Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W), Mumbai - 400058

RE-EXAMINATION, DECEMBER 2019

(NEW & OLD)

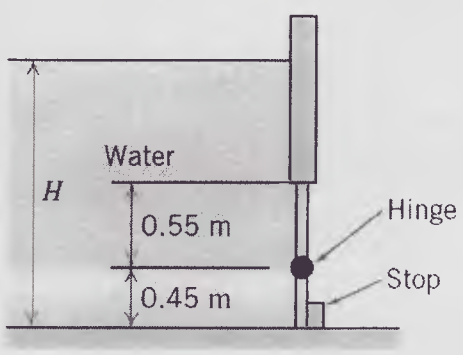
B.Tech. (Mechanical Engineering) — Duration: **Three Hour**
Code: PCC **BTM 403** — Maximum Points :**100**
Course: **FLUID MECHANICS** — Semester : **IV**

Important Notes:

- Answer any FIVE from seven questions,
- Answers to all sub questions should be grouped together for evaluation,
- Make suitable assumption if needed with proper reasoning,
- Data shown under column CO, BL and PI are only for academic evaluation (CO: Course Outcome, BL: Blooms Taxonomy, PI: Performance Indicator)

		Points	CO	BL	PI
1.	**A.** Define and explain following terms: i) Stagnation temperature ii) Effect of area variation on Mach number iii) Chocked flow iv) Shock Wave	**[10]**	1	1	
	B. Two reservoirs 5.2 km apart are connected with a pipeline which consists of a 225 mm diameter pipe for the first 1.6 km sloping at 5.7 m per km. For remaining distance the pipe diameter is 150 mm laid at a slop of 1.9 m per km. The levels of water above the pipe opening are 6 m in the upper reservoir and 3.7 m in lower reservoir. Calculate the rate of discharge by assuming, f = 0.024 for both pipes, and Coefficient of contraction = 0.6.	**[10]**	3,4	3	
2.	**A.** What is hydrostatic pressure? Derive an expression to estimate the force acting on an inclined plane lamina submerged in liquid. Also find an expression for point of application of this resultant force.	**[10]**	1,2	1,2	
	B. A U-tube acts as a water siphon. The bend in the tube is 1 m above the water surface; the tube outlet is 7 m below the water surface. The water issues from the bottom of the siphon as a free jet at atmospheric pressure. Determine (after listing the necessary assumptions) the speed of the free jet and the minimum absolute pressure of the water in the bend.	**[10]**	4	3	
3.	**A.** Comment and extract following information from velocity vector $\vec{V} = (4 + xy + 2t)\vec{i} + 6x^3\vec{j} + (3xt^2 + z)\vec{k}$ a. Find velocity at a point(3,2,1) when t=2s. b. Is it a 1D, 2D or 3D flow? c. Is the flow uniform or non-uniform? d. Find local, convective and total acceleration at a point located at (2,4,-4) and at time t=3s. e. Develop expression for linear or angular deformation, if any. f. Is it a compressible or incompressible? g. Is this flow irrotational? Justify your answer.	**[10]**	1,2	4	

	B. Stating all assumption, derive Bernoulli's equation along a streamline starting from Navier-Stokes equation.	**[10]**	4	4,5
4.	**A.** What is Von Karmon's Integral equation? Derive it.	**[10]**	1	1,2
	B. Consider two long, horizontal parallel plates with a viscous incompressible fluid placed between them. The two plates moves in two opposite direction with two different constant velocities. There is no pressure gradient and the only body force due to the weight. Starting with the Navier-Stokes equation, determine an expression for the velocity profile for laminar flow between the two plates.	**[10]**	3	4,5
5.	**A.** What do you understand by laminar and turbulent nature of a fluid flow? Explain developing and developed flow features in a pipe flow and suggest an empirical relation to estimate developing length in these two regimes of fluid flow.	**[10]**	1	1,2
	B. Discuss following terms with illustration: (i) Characteristics of a compressible flow (ii) Moody chart (iii)Hagen Poiseuille flow (iv) Surface tension	**[10]**	3,4	3,4
6.	**A.** What is flow separation? Explain related concept. Is it good or bad? Discuss various methods to control it.	**[10]**	1,3	1,2
	B. A converging nozzle is attached to a 6-cm-diameter hose but the horizontal nozzle turns the water through an angle of 180°. The nozzle exit is 3 cm in diameter and the flow rate is 1000 liter/min. Determine the force components of the water on the nozzle and the magnitude of the resultant force. The pressure in the hose is 400 kPa and the water exits to the atmosphere. Analyze and solve the problem using Reynolds transport theorem.	**[10]**	3,4	3
7.	**A.** Explain following with illustration: a. Streamline and path line of flow b. Viscous and Inviscid flows c. Incompressible and compressible flow d. Steady and transient flows	**[10]**	2,3	3,4
	B. A rectangular gate (width, w = 2 m) is hinged as shown, with a stop on the lower edge. At what depth H will the gate tip?	**[10]**	4	4,5



