



S. Y. B. Tech Sem IV
Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

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



End Semester/Re-Examination - May/June 2026

187526

Program: S.Y.B.Tech (Mechanical) *Sem IV*

Duration: 3 Hours

Course Code: ES-BTM401

Maximum Points: 100

Course Name: Statistics Probability and Laplace Transform

Semester: IV

Note:

1. Attempt Any Five Questions
2. Answers to the sub questions should be grouped together

		Questions	Points	CO	BL	Module														
1	a	A discrete random variable X has p.d.f defined by <table border="1"> <tr> <td>X</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td></tr> <tr> <td>P(X)</td><td>0.2</td><td>k</td><td>0.1</td><td>2k</td><td>0.1</td><td>2k</td></tr> </table> Obtain k, mean and variance.	X	-2	-1	0	1	2	3	P(X)	0.2	k	0.1	2k	0.1	2k	6	CO1	BL5	2
X	-2	-1	0	1	2	3														
P(X)	0.2	k	0.1	2k	0.1	2k														
	b	It is claimed that a random sample of 1000 tyres with a mean life of 15629 km is drawn from a population of tyres which has a mean life of 15200 km and a standard deviation of 1248 km. Test the validity of claim at 5% level of significance.	6	CO2	BL5	4														
	c	Evaluate (i) $L\{e^{-3t} \cos 3t \cdot \sin 2t\}$ (ii) $L\left\{\frac{\sin 4t}{t}\right\}$	8	CO3	BL3	6														
2	a	A potential buyer of light bulbs bought 50 bulbs of each of 2 brands. Upon testing the bulbs, he found that brand A had a mean life of 1282 hours with a standard deviation of 80 hours, and brand B had a mean life of 1256 hours with a standard deviation of 90 hours. Can the buyer be quite certain that the mean life of the two brands differ?	6	CO3	BL5	4														
	b	If X is a continuous random variable with probability density function	6	CO1	BL2	3														



Bharatiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING

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



End Semester/Re-Examination – May/June 2026

		$f(x) = \begin{cases} kx, & 0 \leq x \leq 1 \\ k, & 1 \leq x \leq 2 \\ k(3-x), & 2 \leq x \leq 3 \\ 0, & \text{elsewhere} \end{cases}$ Find k and $P(1.5 \leq x \leq 2.5)$																										
c	The height in cm of fathers (x) and of the sons (y) are given below	<table><tr><td>X</td><td>165</td><td>160</td><td>170</td><td>163</td><td>173</td><td>158</td><td>178</td><td>170</td><td>175</td><td>180</td></tr><tr><td>Y</td><td>173</td><td>168</td><td>173</td><td>165</td><td>175</td><td>168</td><td>173</td><td>170</td><td>173</td><td>178</td></tr></table> Estimate the height of the son if the height of the father is 172 cm. Also estimate the height of the father if the height of the son is 173 cm. What is the coefficient of correlation between the height of fathers and sons?	X	165	160	170	163	173	158	178	170	175	180	Y	173	168	173	165	175	168	173	170	173	178	8	CO1	BL3	1
X	165	160	170	163	173	158	178	170	175	180																		
Y	173	168	173	165	175	168	173	170	173	178																		
3	a	Evaluate $L^{-1} \left\{ \frac{3s^2 - 5}{(s-1)(s^2+1)} \right\}$	6	CO2	BL4	7																						
	b	Calculate the correlation coefficient between x and y from the following data $n=10, \sum x=140, \sum y=150, \sum (x-10)^2=180, \sum (y-15)^2=215, \sum (x-10)(y-15)=60$.	6	CO1	BL5	1																						
	c	Find Mean and Variance of Binomial Distribution	8	CO1	BL5	2																						
4	a	Compute spearman's rank correlation coefficient for the following data <table><tr><td>X</td><td>11</td><td>13</td><td>20</td><td>20</td><td>15</td><td>40</td></tr><tr><td>Y</td><td>12</td><td>18</td><td>24</td><td>24</td><td>49</td><td>24</td></tr></table>	X	11	13	20	20	15	40	Y	12	18	24	24	49	24	6	CO1	BL5	1								
X	11	13	20	20	15	40																						
Y	12	18	24	24	49	24																						



Bharatiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING

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



End Semester/Re-Examination – May/June 2026

	b	There are 80 fishes in a pool, out of which 10 are golden. 5 fishes are taken at random from the pool. What is the probability that (a) exactly 3 fishes are golden (b) At least 2 fishes are golden?	6	CO1	BL3	2																											
	c	For normal distribution, 30% items are below 45 and 8% items are above 64. Find the mean and variance of the normal distribution	8	CO2	BL3	3																											
5	a	Evaluate $L^{-1} \left\{ \log \left(\frac{(s-1)(s+2)}{(s^2+9)} \right) \right\}$	6	CO3	BL4,5	7																											
	b	Two random sample gave the following data <table border="1"><thead><tr><th>Sample No</th><th>Size</th><th>Mean</th><th>Variance</th></tr></thead><tbody><tr><td>1</td><td>1000</td><td>67.42</td><td>2.58</td></tr><tr><td>2</td><td>1200</td><td>67.25</td><td>2.5</td></tr></tbody></table> Is the difference between standard deviation significant?	Sample No	Size	Mean	Variance	1	1000	67.42	2.58	2	1200	67.25	2.5	6	CO2	BL4	4															
Sample No	Size	Mean	Variance																														
1	1000	67.42	2.58																														
2	1200	67.25	2.5																														
	c	Two independent samples of 8 & 7 items gave the following results <table border="1"><thead><tr><th>Sample</th><th>9</th><th>11</th><th>13</th><th>11</th><th>15</th><th>9</th><th>12</th><th>14</th></tr></thead><tbody><tr><td>A:</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Sample B:</td><td>10</td><td>12</td><td>10</td><td>14</td><td>9</td><td>8</td><td>10</td><td></td></tr></tbody></table> Examine whether the difference between the mean of samples is significant at 5% level of significance?	Sample	9	11	13	11	15	9	12	14	A:									Sample B:	10	12	10	14	9	8	10		8	CO2	BL2, BL4	
Sample	9	11	13	11	15	9	12	14																									
A:																																	
Sample B:	10	12	10	14	9	8	10																										
6	a	Evaluate $\int_0^{\infty} e^{-t} \sqrt{1+\sin t} dt$	6	CO3	BL5	6																											



Bharatiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING

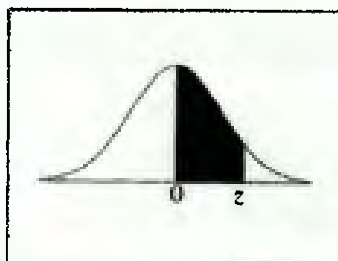
(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai - 400058



End Semester ~~Re-Examination~~ – May/June 2026

	b	Certain pesticide is packed into bags by a machine. A random sample of 10 bags is drawn and their contents are found to weigh (in kg) as follows 50, 49, 52, 44, 45, 48, 46, 45, 49, 45 Test if average packing can be taken to be 50 kg at 5% LOS.	6	CO2	BL3	5												
	c	Using Convolution Theorem, Evaluate $L^{-1} \left\{ \frac{s}{(s^2 + 4)^2} \right\}$	8	CO3	BL3, BL5	7												
7	a	Fit a Poisson distribution to the following data <table border="1" style="margin: 10px auto;"> <tr> <td>x</td> <td>0</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> </tr> <tr> <td>f</td> <td>122</td> <td>60</td> <td>15</td> <td>2</td> <td>1</td> </tr> </table>	x	0	1	2	3	4	f	122	60	15	2	1	6	CO1	BL2, BL3	2
x	0	1	2	3	4													
f	122	60	15	2	1													
	b	The distribution of marks obtained by a group of students may be assumed to be normal with mean 50 marks and standard deviation 15 marks. Estimate the proportion of students with marks less than 35. If 15% of the students secured more than K marks, determine K.	6	CO2	BL5	3												
	c	Using Laplace Transforms, solve the following differential equation $\frac{d^2 y}{dt^2} - 2 \frac{dy}{dt} + y = e^t, \text{ given that } y(0) = 2, y'(0) = -1$	8	CO3	BL1, BL3	7												

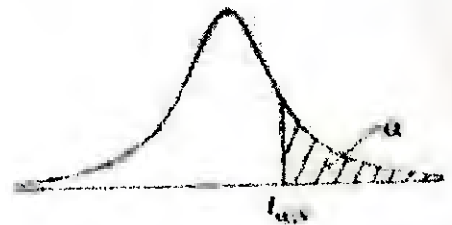
Standard Normal Distribution Table



z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
0.7	.2580	.2611	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
3.1	.4990	.4991	.4991	.4991	.4992	.4992	.4992	.4992	.4993	.4993
3.2	.4993	.4993	.4994	.4994	.4994	.4994	.4994	.4995	.4995	.4995
3.3	.4995	.4995	.4995	.4996	.4996	.4996	.4996	.4996	.4996	.4997
3.4	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4998
3.5	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998

Table of the Student's *t*-distribution

The table gives the values of $t_{\alpha, v}$ where
 $\Pr(T_v \geq t_{\alpha, v}) = \alpha$, with v degrees of freedom



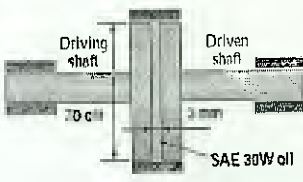
$\alpha \backslash v$	0.1	0.05	0.025	0.01	0.005	0.001	0.0005
1	3.078	6.314	12.076	31.821	63.657	318.310	636.620
2	1.886	2.920	4.303	6.965	9.925	22.326	31.598
3	1.638	2.353	3.182	4.541	5.841	10.213	12.924
4	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	1.319	1.714	2.069	2.500	2.807	3.485	3.767
24	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	1.296	1.671	2.000	2.380	2.660	3.232	3.460
120	1.289	1.658	1.980	2.358	2.617	3.160	3.373
∞	1.282	1.645	1.960	2.326	2.576	3.090	3.291

**END SEMESTER/RE-EXAMINATION, MAY-JUNE 2026**

20/5/26

PROGRAM: SY B.Tech. (Mechanical), Semester-IV
COURSE: PE-BTM402 – Fluid MechanicsTotal points: 100
Duration: 3 HOURS**Note:**

- Answer any 5 questions. Each question carries 20 points
- Answer should be question specific and to the point.
- All component of a question must be answered together.
- Data in the last column represents course outcome and Blooms Taxonomy of respective question

- | | | CO/BI |
|-----|--|----------|
| Q1. | A. Differentiate between -
a) Newtonian and Non-Newtonian flow
b) Manometer and Piezometer
c) Fan, Blower and Compressor
d) Series and Parallel flow | 10 1/2 |
| | B. The clutch system as shown in the adjacent figure, is used to transmit torque through a 3-mm-thick oil film with, $\mu=0.38 \text{ N.s/m}^2$, between two identical 30-cm-diameter disks. When the driving shaft rotates at a speed of 1450 rpm, the driven shaft is observed to rotate at 1398 rpm. Assuming a linear velocity profile for the oil film, determine the transmitted torque and power lost due to viscous effect. | 10 3/3 |
| |  | |
| Q2. | A. Derive an expression for the hydrostatic force and its point of action, acting on a thin plane surface of arbitrary shape immersed in a liquid and inclined at an angle θ to the free surface. Further, explain the method to determine the resultant force on a curved surface subjected to fluid pressure. | 10 2/3/3 |
| | B. Compare compressible and incompressible flows, highlighting their distinguishing characteristics and physical implications.
At a certain point in a flow of oxygen O_2 at 32°C , the flow velocity is 620 m/s
a) Calculate Mach number at this point.
b) Determine the corresponding stagnation temperature.
Assume suitable thermodynamic properties for oxygen. | 10 1,2/4 |
| Q3. | A. Derive Bernoulli's equation along a streamline starting from N-S Equation and clearly state the underlying assumptions. Discuss the physical meaning of each term and critically examine the limitations of the equation in real fluid flows.
With appropriate illustrations, explain the following concepts:
a) Static pressure, dynamic pressure, hydrostatic pressure, and stagnation pressure
b) Hydraulic gradient line and Energy gradient line. | 10 4/2,3 |
| | B. A test tube is spun in a centrifuge. The tube support is mounted on a pivot so that the tube swings outward as rotation speed increases. At high speeds, the tube is nearly horizontal. Find, (a) an expression for the radial component of acceleration of a liquid element located at radius r , (b) the radial pressure gradient dp/dr , and (c) the required angular velocity to generate a pressure of 250 MPa in the bottom of a test tube containing water. (The free surface and bottom radii are 50 and 130 mm, respectively.) | 10 3/2,3 |
| Q4. | A. Derive the general equation of hydrostatics stating necessary assumptions. Apply it to | 10 2/3 |

determine the pressure variation with depth in a liquid contained in a freely falling container, and comment on the result.

