FLUIDMECHANICS

Subject Code: **CE305PC**

Regulations:R**22-**JNTUH

Class :IIYearB.TechCEISemester

Departmentof CivilEngineering

BHARATINSTITUTEOFENGINEERINGANDTECHNOLOGY

Ibrahimpatnam-501510,Hyderabad

FLUIDMECHANICS-I(CE305PC)
COURSEPLANNER

I. COURSEOVERVIEW:

Theaimofthiscourseistointroducebasicprinciplesoffluidmechanicsanditisfurtherextendedtocovertheapplicationoffluidmechanicsbytheinclusionoffluidmachinery.Nowadaystheprinciplesoffluidmechanicsfindwideapplicationsinmanysituations.Thecoursedealswiththefluidmachinery,liketurbines,pumpsingeneralandinpowerstations.Thiscoursealsodealswiththelargevarietyoffluids suchasair, water, steam, etc; however the major emphasis is given forthe studyofwater.

II. PREREQUISITE(S):

Leve	Credi	Period	Prerequisite
UG	3	4	EngineeringPhysics,Thermodynamics,Engineering

III. COURSEOBJECTIVES:

Theobjectivesofthecoursearetoenablethestudent;

I. Tounderstandthebasicprinciplesoffluidmechanics
II. Toidentifyvarioustypesofflows
III. To understandboundarylayerconceptsandflowthroughpipes
IV. To evaluatetheperformanceofhydraulicturbines
V. Tounderstandthefunctioningandcharacteristiccurvesofpumps.

IV. COURSEOUTCOMES:

At theend ofthiscourse,a studentwillbeableto:

1. Explaintheeffectoffluidpropertiesonaflowsystem.
2. Identifytypeoffluidflowpatternsanddescribecontinuityequation.
3. Analyzeavarietyofpracticalfluid flowand measuringdevicesandutilize fluid mechanics principles in design.
4. Demonstrateboundarylayerconcepts.
5. Explainthe concept ofprandtlcontribution.
6. EvaluatetheVonkarmenmomentumintegralequation.
7. AnalyzetheclosedconduitflowsusingRenold'sexperiment.
8. Analyzethe lawsoffluidfrictionusingDarcy'sequation.
9. Evaluatethehead lossesinpipes.
10. Solvepipenetworkproblems.

V. HOWPROGRAMOUTCOMESARE ASSESSED:

Programoutcomes		Level	Proficiency assessedby
PO1	**General knowledge:** An ability to apply the knowledge of mathematics,scienceandEngineeringforsolvingmultifaceted issuesofElectricalEngineering	S	Assignments

PO2	**ProblemAnalysis:** Anabilitytocommunicateeffectivelyand toprepareformaltechnicalplansleadingtosolutionsand detailed reports for electrical systems	N	Exercise
PO3	**Design/Development of solutions:** To develop Broad theoreticalknowledgeinElectricalEngineeringandlearnthe methodsofapplyingthemtoidentify, formulateandsolve practical problems involving electrical power	H	Assignments ,Discussion
PO4	**Conductinvestigationsofcomplexproblems**: Anabilityto apply the techniques of using appropriate technologies to investigate,analyze,design,simulateand/or fabricate/	H	Exercise
	commissioncompletesystemsinvolvinggeneration, transmissionanddistributionofelectricalenergy		
PO5	**Modern tool usage:** An ability to model real life problems using different hardware and software platforms, both offline andreal-timewiththe helpofvarioustoolsalongwithupgraded versions.	N	------
PO6	**Theengineerandsociety**: AnAbilitytodesignandfabricate modules,controlsystemsandrelevantprocessestomeetdesired performance needs, within realistic constraints for social needs	S	Exercise
PO7	**Environment and sustainability:** AnabilityTo estimate the feasibility,applicability,optimalityandfuturescopeofpower networks and apparatus for design of eco-friendly with sustainability	S	Discussion, Seminars
PO8	**Ethics:** To Possess an appreciation of professional, societal, environmentalandethicalissuesandproperuseofrenewable resources	N	Discussion, Seminars
PO9	**Individualand team work:** An Abilityto designschemes involvingsignalsensingandprocessingleadingtodecision making for real time electrical engineering systems and processesatindividualandteamlevels	S	Discussions
PO10	**Communication:** anAbilityto workinateamand comprehend his/her scope of work, deliverables , issues and be able to communicate both in verbal ,written for effective technical presentation	S	Discussion, Seminars
PO11	**Life-long learning**: An ability to align with and upgrade to higher learningandresearchactivitiesalongwithengagingin life-longlearning.	N	-----
PO12	**Projectmanagementandfinance**:Tobe familiarwithproject managementproblemsandbasicfinancialprinciplesforamulti-disciplinary work	S	Prototype, Discussions

VI. HOWPROGRAMSPECIFICOUTCOMESAREASSESSED:

Programoutcomes	**Level**	**Proficiency assessed by**

PSO1	**ProfessionalSkills:** Anabilityto understandthebasicconcepts in Electronics & Communication Engineering and to apply them to various areas, like Electronics, Communications, Signalprocessing,VLSI,Embeddedsystemsetc.,inthedesign and implementation of complex systems.	H	Lectures and Assignm ents
PSO2	**Problem-solving skills:** An ability to solve complex Electronics and communication Engineering problems, using latesthardwareandsoftwaretools,alongwithanalyticalskills toarrivecosteffectiveandappropriate solutions.	S	Tutorials
PSO3	**SuccessfulcareerandEntrepreneurship:**Anunderstanding	S	Seminars

	of social-awareness & environmental-wisdom along with ethicalresponsibilityto haveasuccessfulcareerandto sustain passion and zeal for real-world applications using optimal resourcesasanEntrepreneur.		and Projects

N-None **S-Supportive** **H–HighlyRelated**

VII. SYLLABUS:

JNTUHSYLLABUS

UNIT– I:INTRODUCTION

Dimensions and units – physical properties of fluids specific gravity, viscosity, surface tension, vapor pressure and their influences on fluid motion pressure at a point, Pascal's law, Hydrostatic law – atmospheric, gauge and vacuum pressure measurement of pressure. Pressure gauges, Manometers: differential and Micro Manometers.