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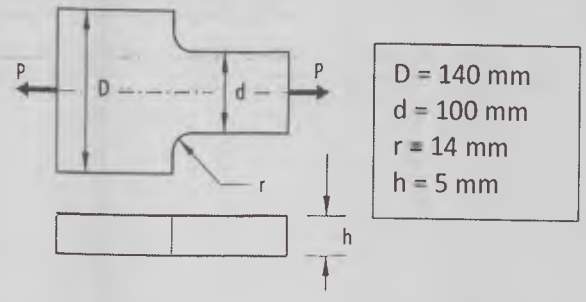
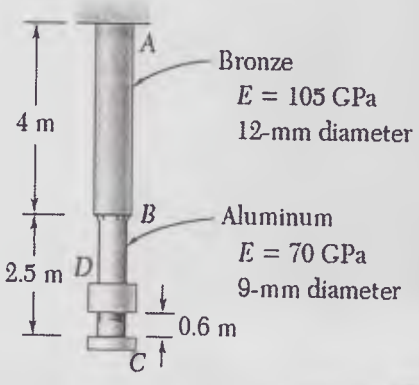
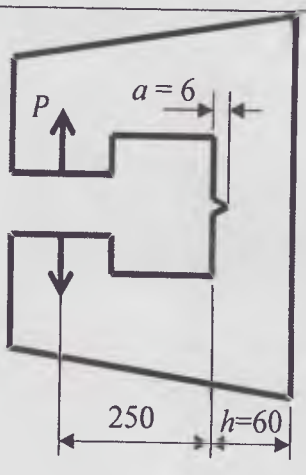
PREVIOUS SEMESTER EXAMINATION – DECEMBER 2019

Program: B.Tech. in Mechanical Engg.
Course Code: PCC-BTM405
Course Name: Solid Mechanics

Duration: 3 Hours
Maximum Points: 100
Semester: IV

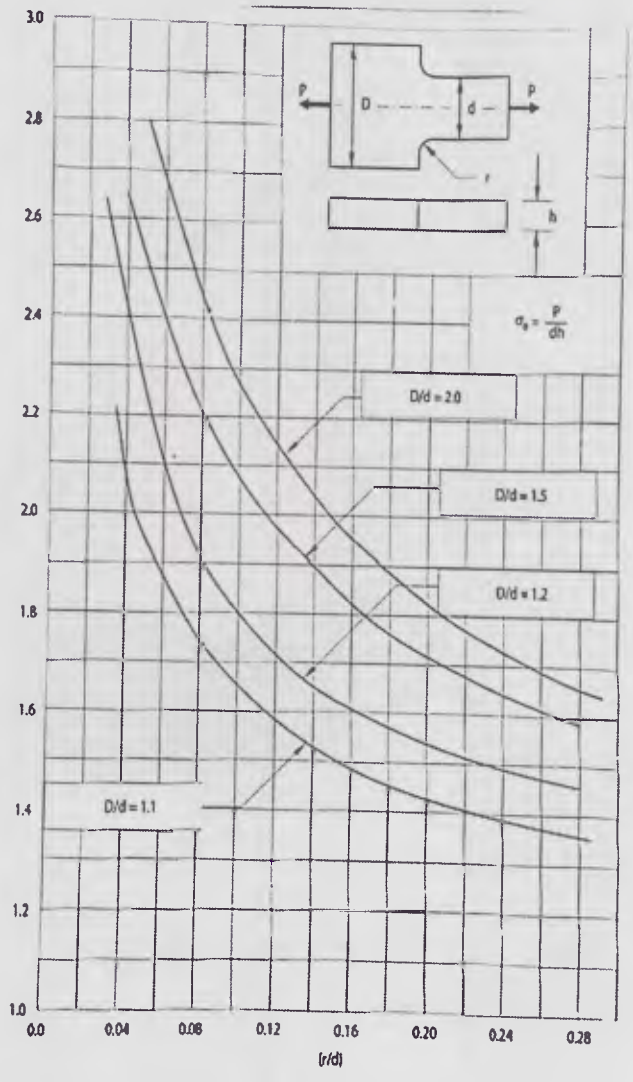
Notes:
1. Attempt **any five** questions.
2. Assume suitable data if necessary.