- B. Water flows steadily through a horizontal 90° pipe bend, turning from the x-direction to the y-direction. The inlet diameter is 0.30 m and the outlet diameter is 0.20 m. The discharge is 0.18 m³/s. The pressures at the inlet and outlet are 220 kPa and 140 kPa, respectively. Apply the Reynolds Transport Equation to determine the force components (x and y) exerted by the fluid on the bend. Also find the magnitude and direction of the resultant force. 10 2/4

- Q5. A. A viscous fluid is confined between two large parallel plates separated by a distance h. The lower plate is stationary, while the upper plate moves with a constant velocity U. Using the differential approach of flow analysis and listing all applicable assumptions, 10 3/2,3
- Derive an expression for the velocity distribution of the flow.
 - Determine the shear stress distribution across the gap.
 - Calculate the discharge per unit width.

- C. A second-degree velocity distribution in the boundary layer (U is free stream velocity) is given by, 10 3/4

$$\frac{u}{U} = 2\frac{y}{\delta} - \left(\frac{y}{\delta}\right)^2$$

Using the integral momentum equation determine the expression for the following terms.

- the boundary layer thickness
- the boundary layer skin friction coefficient,
- the displacement and momentum thicknesses.

- Q6. A. Answer the following with suitable explanations and equations: 10 1/2,1
- Differentiate between viscous stress and Reynolds stress.
 - How can you determine whether flow in a pipe is laminar or turbulent?
 - Write the velocity profile equations for laminar and turbulent pipe flow, and sketch their superimposed velocity distributions.
 - Define developing flow and fully developed flow. State the expressions used to estimate the entry length for laminar and turbulent flow.

- B. A pipeline of diameter 0.5 m and total length 1200 m carries water under a constant head difference of 25 m. To increase the discharge, an additional pipe of the same diameter is laid parallel to the existing pipe over the last 600 m length. 10 3,4/4
- Assuming Darcy friction factor $f=0.04$ for all pipes and neglecting minor losses, determine:
- The discharge through the pipeline before the additional pipe is introduced.
 - The discharge through the pipeline after the parallel pipe is added.
 - The percentage increase in discharge.

- Q7. A. Explain the concept of boundary layer formation and its growth over a surface. Discuss how boundary layer behaviour influences drag and lift forces acting on a body. 10 2,3/2

- B. Explain the concept of a streamline. Derive the general differential equation of a streamline for a given velocity field. 10 1/3,4
- If a flow field exhibits diverging streamlines, what can be inferred about the variation of velocity and pressure in that region? Justify your answer.
 - For a two-dimensional steady flow with velocity components $u=2x$, $v=-2y$, derive the equation of the streamlines.

**END SEMESTER MAY 2026 / ~~RE-EXAMINATION JULY 2026~~**

SET 1

27/9/26

Program: S.Y.B. Tech. (Mechanical Engineering)

Duration: 3 Hrs

Course Code: PC-BTM403

Maximum Points: 100

Course Name: Mechanical Measurement and Control

Semester: IV

Notes:

1. Question number 1 and 2 are compulsory
2. Solve any 3 questions from question number 3 to 7
2. If necessary assume suitable data with justification
3. Draw neat labeled sketches wherever required.

Q. No.	Questions	Points	CO	BL	M.N.
1 (a)	A temperature probe is transferred from air at 25°C to air at 35°C, then to water at 70°C, and back to air at 35°C. Assume that in each case the transfer is "instantaneous". The effective time constants and the timing sequence are as follows: In air, probe dry, $\tau = 35$ s; In water, $\tau = 2$ s; In air, probe wet, $\tau = 15$ s; For $t < 0$, $T = 25^\circ\text{C}$ (initial temperature) $0 < t < 7$, $T = 35^\circ\text{C}$ (dry probe in air) $7 < t < 15$, $T = 70^\circ\text{C}$ (probe in water), $15 < t < 30$, $T = 35^\circ\text{C}$ (wet probe in air). Calculate the indicated temperature at the end of each time interval and sketch the rough appropriate indicated temperature (time relationship between $t=0$ and $t=30$ s).	10	1,4	5	6
1 (b)	A bubbler or purge method is used to measure the water level. Air compressor having pressure range of 0-5 bar is used for the measurement of the water level. Air tube with opening at the bottom of the tank is used to purge the air in the water tank. Operator initially purge the 3 bar pressure in the air tube and no air bubbles are observed. The pressure is varied to maximum rating of 5 bar although no air bubble is observed. In fact at the setting of 5 bar pressure the water rises into the air tube up to 5 meters measured from bottom of the tank. Estimate the water level in the tank from the different observations provided.	10	1,2	3	4



Munshi Nagar, Andheri (W) Mumbai - 400058



Page 2 of 4



4 (b)	Explain step by step approach with labeled sketch to measure the flow rate of water coming at your home with valve full open using the devices/equipments/utilities available at home and found in daily usages. (Answer must be supported with neat labeled sketches)	10	1, 2, 3	5	4
5 (a)	The discharge coefficient C_d of an orifice can be found by collecting the water that flows through during a time interval when it is under a constant head h. The formula is $C_d = \frac{W}{\rho A \sqrt{2gh}}$ Find C_d and its possible error if: $W=390 \pm 0.25$ kg, $t=600 \pm 2$ s, $d=12 \pm 0.03$ mm, $\rho=1050 \pm 0.1\%$ kg/m³, $A=\pi d^2/4$, $h=3.6 \pm 0.03$ m, $g=9.81 \pm 0.1\%$ m/s²	10	1, 2	5	1
5 (b)	For the system having closed loop transfer function $T(s) = \frac{25}{s^2 + 5s + 25}$ find peak time, rise time, delay time, percent overshoot, and settling time.	10	4	5	6
6 (a)	An accelerometer has a seismic mass of 0.08 Kg and a spring constant of 2×10^3 N/m. Maximum mass displacement is ± 0.015 m (before mass hits the stop). Calculate (a) maximum measurable acceleration and (b) natural frequency.	10	1, 2	3	3, 4
6 (b)	It is proposed to develop measurement and control system for maintaining flow rate and pressure of water in pharmaceutical industry for operating to its best efficiency point. Proposed design aimed to retrieved data from system and controlled it remotely using internet network system. Students are instructed to present architecture of such network integrated measurement and control system (explain with neat schematic diagram).	10	1, 2, 3	5	4
7 (a)	A single strain gauge having resistance of 110Ω is mounted on a steel cantilever beam at a distance 0.15 m from the free end. The beam dimensions are 25 cm (length) x 2.0 cm (width) x 0.3 cm (depth). An unknown force F applied at the free end produces a deflection of 11.8 mm of the free end. If the change in gauge resistance is found to be 0.155Ω,	10	2, 3	5	2



Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai - 400058



END SEMESTER MAY 2026 / RE-EXAMINATION JULY 2026

SET 1

	calculate the gauge factor. Deflection of the free end $\delta = FL^3/3EI$. Take Young's modulus for steel as $200 \times 10^9 \text{ N/m}^2$																									
7 (b)	Following is the calibration data of a pressure transducer:	10	1,2	4	1,2																					
	<table><tr><th>q_i (Mpa)</th><th>q_o (increasing) (Mpa)</th><th>q_o (decreasing) (Mpa)</th></tr><tr><td>0</td><td>2</td><td>2</td></tr><tr><td>10</td><td>8</td><td>12</td></tr><tr><td>20</td><td>17</td><td>23</td></tr><tr><td>30</td><td>26</td><td>34</td></tr><tr><td>40</td><td>39</td><td>41</td></tr><tr><td>50</td><td>49</td><td>49</td></tr></table>					q_i (Mpa)	q_o (increasing) (Mpa)	q_o (decreasing) (Mpa)	0	2	2	10	8	12	20	17	23	30	26	34	40	39	41	50	49	49
	q_i (Mpa)					q_o (increasing) (Mpa)	q_o (decreasing) (Mpa)																			
	0					2	2																			
	10					8	12																			
	20					17	23																			
	30					26	34																			
	40					39	41																			
50	49	49																								
Find out: (i) The equation for the best-linear fit. (ii) The standard deviation of input q_i , output q_o , slope and intercept. (ii) q_i if the instrument reads $q_o=30$ after calibration.																										



Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai - 400058



25/5/22

END SEM/RE-EXAM EXAMINATION MAY / JUNE 2026

Program: BTECH (MECH.ENGG.)

Duration: 3 hrs

Course Code: MI-BT021

Maximum Points: 100

Course Name: Internet of Things (IOT)

Semester: IV

- Solve any 5 questions out of 7
- Figures to the right indicate full marks
- Provide figures wherever necessary

Q.No.	Questions	Points	CO	BL	PI
1	a) Explain the architecture, working principle, and industrial applications of the following intelligent edge computing platforms used in modern IoT ecosystems, along with neat figures • Arduino Board • Raspberry Pi b) With the help of suitable figures, explain the following stages in an advanced IoT ecosystem: • Smart Data Acquisition, Edge Sensing & Cloud Storage • Real-Time Data Processing, AI/ML Analytics & Predictive Intelligence • Interactive Data Visualization, Digital Dashboards & Automated Reporting	[10] [10]	1,2,3	2	3.2.1
2	a) Explain any two with neat sketches • Optical level sensor • Tuning fork level sensor • Capacitance level sensor b) In a smart farming system, sensors collect data such as soil moisture, temperature, and humidity. Explain the role of an IoT gateway in connecting these sensors to the cloud. Also, draw a neat labeled diagram showing the flow of data from sensors to the cloud through an IoT gateway	[10] [10]	1,2,3	2	5.1.2
3	a) Enlist the following two enabling technologies of IOT with figures? • Big data analytics • MEMS b) Write short notes on (any two) • NBIOT • SIGFOX • LORA & LORAWAN • Z-WAVE • ZIGBEE	[10] [10]	1,2,4	2	5.1.2

**END SEM/RE-EXAM EXAMINATION MAY / JUNE 2026**

4	Write short notes on (Any three) • Edge, fog & cloud computing • Technological challenges faced by IOT Devices • Consideration of the mounting requirements for sensors • Vibration sensor • Ultrasonic sensor	[20]	1,2,3	3	5.1.2
5	Compare and explain the following signal analysis approaches used in intelligent sensing and Industrial IoT systems: a) Digital Signal Processing (DSP) — Physics & Mathematics Based b) AI-Based Signal Decomposition — Data-Driven Learning Explain highlighting the following aspects -Working principle of both approaches -Mathematical modelling vs data-driven learning concepts -Signal filtering, feature extraction, and pattern recognition techniques -Role of AI/ML in adaptive signal decomposition and anomaly detection -Industrial applications in predictive maintenance, smart sensing, or condition monitoring -Comparative advantages, limitations, and future trends in intelligent signal analytics.	[20]	1,2,3	3	5.1.2
6	a) What is an Industrial Internet of Things (IIoT) platform, and how can it be used in a smart factory/smart grid computing to perform tasks like real-time monitoring, predictive maintenance, and secure communication between? Describe its key features with neat labelled framework? b) Compare Traditional smart sensor and AI enabled smart sensor	[15] [05]	3,4	3	5.1.2
7	a) Explain the following IOT protocols with neat figure • MQTT • AMQP • COAP • HTTP b) IOT – Block Chain Integration with neat labelled figure	[15] [05]	3,4	3	5.1.2
***** All the Best *****					



Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai - 400058

END SEM EXAMINATIONS (Even SEM) May 2026-2



Program: B.Tech Mechanical engg

Duration: 3.00 hr

Course Code: PC-BTM404

Maximum Points: 100

Course Name: Kinematics of Machinery

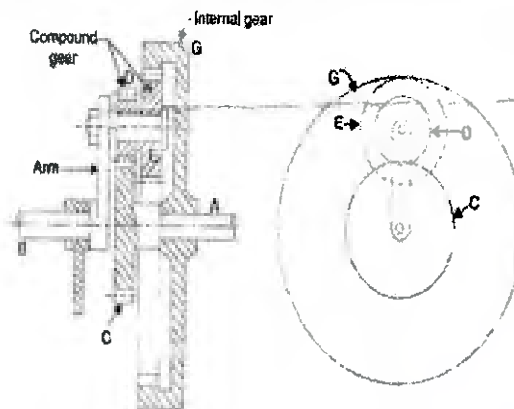
Semester: IV

Notes:

1. Question number **ONE is compulsory** solve any **four** out of remaining
2. **Question nos. two and three should be solved on drawing sheet.**
3. Answers to each sub-questions are grouped together
4. Use of scientific calculator is allowed
5. Begin answer to each question on new page.
6. **Candidates should write the answer legibly**

Q. No.	Questions	Pts	C o s	BL
1	a) State and explain Grashof's Law for a four-bar linkage b) What is the Coriolis component of acceleration ? Under what condition does it exist? c) State and explain Kennedy's Theorem . d) Sketch a Pantograph and state its primary application. e) What is Interference in gears? How can it be prevented?	4x5	1 2 3 4	1,2
2	a) A crank-rocker linkage has a 400 mm frame, a 200 mm crank, a 500 mm coupler and a 400 mm rocker. For the given mechanism find the minimum and maximum transmission angle. Sketch both the toggle position and find corresponding crank angles and transmission angles. (Note: Solve graphically and use 1:10 scale). b) For the above given mechanism, find the angular velocities and acceleration of coupler and follower if input uniform angular velocity of crank is 1 rad/sec. Crank makes 40 degrees with frame. (Use relative velocity and acceleration method).	8 12	3	3,4
3	a) Use following data in drawing the displacement, velocity, acceleration verses theta (θ) diagram for a cam in which a knife-edged follower is raised and lowered with SHM: least radius of cam 25 mm, lift 45 mm, angle of ascent 120° , angle of descent 90° , dwell between ascent and descent 40° , cam rotation 180 rpm. Determine the maximum velocity and acceleration during ascent and descent.	14	4	3

	b) Deduce the expression for displacement, velocity and acceleration of the follower when it moves with SHM.	6		
4	a) State the fundamental law of gearing, deduce the expression for the same. b) Two spur gears have 18 and 27 teeth respectively. The module is 4 mm and the pressure angle is 20° . If the addendum is one module, calculate: Length of the path of contact, angle of action for both the gears and contact ratio. Also calculate velocity of sliding at the beginning and end of contact.	6 14	4	3
5	a) Two shafts A and B are co-axial. Gear C (50 teeth) is rigidly mounted on shaft A. Compound gear D-E mesh with C and internal gear G. D has 20 teeth and gears with C, E has 30 teeth and gears with internal gear G. Gear G is fixed and concentric with shaft. The compound gear D-E is mounted on a pin, which projects from an arm keyed to the shaft B. If the shaft A rotates at 150 rpm, find the speed of the shaft B and number of teeth on gear G. b) Deduce the expression for minimum number of teeth on gear wheel.	10 10	4	4
6	In a slotted-lever crank mechanism, the distance between fixed pivots (vertical) is 50 cm and the crank which makes 150° with frame has length of 25 cm. If crank rotates at 90 rpm (uniform clock-wise) find the angular velocity and angular acceleration of the slotted lever.	20	3	2
7	a) Define kinematic pair and classify them based on various criterion. b) Compare Davis and Ackermann steering gears . Derive the condition for "correct steering" and explain why Ackermann is preferred in modern vehicles.	10 10	2	3





Bharatya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING

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



END SEMESTER EXAMINATION MAY 2026 / RE - EXAM JULY 2026

Program: S.Y. B. Tech. Mechanical

Duration: 03 Hr.

