



MECHANICAL ENGINEERING GATE-2020

33
YEARS
SOLUTION

MECHANICAL
ENGINEERING

GATE

2020



33
YEARS
SOLUTION

GATE SOLUTIONS MECHANICAL ENGINEERING

1987 - 2019



Office: F-126, (Lower Basement), Katwaria Sarai, New Delhi-110 016

Phone: 011-2652 2064 ■ **Mobile:** 81309 09220, 97118 53908

Email: info.publications@iesmaster.org, info@iesmaster.org

Web: iesmasterpublications.com, iesmaster.org



IES MASTER PUBLICATION

F-126, (Lower Basement), Katwaria Sarai, New Delhi-110016

Phone : 011-26522064, **Mobile** : 8130909220, 9711853908

E-mail : info.publications@iesmaster.org

Web : iesmasterpublications.com

All rights reserved.

Copyright © 2019, by IES MASTER Publication. No part of this booklet may be reproduced, or distributed in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise or stored in a database or retrieval system without the prior permission of IES MASTER Publication, New Delhi. Violates are liable to be legally prosecuted.

Second Edition : 2017

Third Edition : 2018

Fourth Edition : 2019

PREFACE

The Graduate Aptitude Test in Engineering (GATE) is an All-India examination administered and conducted in eight zones across the country by the GATE Committee comprising of Faculty members from IISc, Bangalore and other seven IITs on behalf of the National Coordinating Board, Department of Education, Ministry of Human Resources Development.

The GATE score/rank is used for admissions to Post Graduate Programmes (ME, M.Tech, MS, direct PhD) in institutes like IIT and IISc, etc. with financial assistance offered by the Ministry of Human Resource Development. PSUs too use the GATE scores for recruiting candidates for various prestigious jobs with attractive remuneration.

The door to GATE exam is through previous year question papers. If you are able to solve question papers in access of 10 years, you are sure to clear the GATE exam, and open new vistas of career and learning.

The **Mechanical Engineering GATE 2020** book from IES Master offers detailed topic-wise solutions for the past 33 years question papers. The emphasis is clearly on the understanding of concepts and building upon a holistic picture. So as you finish a topic, for instance, Planer Mechanism, you will find all the previous years' question papers with detailed explanation under that particular topic.

The approach has been to provide explanation in such a way that just by going through the solutions, students will be able to understand the basic concepts and will apply these concepts in solving other questions that might be asked in future exams.

Every care has been taken to bring an error-free book. However, comments, suggestions, and feedback for improvement in the future editions are most welcome.

IES Master Publication
New Delhi

CONTENT

1. Fluid Mechanics	01 – 84
2. Heat Transfer	85 – 155
3. Refrigeration and Air Conditioning	156 – 188
4. Thermodynamics and Applications	189 – 312
5. Engineering Mechanics	313 – 361
6. Theory of Machines	362 – 454
7. Strength of Materials	455 – 552
8. Machine Design	553 – 610
9. Industrial Engineering	611 – 685
10. Production Engineering	686 – 983
11. Engineering Mathematics	984 – 1079
12. General Aptitude	1080 – 1116
13. English.....	1117 – 1125



IES MASTER

Institute for Engineers (IES/GATE/PSUs)

Genius Batch

for **ESE GATE PSUs**

SESSION 2019-20

A Classroom Program for **SMART LEARNERS**

- Uniform and collective progress
- Get the **rub-off** with the **best engineering minds**
- Focus on concepts and problem solving
- **Regular practice tests**
- Classes by highly experienced faculty