Hydrostatic forces on submerged plane, horizontal, vertical, inclined and curved surfaces – Center of pressure, Derivations and problems.

UNITII:FLUIDKINEMATICS

Descriptionoffluid flow, streamline, path line, streak lines and streamtube. Classificationof flows: Steady, unsteady, uniform, non-uniform, laminar, turbulent, rotational and irrotational flows – Equation of continuity for one, two, three dimensional flows – stream and velocity potential functions, flow net analysis.

UNIT–III:FLUIDDYNAMICS

Surface and body forces – Euler's and Bernoulli's equations forflow along a stream line for 3-D flow, (Navier stokes equations (Explanationary) Momentum equation and its application – forces on pipe bend. Pitot tube, Venturi meter and orifice meter – classification of orifices, flow over rectangular, triangular and trapezoidal and stepped notches – Broad crested weirs

UNIT –IV: BOUNDARY LAYER THEORY

Approximate solutions of Navier stokes equations – Boundary layer – concepts, Prandtl contribution, characteristics of boundary layer along a thin flat plate, vonkarmen momentum integral equation, laminar and turbulent boundary layers(no deviation), BL in transition, separation of BL, control of BL, flow around submerged objects – Drag and Lift – Magnus effect.

UNIT– V: CLOSEDCONDUITFLOW

Reynolds'sexperiment –characteristicsofLaminar&Turbulent flows.Flowbetweenparallel plates, flow through long tube, flow through inclined tubes.

Laws of fluid friction – Darcy's equation, Minor losses – pipes in series – pipes in parallel – Total energy line and hydraulic gradient line. Pipe network problems, variation of friction factor with Reynolds number – Moody's chart.

SUGGESTEDBOOKS:

TEXTBOOKS:

1. FluidMechanicsbyModiand Seth,Standard Book House
2. AtextbookofFluid Mechanicsand Hydraulic MachinesbyDr.R.K.Bansal
3. Introduction to Fluid Machines by S.K. Som & G. Biswas (Tata McGraw-Hill Publishers Pvt. Ltd.)

4. Introduction to Fluid Machines by Edward J. Shaughnessy, Jr, Ira M. Katz and James P.Schaffer, Oxford University Press, New Delhi.

REFERENCEBOOKS:

1. FluidMechanicsbyJ.F. Douglas, J.M.GaserekandJ.A. Swaffirld
2. FluidMechanicsbyFrank.M.White(TataMcGraw-HillPvt.ltd)
3. FluidMechanicsbyA.K.Mohanty.
4. FluidMechanicsandMachinerybyD.Ramdurgaia

NPTELWEBCOURSE:

http://nptel.ac.in/courses/112104118/

NPTELVIDEOCOURSE:

http://nptel.ac.in/courses/112104118/#

GATE SYLLABUS:

Properties offluids, principle ofconservation ofmass, momentum, energyand corresponding equations, potential flow, applications of momentum and Bernoulli's equation, laminar and turbulent flow, flow in pipes, pipe networks. Concept of boundary layer and its growth. Uniform flow, critical flow and gradually varied flow in channels, specific energy concept, hydraulic jump. Forcesonimmersed bodies, flow measurementsinchannels, tanksand pipes. Dimensional analysis and hydraulic modeling. Kinematics of flow, velocity triangles and specific speed of pumps and turbines

IESSYLLABUS:

FLUIDMECHANICS, OPENCHANNELFLOW, PIPEFLOW:

FluidProperties,Pressure,Thrust,Buoyancy; FlowKinematics;Integrationofflowequations; Flow measurement; Relative motion; Moment of momentum; Viscosity, Boundary layer and Control, Drag, Lift; dimensional Analysis, Modeling; Cavitations; Flow oscillations; Momentum and Energy principles in Open channel flow, Flow controls, Hydraulic jump, Flowsectionsandproperties;Normalflow,Graduallyvaried flow;Surges;Flowdevelopment and losses in pipe flows, Measurements; Siphons; Surges and Water hammer; Delivery of Power Pipe networks

VIII. COURSEPLAN:

Lecture No.	Week	Unit	Topicstobecovered	Learning Objective	References
1.	1	1	**UNIT-I** Introduction,dimensionsand units	Outlineofvarious units	R4, T2
2.	1	1	Physical properties of fluids-specificgravity,viscosity,Surface tension, vapour pressure and their influenceonfluid motion	Explainfluid properties	R4, T1
3.	1	1	Physical properties of fluids-specificgravity,viscosity,Surface tension, vapour pressure and their influenceonfluid motion	Explainfluid properties	R4
4.	1	1	Physical properties of fluids-specificgravity,viscosity,Surface tension, vapour pressure and their influenceonfluid motion	Explainfluid properties	R4

5.	2	1	Physical properties of fluids-specificgravity,viscosity,Surface tension, vapour pressure and their influenceonfluid motion	Explainfluid properties	R4
6.	2	1	Atmospheric,gaugeand vacuum pressures	Distinguishvarious pressures	R4
7.	2	1	Measurementofpressure-piezometer,U-tubeanddifferential manometers	Determinepressure withdifferent instruments	R4, T1,T2
8.	2	1	Measurement of pressure-piezometer,U-tubeanddifferential manometers	Determinepressure with different instruments	R4, T1,T2
9.	3	1	Measurementofpressure-piezometer,U-tubeanddifferential manometers	Determinepressure withdifferent instruments	R4, T1,T2
10.	3	1	Measurement of pressure-piezometer,U-tubeanddifferential manometers	Determinepressure with different instruments	R4, T1,T2
11.	3	2	Unit-II:FluidKinematics:Stream line, path line, streak line and streamtube	Differentiatevarious flow lines	R4, T2
12.	3	2	FluidKinematics:Streamline,path line, streaklineandstreamtube	Differentiatevarious flowlines	R4, T2
13.	4	2	Classificationofflows-steadyand unsteady, uniform and non uniform, laminar and turbulent, rotationalandirrotationalflows	Classifyanddescribe various flows	R4, T1,T2
14.	4	2	Classificationofflows-steadyand unsteady, uniform and non uniform, laminar and turbulent, rotationalandirrotationalflows	Classifyanddescribe various flows	R4, T1,T2
15.	4	2	Equationofcontinuityforone dimensionalflowandthree dimensional flows	Formulatecontinuity equationfor1and3- d flow	R4, T1
16.	4	2	Equationofcontinuityforone dimensional flow and three dimensionalflows	Formulatecontinuity equationfor 1and3-dflow	R4, T1
17.	5	3	UNIT-III-Fluiddynamics:Surface andbodyforces	Listvarious forces	R4
18.	5	3	Euler’sandBernoulli’sequations for flow along a stream line	FormulateEuler’s and Bernoulli’s equations	R4, T2
19.	5	3	Euler’sandBernoulli’sequations for flow along a stream line	FormulateEuler’s andBernoulli’s equations	R4, T2