Course Code: PC-BTM405

Maximum Points: 100

Course Name: Dynamics of Machinery

Semester: IV

Notes:

1. Solve any FIVE questions.
2. Each question carries equal marks.
3. Assume suitable data wherever necessary and justify the same.

Q.No.	Questions	Points	CO	BL	Module No.
1 (a)	Derive the expression for the Energy Stored in a Flywheel.	10	1	1	1
1(b)	A rope brake dynamometer uses a brake drum of 0.6 m diameter. The load on the tight side is 250 N and slack side tension is 40 N. Calculate the brake power when the drum speed is 500 rpm.	10	1	1	1
2 (a)	An automobile is travelling along a curved track of 200 m mean radius. Each of the four road wheels have a mass of 80 kg with a radius of gyration of 0.4 m. The rotating parts of the engine have a mass moment of inertia of 10 kg m ² . The crankshaft rotates in the same direction as the road wheels. The gear ratio of the engine to the back wheels is 5:1. The vehicle has a mass of 3000 kg and its centre of gravity is 0.5 m above the road level. The width of the track of the vehicle is 1.5 m. Calculate the limiting speed of the vehicle around the curve for all four wheels to maintain contact with the road surface.	10	1	2	2
2 (b)	During a turning maneuver, how does the gyroscopic couple generated by the engine rotor influence the nose and tail movement of an aeroplane? Explain with suitable reasoning.	10	1	2	2
3 (a)	In a watt governor, the ball arms and sleeve arms are of equal length and are hinged on the spindle axis. Starting from the basic force balance, derive the equation relating governor height and speed. Hence prove that the equilibrium speed is independent of ball mass.	10	1	3	3
3 (b)	A Porter Governor has four equal arms, each of length 250 mm, with the upper arms pivoted on the spindle axis. Each rotating ball has a mass of 5 kg, while the central sleeve carries a load of 25 kg. The radius of rotation of the balls is 150 mm at the minimum equilibrium speed and 200 mm at the maximum equilibrium speed. Determine the following for the governor: 1. Minimum and maximum equilibrium speeds 2. Range of speed	10	1	3	3



Bharatiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING

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



END SEMESTER EXAMINATION MAY 2026 / RE - EXAM JULY 2026

	3. Total sleeve lift 4. Governor effort 5. Power of the governor Evaluate the above parameters for the following conditions: (a) Neglecting friction at the sleeve (b) Considering sleeve friction equivalent to 10 N. Also comment on the effect of sleeve friction on the sensitiveness and operating range of the governor.				
4 (a)	Explain the force distribution in a Double Block Brake system. Explain the concept of self-energizing action in a Double Shoe Brake.	10	1	3	4
4 (b)	Explain the uniform pressure and uniform wear theories used in the design of Multiple Disc Clutches.	10	1	2	4
5(a)	By considering the restoring force and equilibrium position of the system, derive the expressions for natural frequency in: • free longitudinal vibrations, and • free transverse vibrations.	10	3	2	5
5 (b)	Discuss the industrial applications and practical importance of longitudinal, transverse, and torsional free vibrations. Explain how resonance in each type of vibration can affect the safety and reliability of engineering systems.	10	3	3	5
6 (a)	An industrial machine of mass 8 kg is mounted on a vibration isolation system having an equivalent stiffness of 5.4 N/mm. To reduce excessive oscillations during operation, a viscous dashpot is connected to the system. The dashpot develops a damping force of 40 N when the vibrating mass moves with a velocity of 1 m/s. Based on the above data, determine the following characteristics of the vibrating system: 1. Critical damping coefficient 2. Damping ratio (damping factor) 3. Logarithmic decrement 4. Ratio of two successive amplitudes of vibration Assume the system undergoes underdamped free vibration.	10	4	3	6
6 (b)	A single degree of freedom mechanical system consisting of a mass, spring, and viscous damper undergoes free vibration without the action of any external periodic force. (a) Develop the differential equation governing the motion of the damped vibrating system using Newton's second law. (b) By assuming an appropriate solution to the governing equation, derive the expression for the frequency of damped oscillation of the system.	10	4	3	6



Bharatiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING

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



END SEMESTER EXAMINATION MAY 2026 / RE - EXAM JULY 2026

7 (a)	A high-speed marine propulsion shaft system carries four rotating masses A, B, C, and D of 200 kg, 300 kg, 400 kg, and 200 kg respectively. These masses rotate at radii of 80 mm, 70 mm, 60 mm, and 80 mm in different planes along the shaft. The planes of rotation are located such that, measured from plane A, planes B, C, and D are at distances of 300 mm, 400 mm, and 700 mm respectively. The angular positions of the masses measured anticlockwise are as follows: From A to B = 45°, From B to C = 70°, From C to D = 120° To eliminate unbalanced forces and couples during operation, two balancing masses are to be installed in planes X and Y. The location of the balancing planes is given below: - Distance between planes A and X = 100 mm - Distance between planes X and Y = 400 mm - Distance between planes Y and D = 200 mm If both balancing masses rotate at a radius of 100 mm, determine: - The magnitude of each balancing mass - The angular position of each balancing mass for complete dynamic balancing of the shaft system.	10	2	3	7
7 (b)	A high-speed centrifugal pump rotor carries an unbalanced rotating mass that produces excessive vibration and bending moments on the shaft during operation. To ensure smooth running and reduce bearing loads, the rotor is dynamically balanced using two balancing masses placed in different planes along the shaft. With the help of a neat sketch and vector diagrams, explain the principle of balancing a single revolving mass by two rotating masses placed in different planes. Also derive the necessary conditions for complete dynamic balancing of the system.	10	2	4	7



Bharatiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING

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



End Semester/Re-Examination – ~~May~~ ^{July} June 2026

Program: S.Y.B.Tech (Mechanical) **Second Year**

Duration: 3 Hours

Course Code: ES-BTM401

Sem-IV

Maximum Points: 100

Course Name: Statistics Probability and Laplace Transform

Semester: IV

Note:

13/07/26

1. Attempt Any Five Questions
2. Answers to the sub questions should be grouped together

		Questions	Points	CO	BL	Module																
1	a	The probability density function of a random variable is <table><tr><td>X</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>P(X)</td><td>2k</td><td>4k</td><td>5k</td><td>7k</td><td>10k</td><td>15k</td><td>17k</td></tr></table> Find (i) k (ii) $P(2 \leq X \leq 5)$ (iii) $P(X \geq 3)$	X	0	1	2	3	4	5	6	P(X)	2k	4k	5k	7k	10k	15k	17k	6	CO1	BL5	2
X	0	1	2	3	4	5	6															
P(X)	2k	4k	5k	7k	10k	15k	17k															
	b	An ambulance service claims that it takes an average of 8.9 minutes to reach its destination in emergency calls. To check this claim, the agency that licenses ambulance services has them timed for 80 emergency calls, yielding a mean of 9.1 minutes with a standard deviation of 1.5 minutes. What can they conclude at the 5% level of significance?	6	CO2	BL5	4																
	c	Evaluate (i) $L\{e^{-4t} \sin 3t \cdot \sin 2t\}$ (ii) $L\left\{\frac{\sin 3t}{t}\right\}$	8	CO3	BL3	6																
2	a	A potential buyer of light bulbs bought 50 bulbs of each of 2 brands. Upon testing the bulbs, he found that brand A had a mean life of 1282 hours with a standard deviation of 80 hours, and brand B had a mean life of 1256 hours with a standard deviation of 90 hours. Can the buyer be quite certain that the mean life of the two brands differ?	6	CO3	BL5	4																

**SARDAR PATEL COLLEGE OF ENGINEERING**

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai - 400058

**End Semester/Re-Examination - ^{July} May/June 2026**

	b	A random variable X has probability density function $f(x)=\begin{cases} Cx, & 1 \leq X \leq 2 \\ Cx^2, & 2 < X < 3 \\ 0, & \text{otherwise} \end{cases}$ Find the constant C and $P(X > 1.5)$	6	CO1	BL2	3																						
	c	The heights in cm of fathers (x) and of the sons (y) are given below <table border="1"><tr><td>X</td><td>165</td><td>160</td><td>170</td><td>163</td><td>173</td><td>158</td><td>178</td><td>170</td><td>175</td><td>180</td></tr><tr><td>Y</td><td>173</td><td>168</td><td>173</td><td>165</td><td>175</td><td>168</td><td>173</td><td>170</td><td>173</td><td>178</td></tr></table> Estimate the height of the son if the height of the father is 172 cm. Also estimate the height of the father if the height of the son is 173 cm. What is the coefficient of correlation between the height of fathers and sons?	X	165	160	170	163	173	158	178	170	175	180	Y	173	168	173	165	175	168	173	170	173	178	8	CO1	BL3	1
X	165	160	170	163	173	158	178	170	175	180																		
Y	173	168	173	165	175	168	173	170	173	178																		
3	a	Evaluate $L^{-1} \left\{ \frac{2s-3}{(s+1)^2(s+3)} \right\}$	6	CO2	BL4	7																						
	b	A sample of 25 pairs of values x and y gave the following results: $\sum x = 127, \sum y = 100, \sum x^2 = 760, \sum y^2 = 449, \sum xy = 500$. Later, it was found that two pairs of values were taken as (8,14) and (8,6) instead of the correct values (8,12) and (6,8). Find correct correlation coefficient between x and y.	6	CO1	BL5	1																						
	c	Find Mean and Variance of Poisson Distribution	8	CO1	BL5	2																						
4	a	Compute spearman's rank correlation coefficient for the following data <table border="1"><tr><td>X</td><td>36</td><td>56</td><td>20</td><td>42</td><td>33</td><td>44</td><td>50</td><td>15</td><td>60</td></tr><tr><td>Y</td><td>50</td><td>35</td><td>70</td><td>58</td><td>75</td><td>60</td><td>45</td><td>80</td><td>38</td></tr></table>	X	36	56	20	42	33	44	50	15	60	Y	50	35	70	58	75	60	45	80	38	6	CO1	BL5	1		
X	36	56	20	42	33	44	50	15	60																			
Y	50	35	70	58	75	60	45	80	38																			

**End Semester/Re-Examination – ^{July} May/June 2026**

	b	During war, 1 ship out of 7 was sunk on average during a certain voyage. What is the probability that out of a convoy of 6 ships (i) exactly 3 will arrive safely, (ii) at least 3 will arrive safely?	6	CO1	BL3	2																		
	c	For normal distribution 30% items are below 45 and 8% items are above 64. Find the mean and variance of the normal distribution	8	CO2	BL3	3																		
5	a	Evaluate $L^{-1} \left\{ \log \left(\frac{(s-1)(s-2)}{(s-3)(s-4)} \right) \right\}$	6	CO3	BL4,5	7																		
	b	Two random sample gave the following data <table border="1"><thead><tr><th>Sample No</th><th>Size</th><th>Mean</th><th>Variance</th></tr></thead><tbody><tr><td>1</td><td>1000</td><td>67.42</td><td>2.58</td></tr><tr><td>2</td><td>1200</td><td>67.25</td><td>2.5</td></tr></tbody></table> Is the difference between standard deviation significant?	Sample No	Size	Mean	Variance	1	1000	67.42	2.58	2	1200	67.25	2.5	6	CO2	BL4	4						
Sample No	Size	Mean	Variance																					
1	1000	67.42	2.58																					
2	1200	67.25	2.5																					
	c	Two independent samples of sizes 8 and 7 contained the following values <table border="1"><tbody><tr><td>Sample I</td><td>19</td><td>17</td><td>15</td><td>21</td><td>16</td><td>18</td><td>16</td><td>14</td></tr><tr><td>Sample II</td><td>15</td><td>14</td><td>15</td><td>19</td><td>15</td><td>18</td><td>16</td><td></td></tr></tbody></table> Is the difference between the sample means significant?	Sample I	19	17	15	21	16	18	16	14	Sample II	15	14	15	19	15	18	16		8	CO2	BL2, BL4	5
Sample I	19	17	15	21	16	18	16	14																
Sample II	15	14	15	19	15	18	16																	
6	a	Evaluate $\int_0^{\infty} e^{-t} t \sqrt{1+\sin t} dt$	6	CO3	BL5	6																		
	b	Test results for the breaking strength of 10 pieces of metal were: 578, 572, 570, 568, 572, 570, 570, 572, 596, and 584 kg. Test whether the mean breaking load of the metal wire can be assumed to be 577 kg at 5% LOS.	6	CO2	BL3	5																		