Q. No.	Questions	Points	CO	BL	PI
Q1	A) A thick cylindrical reactor vessel has internal radius of 200 mm. It is subjected to internal pressure of 1.0 MPa and external pressure of 0.5 MPa. If E = 200 GPa and ν = 0.3, determine the thickness as per Maximum Principal stress theory of failure. Consider tensile strength as 400 MPa and factor of safety as 3.0. Also determine the changes in internal and external radii.	(10)	2	3	2.3.3
	B) Discuss the concept of plane stress and plane strain conditions used to solve elasticity problem. Give two examples of each type. What is the advantage of this concept? Compare between these two conditions in terms of relationship between stress and strain components in each case.	(10)	1	2	2.1.2
Q2	A) A flat plate as shown in the figure is made of material with ultimate tensile strength of 500 MPa. Calculate the safe load it can carry with factor of safety as 5.0.  Define the term 'stress concentration factor' and give practical examples where the factor plays important role in design calculation	(10)	2	3	2.2.3
	B) A solid steel bar 2 m long, is 50 mm in diameter for 500 mm of its length, 40 mm in diameter for 500 mm and 20 mm in diameter for the remaining length. The bar is subjected to a torque and the resulting	(5)	4	3	2.2.3

	maximum shear stress in the smallest section is 10 MPa. Taking G = 80 GPa, find the energy stored in the bar. C) Explain the generalized statement of Hooke's law used for describing behavior of a material. What do Lame's coefficients represent for isotropic materials?	(5)	2	2	2.1.2
Q3	A) The state of stress τ_{ij} at a point is as shown. Calculate the principal stresses and find the principal directions associated with the maximum and minimum principal stresses. $\tau_{ij} = \begin{bmatrix} 3 & -2 & 2 \\ -2 & 1 & -1 \\ 2 & -1 & 2 \end{bmatrix}$	(10)	1	3	2.4.1
	B) Collar D is released from rest in the position shown in the figure and it is stopped by a small plate attached at end C of the vertical rod ABC. Determine mass of collar for which the maximum normal stress in portion BC is 100 MPa. 	(10)	4	3	2.3.1
Q4	A) Figure shows a 50 mm thick metal plate frame for a clamping device (all dimensions in mm). Find safe load P in the presence of a crack in the frame at location shown. Material data: $K_{Ic} = 60$ MPa$\sqrt{\text{m}}$, $\sigma_Y = 800$ MPa. 	(10)	2	3	2.2.3
	B) Explain following terms highlighting their significance for analyzing real life problems: (i) Principal stress, (ii) Fracture toughness of material, (iii) Shear Flow, (iv) stress concentration factor, (v) Proof resilience.	(10)	2	2	2.1.2
Q5	A) Explain general features of metal plasticity. Describe the Bauschinger effect with the help of load vs displacement plot. Illustrate the effect using a simple model of 3 bars.	(10)	3	3	2.1.2
	B) Discuss the principle of superposition with suitable example and provide its proof along with necessary conditions for its applicability. Based on the principle of superposition, prove the principle of uniqueness.	(10)	3	5	2.3.2

Q6	A) Derive Cauchy's relations for stress component. Using these relations, for the stress matrix τ_{ij}, determine magnitude of the normal and shear stress on a plane equally inclined to x, y and z planes. $\tau_{ij} = \begin{bmatrix} 1 & -1 & 2 \\ -1 & 3 & -3 \\ 2 & -3 & 2 \end{bmatrix}$	(10)	1	3	2.4.1
	B) A thin walled box section of width = $2a$, breadth = a and wall thickness = t is be compared with a solid section of diameter a. Find the thickness t so that the two sections have same maximum stress for the same torque.	(5)	2	3	2.3.1
	C) A 20 mm long cast iron rod of 25 mm diameter is pressed on to a thick copper plate with a force of 20 N. Determine (i) the width of the contact area, (ii) the maximum contact pressure, (iii) The maximum shear stress on the contact surface. $E_{C.I.}$= 41.4 GPa, $\nu_{C.I.} = 0.211$, E_{Cu}= 44.7 GPa, $\nu_{Cu} = 0.326$	(5)	2	3	2.3.1
Q7	A) State the six compatibility equations governing the deformation behavior of elastic bodies. What is the physical significance of these equations?	(5)	3	2	2.1.2
	B) The displacement field for a body is given by: $\bar{u} = [(2x^2 + y^3 + z)\bar{\imath} + (3x + 5z^2)\bar{\jmath} + (2y^2 + 4z)\bar{k}]10^{-4}$ What are the strain components at (-1, 1, -1)?	(5)	3	3	2.3.1
	C) Discuss three modes of fracture. Give two practical examples of each mode.	(5)	2	2	2.1.2
	D) A steel disk of 750 mm diameter is shrunk on a steel shaft of 75 mm diameter. The interference on diameter is 0.02 mm. Find the rotation speed at which contact pressure is zero. Consider E = 200 GPa, ν = 0.3 and density = 7850 kg/m^3.	(5)	2	3	2.4.1