20.	5	3	Euler'sandBernoulli'sequations for flow along a stream line	FormulateEuler's and Bernoulli's equations	R4, T2
21.	6	3	Momentum equation and its applicationonforceonpipebend	Applymomentum equationforapipe bend	R4, T2
22.	6	3	Momentum equation and its applicationonforceonpipebend	Apply momentum equationforapipe bend	R4, T2
23.	6	3	BOUNDARYLAYER CONCEPTS:Definition,thickness, characteristics along thin plate	Defineboundary layer	R4, T2
24.	6	3	Laminarandturbulent boundary layers(Noderivation),boundary layer in transition	Distinguishboundary layer of laminar, turbulent and transition	R4, T2
25.	7	3	Laminarandturbulent boundary layers(Noderivation),boundary layer in transition	Distinguishboundary layer of laminar, turbulentand transition	R4, T2
26.	7	3	Separationofboundarylayer, submergedobjects- dragandlift	Explainseparationof boundarylayer	R4, T1
27.	7	3	Separationofboundarylayer, submergedobjects- dragandlift	Explainseparationof boundarylayer	R4, T1
28.	7	3	Closedconduitflow:Reynolds's experiment	Demonstrate Reynold's experiment	R4
29.	8	3	DarcyWeisbachequation-minor lossesinpipes	Formulatethe Darcy'sequation	T2
30.	8	3	DarcyWeisbachequation-minor lossesinpipes	Formulatethe Darcy'sequation	T2
31.	8	3	Pipesinseriesandpipesinparallel	Discusstheseries and parallel connectionsofpipes	R4, T1
32.	8	3	Pipesinseriesandpipesinparallel	Discussthe series and parallel connectionsofpipes	R4, T1
33.	9	3	Totalenergyline-hydraulic gradient line	Construct total energyandhydraulic gradient lines	R4, T1,T2
34.	9	3	Totalenergyline-hydraulic gradient line	Construct total energyandhydraulic gradientlines	R4, T1,T2
35.	9	3	Totalenergyline-hydraulic gradient line	Construct total energyandhydraulic gradient lines	R4, T1,T2

36.	9	3	Measurementofflow:Pitottube, venturemeter,andorifice meter, flownozzle	Measurethe discharge	R4, T2
37.	10	3	Measurementofflow:Pitottube, venturemeter,andorificemeter, flow nozzle	Measurethe discharge	R4, T2
38.	10	3	Measurementofflow:Pitottube, venturemeter,andorifice meter, flownozzle	Measurethe discharge	R4, T2
39.	10	3	Measurementofflow:Pitottube, venturemeter,andorificemeter, flow nozzle	Measurethe discharge	R4, T2
40.	10	4	UNIT – IV: Basics of Turbo machinery:Hydrodynamicforceof jets on stationary and moving flat, inclinedvanes	Discusstheeffectof hydrodynamicforce on flat vanes	R4, T1
41.	11	4	Basics of Turbo machinery: Hydrodynamic force of jets on stationaryandmovingflat,inclined vanes	Discusstheeffectof hydrodynamicforce on flat vanes	R4, T1
42.	11	4	Curvedvanes,jetstrikingcentrally andattip,velocitydiagrams,work done and efficiency, flow over radialvanes	Draw the velocity trianglesforCurved vanes	R4, T1,T2
43.	11	4	HydraulicTurbines:classification ofturbines,headsandefficiencies, impulse and reaction turbines	Classifytheturbines	R4, T1,T2
44.	11	4	Peltonwheel,Francisturbineand Kaplan turbine-working proportions, work done, efficiencies	Evaluate the performanceof turbines	R4, T1,T2
45.	12	4	Peltonwheel,Francisturbineand Kaplan turbine-working proportions, work done, efficiencies	Evaluate the performanceof turbines	R4, T1,T2
46.	12	4	Hydraulicdesign-drafttubetheory – functions and efficiency	Describe the functionsofdraft tube	R4, T2
47.	12	4	Hydraulicdesign-drafttubetheory – functions and efficiency	Describethe functionsofdraft tube	R4, T2
48.	12	4	Hydraulicdesign-drafttube theory –functionsand efficiency	Describethe functionsofdraft	R4
				tube	

49.	1 3	4	Hydraulicdesign-drafttubetheory – functions and efficiency	Describe the functionsofdraft tube	R4
50.	1 3	4	Performanceofhydraulicturbines: Geometric similarity, unit and specific quantities, characteristic curves	Defineunitquantities and Draw characteristic curves	R4
51.	1 3	4	Performanceofhydraulicturbines: Geometric similarity, unit and specific quantities, characteristic curves	Defineunitquantities and Draw characteristic curves	R4
52.	1 3	4	Performanceofhydraulicturbines: Geometric similarity, unit and specific quantities, characteristic curves	Defineunitquantities and Draw characteristic curves	R4
53.	1 4	4	Governingofturbines, selectionof type ofturbine	Illustratethe governing ofturbines	R4, T2
54.	1 4	4	Cavitation,surgetank,water hammer	ExplainCavitation, waterhammer,surge tank	R4, T2
55.	1 4	5	UNIT-V:Centrifugal pumps: Classification, working, work done-barometricheadlossesand efficiencies	ClassifyandExplain the working of centrifugal pump	R4, T2
56.	1 4	5	Classification,working,work done-barometricheadlossesand efficiencies	ClassifyandExplain the working of centrifugalpump	R4, T2
57.	1 5	5	Classification, working, work done-barometricheadlossesand efficiencies	ClassifyandExplain the working of centrifugalpump	R4, T2
58.	1 5	5	Classification,working,work done-barometricheadlossesand efficiencies	ClassifyandExplain the working of centrifugalpump	R4, T2
59.	1 5	5	Specificspeed–performance characteristic curves, NPSH.	Compare the characteristiccurves ofcentrifugalpump	R4, T1,T2
60.	1 5	5	Specificspeed–performance characteristic curves, NPSH.	Comparethe characteristiccurves of centrifugal pump	R4, T1,T2
61.	1 6	5	Reciprocating pumps: working, discharge,slip,indicatordiagrams	Describe and Evaluate the performance of reciprocatingpumps	R4, T1,T2
62.	1 6	5	Reciprocatingpumps:working, discharge,slip,indicatordiagrams	Describeand Evaluatethe	R4, T1,T2