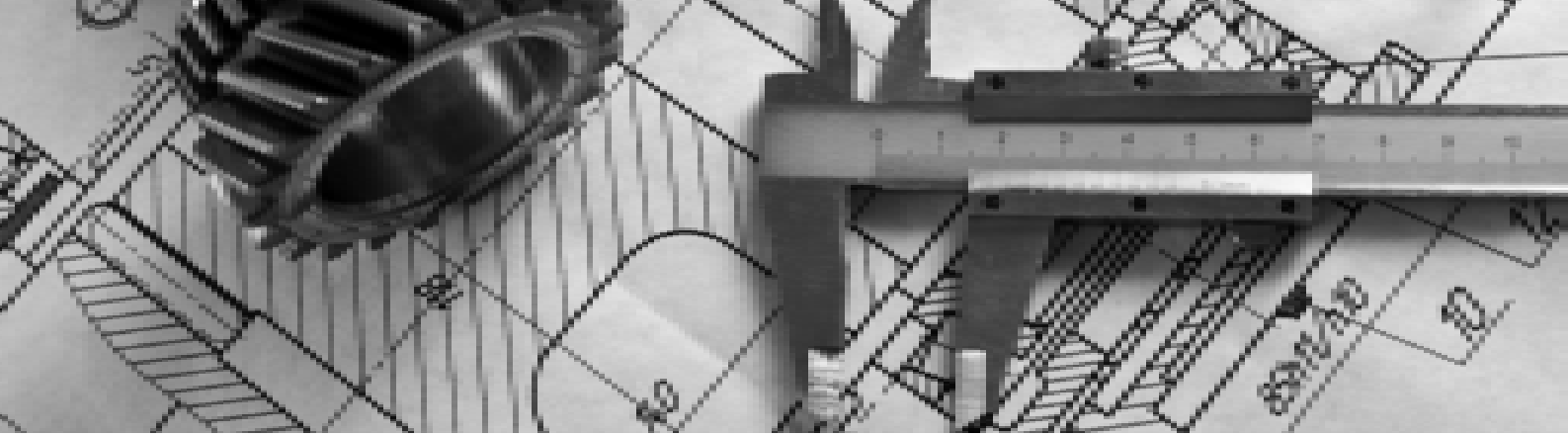
Batches start on

24th May (Morning)

14th June (Evening)

Call **97118 53908, 80100 09955**

APPLY ONLINE



UNIT-1

FLUID MECHANICS

SYLLABUS

Fluid properties, fluid statics, manometry, buoyancy, forces on submerged bodies, stability of floating bodies, control volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation, dimensional analysis, viscous flow of incompressible fluids, boundary layer; elementary turbulent flow; flow through pipes, head losses in pipes, bends and fittings.

Turbomachinery: impulse and reaction principles, velocity diagrams, Pelton wheel, Francis and Kaplan turbines.

CONTENTS

Chapter No.	Topic	Page No.
1.	Fluid Properties	02 – 05
2.	Fluid Statics.....	06 – 14
3.	Fluid Kinematics	15 – 29
4.	Fluid Dynamics	30 – 47
5.	Incompressible Fluids Flow	48 – 61
6.	Boundary Layer and Dimensional Analysis	62 – 71
7.	Turbomachinery.....	72 – 84

1

FLUID PROPERTIES

1- Mark

1. The difference in pressure (in N/m^2) across an air bubble of diameter 0.001 m immersed in water (surface tension = 0.072 N/m) is _____
[GATE 2014]
2. For a Newtonian fluid
(a) Shear stress is proportional to shear strain
(b) Rate of shear stress is proportional to shear strain
(c) Shear stress is proportional to rate of shear strain
(d) Rate of shear stress is proportional to rate of shear strain
[GATE 2006]
3. A static fluid can have
(a) non-zero normal and shear stress
(b) negative normal stress and zero shear stress
(c) positive normal stress and zero shear stress
(d) zero normal stress and non-zero shear stress
[GATE 2001]
4. The SI unit of kinematic viscosity (ν) is
(a) m^2/sec (b) $\text{kg}/(\text{m}\cdot\text{sec})$
(c) m/sec^2 (d) m^3/sec^2
[GATE 2001]
5. Kinematic viscosity of air at 20°C is given to be $1.6 \times 10^{-5} \text{ m}^2/\text{s}$. Its kinematic viscosity at 70°C will be vary approximately
(a) $2.2 \times 10^{-5} \text{ m}^2/\text{s}$ (b) $1.6 \times 10^{-5} \text{ m}^2/\text{s}$
(c) $1.2 \times 10^{-5} \text{ m}^2/\text{s}$ (d) $3.2 \times 10^{-5} \text{ m}^2/\text{s}$
[GATE 1999]
6. If 'p' is the gauge pressure within a spherical droplet, the gauge pressure within a bubble of the same fluid and of same size will be
(a) $\frac{p}{4}$ (b) $\frac{p}{2}$
(c) p (d) 2p
[GATE 1999]
7. Match 4 correct pairs between List-I and List-II.
List-I
(A) Steam nozzle (B) Compressible flow
(C) Surface tension (D) Heat conduction
List-II
(1) Mach Number
(2) Reaction Turbine
(3) Biot Number
(4) Nusselt Number
(5) Super saturation
(6) Weber Number
[GATE 1997]
8. The dimension of surface tension is
(a) ML^{-1} (b) L^2T^{-1}
(c) $\text{ML}^{-1} \text{T}^2$ (d) MT^{-2}
[GATE 1996]
9. A fluid is said to be Newtonian when the shear stress is
(a) directly proportional to the velocity gradient
(b) inversely proportional to the velocity gradient
(c) independent of the velocity gradient
(d) none of the above
[GATE 1995]