ANNEXURE: USEFUL FORMULAE



Stresses for two cylinders in contact with each other

$$b = \sqrt{\frac{2F}{\pi l}\left[\frac{\frac{(1-\nu_1^2)}{E_1}+\frac{(1-\nu_2^2)}{E_2}}{\frac{1}{d_1}+\frac{1}{d_2}}\right]}$$

$$p_{max} = \frac{2}{\pi}\frac{F}{bl}$$

$$\sigma_x = -2\nu p_{max}\left[\sqrt{\left(1+\frac{z^2}{b^2}\right)}-\frac{z}{b}\right]$$

$$\sigma_y = -p_{max}\left[\left(2-\frac{1}{1+z^2/b^2}\right)\sqrt{1+z^2/b^2}-2\frac{z}{b}\right]$$

$$\sigma_z = -p_{max}\left[\frac{1}{\sqrt{1+z^2/b^2}}\right]$$

Stresses in thick pressurized cylinders

$$\sigma_r = \frac{p_a a^2 - p_b b^2}{b^2-a^2} - \frac{a^2 b^2}{r^2}\times\frac{p_a - p_b}{b^2-a^2}$$

$$\sigma_\theta = \frac{p_a a^2 - p_b b^2}{b^2-a^2} + \frac{a^2 b^2}{r^2}\times\frac{p_a - p_b}{b^2-a^2}$$

$\sigma_z = 0$ with both ends open

$\sigma_z = \nu(\sigma_r + \sigma_\theta)$ with both ends closed

Stresses in rotating solid disks

$$\sigma_r = \frac{3+\nu}{8}\rho\omega^2(b^2 - r^2)$$

$$\sigma_\theta = \frac{3+\nu}{8}\rho\omega^2 b^2 - \frac{1+3\nu}{8}\rho\omega^2 r^2$$

Stresses in rotating disks with central hole

$$\sigma_r = \frac{3+\nu}{8}\rho\omega^2\left(b^2 + a^2 - \frac{a^2b^2}{r^2} - r^2\right)$$

$$\sigma_\theta = \frac{3+\nu}{8}\rho\omega^2\left(b^2 + a^2 + \frac{a^2b^2}{r^2} - \frac{1+3\nu}{3+\nu}r^2\right)$$

SIF for edge cracked plate subjected to axial load P / bending moment M

$(K_I)_P = \frac{P}{Bh}\sqrt{\pi a}\,Y_P$,

$$Y_P = 1.12 - 0.23\alpha + 10.55\alpha^2 - 21.72\alpha^3 + 30.39\alpha^4;\ \alpha = a/h$$

$(K_I)_M = \frac{6M}{Bh^2}\sqrt{\pi a}\,Y_M$

$$Y_M = 1.122 - 1.4\alpha + 7.33\alpha^2 - 13.08\alpha^3 + 14\alpha^4;\ \alpha = a/h$$

(2)

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PREVIOUS [redacted] **semester Examination(OLD COURSE)(A.Y.17-18)**

DECEMBER 2019

Maximum Marks: **100** Duration: **3 hour**

Class: **S.Y.B.Tech** Semester: **IV** Program:**Mechanical Engineering**

Name of the Course: **Applied Mathematics IV** Course Code : **BTM401**

Instructions:

- Question number.**1** is **compulsory**.
- Attempt any FOUR questions out of remaining SIX questions.
- Answers to all sub questions should be **grouped** together.

Q		Points	CO	B.L.	P.I.
1(a)	For the following data Find the approximate cost of maintaining a 3 years old car Age of cars(years): 2, 4, 6, 7, 8, 10, 12 Annual Maintenance (Rs.): 1600, 1500, 1800, 1900, 1700, 2100, 2000	5	1	1	1.2.1
(b)	The following data represents the biological values of protein from cow's and buffalo's milk at a certain level. Cow' milk: 1.82, 2.02, 1.88, 1.61, 1.81, 1.54	5	1	4	2.4.1