				performanceof reciprocatingpumps	
63.	1 6	5	Reciprocating pumps: working, discharge,slip,indicatordiagrams	Describe and Evaluate the performanceof reciprocatingpumps	R4, T1,T2
64.	1 6	5	Reciprocating pumps: working, discharge,slip,indicatordiagrams	Describe and Evaluate the performanceof reciprocatingpumps	R4, T1,T2

IX. MAPPINGCOURSEOUTCOMESLEADINGTOTHEACHIEVEMENTOFPROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Objectives	ProgramOutcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I					H						S				
II					H										
III		H			H										H
IV	H	H	S											H	H
V			S		H										

N=None **S=Supportive** **H=Highlyrelated**

X. QUESTIONBANK:(JNTUH)
DESCRIPTIVEQUESTIONS:(WITHBLOOMSPHRASES)
UNIT-I
SHORTANSWERQUESTIONS-

S.NO	Question	Blooms TaxonomyLevel	Programme Out come
1	Definedensity,weightdensity.	Understanding	1
2	Definespecificvolume	Understanding	1
3	DefineNewton's lawsofviscosity.	Understanding	1
4	Definesurfacetension.	Understanding	1
5	Definecompressibility.	Understanding	1
6	Define viscosity.	Understanding	1
7	Definevapour pressure.	Understanding	1

8	Defineatmosphericgaugeandvacuum pressure.	Understanding &remembering	1
9	Definecompressibleandincompressible fluid.	Understanding	1
10	Defineandclassifythemanometers.	Understanding	1
11	Definespecificgravity.	Understanding	1
12	DefineMonometer	Understanding	1
13	DefineCohesion	Understanding	1
14	Defineadhesion	Understanding	1
15	HowareFluids Classified?	Understanding	2
16	WhataretheunitsofSurfacetension?	Understanding	2

LONG ANSWER QUESTIONS-

S. No	**Question**	**Blooms Taxonomy Level**	**Programme Out come**
1	State Newton's law viscosity and explain how viscosityvarieswithtemperatureforliquidsandgases	Understanding &remembering	9
2	Deriveanexpression for surfacetensiononaliquid jet.	Analyze	9
3	Deriveanexpression forsurfacetensiononaliquid droplet.	Analyze	9
4	Howdoyoumeasurethepressurebyusing manometersandmechanicalgauges?	Analyze& Apply	9
5	Prove that volumetric strain of a cylindrical rod which issubjectedto anaxialtensile load isequaltothestrain inthelengthminustwicethestrainifdiameter.	Analyze& Apply	9
6	Whydoesthe viscosityofa gasincreaseswiththe increasesintemperaturewhilethatofaliquid decreases with increase in temperature?	Analyze& Apply	9
7	Calculatedensity, specificweightandweightof1 liter ofpetrolofspecificgravity0.7	Analyze& Apply	9
8	StateNewton'slawviscosityandexplainhow viscosityvarieswithtemperatureforliquidsand gases	Analyze& Apply	9
9	Explainthephenomenonofcapillarity.Obtainan expression forcapillarityrise ofa fluid.	Analyze& Apply	9
10	Developtheexpressionfortherelationbetweengauge pressurePinsideadropletofliquidandthesurface tension.	Analyze& Apply	9

UNIT-2

SHORTANSWERQUESTIONS-

S. N	Question	Blooms TaxonomyLevel	Programme Out come
1	Definepath line,streamline,streamtubeand streakline.	Understanding	9
2	Definesteadyandunsteadyflows.	Understanding	9
3	Definerotationalandir-rotational flows.	Understanding& remembering	9
4	Defineuniformandnonuniformflows.	Understanding& remembering	9
5	Define andstatethe applicationsofmomentum equation.	Understanding& remembering	9
6	Definelaminarandturbulent flows.	Understanding& remembering	9
7	Definecompressibleandincompressible flows.	Understanding& remembering	9
8	Definethe equationofcontinuity.	Understanding& remembering	9
9	Definethetermsvelocitypotentialandstream functions.	Understanding& remembering	9
10	Definethetermsvertex,free vortexflows and forcedvortexflows.	Understanding& remembering	9
11	Mentiononedifferencebetweenstreamlineand pathline	Understanding	9
12	Whatarestreaklines?	Understanding	9
13	Whatisonedimensionalflowwithexample?	Understanding	9

LONG ANSWER QUESTIONS-

S. No	Question	Blooms TaxonomyLevel	Programme Out come
1	Sketchtheflow patternofan idealfluid pasta cylinderwithcirculation.	Understanding	12
2	Derive the condition for ir-rotational flow. Provethatforpotentialflow,boththestream functionandvelocitypotentialfunctionmust satisfyLaplaceequation.	Understanding	12
3	Deriveanexpressionfortotalpressure ona planesurfacesubmergedinaliquidofspecific weight with an inclination an angle θ.	Understanding	12
4	Obtainanexpression for continuityequation for a3-DFlow.	Analyze&Apply	12
5	Bringoutthemathematicalandphysical	Analyze&Apply	12

	distinctionbetweenrotationalandir-rotational flows.		
6	Describetheuseandlimitationsofflownets	Analyze&Apply	12
7	Obtainanexpression for continuityequation for a1-DFlow	Analyze&Apply	12
8	Derivepathline,streamline,andstreakline.	Analyze&Apply	12
9	Stateteproperties ofstreamfunctionand proveeachoneofthem.	Analyze&Apply	12
10	Whatisastreamtubeandexplainareits characteristics.	Analyze&Apply	12
11	Drawthe flowpatternofanon-idealfluidpast a cylinder with rotation.	Analyze&Apply	12