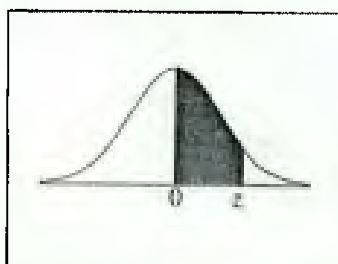


Bharatiya Vidya Bhawan's

SARDAR PATEL COLLEGE OF ENGINEERING(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai – 400058**End Semester/Re-Examination – ^{July}May/June 2026**

	c	Using Convolution Theorem, Evaluate $L^{-1} \left\{ \frac{s}{(s^2 + 1)^2} \right\}$	8	CO3	BL3, BL5	7												
7	a	Fit a binomial distribution to the following data <table border="1"><tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>f</td><td>12</td><td>66</td><td>109</td><td>59</td><td>10</td></tr></table>	x	0	1	2	3	4	f	12	66	109	59	10	6	CO1	BL2, BL3	2
x	0	1	2	3	4													
f	12	66	109	59	10													
	b	The weights of 5000 students are found to be normally distributed with mean 50 kilograms and standard deviation 5 kg. Find the number of students with weights (i) less than 45 kg. (ii) Between 45 and 60 kg.	6	CO2	BL5	3												
	c	Using Laplace Transforms, Solve the following differential equation $\frac{d^2y}{dt^2} + 6\frac{dy}{dt} + 9y = t^2 e^{-3t}$, given that $y(0) = 0$, $y'(0) = -1$	8	CO3	BL1, BL3	7												

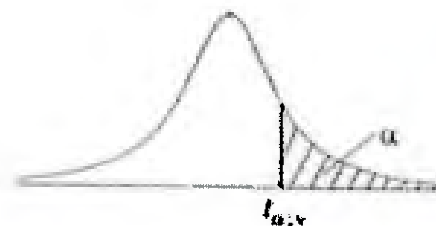
Standard Normal Distribution Table



z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
0.7	.2580	.2611	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
3.1	.4990	.4991	.4991	.4991	.4992	.4992	.4992	.4992	.4993	.4993
3.2	.4993	.4993	.4994	.4994	.4994	.4994	.4994	.4995	.4995	.4995
3.3	.4995	.4995	.4995	.4996	.4996	.4996	.4996	.4996	.4996	.4997
3.4	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4998
3.5	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998

Table of the Student's t -distribution

The table gives the values of $t_{\alpha;v}$ where
 $\Pr(T_v \geq t_{\alpha;v}) = \alpha$, with v degrees of freedom



$\alpha \backslash v$	0.1	0.05	0.025	0.01	0.005	0.001	0.0005
1	3.078	6.314	12.076	31.821	63.657	318.310	636.620
2	1.886	2.920	4.303	6.965	9.925	22.326	31.598
3	1.638	2.353	3.182	4.541	5.841	10.213	12.924
4	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	1.319	1.714	2.069	2.500	2.807	3.485	3.767
24	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	1.296	1.671	2.000	2.390	2.660	3.232	3.460
120	1.289	1.658	1.980	2.358	2.617	3.160	3.373
∞	1.282	1.645	1.960	2.326	2.576	3.090	3.291



SARDAR PATEL COLLEGE OF ENGINEERING

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



~~END SEMESTER EXAMINATION MAY 2026~~ / **RE - EXAM JULY 2026**

Program: S.Y. B. Tech. Mechanical

Course Code: PC-BTM405

Course Name: Dynamics of Machinery

Duration: 03 Hr.

Maximum Points: 100

Semester: IV

Sem = IV

14/07/26

Notes:

1. Solve any FIVE questions.
2. Each question carries equal marks.
3. Assume suitable data wherever necessary and justify the same.

Q.No.	Questions	Points	CO	BL	Module No.
1 (a)	Study of Engine Performance Characteristics Through Turning Moment Diagram of a Four-Stroke Engine. Illustrate the Turning Moment Diagram for a Multi-Cylinder Engine and explain its advantages over a single-cylinder engine.	10	1	1	1
1 (b)	In a Bevis-Gibson Flash Light Torsion Dynamometer, the shaft diameter is increased while transmitting the same power. Explain how the angular twist and instrument reading are affected.	10	1	1	1
2 (a)	The turbine rotor of a ship has a mass of 4000 kg. Its radius of gyration is 0.5 m and a speed of 3000 rpm clockwise when looking from stern. Determine the gyroscopic couple and its effect on the ship: (a) when the ship is steering to the left on a curve of 105 m radius at a speed of 36 km/h and (b) when the ship is pitching in a simple harmonic motion, the bow falling with its maximum velocity. The period of pitching is 45 s and the total angular displacement between the two extreme positions of pitching is 15°.	10	1	2	2
2 (b)	A fighter aircraft with a high-speed propeller takes a sudden right turn during flight. Discuss the gyroscopic effects acting on the aeroplane and their influence on flight stability.	10	1	2	2
3 (a)	Define and explain the following terms relating to governors: 1. Stability, 2. Sensitiveness, 3. Isochronism, and 4. Hunting.	10	1	3	3
3 (b)	A Porter Governor has equal upper and lower arms each 300 mm long, pivoted on the axis of rotation. Each governor ball has a mass of 6 kg and the central sleeve carries a load of 30 kg. The radius of rotation of the balls is 140 mm when the governor just begins to lift and 220 mm when the governor reaches its maximum speed position. Calculate the following: 1. Minimum equilibrium speed 2. Maximum equilibrium speed 3. Range of speed 4. Total sleeve lift 5. Governor effort 6. Power of the governor	10	1	3	3



SARDAR PATEL COLLEGE OF ENGINEERING

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



END SEMESTER EXAMINATION MAY-2026 / RE - EXAM JULY 2026

	Determine the above values for the following cases: (a) Neglecting friction at the sleeve (b) Considering sleeve friction equivalent to 15 N. Further, discuss the influence of sleeve friction on the stability and sensitiveness of the governor.				
4 (a)	Draw and explain a Single Shoe Brake. Why is it sometimes referred to as a self-energizing brake?	10	1	3	4
4 (b)	Derive an expression for the energy lost during engagement of a clutch when two rotating members initially have different angular speeds.	10	1	2	4
5 (a)	A vertical bar fixed at one end and carrying a load at the free end undergoes longitudinal vibrations. Starting from the equilibrium of forces, derive the expression for the natural frequency of free longitudinal vibrations. Hence determine whether the frequency depends on the magnitude of gravitational acceleration.	10	3	2	5
5 (b)	Explain with neat sketches the occurrence of: - longitudinal vibrations in drilling machines, - transverse vibrations in rotating blades, - torsional vibrations in gear drive systems.	10	3	3	5
6 (a)	A precision instrument is mounted on a helical spring and operates in an oil-damped environment where the damping resistance is directly proportional to the velocity of vibration. During testing, the system is found to execute damped vibrations at a frequency of 90 cycles per minute. It is also observed that after one complete cycle, the amplitude reduces to 20% of its original value. Determine the natural frequency of the system for undamped free vibration.	10	4	3	6
6 (b)	An automobile suspension system fitted with shock absorbers is designed to control excessive vibrations caused by road irregularities. With reference to such an industrial application, explain the following damping conditions in a vibrating system: - Underdamped condition, - Critically damped condition - Overdamped condition Also discuss the effect of each damping condition on ride comfort, stability, and vibration control in practical engineering systems.	10	4	3	6
7 (a)	A turbo-generator shaft system used in a thermal power plant carries four rotating masses P, Q, R, and S of 250 kg, 350 kg, 450 kg, and 300 kg respectively. The masses rotate at radii of 90 mm, 75 mm, 65 mm, and 85 mm in different planes along the shaft. Measured from plane P, the planes of masses Q, R, and S are located at distances of 350 mm, 500 mm, and 850 mm respectively. The angular positions of the masses measured anticlockwise are given as follows: P to Q = 50°, Q to R = 80°, R to S = 110°	10	2	3	7



Bharatiya Vidya Bhawan
SARDAR PATEL COLLEGE OF ENGINEERING

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



~~END SEMESTER EXAMINATION MAY 2026~~ RE - EXAM JULY 2026

	To minimize vibration and ensure stable operation, two balancing masses are to be installed in balancing planes M and N. The arrangement of the balancing planes is as follows: - Distance between planes P and M = 150 mm - Distance between planes M and N = 500 mm - Distance between planes N and S = 250 mm If the balancing masses rotate at a radius of 120 mm, determine: - The magnitude of each balancing mass - The angular position of each balancing mass required for complete dynamic balancing of the shaft system.				
7 (b)	In an aircraft engine crankshaft system, an unbalanced rotating mass may generate severe dynamic forces and couples, leading to vibration, noise, and reduced service life of bearings. To achieve smooth and reliable operation, the unbalanced mass is dynamically balanced using two rotating balancing masses placed in separate planes along the shaft. Explain, with the help of neat sketches, how a single revolving mass can be balanced by two masses rotating in different planes. Also discuss the conditions required for complete dynamic balancing in such systems.	10	2	4	7

**END SEMESTER MAY 2026 / RE-EXAMINATION-JULY 2026****SET 2***Second Year*Program: S.Y.B. Tech. (Mechanical Engineering)

Duration: 3 Hrs

Course Code: PC-BTM403

Maximum Points: 100

Course Name: Mechanical Measurement and Control*Sem-IV*
Semester: IV*15/07/26*

Notes:

1. Question number 1 and 2 are compulsory
2. Solve any 3 questions from question number 3 to 7
2. If necessary assume suitable data with justification
3. Draw neat labeled sketches wherever required.

Q. No.	Questions	Points	CO	BL	M.N.												
1 (a)	Reduce the block diagram shown in below figure to a single transfer function	10	4	5	5												
1 (b)	The flow of cooling water in a manufacturing process is measured by a horizontal venturimeter with 200 mm inlet and 100 mm throat. The U-tube mercury manometer connected between inlet and throat of venturi shows a differential pressure of 220 mm mercury. Calculate the water flow rate if coefficient of discharge is 0.98, specific gravity of mercury 13.6 and density of water 1000kg/m³	10	1,2	3	4												
2	Following table list the measuring instruments (left hand side column of the table) and its characteristics and/or application (right hand side column of the table) of the system. Students shall match the measuring instrument with the corresponding characteristics or application. <table><tr><th>Measuring Instruments</th><th>Characteristics/Measurand</th></tr><tr><td>Mercury in Glass Manometer</td><td>First Order System</td></tr><tr><td>McLeod Gauge</td><td>Liquid Level</td></tr><tr><td>Rotameter</td><td>Pressure</td></tr><tr><td>Float Gauges</td><td>Second Order System</td></tr><tr><td>Seismic Accelerometer</td><td>Flow rate</td></tr></table>	Measuring Instruments	Characteristics/Measurand	Mercury in Glass Manometer	First Order System	McLeod Gauge	Liquid Level	Rotameter	Pressure	Float Gauges	Second Order System	Seismic Accelerometer	Flow rate	05	1 to 4	4	2 to 7
Measuring Instruments	Characteristics/Measurand																
Mercury in Glass Manometer	First Order System																
McLeod Gauge	Liquid Level																
Rotameter	Pressure																
Float Gauges	Second Order System																
Seismic Accelerometer	Flow rate																