	Buffalo's milk	2.00	1.83	1.86	2.03	2.19	1.88				
	Examine if the average values of protein in the two samples in the two samples significantly differ.LOS 5%.										
(c)	Solve $\frac{\partial u}{\partial x} = 4\frac{\partial u}{\partial y}$, where $u(0, y) = 8e^{-3y}$ using method of separation of variables.							**5**	**3**	**4**	**2.4.3**
(d)	Prove that $\vec{F}=(2xy+z^3)\hat{i}+(x^2+z)\hat{j}+(y+3xz^2)\hat{k}$ is conservative and find the work done by $\vec{F}$ displacing the particle from A (0, 1, 1) to B(1,0,2).							**5**	**1**	**5**	**2.4.3**
2 (a)	Given below is the probability distribution of a drv x with mean=16 then find 'a' & b and variance of x.							**6**	**1**	**2**	**1.2.1**
	X	8	12	16	20	24					
	P	1/8	a	b	1/4	1/12					
(b)	Verify Green's theorem in the plane for $\oint_c (x^2 - y)dx + (2y^2 + x)dy$ around the boundary of region defined by $y = x^2$ & $y = 4$.							**6**	**2**	**5**	**2.4.1**
(c)	An insurance company has discovered that only about 0.1% of the population is involved in a certain type of accident each year. Is its 10,000 policy holders were randomly selected from the population, what is the probability that not more than 5 of clients are involved in such an accident next year?							**8**	**1**	**3**	**2.4.3**
3 (a)	Compute spearman's rank coorelation coefficient for the following data							**6**	**1**	**1**	**2.4.1**
	X	40	42	45	35	36	39				
	Y	46	43	44	39	40	43				
(b)	Apply Stoke's theorem to evaluate $\oint_c (x+y)dx + (2x-z)dy + (y+z)dz$ where C is the boundary							**6**	**2**	**5**	**1.2.1**

	of the triangle with vertices (2, 0, 0), (0, 3, 0) and (0, 0, 6).				
(c)	A crv X has PDF defined as $f(x)=\begin{cases} A+Bx, 0\le x\le 1 \\ 0, elsewhere \end{cases}$ If the mean of the distribution is 1/3. Find A & B.	8	1	2	2.4.4
4 (a)	A string is stretched and fastened to two point's *l* apart. Motion is started by displacing the string in the form $y = a\sin\frac{nx}{\ell}$ from which it is released at time t = 0, show that the displacement of any point at a distance x from one end at time t is given by y (x, t) = $y = a\sin\frac{\pi x}{\ell}\cos\frac{\pi ct}{\ell}$.	6	2	5	2.4.3
(b)	Ten individuals are chosen at random from a population and their heights are found to be (in inches): 63, 63, 66, 67, 68, 69, 70, 70, 71 & 72. In the light of the data discuss the suggestion that the mean height in the population is 66 inches	6	1	4	2.4.3
(c)	If the mean of a binomial distribution is 3 and the variance is $\frac{3}{2}$, find the probability of obtaining atleast 4 success.	8	3	7	2.4.2
5 (a)	The probability of a man hitting the target is ¼.(i)If he fires 7 times what is the probability of his hitting the target atleast targets atleast twice ?(ii)How many times must he fire so that the probability of his hitting the once is greater than 2/3?	6	1	3	2.4.2
(b)	Calculate the correlation coefficient for the following data: X: 10, 12, 14, 15, 16, 17, 18, 10, 14, 15 Y: 17, 16, 15, 12, 10, 9, 8, 15, 13, 12	6	1	2	1.2.1
(c)	Verify Stoke's theorem for the vector field $\vec{F}=(x^2-y^2)\hat{i}+2xy\hat{j}$ over the box bounded by planes x = 0, x = a, y = b, z = C if the face z = 0 is cut	8	2	5	2.4.3
6(a)	The theory predicts the proportions of bean in the four groups A, B, C & D should be 9:3:3:1. In an experiment among 1600 beans, the number in the four group are 882, 313, 287 & 118.	6	1	4	1.1.1

	Does the experimental result support the theory?				
(b)	Verify Divergence Theorem for $\vec{F}=(x^2-yz)\hat{i}+(y^2-zx)\hat{j}+(z^2-xy)\hat{k}$ taken over the rectangular parallelepiped $0 \le x \le a, 0 \le y \le b, 0 \le z \le c$.	**6**	**2**	**5**	**2.4.3**
(c)	Obtain all possible solutions of one dimensional Wave Equation.	**8**	**3**	**7**	**1.2.1**
7(a)	Obtain all possible solutions of one dimensional Heat equation	**6**	**3**	**3**	**1.2.1**
(b)	In an examination marks obtained by students in mathematics, physics and chemistry are normally distributed with means 51,53 and 46 with standard deviations 15,12,16 respectively. Find the probability of securing total marks (i) 180 or more (ii) 90 or below.	**6**	**1**	**2**	**2.4.3**
(c)	Find the angle between the lines of regression	**8**	**1**	**1**	**1.2.1**