UNIT-3

SHORTANSWERQUESTIONS-

S. No	Question	Blooms Taxonomy Level	Program me Out come
1	Namethedifferentforcespresentinafluid flow.	understanding	10
2	WhatisEuler'sequationofmotion.	understanding	10
3	Whatisventurimeter.	understanding	10
4	Defineanorificemeter.	understanding	10
5	Whatisapitottube.	Understanding	10
6	Define momentofmomentumequation.	understanding	10
7	DefinecontinuityandBernoulli'sequation.	Remembering	10
8	Whatisafreejetofaliquid.	Understanding &evaluate	10
9	Whatarethedifferentformsofenergyina flowing fliud.	Understanding &evaluate	2
10	Explaindifferent typesofpitot tubes.	Understanding	2
11	GiveEnergyEquationofanidealFlowalong a Streamline	Understanding &Evaluate	2

LONG ANSWER QUESTIONS-

S. No	Question	Blooms TaxonomyLevel	Progra mme Out come
1	Deriveanexpressionfordisplacement thicknessduetoformationofboundary layer	Understanding	9
2	How do you distinguish sharp crested weir from a broad crested weir? Derive the expressionfordischargeoverasharpcrested rectangularweir?	Analyze&Apply	9
3	FortheEuler'sequationofmotionwhichforces	Analyze&Apply	9

	aretakenintoconsideration.		
4	WhatisEuler'sequation?Howwillyouobtain Bernoulli'sequationfrom it.	Analyze&Apply	9
5	Discusstherelativemeritsanddemeritsof venturimeterwithrespecttoorificemeter.	Analyze&Apply	9
6	Whatisthedifferencebetweenthepitottube andpitot statictube.	Analyze&Apply	9
7	Whatisthedifferencebetweenthemomentum equationandimpulsemomentumequation.	Analyze&Apply	9
8	Derive Euler's equation of motion along a streamlineforanidealfluidandclearlythe assumptions.	Analyze&Apply	9
9	Whyisdivergencemoregradualthan convergence in a venturimeter.	Analyze&Apply	9
10	Explain the principle of venturimeter with a neat sketch.derivetheexpressionrateofflowof fluidthrough it.	Analyze&Apply	9

UNIT-4
SHORTANSWERQUESTIONS-

S. No	Question	Blooms Taxonomy Level	Programme Out come
1	Whatdoyouunderstandbythetermsboundary layertheory.	understanding	l
2	Whatismeantbyboundarylayer.	understanding	l
3	Whatdoyoumeanbyboundarylayer separation.	remembering	l
4	Definedisplacementthickness.	remembering	l
5	Whatarethedifferentmethodsofpreventing theseparating ofboundarylayers.	understanding	l
6	Whatistheeffectofpressuregradienton boundarylayerseparation.	remembering	l
7	Definelaminarboundarylayerandturbulent boundarylayer.	understanding	l
8	Define laminarsublayerand boundarylayer thickness.	Understanding &remembering	l
9	Define lift.	Understanding &remembering	l
10	Definemagnuseffect.	Understanding	l

LONG ANSWER QUESTIONS-

S.	Question	Blooms	Programme

No		Taxonomy Level	Outcome
1	Deriveanexpressionfordisplacement thicknessduetoformationofboundarylayer.	Analyze& Apply	10
2	Explainwithsketchesthethreemethodsof boundarylayercontrol.	Analyze& Apply	10
3	Deriveanexpressionfor momentumthickness ofboundarylayer.	Analyze& Apply	10
4	Explainmagnuseffectandtheoryofliftfor airfoils.	Analyze& Apply	10
5	Derivetheexpressionfortheenergyand momentum correction factor	Analyze& Apply	10
6	Whataretheboundaryconditionsthatmustbe satisfiedbyagivenvelocityprofileinlaminar boundary layer flows.	Understandin g	10
7	ObtainVonkarman momentumintegral equation.	Understandin g	10
8	Explain boundary layer separation? Mention fewmethodstopreventordelaytheseparation ofboundarylayer?	Evaluate	10
9	DerivePrandtl'sboundarylayer equation.	Evaluate	10
10	Derive expressions for boundary layer thickness,boundaryshearstressandfriction draginaturbulentboundarylayer	Analyze& Apply	10

UNIT-5
SHORTANSWERQUESTIONS-

S. No	Question	Blooms TaxonomyLevel	Programme Out come
1	DefineReynold'sexperiment.	Understanding	6
2	Whatarethecharacteristicsoflaminarflows.	Remembering	6
3	Whatarethecharacteristicsofturbulentflows.	Remembering& Understanding	6
4	Whatisthe flowbetweenparallellines.	Remembering& Understanding	6
5	Whatarethelawsoffluidfriction.	Understanding	6
6	DefineDarcy'sequation.	Understanding	6
7	What areminorlossesinpipesinseries.	Understanding& remembering	6
8	What areminorlossesinpipesinparallel.	Understanding	6
9	Whatisenergyline.	Remembering& Understanding	6

10	Whatishydraulicgradient line.	Understanding	6

LONG ANSWER QUESTIONS-

S. No	Question	Blooms TaxonomyLevel	Progra mme Out come
1	Obtaintheconditionformaximumefficiencyin transmissionofpowerthrough pipeline	Analyze&Apply	15
2	Deriveformulasforhydraulicgradient and total energy lines	Analyze&Apply	15
3	Derivetheequationforheadloss inpipesdue tofrictionDarcy-Weisbachequation.	Analyze&Apply	15
4	Whataretheminorlossesinpipes?Givethe appropriateformulaetocalculatethelosses.	Analyze&Apply	15
5	Whatdoyouunderstandbyturbulentflow? Whatfactordecidesthetypeofflowinpipes?	Apply	15
6	Deriveanexpression forthelossofhead dueto frictioninpipes.	Analyze&	15
7	DeriveDarcy-Weisbachequation.	Analyze&Apply	15
8	Whatisthevelocitydefect?Derivean expressionforvelocitydefectinpipes?	Analyze&Apply	15
9	Whyarethepipesconnectedinparallel.	Analyze&Apply	15
10	Explainwhat doyouunderstandbyhydraulic grade line and total energy line. Discuss its practicalsignificanceinanalysisoffluidflow problems.	Analyze&Apply	15