	Further student shall depict working principle of the measurement instrument listed on left hand side column of the table with only neat labelled sketch. (Note: Credits will be given only if match is perfect)	15			
3 (a)	A diaphragm pressure gauge is constructed of a spring steel to measure differential of 7 MN/m^2 . The diameter of diaphragm is 12.5 mm. Calculate the thickness of diaphragm, if the maximum deflection of 0.333 of thickness. Also calculate the natural frequency of diaphragm. Given: Youngs modulus= 200 GN/m^2 , Poissons ratio-0.28 and density of steel= 7800 kg/m^3 . Explain how diaphragm pressure gauge can be used for measurement of differential pressure.	10	2,3	4	4
3 (b)	Temperature is measured of a liquid system using mercury in glass thermometer. Temperature of a liquid system is 800°C . Time constant of thermometer is 5s. Estimate (i) temperature shown by thermometer after 4 and 10 seconds. (ii) temperatures at same time instances if thermometer is initially at 300°C . Recommend changes to be made in design of thermometer for better response of the system.	10	2,4	5	6
4 (a)	The transfer function of a measurement system is given as $\frac{361}{(s^2 + 16s + 361)}$ Find the following for a unit step input: Undamped natural frequency, damping ratio, damped natural frequency, settling time, peak time, rise time, percentage overshoot.	10	4	5	6
4 (b)	Explain step by step approach with labeled sketch to measure the relative humidity to be measured with the help of temperature measurement systems and concern chart. Explain the process plan with clear mention about the devices/equipment/utilities to be used. (Answer must be supported with neat labeled sketches)	10	1, 2,3	5	
5 (a)	The output power of a rotating shaft is measured by a dynamometer. The relationship for output power is $P = \frac{2\pi \times 9.81 FLR}{t \times 10^6} \text{ kW.}$ Where F=force at the end of torque arm, kg; L=length of torque arm, mm; R=Number of revolution during time t;	10	1,2	5	1



	t=time for test run, s. and The test data are: F=4.58±0.02 kg, L=397 ±1.3mm. R=1202±1 revolution, t=60±0.5 s. Find output power in kW and limiting error (kW) in measurement of power.																								
5 (b)	A system is given by differential equation $\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 8y = 8x$ where y=output and x=Input. Determine all time domain specifications for unit step input.	10	4	5	6																				
6 (a)	With neat labelled sketch explain (i) Laser Doppler Anemometer (ii) Optical Encoder	10	1,2	3	3,4																				
6 (b)	It is proposed to develop measurement and control system for maintaining flow rate and pressure of water in reaction type hydraulic turbine for operating to its best efficiency point. Proposed design aimed to retrieved data from system and controlled it remotely using internet network system. Students are instructed to present architecture of such network integrated measurement and control system (explain with neat schematic diagram).	10	1,2,3	5	4,7																				
7 (a)	The temperature T of a small copper sphere cooling in air is measured as a function of time τ to yield the following data: <table><tr><td>τ (s)</td><td>0.2</td><td>0.6</td><td>1.0</td><td>1.8</td><td>2.0</td><td>3.0</td><td>5.0</td><td>6.0</td><td>8.0</td></tr><tr><td>T (°C)</td><td>146.0</td><td>129.5</td><td>114.8</td><td>90.3</td><td>85.1</td><td>63.0</td><td>34.6</td><td>25.6</td><td>14.1</td></tr></table> An exponential decrease in temperature is expected from lumped mass modeling. Obtain a best fit to represent these data. Let us take the equation for the best fit to be $T = Ae^{-a\tau}$ where A and a are constants to be determined.	τ (s)	0.2	0.6	1.0	1.8	2.0	3.0	5.0	6.0	8.0	T (°C)	146.0	129.5	114.8	90.3	85.1	63.0	34.6	25.6	14.1	10	1,2	4	1,2
τ (s)	0.2	0.6	1.0	1.8	2.0	3.0	5.0	6.0	8.0																
T (°C)	146.0	129.5	114.8	90.3	85.1	63.0	34.6	25.6	14.1																
7 (b)	A strain gauge is bonded to a beam which is 12 cm long and has a cross sectional area of 3.8 cm ² . The unconstrained resistance and gauge factor of the strain gauges are 220 Ω and 2.2 respectively. On the application of axial load the resistance of the gauges changes by 0.015 Ω . If the modulus of elasticity for steel is 207x10 ⁹ N/m ² , calculate (i) The change in length of the steel beam (ii) The amount of force applied to the beam.	10	2,3	5	2																				



Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING, MUMBAI

DEPARTMENT OF MECHANICAL ENGINEERING



~~END SEMESTER~~/RE-EXAMINATION, ~~MAY-JUNE~~ 2026

July

PROGRAM: SY B.Tech. (Mechanical), Semester-IV

COURSE: PE-BTM402 – Fluid Mechanics

Sem - IV

Total points: 100
Duration: 3 HOURS

Note:

- Answer any 5 questions. Each question carries 20 points
- Answer should be question specific and to the point.
- All component of a question must be answered together.
- Data in the last column represents course outcome and Blooms Taxonomy of respective question

16/07/2026

CO/BI

- Q1. A. Answer the following with suitable explanations and equations: 10 1/2,1
- Differentiate between viscous stress and Reynolds stress.
 - How can you determine whether flow in a pipe is laminar or turbulent?
 - Write the velocity profile equations for laminar and turbulent pipe flow, and sketch their superimposed velocity distributions.
 - Define developing flow and fully developed flow. State the expressions used to estimate the entry length for laminar and turbulent flow.
- B. A pipeline of diameter 0.25 m and total length 1000 m carries water under a constant head difference of 25 m. To increase the discharge, an additional pipe of the same diameter is laid parallel to the existing pipe over the last 500 m length. Assuming Darcy friction factor $f=0.04$ for all pipes and neglecting minor losses, determine: 10 3,4/4
- The discharge through the pipeline before the additional pipe is introduced.
 - The discharge through the pipeline after the parallel pipe is added.
 - The percentage increase in discharge.
- Q2. A. Derive an expression for the hydrostatic force and its point of action, acting on a thin plane surface of arbitrary shape immersed in a liquid and inclined at an angle θ to the free surface. Further, explain the method to determine the resultant force on a curved surface subjected to fluid pressure. 10 2,3/3
- B. Compare compressible and incompressible flows, highlighting their distinguishing characteristics and physical implications. 10 1,2/4
- At a certain point in a flow of oxygen N_2 at $45^\circ C$, the flow velocity is 420 m/s
- Calculate Mach number at this point.
 - Determine the corresponding stagnation temperature.
- Assume suitable thermodynamic properties for oxygen.
- Q3. A. Derive Bernoulli's equation along a streamline starting from N-S Equation and clearly state the underlying assumptions. Discuss the physical meaning of each term and critically examine the limitations of the equation in real fluid flows. 10 4/2,3
- With appropriate illustrations, explain the following concepts:
- Static pressure, dynamic pressure, hydrostatic pressure, and stagnation pressure
 - Hydraulic gradient line and Energy gradient line.
- B. A test tube is spun in a centrifuge. The tube support is mounted on a pivot so that the tube swings outward as rotation speed increases. At high speeds, the tube is nearly horizontal. Find, (a) an expression for the radial component of acceleration of a liquid element located at radius r , (b) the radial pressure gradient dp/dr , and (c) the required angular velocity to generate a pressure of 250 MPa in the bottom of a test tube containing water. (The free surface and bottom radii are 50 and 130 mm, respectively.) 10 3/2,3

- Q4. A. Derive the general equation of hydrostatics stating necessary assumptions. Apply it to determine the pressure variation with depth in a liquid contained in a freely falling container, and comment on the result. 10 2/3
- B. Water flows steadily through a horizontal 60° pipe bend, turning from the x-direction to the y-direction. The inlet diameter is 0.30 m and the outlet diameter is 0.20 m. The discharge is 0.18 m³/s. The pressures at the inlet and outlet are 220 kPa and 150 kPa, respectively. 10 2/4

Apply the Reynolds Transport Equation to determine the force components (x and y) exerted by the fluid on the bend. Also find the magnitude and direction of the resultant force.

- Q5. A. A viscous fluid is confined between two large parallel plates separated by a distance h . The lower plate is stationary, while the upper plate moves with a constant velocity U . Using the differential approach of flow analysis and listing all applicable assumptions, 10 3/2,3
- Derive an expression for the velocity distribution of the flow.
 - Determine the shear stress distribution across the gap.
 - Calculate the discharge per unit width.

- B. A second-degree velocity distribution in the boundary layer (U is free stream velocity) is given by, 10 3/4

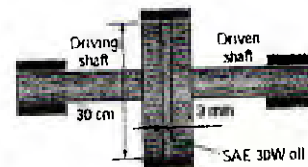
$$\frac{u}{U} = 2\frac{y}{\delta} - \left(\frac{y}{\delta}\right)^2$$

Using the integral momentum equation determine the expression for the following terms.

- the boundary layer thickness
- the boundary layer skin friction coefficient,
- the displacement and momentum thicknesses.

- Q6. A. Differentiate between - 10 1/2
- Newtonian and Non-Newtonian flow
 - Drag and Lift
 - Fan, Blower and Compressor
 - Series and Parallel flow

- B. The clutch system as shown in the adjacent figure, is used to transmit torque through a 3-mm-thick oil film with, $\mu = 0.38 \text{ N.s/m}^2$, between two identical 30-cm-diameter disks. When the driving shaft rotates at a speed of 1450 rpm, the driven shaft is observed to rotate at 1398 rpm. Assuming a linear velocity profile for the oil film, determine the transmitted torque and power lost due to viscous effect. 10 3/3



- Q7. A. Explain the concept of boundary layer formation and its growth over a surface. Discuss how boundary layer behaviour influences drag and lift forces acting on a body. 10 2,3/2
- B. Explain the concept of a streamline. Derive the general differential equation of a streamline for a given velocity field. 10 1/3,4
- If a flow field exhibits diverging streamlines, what can be inferred about the variation of velocity and pressure in that region? Justify your answer.
 - For a two-dimensional steady flow with velocity components $u=2x$, $v=-2y$, derive the equation of the streamlines.



Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai - 400058



~~END SEM EXAMINATIONS~~ (Even SEM) ~~May 2026~~

RE-EXAMINATION

July

17/07/26

Second Year

Program: BTech Mechanical engg

Duration: 3.00 hr

Course Code: PC-BTM404

Maximum Points: 100

Course Name: Kinematics of Machinery

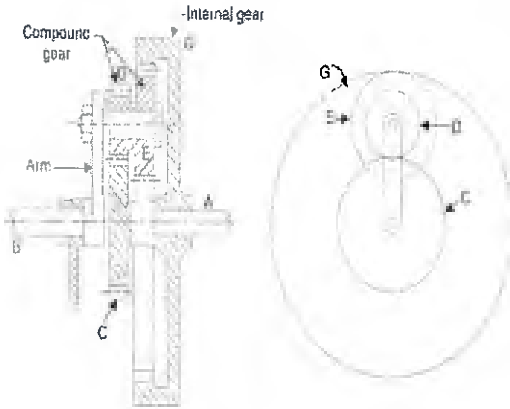
Sem-IV

Semester: IV

Notes:

1. Question number **ONE is compulsory** solve any **four** out of remaining
2. **Question nos. two and three should be solved on drawing sheet.**
3. Answers to each sub-questions are grouped together
4. Use of scientific calculator is allowed
5. Begin answer to each question on new page.
6. **Candidates should write the answer legibly**

Q.No.	Questions	Pts	Cos	BL
1	a) Define Kinematic Link, pair, mechanism and Structure. b) Write the Kutzbach criterion for the mobility of planar mechanisms and explain the terms involved in it. c) Define Instantaneous Centre of Rotation and classify them. d) Define Pressure Angle in cam mechanisms. Why is a smaller pressure angle preferred? e) What is Interference in gears? How can it be prevented?	4x5	1 2 3 4	2,3
2	a) A crank-rocker linkage has a 150 mm frame, a 50 mm crank, a 120 mm coupler and 80 mm rocker. For the given mechanism find the minimum and maximum transmission angle. Sketch both the toggle position and find corresponding crank angles and transmission angles. (Solve graphically, use half scale). b) For the above given mechanism, find the angular velocities and acceleration of coupler and follower. Crank having 2 rad/sec uniform angular velocity and makes 60° (counter clock wise) with the frame. (use relative velocity and acceleration method)	8 12	3	3,4
3	a) Use following data in drawing the displacement, velocity, acceleration verses theta (θ) diagram for a cam in which a knife-edged follower is raised and lowered with SHM: least radius of cam 30 mm, lift 60 mm, angle of ascent 150°, angle of descent 120°, dwell between ascent and descent 30°, cam rotation 150 rpm. Determine the maximum velocity and acceleration during ascent and descent.	14	4	3

	b) Deduce the expression for displacement, velocity and acceleration of the follower when it moves with cycloidal motion.	6		
4	a) State the fundamental law of gearing, deduce the expression for the same. b) Two spur gears have 24 and 30 teeth respectively. The module is 6 mm and the pressure angle is 20° . If the addendum is one module, calculate: Length of the path of contact, angle of action for both the gears and contact ratio. Also calculate velocity of sliding at the beginning and end of contact.	6 14	4	3
5	a) Two shafts A and B are co-axial. Gear C (40 teeth) is rigidly mounted on shaft A. Compound gear D-E mesh with C and internal gear G. D has 20 teeth and gears with C, E has 35 teeth and gears with internal gear G. Gear G is fixed and concentric with shaft. The compound gear D-E is mounted on a pin, which projects from an arm keyed to the shaft B. If the shaft A rotates at 120 rpm, find the speed of the shaft B and number of teeth on gear G. b) Deduce the expression for minimum number of teeth on gear wheel.	 10	4	4
6	In a slotted-lever crank mechanism, the distance between fixed pivots (vertical) is 50 cm and the crank which makes 120° with frame has length of 30 cm. If crank rotates at 60 rpm (uniform clock-wise) find the angular velocity and angular acceleration of the slotted lever.	20	3	3
7	a) State the conditions for straight line generating mechanism. Sketch the Peaucellier mechanism and prove that the tracing point 'P' describes the straight line. b) State and explain various approximate st. line generating mechanisms	10 10	2	3