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Previous semester Examination(A.Y.18-19)

DECEMBER 2019

Maximum Marks: **100** Duration: **3 hour**

Class: **S.Y.B.Tech** Semester: **IV** Program:**Mechanical Engineering**

Name of the Course: **Applied Mathematics IV** Course Code : **BSC-BTM401**

Instructions:

- Question number.**1** is **compulsory**.
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<table>
<tr><td>Age of cars(years)</td><td>2</td><td>4</td><td>6</td><td>7</td><td>8</td><td>10</td><td>12</td></tr>
<tr><td>Annual Maintenance (Rs.)</td><td>1600</td><td>1500</td><td>1800</td><td>1900</td><td>1700</td><td>2100</td><td>2000</td></tr>
</table></td><td>5</td><td>1</td><td>1</td><td>1.2.1</td></tr>
<tr><td>(b)</td><td>Prices of shares of a company on different days in a month were found to be 66, 65, 69, 70, 69, 71, 70, 63, 64 and 68.Discuss whether the price of shares to be 65.</td><td>5</td><td>1</td><td>4</td><td>2.4.1</td></tr>
</table>

(c)	Solve $\frac{\partial u}{\partial x} = 4\frac{\partial u}{\partial y}$, where $u(0, y) = 8e^{-3y}$ using method of separation of variables.	5	3	4	2.4.3
(d)	Prove that $\vec{F}=(2xy+z^3)\hat{i}+(x^2+z)\hat{j}+(y+3xz^2)\hat{k}$ is conservative and find the work done by $\vec{F}$ displacing the particle from A (0, 1, 1) to B(1,0,2).	5	1	5	2.4.3
2 (a)	Given below is the probability distribution of a drv x with mean=16 then find 'a' & b and variance of x. X | 8 | 12 | 16 | 20 | 24 P | 1/8 | a | b | 1/4 | 1/12	6	1	2	1.2.1
(b)	Verify Green's theorem in the plane for $\oint_c (x^2 - y)dx + (2y^2 + x)dy$ around the boundary of region defined by $y = x^2$ & $y = 4$.	6	2	5	2.4.1
(c)	An insurance company has discovered that only about 0.1% of the population is involved in a certain type of accident each year. Is its 10,000 policy holders were randomly selected from the population, what is the probability that not more than 5 of clients are involved in such an accident next year?	8	1	3	2.4.3
3 (a)	Compute spearman's rank coorelation coefficient for the following data X | 40 | 42 | 45 | 35 | 36 | 39 Y | 46 | 43 | 44 | 39 | 40 | 43	6	1	1	2.4.1
(b)	Apply Stoke's theorem to evaluate $\oint_C (x+y)dx + (2x-z)dy + (y+z)dz$ where C is the boundary of the triangle with vertices (2, 0, 0), (0, 3, 0) and (0, 0, 6).	6	2	5	1.2.1
(c)	A crv X has PDF defined as $f(x) = \begin{cases} A+Bx, 0 \le x \le 1 \\ 0, elsewhere \end{cases}$	8	1	2	2.4.4

	If the mean of the distribution is 1/3. Find A & B.				
4 (a)	A string is stretched and fastened to two point's l apart. Motion is started by displacing the string in the form $y = a\sin\frac{nx}{\ell}$ from which it is released at time t = 0, show that the displacement of any point at a distance x from one end at time t is given by y (x, t) = $y = a\sin\frac{\pi x}{\ell}\cos\frac{\pi ct}{\ell}$.	6	2	5	2.4.3
(b)	Tests to made on the breaking strengths of 10 pieces of metal gave the following results in kg. 578, 572, 570, 568, 572, 570,570, 572, 596, 584 test at 5% los if the mean breaking strength of the metal wire can be assumed as 577 kg.	6	1	4	2.4.3
(c)	If the mean of a binomial distribution is 3 and the variance is $3/2$, find the probability of obtaining atleast 4 success.	8	3	7	2.4.2
5 (a)	The probability of a man hitting the target is ¼.(i)If he fires 7 times what is the probability of his hitting the target atleast targets atleast twice ?(ii)How many times must he fire so that the probability of his hitting the once is greater than 2/3?	6	1	3	2.4.2
(b)	Calculate the correlation coefficient for the following data:	6	1	2	1.2.1
(c)	Verify Stoke's theorem for the vector field $\vec{F}=(x^2-y^2)\hat{i}+2xy\hat{j}$ over the box bounded by planes x = 0, x = a, y = b, z = C if the face z = 0 is cut	8	2	5	2.4.3
6(a)	The theory predicts the proportions of bean in the four groups A, B, C & D should be 9:3:3:1. In an experiment among 1600 beans, the number in the four group are 882, 313, 287 & 118. Does the experimental result support the theory?	6	1	4	1.1.1
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X	10	12	14	15	16	17	18	10	14	15
Y	17	16	15	12	10	9	8	15	13	12