XI. OBJECTIVEQUESTIONS:JNTUH

UNIT-1

1. TheSIunitofkinematic viscosity(u)is:
   (a) m^2/s(b) kg/m-s(c)m/s^2(d)m^3/s^2
2. Kinematic viscosityofair at 20°C is givento be 1.6 × 10-5m2/s. Itskinematic viscosityat 70°C will be vary approximately
   (a)2.210-5m^2/s(b)1.610-5m^2/s (c)1.210-5m^2/s (d)3.210-5m^2/s
3. ForaNewtonianfluid
   (a) Shearstressisproportionaltoshear strain
   (b) Rateofshearstressisproportionalto shearstrain
   (c) Shear stressisproportionalto rateofshearstrain
   (d) Rateofshearstressisproportionaltorateofshearstrain

4. Thedimensionofsurfacetensionis:
   (a)ML-^{1}(b) L^2T-^{1}(c)$ML^{-1}T^1$(d)MT^{-2}
5. Thedimensionsofsurfacetension is:
   (a)N/m^2 (b)J/m (c)J/m^2(d)W/m

6. Assertion(A):Inafluid,therateofdeformationisfarmoreimportantthanthetotal deformation itself.

   Reason(R):Afluidcontinuestodeformsolongastheexternalforcesareapplied.

   (a) BothAandRareindividuallytrueandRisthecorrectexplanationofA

   (b) BothAandRareindividuallytruebutRisnotthecorrectexplanationofA

   (c) AistruebutRisfalse (d)AisfalsebutRistrue

7. Newton's law ofviscositydependsuponthe

   (a) Stressandstraininafluid (b)Shearstress,pressureandvelocity

   (c)Shearstressandrateofstrain (d)Viscosityandshearstress

8. The shear stress developed in lubricating oil, of viscosity 9.81 poise, filled between twoparallel plates 1 cm apart and moving with relative velocityof 2 m/s is:

   (a)20N/m^2 (b)196.2N/m^2 (c) 29.62N/m^2 (d)40N/m^2

9. Anoilofspecificgravity0.9hasviscosityof0.28Strokesat380^{O}C.Whatwillbeits viscosity in Ns/m^2?

   (a)0.2520 (b)0.0311 (c)0.0252 (d) 0.0206

UNIT-2

1. Inatwo-dimensionalvelocityfieldwithvelocitiesuandvalongthexandydirections respectively, the convective acceleration along the x-direction is given by ____________________.
2. Theradial velocityv, atanyradiusr, whenthegap width is h,is______________.
3. The radialcomponent ofthefluid accelerationatr= Ris_____________.
4. Forafluidelementinatwodimensionalflowfield(x-yplane),ifitwillundergo

   (a) Translationonly (b)Translationandrotation

   (c)Translationanddeformation(d)Deformationonly

5. Forafluidelementinatwodimensionalflowfield(x-yplane),ifitwillundergo

   (a) Translationonly (b)Translationandrotation

   (c)Translationanddeformation (d)Deformationonly

6. A two-dimensional flow fieldhas velocities along the x andy directions given by u = x2t and v = – 2xyt respectively, where t is time.The equation of streamlines is ______________.
7. Inadiabaticflowwithfriction, thestagnationtemperaturealongastreamline

   (a)Increases (b)Decreases (c)Remainsconstant (d)None

8. Streamlines,pathlinesandstreaklinesarevirtuallyidenticalfor

   (a) Uniformflow (b)Flowofidealfluids

   (c) Steadyflow (d)Nonuniformflow

9. Circulationisdefinedaslineintegraloftangentialcomponentofvelocityabouta

   (a) Closedcontour(path)inafluidflow (b)Opencontour(path)inafluidflow

   (c) Closedoropencontour(path) inafluidflow(d)None

10. Existenceofvelocitypotentialimpliesthat

    (a) Fluid isincontinuum(b)Fluidisirrotational

    (c)Fluidisideal (d)Fluidiscompressible

UNIT-3

1. Bernoulli'sequationcanbeappliedbetweenanytwopointsonastreamlinefora rotational flowfield

   (a)True (b)False (c)Insufficient data (d)Can'tsay

2. NavierStoke'sequationrepresentstheconservationof

   (a)Energy (b)Mass (c)Pressure (d) Momentum

3. Inaventurimeter,theangleofthedivergingsectionismorethanthatofconverging section.
(a)True (b)False (c)Insufficient data (d)Can'tsay
4. A venturimeter of 20 mmthroat diameter is used to measure the velocity of water in a-horizontalpipeof40 mmdiameter.Ifthepressuredifference betweenthepipeandthroat sections is found to be 30 kPa then, neglecting frictional losses, the flow velocity is:
(a)0.2m/s (b)1.0m/s (c)1.4m/s (d)2.0m/s
5. Two balls of mass m and 2 m are projected with identical velocities from the same point making angles 30°and 60°withthe verticalaxis, respectively. The heights attained bythe balls will be identical.
(a)True(b)False (c)None(d)Can'tsay
6. Whichcombinationofthe followingstatementsabout steadyincompressible forced vortex flow is correct?
P:Shearstressiszero atallpoints inthe flow.Q:Vorticityis zero atallpointsinthe flow R: Velocity is directly proportional to the radius from the centre of the vortex.
S:Totalmechanicalenergyperunitmassisconstantintheentireflowfield.
(a)PandQ(b)RandS(c) PandR (d)P andS
7. A closed cylinder having a radius R and height H is filled with oil of density ρ. If the cylinder is rotated about its axis at an angular velocity of ω , then thrust at the bottom of the cylinder is __________.
8. Bernoulli'sequationrepresentsthe
(a) Forcesatanypoint inthe flow fieldand isobtainedbyintegratingthe momentum equation for viscous flows.
(b) Energiesat anypoint intheflowfieldandisobtainedbyintegratingtheEuler equations.
(c) Momentumatanypointintheflowfieldandisobtainedbyintegratingthem equation of continuity.
(d) Moment ofmomentumandisobtainedbyintegratingtheenergyequation.
9. Considerthefollowingassumptions:
A.The fluid iscompressible.B.Thefluid isinviscid.
C.Thefluidisincompressibleandhomogeneous.
D.Thefluidisviscousand compressible.
TheEuler'sequationofmotionrequiresassumptions indicatedin:
(a)1and 2 (b)2and 3 (c)1 and4(d)3and4
10. HowisthevelocitycoefficientC_v,thedischargecoefficientC_d,andthecontraction coefficient Cc of an orifice related?
(a)$C_v=C_cC_d$ (b) $C_c=C_vC_d$ (c) $C_d=C_cC_v$ (d)$C_cC_vC_d=1$