ANSWER KEY

:: 1 MARK ::		ANSWER KEY		:: 2 MARKS ::	
1. (288 N/m ²)	4. (a)	8. (d)	1. (1)		
2. (c)	5. (a)	9. (a)	2. (26.4)		
3. (b)	6. (d)				
	7. (a-5, b-1, c-6, d-3)				

EXPLANATIONS

1- Mark

Sol-1:

The pressure difference across an air bubble in water,

$$\Delta P = \frac{4\sigma}{d} = \frac{4 \times 0.072}{0.001}$$

$$= 288 \text{ N/m}^2$$

$$\Delta p = 288 \text{ N/m}^2$$

Sol-2: (c)

A fluid is said to be a Newtonian fluid, if the shear stress is directly proportional to rate of angular deformation or rate of shear strain or velocity gradient,

Sol-3: (b)

A static fluid can never have shear stress and has negative normal stress.

Sol-4: (a)

$$v = \frac{\mu}{\rho}$$

$$\text{unit of } v = \frac{\text{N-s/m}^2}{\text{kg/m}^3} = \frac{\text{kg/m-s}}{\text{kg/m}^3}$$

$$v = \text{m}^2/\text{sec}$$

Sol-5: (a)

$$v_{20^\circ\text{C}} = 1.6 \times 10^{-5} \text{ m}^2/\text{s}$$

Dynamic & kinematic viscosity of air increases with increase in temperature. Kinematic viscosity of air at 70°C is about $2.2 \times 10^{-5} \text{ m}^2/\text{s}$.

Sol-6: (d)

For spherical droplet :

$$\sigma \times \pi d = p \times \frac{\pi}{4} d^2$$

$$\sigma = \frac{pd}{4} \quad \dots\dots\dots(1)$$

For spherical bubble :

$$\sigma \times \pi d \times 2 = p_b \times \frac{\pi}{4} d^2$$

$$\sigma = \frac{p_b d}{8} \quad \dots\dots\dots(2)$$

Equating the surface tensions in equation (1) and (2)

$$\frac{pd}{4} = \frac{p_b d}{8}$$

$$p_b = 2p$$

Sol-7: A-5; B-1; C-6; D-3

Mach Number is related to compressible flow. Weber number is related to surface tension. Supersaturation of steam takes place in steam nozzle due to delay in condensation. Biot number is relevant to heat conduction.

Sol-8: (d)

Surface Tension, σ

$$\sigma \times L = \text{Force}$$

$$\sigma = \frac{\text{Force}}{L} = \frac{\text{MLT}^{-2}}{L}$$

$$\sigma = \text{MT}^{-2}$$



Scan to Download IES Master App



Features

- ✓ Daily updates
- ✓ Timely notifications
- ✓ On the fly bookmark of important notes and questions
- ✓ Practice questions on all topics
- ✓ Study materials - in the form of notes, quizzes, and videos

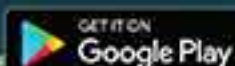
Pocket the Knowledge

As a maverick ESE/GATE platform, we embark upon being your learning partner, in your pursuit of excellence.

True to the likings of engineering students, here, information comes crisp, compact and exact, accompanied by myriad of illustrations that one's eyes can feast upon, and brain to exercise and hone its capabilities. We believe that illustrations speak louder than words; and figurines communicate faster than complex wordy pages.

As your eyeballs roll through the app, concepts on all topics - from Material Science to Currents, right from the ESE and GATE toppers - shall come alive before you.

In the swarm of devices based on touch-based, smart technology, IES Master App literally manifests its belief that a right 'touch' can change one's world.



Also visit @

iesmaster.org | iesmasterpublications.com



Like us on facebook
[/iesmaster01](https://www.facebook.com/iesmaster01)



Follow us on twitter
[/ies_master](https://twitter.com/ies_master)



Watch us on youtube
[/iesmaster01](https://www.youtube.com/iesmaster01)



amazon.com

Flipkart



iesmasterpublications.com



IES MASTER PUBLICATION

F-126 (Lower Basement), Katwaria Sarai, New Delhi-110016

Phone : 011 26522064, Mobile : 97 1185 3908

E-mail : info_publications@iesmaster.org, info@iesmaster.org

Web : iesmasterpublications.com

₹ 850.00

(978 913 0090 11 1)