(c)	Obtain all possible solutions of one dimensional Wave Equation.	8	3	7	1.2.1
7(a)	Obtain all possible solutions of one dimensional Heat equation	6	3	3	1.2.1
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(14)

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W), Mumbai - 400058

RE-EXAMINATION, DECEMBER 2019

(NEW & OLD)

B.Tech. (Mechanical Engineering) — Duration: **Three Hour**
Code: PCC **BTM 403** — Maximum Points :**100**
Course: **FLUID MECHANICS** — Semester : **IV**

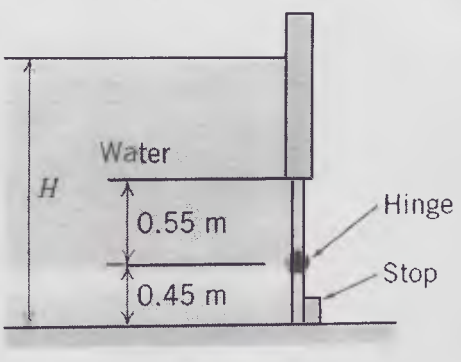
Important Notes:

- Answer any FIVE from seven questions,
- Answers to all sub questions should be grouped together for evaluation,
- Make suitable assumption if needed with proper reasoning,
- Data shown under column CO, BL and PI are only for academic evaluation

(CO: Course Outcome, BL: Blooms Taxonomy, PI: Performance Indicator)

		Points	CO	BL	PI
1.	**A.** Define and explain following terms: i) Stagnation temperature ii) Effect of area variation on Mach number iii) Chocked flow iv) Shock Wave	**[10]**	1	1	
	B. Two reservoirs 5.2 km apart are connected with a pipeline which consists of a 225 mm diameter pipe for the first 1.6 km sloping at 5.7 m per km. For remaining distance the pipe diameter is 150 mm laid at a slop of 1.9 m per km. The levels of water above the pipe opening are 6 m in the upper reservoir and 3.7 m in lower reservoir. Calculate the rate of discharge by assuming, f = 0.024 for both pipes, and Coefficient of contraction = 0.6.	**[10]**	3,4	3	
2.	**A.** What is hydrostatic pressure? Derive an expression to estimate the force acting on an inclined plane lamina submerged in liquid. Also find an expression for point of application of this resultant force.	**[10]**	1,2	1,2	
	B. A U-tube acts as a water siphon. The bend in the tube is 1 m above the water surface; the tube outlet is 7 m below the water surface. The water issues from the bottom of the siphon as a free jet at atmospheric pressure. Determine (after listing the necessary assumptions) the speed of the free jet and the minimum absolute pressure of the water in the bend.	**[10]**	4	3	
3.	**A.** Comment and extract following information from velocity vector $\vec{V} = (4 + xy + 2t)\vec{i} + 6x^3\vec{j} + (3xt^2 + z)\vec{k}$ a. Find velocity at a point(3,2,1) when t=2s. b. Is it a 1D, 2D or 3D flow? c. Is the flow uniform or non-uniform? d. Find local, convective and total acceleration at a point located at (2,4,-4) and at time t=3s. e. Develop expression for linear or angular deformation, if any. f. Is it a compressible or incompressible? g. Is this flow irrotational? Justify your answer.	**[10]**	1,2	4	