UNIT-4

1. Ina fullydeveloped regionofthe pipeflow ___________.
(a) Thevelocityprofilecontinuouslychanges fromlineartoparabolic shape
(b) Thepressuregradientremainsconstantinthedownstreamdirection
(c) Thepressuregradient continuouslychangesexceedingthewallshearstressinthe downstream direction The pipe is not running full
2. Inasteadyflowofoilinthefullydevelopedlaminar regime,theshear stressis:
(a) Constantacrossthe pipe
(b) Maximumat thecentreand decreasesparabolicallytowardsthepipewallboundary

(c) Zero attheboundaryandincreaseslinearlytowardsthe centre.
(d) Zeroatthecentreandincreasestowardsthepipewall.

3. A40 mm diameter 2m long straight uniformpipe carries a steady flow ofwater (viscosity 1.02 centipoises) at the rateof 3.0 liters per minute. What is the approximate value of the shear stress on the internal wall of the pipe?
   (a) 0.0166 dyne/cm^2(b)0.0812 dyne/cm^2(c)8.12dyne/cm^2(d)0.9932dyne/cm^2
4. The pressure drop for a relatively low Reynolds number flow in a 600mm, 30m long pipeline is 70 kPa. What is the wall shear stress?
   (a)0Pa(b)350Pa(c)700Pa(d)1400Pa
5. The pressure drop in a 100 mm diameter horizontal pipe is 50 kPa over a length of 10 m. The shear stress at the pipe wall is:
   (a)0.25 kPa(b)0.125kPa(c)0.50 kPa(d)25.0kPa
6. Laminar developed flow at an average velocityof 5 m/s occurs in a pipe of 10 cmradius. The velocity at 5 cm radius is:
   (a)7.5m/s(b) 10m/s(c) 2.5m/s(d) 5m/s
7. The power consumed per unit length in laminar flow for the same discharge, varies directlyas Dn where D is the diameter of the pipe. What is the value of ‘n’?
   (a)½(b) -1/2(c) -2(d)-4
8. A fully developed laminar viscous flow through a circular tube has the ratio of maximum velocity to average velocity as(a) 3.0 (b) 2.5 (c) 2.0 d) 1.5
9. WhichoneofthefollowingisthecharacteristicofafullydevelopedLaminarflow?
   (a) Thepressuredropintheflowdirectioniszero
   (b) Thevelocityprofilechangesuniformlyin theflowdirection
   (c) Thevelocityprofiledoesnotchangeintheflow direction
   (d) TheReynoldsnumberforthe flow iscritical
10. TheMINIMUMvalueoffrictionfactor‘f’thatcanoccurinlaminarflowthrougha circular pipe is:
   (a)0.064 (b)0.032(c)0.016(d) 0.008

UNIT-5

1. The thicknessoflaminar boundarylayer at adistance ‘x’ fromthe leading edgeover a flat varies as _________.
2. Themassflowrate(inkg/s)acrossthesectionq– ris:
   (a)Zero (b)0.05 (c)0.10 (d) 0.15
3. Theintegrated drag force(inN)ontheplate,betweenp– s,is:
   (a)0.67 (b)0.33 (c)0.17 (d) Zero
4. Flowseparationiscausedby:
   (a) Reductionofpressuretolocalvapourpressure (b)Anegativepressure gradient
   (c)Apositivepressure gradient (d)Thinningofboundarylayerthicknessto zero.
5. Consideralaminarboundarylayeroveraheatedflatplate.Thefreestreamvelocityis U∞. At somedistance xfromthe leadingedgethe velocityboundarylayerthicknessis *t*δ. Ifthe Prandtlnumberisgreaterthan1,then
   (a)∂V>∂T (b) ∂T>∂V (c)∂V=∂T (d)Noneofthese
6. Intheboundarylayer,theflowis:
   (a) Viscousandrotational(b)Inviscidandirrotational
   (c)Inviscidandrotational(d)Viscousandirrotational

7. In the region ofthe boundary layer nearest to the wallwhere velocity is not equalto zero, the viscous forces are:
   (a) Ofthesameorderofmagnitudeastheinertialforces (b)Morethaninertialforces
   (c)Lessthaninertialforces (d)Negligible
8. The critical value of Reynolds number for transition from laminar to turbulent boundary layer in external flows is taken as:
   (a)2300 (b)4000 (c)5×10^5 (d)3×10^6
9. The‘velocitydefectlaw’isso named becauseitgovernsa
   (a) Reverseflowregionneara wall (b)Slip-streamflowatlowpressure
   (c) Flowwithalogarithmicvelocityprofilealittleawayfromthewall
   (d) Re-circulatingflownearawall
10. The hydrodynamic boundary layerthicknessis defined as the distancefrom the surfacewhere the
   (a) Velocityequalsthelocalexternal velocity
   (b) Velocityequals theapproach velocity
   (c) Momentumequals99%ofthemomentumofthe free stream
   (d) Velocityequals99%ofthe localexternalvelocity

