☐ ; If No, Suggestions:
Difficulty level	Very High ☐ High ☐ Moderate ☑ Low☐
Percentage of Similarity questions in Set A & B	40%
Final decision	Accepted without corrections☑ Accepted with minor corrections☐ Not accepted☐

13/01/2023

Signature with date
of CIE Question paper setter

17/1/23

Name and Signature with date
of CIE Question paper Scrutiniser

K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
THIRD INTERNAL TEST QUESTION PAPER 2022-23 ODD SEMESTER

SET: B

USN | | | | | | | | | | |

Degree	:	**B. E.,**	**Semester**	:	**V**
Branch	:	**Mechanical Engineering**	**Course Code**	:	**18ME52**
Course Title	:	**Design of Machine Elements-I**	**Date**	:	**18/01/2023**
Duration	:	**90 Minutes**	**Max Marks**	:	**30**

Note: Answer **ONE full** question from each part.

K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks	CO	K-Level
	PART-A			
1(a)	**Explain** in brief types of failures in riveted joints.	5	CO4	K2
(b)	**Design** a longitudinal joint for a boiler of 1m diameter, subjected to a steam pressure of 2Mpa. Select double riveted joint with double cover straps, with a required efficiency of 75%. Take the following allowable stress. Tensile stress (σ_t=80)Mpa, shear stress (τ =60Mpa), Compressive stress (σ_c=120Mpa).	10	CO4	K4
	OR			
2(a)	**Explain** Caulking & Fullering with a neat sketch.	5	CO4	K2
(b)	A boiler shell of 1m diameter has a circumferential triple riveted lap joint. The maximum pressure in the boiler is 2Mpa. **Design** the riveted joint if the allowable stress in tension, shear and compression is 120Mpa, 80Mpa and 160Mpa respectively.	10	CO4	K4
	PART –B			
3(a)	Briefly Explain Self locking and Overhauling. **Derive** torque required to raise the load.	7	CO5	K3
(b)	A Double threaded power screw with trapezoidal ISO thread is used to lift a load of 300KN. The nominal diameter is 100mm and the pitch is 12mm. The coefficient of friction is 0.15. Neglecting collar friction, **Determine** (i) Torque required to lift the load (ii) Torque required to lower the load (iii) Efficiency of the screw (iv) Check whether the screw is self locking or Overhauling.	8	CO5	K3
	OR			
4(a)	**Design** a screw jack with a lift of 300mm to lift a load of 50KN. Select C40 steel ($\sigma_y = 328.6MPa$) for screw and soft phosphor bronze ($\sigma_{ut} = 345MPa, \sigma_y = 138MPa$) for nut.	15	CO5	K4

13/01/2022

Name & Signature of Course In charge

(Anilkumar. A)