**SARDAR PATEL COLLEGE OF ENGINEERING**

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai - 400058 *July*~~END SEM~~ **RE-EXAM EXAMINATION MAY / JUNE 2026**Program: BTECH (MECH. ENGG.) *Second Year* Duration: 3 hrsCourse Code: MI-BT021 *Sem-IV* Maximum Points: 100Course Name: Internet of Things (IOT) Semester: IV

- Solve any 5 questions out of seven
- Figures to the right indicate full marks
- Provide figures wherever necessary

20/07/26

Q.No.	Questions	Points	CO	BL	PI
1	a) Discuss the role of emerging technologies in the evolution of next-generation IoT systems. Explain the significance of 5G communication, Edge AI, and IoT-Blockchain integration in improving real-time analytics, decentralized security, intelligent decision-making, and autonomous IoT operations. Also discuss future trends and design opportunities in Industrial IoT ecosystems. b) Explain the following sensors with figures 1) Ultrasonic sensor 2) Temperature sensor	[10] [10]	1,2,3	2	3.2.1, 5.1.2
2	a) Explain the following two enabling technologies of IOT with figures? • Embedded Systems • Cloud computing b) Explain the following 1) Role of smart material in multi modal sensing 2) Role of IOT Autonomous Vehicles	[10] [10]	1,2,3	2	3.2.1, 5.1.2
3	Write short notes on (any three) • ZIGBEE • ZWAVE • SIGFOX • NB-IOT • LORA & LORAWAN	[20]	2,3	2	5.1.2
4	a) Design an IoT-based intelligent monitoring system for a smart industrial or smart city application of your choice. Provide the complete figure/architecture of the same. Justify the selection of suitable sensors, IoT hardware platforms, and communication protocols required for efficient system operation. Your answer should include: Criteria for selection of sensors based on accuracy, range, sensitivity, response time, and environmental conditions	[20]	2,3	2	5.1.2

**SARDAR PATEL COLLEGE OF ENGINEERING**

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai – 400058

**END-SEM/RE-EXAM EXAMINATION MAY / JUNE 2026**

	b) Selection and comparison of an IIoT platform c) Choice of suitable IoT communication protocols such as MQTT, HTTP, CoAP, ZigBee, LoRaWAN, Bluetooth, Wi-Fi, or 5G d) System architecture and data flow with neat block diagram e) Edge/cloud integration and real-time monitoring f) Power consumption, scalability, interoperability, and security considerations g) Industrial applications, implementation challenges, and future enhancements in Industry 4.0 ecosystems				
5	h) What is the significance of an IIOT platform? What is the difference between an IOT & IIOT platform? List the various types of IIOT platform? Explain any one IIOT platform in detail along with neat figure of its framework? i) Explain the disadvantages of microcontrollers & microprocessors as compared to an IOT ecosystem?	[15] [05]	2,3	2	5.1.2
6	a) Explain the role and architecture of IoT Gateways in modern IoT ecosystems with the help of a neat block diagram. Discuss their functions in protocol conversion, data aggregation, edge processing, device management, security, and cloud connectivity. Also explain the importance of IoT gateways in Industrial IoT (IIoT), smart manufacturing, and real-time intelligent monitoring systems. b) Explain new business & revenue models emerging in the realm of an IOT ecosystem	[15] [05]	3,4	2	5.1.2
7 (a)	Discuss the major privacy, security, and technological challenges faced in modern IoT ecosystems. Explain issues related to data security, device authentication, interoperability, scalability, power management, and real-time communication in large-scale IoT deployments. Also suggest suitable solutions for secure and reliable IoT implementation.	[10]	3,4	2	5.1.2
(b)	Explain the emerging business opportunities created by the Internet of Things (IoT) in smart manufacturing, healthcare, smart cities, logistics, and connected mobility. Discuss how IoT is transforming traditional business models, enabling data-driven services, predictive maintenance, intelligent automation, and new digital marketplaces.	[10]	3,4	2	5.1.2
***** All the Best *****					



Bharatiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING
(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai - 400058



Re Exam ~~End Semester~~ July 26 Examinations

SET A

Program: CME

Course Code: MIBT011

Course Name: Minor in Management
Principles of Management

Duration: 03 hours

Maximum Points: 100

Semester: IV

Note:

- Question 01 is compulsory
- Attempt any four questions out of remaining 06 questions
- Attempt main question and sub question together
- Draw neat charts wherever required

Sem-IV

20/07/26

Q.No.	Questions	Points	CO	BL
Q.1.A	Explain the functions of management—planning, organizing, staffing, directing, and controlling. Illustrate how these functions are interrelated and essential for achieving organizational goals.	10	01,2,	01
Q.1.B.	Write short notes on any two: 1. Leadership Traits 2. Management by Objectives (MBO) 3. Importance, advantages and Disadvantages of Forecasting 4. Difference between Authority and Power	10	01	L3
Q.2.A.	Explain different types of Organizational structures (functional, divisional, matrix). Compare their advantages and limitations with suitable examples.	10	02	L2
Q.2.B	Case: A retail chain is expanding into three new cities. The operations head must decide how to structure teams, whether to centralize decision-making at headquarters or give autonomy to local managers. Employees are confused about reporting lines, and duplication of tasks is occurring. Questions 1. Explain how proper organizing could resolve the confusion in reporting and duplication of tasks. 2. Recommend an organizational structure suitable for this expansion and justify your choice.	10	04	L5

Q.3.A.	Discuss the evolution of management thought. Compare the contributions of classical, behavioral and modern management approaches and examine their relevance in present-day organizations.	10	01	L1
Q.3.B	How will you classify the levels of Management in an organization? Describe the functions performed by different levels of Management.	10	02	L2
Q.4. A	Tata Motors has undergone significant transformation in recent years. The company faced declining sales and employee dissatisfaction. The leadership introduced new strategies, restructured teams, and implemented training programs to improve performance and morale. However, some employees resisted change due to fear of job loss and unclear communication. Questions: a Identify the leadership style adopted by the company. b What organizational barriers are evident in the case? c Suggest strategies to overcome employee resistance. d Evaluate the importance of training in organizational development.	10	03	L6
Q.4.B.	What are the basic characteristics of formal and informal organization? How does informal organization differ from formal organization?	10	02	L2
Q.5. A	Explain the concept and importance of controlling as a managerial function. Discuss the process of controlling and explain how effective control contributes to organizational efficiency and achievement of objectives.	10	04	L5
Q.5 B.	Discuss Henri Fayol's principles of management . Evaluate their relevance in today's dynamic and technology-driven business environment with suitable examples.	10	01	L2
Q.6.A.	A mid-sized IT company is preparing to launch a new software product. The CEO insists on entering the market quickly, but the project manager highlights the need for detailed planning—market research, competitor analysis, budgeting, and timeline allocation. The team is divided: some want to rush, while others stress structured planning. Questions 1. Identify the importance of planning in this case. How could poor planning affect the product launch? 2. Suggest two planning tools or techniques the project manager could use to balance speed and accuracy.	10	03	L4
Q.6.B	Define motivation and explain its significance in organizational behaviour. Critically discuss the major theories of motivation with suitable examples from workplace situations.	10	05	L2
Q.7. A.	Explain in detail the roles of a manager in an organisation. Draw a neat diagram too.	10	02	L2

Q.7. B	What is the importance of Directing in an organisation. How and why do directing and planning go hand in hand? Explain in detail the elements of Directing with examples.	10	03	L1
--------	---	----	----	----



Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)

Munshi Nagar, Andheri (West), Mumbai - 400058. July

~~End Semester Examination/ Re-Examination, May/June 2026~~

Second Year B.Tech
Mech.

Max. Marks: 100

Class: SY

Semester: IV

Name of the Course: Introduction to Robotics

Duration: 3 hr.

Program: Mechanical/Electrical

Course Code: MI-BT041

Instructions:

- Question 1 is compulsory.
- Illustrate your answers with neat sketches wherever necessary.
- Assume appropriate data if required and state your reason.
- Preferably, write the answers in sequential order.

Sem-IV 20/07/26

Question No		Maximum Marks	Course Outcome Number	Module No.
Q1	a. Explain with a sketch the difference between Spherical (RRP) and Articulated (RRR) robot work envelopes.	5	1	2
	b. Explain why a Hydraulic actuator is preferred over Pneumatic for lifting a 500kg car chassis.	5	2	4
	c. i. If the maximum count possible for an incremental rotary encoder is 6000 pulses and the encoder has a full-scale range of $\pm 270^\circ$, calculate the angular position corresponding to a count of $n = 1250$ pulses. ii. A linear potentiometer with a total length of 172 mm and a total resistance of 7 k Ω is used to measure the displacement of a robotic arm. The potentiometer is connected to a 12V reference voltage (V_R). If the wiper moves by 85 mm, determine: (a) The output voltage (V_0), (b) The resistance between the wiper and ground.	5	3	3
	d. Describe methods of robot programming and explain how they are applied in industrial environments.	5	4	6
Q2	a. Apply the concept of Degree of Freedom (DOF) to a human arm. Explain how a 3-DOF planar robot differs from a 6-DOF spatial robot in terms of tasks they can perform.	10	1	1

	b. Evaluate the design of a Remote Center Compliance (RCC) device. Explain with a sequence diagram how it solves the peg-in-hole misalignment problem without complex programming.	10	3	2
Q3	a. Justify the selection of an Electric Actuator over a Hydraulic Actuator for a SCARA robot performing delicate PCB assembly. Consider precision, force, speed, and maintenance.	10	2	2,4
	b. Explain the characteristics of robotic manipulators with respect to: Reach, Stroke, Accuracy, Precision, Repeatability. Discuss how these parameters influence robot selection for industrial tasks.	10	4	2
Q4	a. Explain the working principle of a camera vision system. Explain the concept of Pixel and resolution. If an image is 640x480 pixels, calculate the total number of pixels and determine if it is sufficient to detect a 1mm crack on a 100mm part.	10	3	3
	b. A Hall-effect sensor and a Tachometer are both used for velocity measurement. Compare their operating principles and evaluate which is more suitable for a low-speed, high-precision joint.	10	3	3
Q5	a. Differentiate between mechanical grippers and vacuum grippers in terms of: i. Working principle ii. Surface requirements iii. Suitability for fragile objects iv. Holding mechanism	10	1	4
	b. A two-finger parallel gripper holds a 2kg steel block vertically. The coefficient of friction is 0.4. Calculate the minimum gripping force required to prevent slippage (Assume $g=9.8 \text{ m/s}^2$, Safety factor=2). Analyze how surface oil on the metal changes the requirement.	10	3	4
Q6	a. Compare open-loop and closed-loop control systems with block diagrams. Give robotic examples where each is used.	10	3	5
	b. Explain the role of control systems in robotics with emphasis on PID control. Discuss the time-domain equation of a PID controller and explain the effect of each term on system performance.	10	2	5

Q7	a. An operator uses Walk-through programming for a paint robot. Explain the role of assistive devices in this method. Compare the density of recorded points required for a smooth paint finish vs. a simple pick-and-place operation.	10	3	6,7
	b. Distinguish between WAVE, AL, and AML languages historically. Explain why most robot manufacturers still use proprietary languages instead of standard Python or C++ for motion control, despite Python being open source.	10	4	6,7

**Previous Semester Examination July 2026**

	dimensions are 25 cm (length) x 2.0 cm (width) x 0.3 cm (depth). An unknown force F applied at the free end produces a deflection of 11.8 mm of the free end. If the changes in gauge resistance is found to be 0.145Ω , calculate the gauge factor. Deflection of the free end $\delta = FL^3/3EI$, where F= Force, L=Length, E= Youngs modulus, I=Moment of Inertia, Take Young's modulus for steel as $200 \times 10^9 \text{ N/m}^2$				
3 (B)	Explain working principle of Mcleod gauge with neat diagram. A Mcleod gauge has volume of bulb and measuring capillary equal to $110 \times 10^{-6} \text{ m}^3$ and measuring capillary diameter of 1.1 mm. (i) Calculate the pressure indicated when the reading of measuring capillary is 28 mm in case approximate formula is used. What is the error if the exact formula is used for pressure measurement?	10	3	2	3.1.1
4 (A)	A bubbler or purge method is used to measure the water level. Air compressor having pressure range of 0-5 bar is used for the measurement of the water level. Air tube with opening at the bottom of the tank is used to purge the air in the water tank. Operator initially purge the 3 bar pressure in the air tube and no air bubbles are observed. The pressure is varied to maximum rating of 5 bar although no air bubble is observed. In fact at the setting of 5 bar pressure the water rises into the air tube up to 5 meters measured from bottom of the tank. Estimate the water level in the tank from the different observations provided.	10	1	2	2.1.2
4 (B)	Following are the different applications/systems/processes wherein the temperature measurement is essential; (i) Processor of the computing system (ii) Temperature of human beings entering institute campus under COVID-19 pandemic situation. Students shall select the appropriate temperature measuring system for the above applications with justification and also explain their working principle with neat labelled sketches. (Note: Points will be assigned to explanation only if selection of system is appropriate).	10	4	6	3.8.1
5 (A)	A diaphragm pressure gauge is constructed of spring steel to measure differential of 7 MN/m^2 . The diameter of diaphragm is 12.5 mm. Calculate the thickness of diaphragm, if the maximum deflection is 0.333 of thickness. Also calculate the natural frequency of diaphragm. Given: Young's modulus= 200 GN/m^2 , Poisson's ratio-0.28 and density of steel= 7800 kg/m^3	10	2	4	4.1.1