	B. Stating all assumption, derive Bernoulli's equation along a streamline starting from Navier-Stokes equation.	**[10]**	4	4,5
4.	**A.** What is Von Karmon's Integral equation? Derive it.	**[10]**	1	1,2
	B. Consider two long, horizontal parallel plates with a viscous incompressible fluid placed between them. The two plates moves in two opposite direction with two different constant velocities. There is no pressure gradient and the only body force due to the weight. Starting with the Navier-Stokes equation, determine an expression for the velocity profile for laminar flow between the two plates.	**[10]**	3	4,5
5.	**A.** What do you understand by laminar and turbulent nature of a fluid flow? Explain developing and developed flow features in a pipe flow and suggest an empirical relation to estimate developing length in these two regimes of fluid flow.	**[10]**	1	1,2
	B. Discuss following terms with illustration: (i) Characteristics of a compressible flow (ii) Moody chart (iii)Hagen Poiseuille flow (iv) Surface tension	**[10]**	3,4	3,4
6.	**A.** What is flow separation? Explain related concept. Is it good or bad? Discuss various methods to control it.	**[10]**	1,3	1,2
	B. A converging nozzle is attached to a 6-cm-diameter hose but the horizontal nozzle turns the water through an angle of 180°. The nozzle exit is 3 cm in diameter and the flow rate is 1000 liter/min. Determine the force components of the water on the nozzle and the magnitude of the resultant force. The pressure in the hose is 400 kPa and the water exits to the atmosphere. Analyze and solve the problem using Reynolds transport theorem.	**[10]**	3,4	3
7.	**A.** Explain following with illustration: a. Streamline and path line of flow b. Viscous and Inviscid flows c. Incompressible and compressible flow d. Steady and transient flows	**[10]**	2,3	3,4
	B. A rectangular gate (width, w = 2 m) is hinged as shown, with a stop on the lower edge. At what depth H will the gate tip?	**[10]**	4	4,5



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SARDAR PATEL COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to University of Mumbai)

Previous Sem- examination Dec 2019

Total Marks: 100 Duration: 3 Hours

CLASS: S.Y. BTech (Mech), Sem: **IV** Course: **Kinematics of machinary-I (PC-BTM 412)**

- Questio no. ONE is compulsory, attempt any **FOUR** questions out of remaining questions.
- Figures to the right indicate full marks.
- Make any suitable assumption if needed with proper reasoning.

1		Define: i) Mobility of Mechanism ii) Kennedy Theorem iii) Kinematic Pair iv) Kinematic Inversion v) Interference in gear vi) Crowning of pulley vii) Chordal action in chain viii) Constraint and applied forces. ix) Pressure angle in cam amd follower. x) Velocity of sliding in gear	**20**
2.		Answer the following	
	a)	Classify kinematic pairs based on various criterions.	**5**
	b)	Prove that the minimum number of binary links in a constrained mechanism with simple hinges is four.	**5**
	c)	Sketch Peaucellier mechanism. Prove that it can be used to generate straight line.	**10**
3	a)	What is condition of correct steering? Show that Davis steering gear mechanism satisfy the condition.	**8**
	b)	Draw sketch and name at least two inversions of a four bar kinematic chain with two revolute and two prismatic pair.	**06**
	c)	Discuss various types of cams.	**06**
4	a)	In a slider crank mechanism, crank rotates with uniform angular velocity of 10 rad/s. Find velocity and acceleration of slider by graphical method, if crank of length 50 mm makes an angle of 90^0 with horizontal. Take connecting rod length equal to 3.5 times crank length.	**08**
	b)	Solve above problem (Q. no.4a) by analytical method-complex algebra	**12**
5	a)	Derive a relation for minimum number of teeth on gear wheel and pinion to avoid interference.	**10**
	b)	Find the module of a pair of gears having 32 and 84 teeth, respectively, whose center distance is 92 mm.	**4**
	c)	A pair of spur gears has 12 and 20 teeth, module 12.5mm, an addendum 12.5mm and a pressure angle of 20^0. Show that gears have interference. Also find the min. no. of teeth in this pair to maintain the same ratio avoiding interference.	**6**

6	a)	A prime mover running at 300 rpm drives a d.c. generator at 500 rpm by a belt drive. Diameter of the pulley on the output shaft of the prime mover is 600mm. Assuming a slip of 3%, determine the diameter of the generator pulley if the belt running over it is 6mm thick.	**4**
	b)	Two pulleys connected by flat belt are rotating in opposite direction to each other on a parallel shafts 1.95m apart, having diameters 450mm and 200mm. Find the length of the belt required and angle of contact between belt and each pulley. What power can be transmitted by belt when the larger pulley rotates at 200 rpm, if the maximum permissible tension in the belt is 1kN and the coefficient of friction between belt and pulley is 0.25.	**8**
	c)	Derive the expression of length for open and cross belt drive. Draw suitable sketch.	8
7	a)	Derive the expression for displacement, velocity and acceleration for following cam motion: i)SHM, ii)UARM (use h = follower stroke, θ_a = angle of ascent, θ_d = angle of descent, ω= angular speed of cam, x = displacement of follower at any time t.)	**10**
	b)	Two shafts are to be connected by a Hook's joint. The driving shaft is rotated at a uniform speed of 500 rpm and the speed of driven shaft must be 475 and 525 rpm. Determine the maximum permissible angle between the shafts.	**10**