XII. GATE QUESTIONS:

1. Jetpumpsareoftenusedinprocess industryfor their
   (a)Highefficiency(b)Easymaintenance
   (c) Largecapacity(d)Capacitytotransportgases,liquidsandmixturesofboth
2. Assuming ideal flow, the force F in Newtonrequired onthe plunger to pushoutthe water is:
   (a)0(b)0.04(c)0.13(d) 1.15
3. Neglect losses in the cylinder and assume fully developed laminar viscous flowthroughout the needle; the Darcy friction factor is 64/Re. where Re is the Reynolds number. Given that the viscosity of water is 1.0 × 10-3 kg/s m, the force F in Newton required on the plunger is:
   (a)0.13(b)0.16(c)0.3(d)4.4
4. For air near atmosphereconditions flowingover aflat plate,thelaminar thermalboundary layer is thicker than the hydrodynamic boundary layer _________.
5. Forflowoffluidoveraheatedplate, thefollowingfluidproperties areknown:viscosity= 0.001 Pa.s; specific heat at constant pressure = 1kJ/kg.K; thermal conductivity = 1W/m.K.
   Thehydrodynamicboundarylayerthicknessataspecifiedlocationontheplateis1 mm.Thethermalboundarylayerthicknessatthesamelocationis:
   (a)0.001mm(b)0.01mm(c)1mm(d)1000mm
6. Afluid flowingoveraflatplatehasthe followingproperties:
   Dynamic viscosity: 25 × 10-6 kg/ms Specificheat:2.0kJ/kgK
   Thermal conductivity: 0.05 W/mk
   Thehydrodynamicboundarylayerthicknessismeasuredtobe0.5mm. The thickness of thermal boundary layer would be:
   (a)0.1mm(b)0.5mm(c)1.0mm(d)None ofthe above
7. Match List-I (Type of fluid) with List-II (Variation of shear stress) and select the correct answer:

List-I List-II

A. Ideal fluid 1.Shearstressvarieslinearlywiththe rateofstrain

B. Newtonianfluid 2.Shearstressdoesnotvarylinearlywiththe rateofstrain

C. Non-Newtonian fluid 3. Fluid behaves like a solid until a minimum yield stress beyond beyondwhichit exhibitsalinear relationship between shear shear stress and the rate of strain

D. Binghamplastic 4.Shear stressiszero

Codes:ABCD ABCD

(a)31 24 (b) 4213 (c)3 2 14 (d)41 23

IESQUESTIONS:

1. Ifapieceofmetalhavingaspecificgravityof13.6isplacedinmercuryofspecific gravity 13.6, then
   (a) Themetalpiecewillsink to thebottom
   (b) The metalpiecesimplyfloatsoverthemercurywithnoimmersion
   (c) Themetalpiecewillbeimmersedinmercurybyhalf
   (d) Thewholeofthemetalpiecewillbeimmersedwithitstopsurfacejustatmercury level.
2. A cylindrical piece of cork weighting 'W' floats with its axis in horizontal position in a liquid of relative density 4. By anchoring the bottom, the cork piece is made to float at neutral equilibrium position with its axis vertical. The vertically downward force exerted by anchoring would be:
   (a)0.5W(b)W(c)2W(d)3W
3. The components ofvelocity in a two dimensional frictionless incompressible flow are u = t2 + 3y and v = 3t + 3x.Whatis the approximate resultant total acceleration at the point (3, 2) and t= 2?
   (a)5(b)49(c)59(d)54
4. Which one ofthe following statements is correct?Irrotational flow is characterized as the one in which _________.
   (a) Thefluid flowsalongastraightline(b)The fluiddoesnotrotateasitmovesalong
   (c) Thenetrotationoffluidparticlesabouttheirmasscentersremainszero.
   (d) Thestreamlinesofflowarecurvedandcloselyspaced
5. Twoflowsarespecifiedas:(A)u=y, v= - (3/2)x(B)u=xy2, v=x2y Which one of the following can be concluded?
   (a) Bothflowsarerotational(b)Bothflowsareirrotational
   (c) FlowAisrotationalwhileflowBis irrotational
   (d) FlowAisirrotationalwhileflowB isrotational
6. Thedifferentialformofcontinuityequationfortwo-dimensionalflowoffluidmaybe writteninthefollowingform □$\frac{\partial u}{\partial x}$+ □□$\frac{\partial v}{\partial y}$ inwhichuandvarevelocitiesinthexandy-directionandρisthedensity.This isvalidfor
   (a) Compressible,steadyflow(b)Compressible,unsteadyflow
   (c)Incompressible,unsteadyflow(d)Incompressible,steadyflow

XIII. WEBSITES:

1. http://www.asce.org
2. http://www.icivilengineer.com
3. http://www.construction-guide.in
4. http://nptel.ac.in/courses/112105171/1

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6. Dr.T.I.Eldho.DepartmentofCivilEngineering,IITBombay

XV. JOURNALS:

1 ThesisDigestoncivilEngineering
2 InternationalEngineeringand TechnologyJournalofCivilandStructure
3 Internationaljournalofcivilengineering
4 Journalofinformationknowledgeandresearch incivilengineering
5 Internationaljournalofcivilengineering andtechnology
6 InternationalJournalofCivilEngineeringandApplications
7 RecentTrendsinCivilEngineeringand Technology
8 World ResearchJournalofCivilEngineering
9 InternationalJournalofStructuralandCivilEngineering
10 InternationalJournalofCivilEngineering(IJCE)
11 InternationalJournalofStructuralandCivilEngineeringResearch
12 InternationalJournalofAdvancedResearchinCivil,Structural,Environmentaland Infrastructure Engineering and Developing

XVI. LISTOFTOPICSFORSTUDENTSEMINARS:

1. Drag
2. Lift
3. DimensionalAnalysis
4. Modeling
5. Cavitations
6. MomentumandEnergyprinciplesinOpenchannelflow
7. Flowcontrols
8. Typesofflow

XVII. CASESTUDIES / SMALL PROJECTS:

1. FluidMechanicsinBrakingSystems
2. DesignOptimizationofaRevolutionaryStableSaltReactor
3. DesigningAgainstWind-loading-PrinceSultanCulturalCentre,Jeddah
4. BreakawayCouplingOptimizationusingCFD
5. OptimizingFluidMixinginaFuelInjectorUsingCFD Analysis