**Previous Semester Examination July 2026**

5 (B)	In laboratory mercury in capillary tube temperature measurement system is available. It was proposed to measure humidity present in the laboratory. Explain step-by-step way to measure humidity. Draw appropriate sketches and flow diagram to explain the procedure	10	2	5	3.6.1
6	With neat labeled diagram explain working of (i) optical encoder (ii) stroboscope (iii) eddy current drag-cup tachometer (iv) piezo-electric accelerometer	20	2	3	2.1.2
7(A)	The discharge coefficient C_d of an orifice can be found by collecting the water that flows through during a time interval when it is under a constant head h . The formula is $C_d = \frac{W}{t\rho A\sqrt{2gh}}$ Find C_d and its possible error if: $W=390\pm0.25$ kg, $t=600\pm2$ s, $d=12\pm0.03$ mm, $\rho=1050\pm0.1\%$ kg/m ³ ; $A=\pi d^2/4$, $h=3.6\pm0.03$ m, $g=9.81\pm0.1\%$ m/s ²	10	4	4	4.1.2
7(B)	The speed of a shaft rotating at 2880 rpm is measured using stroboscope. The stroboscope dial is slowly turned within flashing rates of 96 to 24 per second. Indicate the flash rate setting which give single, double steady images.	10	3	4	2.1.2



Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING, MUMBAI

DEPARTMENT OF MECHANICAL ENGINEERING



PREVIOUS SEMESTER EXAMINATION, JULY 2026, (R18 & R22)

PROGRAM: SY B.Tech. (Mechanical), Semester-IV
COURSE: PE-BTM403 – Fluid Mechanics

Sem-IV

16/07/26

Total points: 100
 Duration: 3 HOURS

Note:

- Answer any 5 questions. Each question carries 20 points
- Answer should be question specific and to the point.
- All component of a question must be answered together.
- Data in the last column represents course outcome and Blooms Taxonomy of respective question

CO/BI

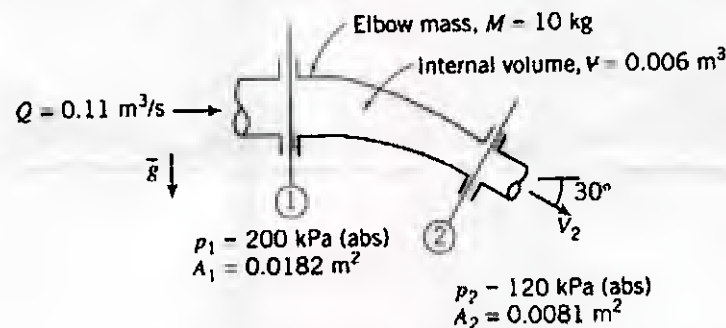
20 1,2/3

Q1 Discuss any Five (05) of the following items with suitable illustration:

- Effect of temperature on the viscosity of liquid and gas.
- Contact angle and capillarity
- Laminar and Turbulent flow
- Inclined Manometer
- Types of Non-Newtonian fluids,
- Local and convective acceleration

Q2 A What do you understand by boundary layer theory? Explain the development of boundary layer over flat plate with appropriate sketch. Discuss following terms in this context: (i) displacement thickness and (ii) momentum thickness. 10 1/1,3

B. Water flows through a 30 degree reducing elbow is shown figure below with available data. Using integral form of governing equation, estimate the component of force that must be provided by the adjacent pipes to keep the elbow from moving. 10 1/3



Q3. A. Develop differential form of general momentum equation. Simplify this equation to following standard equations and explain them: 10 3/2,3

- Euler's Equation,
- Stokes Equation, and
- Navier Stokes Equation

B. The velocity field in fluid medium is given by $\vec{V} = 3xy^2 \vec{i} + 2xy \vec{j} + (2zy + 3t) \vec{k}$, 10 4/3,4

Extract and compute following information from given flow field:

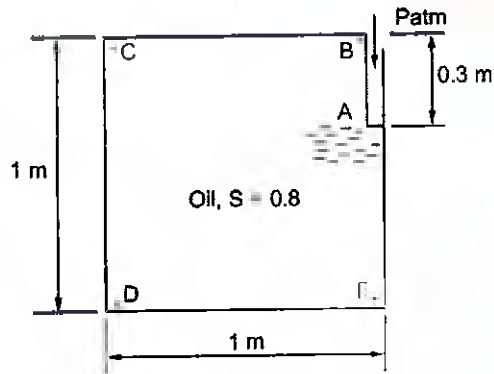
- dimensionality of flow,
- Is this flow possible?
- shear stress on XY plane,
- the magnitude and direction of (a) translational velocity, (b) acceleration, (c) rotational velocity and (d) vorticity of a fluid element at (1,2,1) and at time $t = 3$.

- Q4 A. Starting with the assumption made, derive an expression to estimate total pressure and centre of pressure on a submerged lamina inclined at angle θ from free surface. Analyse the expressions and write your conclusion. Mention the details of variables used in derivation. 10 4/2,3

- B. A container filled with oil of specific gravity 0.8 as shown in adjacent figure. A small opening at A is exposed to atmosphere. Determine the gauge pressure at B, C, D and E when (i) $a_x = 3.9 \text{ m/s}^2$ and $a_y = 0$, (ii) $a_x = 2.45 \text{ m/s}^2$ $a_y = 4.902 \text{ m/s}^2$.

Determine also the values of a_x and a_y if

$$P_A = P_B = P_C$$



10 5/3,4

- Q5 A. (i) What is turbulence? Discuss its characteristic features along with merits and demerits for a flow system. 10 2/3
(ii) Discuss Prandtl's mixing length model of turbulence. 10 2/4,5

- B. Air moves over a flat plate with a uniform free stream velocity of 10 m/s. At a position 15 cm away from the front edge of the plate, what is the boundary layer thickness?

Carry out the calculation after developing an expression for boundary layer thickness using parabolic velocity profile.

10 5/2,1

- Q6 A. Explain your understanding about following points.

- Moody Chart
- Characteristics of a turbulent flow
- Developed and developing flow
- Coefficient of drag and lift

- B. A pipeline of 0.6 m in diameter is 1.5 km long. In order to augment the discharge, another parallel line of the same diameter is introduced in the second half of the length. Neglecting minor losses, find the increase in discharge if $f = 0.04$. The head at inlet is 30 m over that at the inlet. 10 6/3

- Q7 A. Write boundary layer equation under the assumption proposed by Prandtl. What is Von Karman's Momentum Integral equation? Derive a mathematical expression for it. 10 7/1

- B. Under ideal conditions show that the volume flow rate through a venturimeter (a device used to measure flow rate) is given by 10 3/4,5

$$Q = \frac{A_1 A_2}{\sqrt{A_1^2 - A_2^2}} \sqrt{2g \left(\frac{P_1 - P_2}{\rho g} + (Z_1 - Z_2) \right)}$$

Where suffix 1 and 2 refer to the inlet and the throat of the venturimeter. Derive it with assumptions applicable.



Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai - 400058



Previous- SEM EXAMINATIONS July- 2026(R18/R22)

Second Year

Program : BTech Mechanical engg

Duration: 3.00 hr

Course Code: PC-BTM 412

Maximum Points: 100

Course Name: Kinematics of Machinery

*Sem
IV*

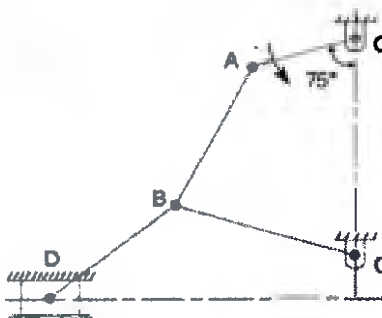
Semester: IV

Notes:

1. Question number ONE is compulsory solve any four out of remaining
2. Question nos. 2,3 and 4 should be solved on drawing sheet.
3. Answers to each sub-questions are grouped together
4. Use of scientific calculator is allowed
5. Begin answer to each question on new page.
6. Candidates should write the answers legibly

17/07/26

Q	Description	Pts	Cos	BL	Md
1	Explain the following : a) Kennedy's theorem b) Mobility of Mechanism c) Mechanism d) Grashoff's law e) Types of Inversion of simple four bar chain (4R-0P) f) The criteria of classification of kinematic pair g) Interference in gear mesh h) Pitch point on cam profile i) Coriolis component of acceleration j) Contact ratio in gear	20	1 2	1,2	1,2,4 ,5,6
2	a) A crank-rocker linkage has a 65 mm frame, a 28 mm crank, a 49 mm coupler and a 44 mm rocker. For the given links draw the minimum and maximum transmission angle. Also draw both the toggle position and measure corresponding crank angles and transmission angles. (Solve graphically). b) In a slider crank mechanism crank is 25 mm long and connecting rod is 110 mm long. Find velocity and acceleration of the slider by analytical method (complex algebra) if crank is making an angle of 35° with horizontal in ccw direction and rotating with the uniform angular velocity of 10 rad/sec in cw direction.	10 10	1,3	3,4	2,3

3	a) Use following data in drawing the displacement, velocity, acceleration verses theta (θ) diagram for a cam in which a roller follower is raised with SHM and is lowered with SHM: least radius of cam 20 mm, lift 50 mm, angle of ascent 120°, angle of descent 120°, dwell between ascent and descent 50°, cam rotation 180 rpm. Determine the maximum velocity and acceleration during ascent and descent. b) Draw Davis steering gear mechanism and derive the expression correct steering	10	4	3	5
Q4	In Fig., the angular velocity of the crank OA is 600 rpm. The dimensions of various links are: OA = 28 mm; AB = 44 mm; BC = 49 mm; and BD = 46 mm; OC = 65 mm. The path of travel of the slider is 11 mm below the fixed point C. The slider moves along a horizontal path and OC is vertical. (link number OC-1, OA-2, AB- 3, BC- 4, BD- 5, Slider -6)  Determine the linear velocity of the slider D and the angular velocity of the link BD, AB and BC. Using: a) IC method (take 1:1 scale and locate all IC's) b) Relative velocity method	12	4	3	6
5	a) State the fundamental law of gearing, deduce the expression for the same. b) A 5 mm module 19 teeth pinion is to drive a 23 teeth gear. The gears are cut on the 20° full-depth involute system. Find and tabulate the addendum, dedendum, clearance, circular pitch, base pitch, base circle radii, length of paths of approach and recess, and contact ratio.	8	4	3	6
6	a) A spur gears with 9 and 36 teeth are to be cut with 20° full-depth cutter with module of 8 mm. i. Determine the amount that the addendum of the gear must be decreased in order to avoid the interference. ii. If the addendum of the pinion is increased by the same amount, determine the contact ratio. b) Deduce the expression for minimum number of teeth on gear wheel.	10	4	4	6
7	a) State the conditions for straight line generating mechanism. Sketch the Peaucellier mechanism and prove that the tracing point 'P' describes the straight line. b) A driving shaft of a Hooke's joint rotates at a uniform speed of 400 rpm. If the maximum variation in the driven shaft is $\pm 5\%$ of the mean speed, determine the greatest permissible angle between the axes of the shafts. What are the maximum and minimum speeds of the driven shaft?	10	2	3	4



Bharatiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous
Institute) Munshi Nagar, Andheri (W) Mumbai - 4



PREVIOUS SEMESTER EXAMINATION JULY 2026

Program: B.Tech Second Year Mechanical

Duration: 03 Hours

Course Code: PC-BTM406

Sem-IV

Maximum Points: 100

Course Name: Material Science (R22)

Semester: IV

Notes:

1. Question no 1 is compulsory
2. Attempt any four questions from the remaining six questions.
3. If necessary assume suitable data with justification
4. Draw neatly labeled sketches wherever required.