17/1/23

Name & Signature of Module Coordinator

HOD ME

Principal

Selected

K S INSTITUTE OF TECHNOLOGY, BANGALORE-109

DEPARTMENT OF MECHANICAL ENGINEERING

ACADEMIC YEAR-2022-2023

SET-B

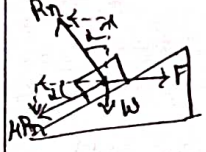
SCHEME OF EVALUATION

Internal: III
Subject: DME-I
Subject code: 18ME52

Sem & Section:V
Date:18/01/2023

Max. Marks:30
Duration: 90 M

Question No:	Points to be Covered	Marks Split	Total Marks
(1a)	Tearing of Plate:- when hole is placed too close to the end of the plate. →	2M	5M.
	Shearing of Rivets:- failure because of shear. →	1.5M	
	Crushing of rivets failure because of compressive load. →	1.5M	
(1b)	Thickness $\Rightarrow t = \frac{P_3 D_1}{2\sigma_t e} = 17mm$ & sketch. →	3M.	10M.
	Dia of rivet $= 6\sqrt{t} = 6\sqrt{17} = 27mm$; $d_1 = 28.5mm$. →	2M.	
	Cover plate $t_1 = t_2 = 0.625 \times t = 10.625mm$.		
	Length $L = t_1 + t + t_2 + 1.5d_1 = 81mm$. →	3M	
	Longitudinal Pitch $P = 100mm$; $P_t = 70mm$; $m = 43mm$		
	Efficiency $= \eta = \frac{\text{least resistance to failure}}{\text{strength of the plate}} = 71.25\% \rightarrow$	2M.	
(2a)	Calking:- * used to get leak proof joint * uses point edge tool at 70-75°	2.5M	05M.
	Fullering:- * used tool that is equal to the thickness of the plate	2.5M	
(2b)	Thickness $t = \frac{D_i P_s}{4\sigma_t e} = 6mm$; Sketch →	3M.	10M.
	Dia $= d = 6\sqrt{t} = 16mm$ & $d_1 = 17mm$. →	02M.	
	Length $= 37.5mm$.		
	Pitch $= 61mm$; $P_t = 42.5mm$; $m = 25.5mm$ →	03M	
	Efficiency $\eta = \frac{\text{Least resistance to failure}}{\text{strength of solid plate.}} \Rightarrow$	03M.	
	$\eta = 73.77\%$.		

Question No:	Points to be Covered	Marks Split	Total Marks
(3a)	Self Locking $\Rightarrow \phi > \alpha$ Overhauling $\Rightarrow \phi < \alpha$	2M.	07M.
	 Horizontal forces: $F = \mu R_n \cos\alpha + R_n \sin\alpha$ Vertical Component $W = R_n \cos\alpha - \mu R_n \sin\alpha$	03M.	
	$\frac{F}{W} = \begin{cases} \frac{\mu + \tan\alpha}{1 - \mu\tan\alpha} \end{cases} \Rightarrow M_{ts} = F \times \frac{d}{2}$ $M_{ts} = W \frac{d}{2} \tan(\phi - \alpha)$	02M	
(3b)	Torque: $M_{ts} = W \frac{d_2}{2} \tan(\phi + \alpha) = 330 \times 10^4$ N-mm.	02M	08M.
	Torque to Lower Load: $M_{ts} = W \frac{d_2}{2} \tan(\phi - \alpha) = 957.18 \times 10^3$ N-mm	02M.	
	Efficiency: $\eta = \frac{d_2 \tan\alpha}{\left(\frac{\mu + \tan\alpha}{1 - \mu\tan\alpha}\right) d_2} = 34.7\%$	02M	
	Condition for self locking: $\tan\alpha > \mu$	02M	
(4)	Design of Screw: $A_c = 707 mm^2$; $d = 36mm$; $d_1 = 30mm$; $d_2 = 33mm$; $d_{nut} = 36.5mm$. Stresses in Screw: $\sigma_{max} = 29.41 N/mm^2$; $\tau_{max} = 47.05 N/mm^2$	03M.	15M.
	Screw head: $H_1 = 54mm$; $d_{c0} = 72mm$; $d_c = 51mm$; $K = 0.147$ Nut: $h = 72mm$; $D_1 = 55mm$; $D_2 = 65mm$; $H = 15mm$.	03M.	
	Buckling: $F_{cr} = 157048.4552 N$	02M.	
	Handle: $L_n = 1765mm$; $d_n = 33mm$.	02M.	
	Cup: $D_3 = 72mm$; $D_4 = 144mm$; $H_3 = 60mm$; $t = 10mm$	03M.	
	Efficiency: $\eta = 13.55\%$.		
	Overhauling: Self locking screw.		
	Body: $H = 450mm$, $D_5 = 100mm$; $D_6 = 150mm$. $D_7 = 225mm$; $t_1 = 30mm$; $t_2 = 10mm$.	02M.	

31/01/2023

Signature of Staff

Signature of HOD