14/7/26

Q. No.	Questions	Points	CO	BL	Module No.
1A	Explain the formation of a TTT diagram using concepts like nucleation rate, growth rate, and overall transformation rate. Draw different cooling rates on a TTT diagram and find the grain size at the end of each cooling curve (i.e., fast cooling, medium cooling, and slow cooling). write their properties.	10	3,4	4,5	3
1B	Elucidate the mechanism by which heat is extracted from a component when liquid quenching media are employed. With a suitable schematic diagram, explain bainite. Analyze the differences between upper and lower bainite.	10	1,3	4,5	5
2A	Explain the physics of atomization with a suitable diagram in powder metallurgy. Explain the gas atomization process.	06	4	2	7
2B	What determines the properties of materials? What are functionally graded materials?	06	1,2	3	1
2C	From the data given below for the Cu-Ni system, plot the equilibrium diagram to scale and label the diagram. The melting point of Cu: 1,085 °C. the melting point of Ni: 1,455 °C Answer the following for 70%Ni alloy composition: A. What is the composition of the first solid crystallizing out from liquid? B. What is the composition of the last liquid present at the end of the solidification process? C. What is the amount of solid and liquid at 1240 °C?	8	3	4,5	3

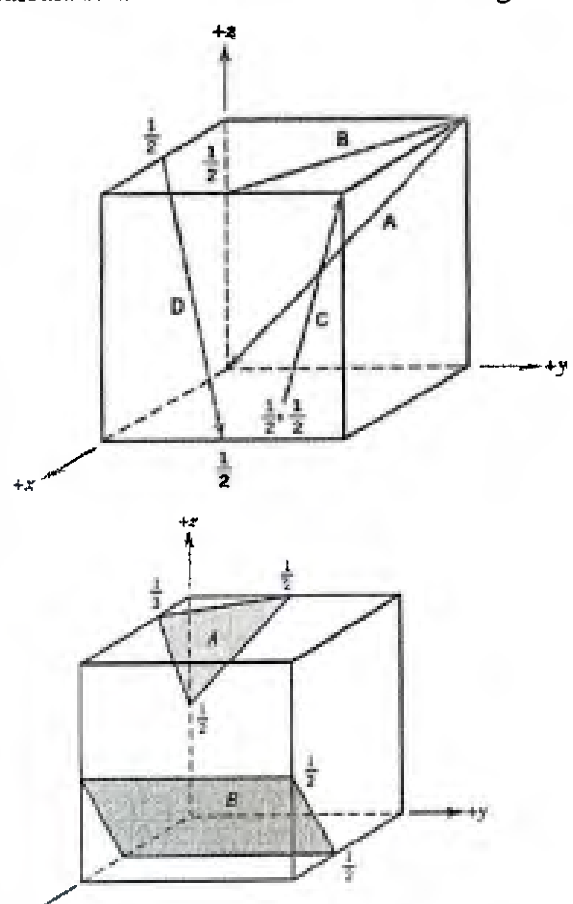


Bharatiya Vidya Bhavan's SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous
Institute) Munshi Nagar, Andheri (W) Mumbai - 4



PREVIOUS SEMESTER EXAMINATION JULY 2026

	<table><tr><td>Weight % Ni</td><td>20</td><td>40</td><td>60</td><td>80</td></tr><tr><td>Liquidus temp. °C</td><td>1200</td><td>1275</td><td>1345</td><td>1440</td></tr><tr><td>Solidus Temp °C</td><td>1165</td><td>1235</td><td>1310</td><td>1380</td></tr></table>	Weight % Ni	20	40	60	80	Liquidus temp. °C	1200	1275	1345	1440	Solidus Temp °C	1165	1235	1310	1380				
Weight % Ni	20	40	60	80																
Liquidus temp. °C	1200	1275	1345	1440																
Solidus Temp °C	1165	1235	1310	1380																
3 A	Determine the Miller indices for the directions and the planes shown in the following unit cell:[Note: provide the stepwise calculations for the given problem] 	10(6+4)	3	5	2															
3B	You have been designated as a material engineer in the medical implant sector, with the task of recommending a suitable material for total hip replacement. Provide your choice of material and its rationale in detail. Justify the reasons behind the selection of this specific material.	05	1	4	1															



Bharatiya Vidya Bhavan's

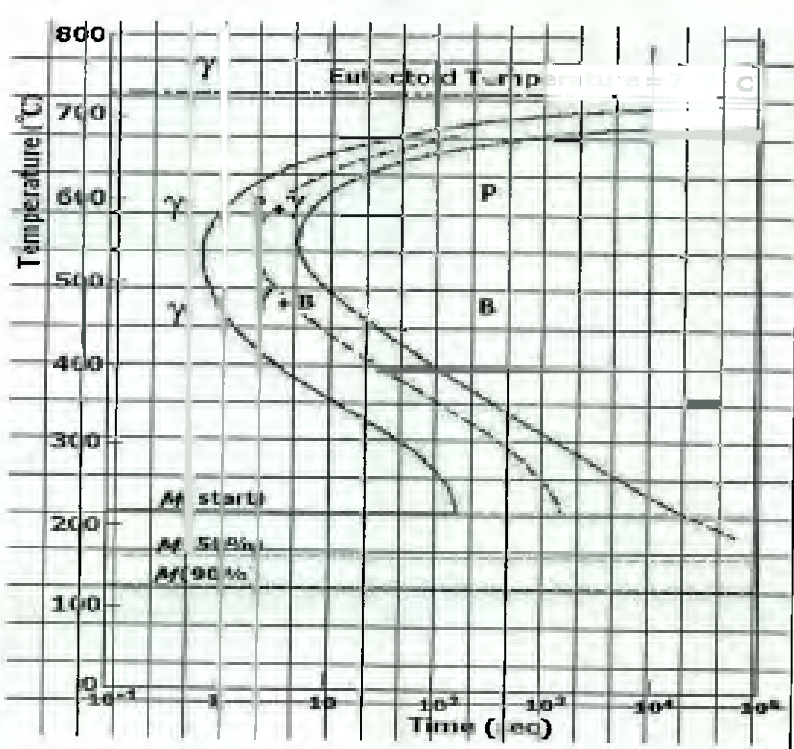
SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous

Institute) Munshi Nagar, Andheri (W) Mumbai – 4



PREVIOUS SEMESTER EXAMINATION JULY 2026

3C	Critically analyze what a Burgers vector is and describe its significance in materials science. Illustrate and explain the position of the Burgers vector for both edge dislocations and screw dislocations.	05	2	3	2
4A	Discuss each case of the heat treatment process of Fe-0.65% C eutectoid steel rapidly cooled from a preheated temperature of 860°C (>727°C) as follows [NOTE: explain, write properties of the final product] 1. Rapidly cool to 630°C, hold for 10 s, rapidly cool to 590°C hold for 10³ s and quench to room temperature 2. Rapidly cool to 300°C, hold for 60 s and quench to room temperature; 3. Rapidly cool to 620 °C, hold for 10 s, rapidly cool to 350 °C, hold for 10⁴ s and quench to room temperature; 	10	4	4	5
4B	Critically analyze what stainless steel is and write the different types of stainless steel. Identify which type of stainless steel is not heat treatable and explain the reasons behind it.	05	4	3	4
4C	Using a schematic diagram, elucidate the powder bed fusion method of additive manufacturing. Discuss the concept of material flowability in additive manufacturing.	05	2	3	7
5A	Write the effect of alloying elements on the properties of materials when they are added to the material composition. 1. Nickel 2. Molybdenum	06	4	4	04



Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous

Institute) Munshi Nagar, Andheri (W) Mumbai - 4



PREVIOUS SEMESTER EXAMINATION JULY 2026

	3. Vanadium 4. Cobalt 5. lead				
5B	Define nanomaterials and elaborate on the top-down and bottom-up approaches used in their synthesis. write any two applications of nanomaterials.	06	4	4	6
5C	Draw Fe-C equilibrium diagram and label the temperature, composition, and phases. Is cementite a compound or a solid solution? Why? Why is the iron-carbon equilibrium diagram drawn up to 6.67% of carbon? Write the peritectic reaction and Determine the exact amount of δ -ferrite and liquid in it.	8	3	4	3
6A	Classify composites based on the form of reinforcement and provide a detailed explanation of fibrous composite materials. Additionally, discuss why mechanical properties are significantly improved at the micro scale compared to the macro scale.	08	4	4	6
6B	Write a composition of the following materials and their application. 1 Cartridge Brass 2 Admiralty gun metal 3 Dow metal	06	3,4	3	4
6C	Discuss the reasons for the increasing demand of ceramic materials in engineering applications. Classify ceramic materials and list their properties.	06	4	3	6
7A	Calculate the equilibrium no of vacancies per cubic meter for copper at 1000°C . The energy for vacancies formation is 0.9eV/atom . The atomic weight and density (at 1000°C) for copper are 63.5 g/mol and 8.4g/cm^3 respectively.	06	2,3	4	2
7B	Explain the characterization of metal powders properties for the following: 1 Particle size and size distribution 2 Particle shape 3 Apparent density 4 Flowability	07	1,4	3	7
7C	Analyze the effect of different process parameters on recrystallization. Draw a graph of annealing temperature versus grain size, tensile strength, and ductility, considering the recrystallization process. Analyze the relationships and implications of these variables	07	4,3	4	5

**PREVIOUS SEMESTER EXAMINATION, JULY 2026, (R23)***Second Year**Sem - IV**16/07/26***PROGRAM:** SY B.Tech. (Mechanical), Semester-IV**COURSE:** PE-BTM402 – Fluid MechanicsTotal points: 100
Duration: 3 HOURS**Note:**

- Answer any 5 questions. Each question carries 20 points
- Answer should be question specific and to the point.
- All component of a question must be answered together.
- Data in the last column represents course outcome and Blooms Taxonomy of respective question

CO/BI

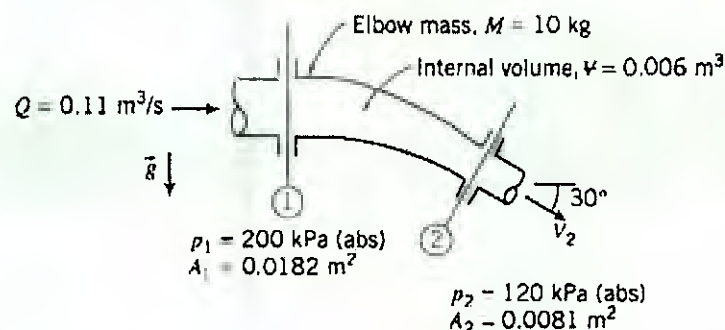
Q1 Discuss any Five (05) of the following items with suitable illustration:

20 1,2/3

- Effect of temperature on the viscosity of liquid and gas.
- Contact angle and capillarity
- Laminar and Turbulent flow
- Inclined Manometer
- Types of Non-Newtonian fluids,
- Local and convective acceleration

Q2 A. What do you understand by boundary layer theory? Explain the development of boundary layer over flat plate with appropriate sketch. Discuss following terms in this context: (i) displacement thickness and (ii) momentum thickness. 10 1/1,3

B. Water flows through a 30 degree reducing elbow is shown figure below with available data. Using integral form of governing equation, estimate the component of force that must be provided by the adjacent pipes to keep the elbow from moving. 10 1/3



Q3. A. Develop differential form of general momentum equation. Simplify this equation to following standard equations and explain them: 10 3/2,3

- Euler's Equation,
- Stokes Equation, and
- Navier Stokes Equation

B. The velocity field in fluid medium is given by $\vec{V} = 3xy^2 \vec{i} + 2xy \vec{j} + (2zy + 3t) \vec{k}$, 10 4/3,4

Extract and compute following information from given flow field:

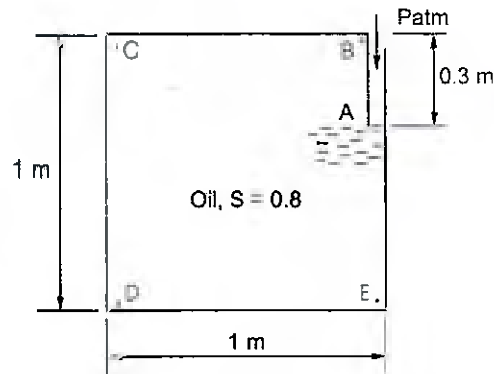
- dimensionality of flow,
- Is this flow possible?
- shear stress on XY plane,
- the magnitude and direction of (a) translational velocity, (b) acceleration, (c) rotational velocity and (d) vorticity of a fluid element at (1,2,1) and at time $t = 3$.

- Q4 A. Starting with the assumption made, derive an expression to estimate total pressure and centre of pressure on a submerged lamina inclined at angle θ from free surface. Analyse the expressions and write your conclusion. Mention the details of variables used in derivation. 10 4/2,3

- B. A container filled with oil of specific gravity 0.8 as shown in adjacent figure. A small opening at A is exposed to atmosphere. Determine the gauge pressure at B, C, D and E when (i) $a_x = 3.9 \text{ m/s}^2$ and $a_y = 0$, (ii) $a_x = 2.45 \text{ m/s}^2$ $a_y = 4.902 \text{ m/s}^2$.

Determine also the values of a_x and a_y if

$$P_A = P_B = P_C$$



10 5/3,4

- Q5 A. (i) What is turbulence? Discuss its characteristic features along with merits and demerits for a flow system. 10 2/3
(ii) Discuss Prandtl's mixing length model of turbulence. 10 2/4,5

- B. Air moves over a flat plate with a uniform free stream velocity of 10 m/s. At a position 15 cm away from the front edge of the plate, what is the boundary layer thickness?

Carryout the calculation after developing an expression for boundary layer thickness using parabolic velocity profile.

- Q6 A. Derive Bernoulli's equation from N-S equation applied along streamlines. Discuss its scope also. 10 3/2,3

- B. The velocity distribution in a pipe is given by, $u = u_{\max} \left[1 + \left(\frac{r}{R} \right)^n \right]$ 10 3/4

where, $u_{\max}$ the maximum velocity, u is the velocity profile at a section and R is the pipe radius. Obtain an expression for mean velocity in terms of $u_{\max}$ and n .

- Q7. A Write boundary layer equation under the assumption proposed by Prandtl. What is Von Karman's Momentum Integral equation? Derive a mathematical expression for it. 10 7/1

- B With a neat sketch, explain the components of a high head hydroelectric power plant and its working. How it differs from mid head and low head power plants. 10 3/1,2
a)