



Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai - 400058

**END SEM/RE-EXAM EXAMINATION MAY / JUNE 2023**

Program: MECHANICAL

Course Code: BS-BTM401

Course Name: Statistics, Probability & LT

- Attempt any five out of seven questions
- Use of scientific calculator is allowed.

Duration: 03 Hours

Maximum Points: 100

Semester: IV

1315/25

QNO	QUESTION	PO INT S	C O	BL	Mod ule no.														
a)	Fit a binomial distribution for the following data and compare the theoretical frequencies with the actual ones: <table><tr><td>X</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>f</td><td>2</td><td>14</td><td>20</td><td>34</td><td>22</td><td>8</td></tr></table>	X	0	1	2	3	4	5	f	2	14	20	34	22	8	06	3	2	4
X	0	1	2	3	4	5													
f	2	14	20	34	22	8													
Q1b)	An urn contains 4 white and 3 red balls. Three balls are drawn with replacement, from this urn. Find μ, σ^2 and σ for the number of red balls drawn.	06	2	2	4														
Q1c)	Obtain laplace transform of $f(t) = \sin \sqrt{t}$	08	1	1	1														
Q2 a)	A & B throw alternately with a pair of ordinary dice. 'A' wins if he throw '6' before 'B' throw '7' and B wins if he throws '7' and B wins before 'A' throws '6'. If A begins. Find their respective chances of winning.	06	3	2	3														
b)	A certain drug is claimed to be effective in curing cold. In an experiment on 500 persons with cold, half of them were given the drug and half of them were given sugar pills. The patients' reactions to the treatment are recorded in the following table. <table><tr><td></td><td>Helped</td><td>Harmed</td><td>No effect</td></tr><tr><td>Drug</td><td>150</td><td>30</td><td>70</td></tr><tr><td>Sugar Pills</td><td>130</td><td>40</td><td>80</td></tr></table> On the basis of this data, can it be concluded that the drug and sugar pills differ significantly in curing cold?		Helped	Harmed	No effect	Drug	150	30	70	Sugar Pills	130	40	80	06	3	2	6		
	Helped	Harmed	No effect																
Drug	150	30	70																
Sugar Pills	130	40	80																
Q2c)	Evaluate $\mathcal{L} \{ \sin 2t \sin 4t \sinh t \}$	08	1	3	1														



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	TIME				
Q3a:	Evaluate $\mathcal{L} \{t\sqrt{1+\sin t}\}$	06	3	2	1
Q3 b)	In an examination marks obtained by students in mathematics, physics and chemistry are normally distributed with means 51,53 and 46 with standard deviations 15,12,16 respectively. Find the probability of securing total marks (i) 180 or more (ii) 90 or below	06	2	4	5
Q3c)	Find the Laplace transforms of $f(t)$, where $f(t) = \begin{cases} \sin 2t, 0 < t < \pi \\ 0, t > \pi. \end{cases}$	08	1	4	1
Q4 a)	The length of time a lady speaks on telephone is found to be a random variable with $\text{PDF } f(x) = \begin{cases} Ae^{-x/5}, x \geq 0 \\ 0, x < 0 \end{cases}$ Find A and the probability that she will speak for (i) more than 10 minutes (ii) less than 5 minutes (iii) between 5 & 10 minutes.	06	2	3	5
Q4 b)	Using laplace transforms Prove that $\int_0^{\infty} e^{-t} \frac{\sin^2 t}{t} dt = \frac{1}{4} \log 5$	06	1	2	2
Q4c)	Of the three men, the chances that a politician, a businessman and an academician will be appointed as a vice chancellor of a university are 0.50, 0.30 & 0.20 respectively. Probability that research is promoted by these people if they are appointed as vice chancellor are 0.3, 0.7 & 0.8 respectively. Determine the probability that research is promoted in the university. Also find if research is promoted in the university what is the probability that the VC is an academician.	08	2	1	4
Q5 a)	In an examination it is laid down that a student passes if he secures 30% or more marks. He is placed in Ist, IInd or IIIrd division according as he secures 60% or more marks, between 45% & 60% and between 30% & 45% respectively. He gets distinction in case he secures 80% or more marks. It is noticed from the result that 10% of the students failed in the examination where as 5% of them obtained distinction. Calculate the percentage of students placed in the second division.	06	2	2	5

**END SEM/RE-EXAM EXAMINATION MAY / JUNE 2025**

Q5 b)	Evaluate: $\mathcal{L}^{-1} \left\{ \frac{s}{(s+1)(s^2+4)} \right\}$	06	1	2	2									
Q5c)	Evaluate: $\mathcal{L}^{-1} \left\{ \tan^{-1} \left(\frac{2}{s^2} \right) \right\}$	08	3	3	3									
Q6a)	Samples of two types of bulbs were tested for length of life and following data were obtained. <table><tr><td></td><td>Size</td><td>Mean</td></tr><tr><td>Sample I</td><td>8</td><td>1234 hours</td></tr><tr><td>Sample II</td><td>7</td><td>1036 hours</td></tr></table> Is the difference in the means sufficient to warrant that type I bulbs are superior to type II bulbs?		Size	Mean	Sample I	8	1234 hours	Sample II	7	1036 hours	06	3	3	7
	Size	Mean												
Sample I	8	1234 hours												
Sample II	7	1036 hours												
Q6b)	In a precision bombing attack there is a 50% chance that any one bomb will strike the target. Two direct hits are required to destroy the target completely. How many bombs must be dropped to give atleast 99% chance of destroying the target?	06	2	3	4									
Q6c)	Using convolution theorem Prove that: $\mathcal{L}^{-1} \left\{ \frac{1}{(s^2+a^2)^2} \right\} = \frac{1}{2a^3} (\sin at - at \cos at)$	08	1	1	2									
Q7a)	For a random sample of 10 pigs fed diet A, the increases in weight in pounds in a certain period were 10, 6, 16, 17, 13, 12, 8, 14, 15, 9. For another random sample of 12 pigs, fed on diet B, the increase in the same period were 7, 13, 22, 15, 12, 14, 18, 8, 21, 23, 10, 17. Test whether the diets A & B differ significantly as regards their effect on increase in weight.	06	3	3	6									
Q7b)	Evaluate: $\mathcal{L}^{-1} \left\{ \log \left \frac{s^2+b^2}{s^2+a^2} \right \right\}$	06	2	2	4									
Q7c)	Solve using Laplace transforms $\frac{dy}{dt} + 2y + \int_0^t y \, dt = \sin t$ Given, $y(0)=1$	08	1	1	3									

Percentage Points of t - distribution



Example

For $\Phi = 10$ and $\alpha = 1$

$P(|t| > 1.812) = 0.1$

P	0.20	0.10	0.05	0.02	0.01
1	3.078	6.314	12.706	31.821	63.657
2	1.886	2.920	4.303	6.965	12.925
3	1.638	2.353	3.182	4.541	9.341
4	1.533	2.132	2.776	3.747	7.604
5	1.476	2.015	2.571	3.365	6.032
6	1.440	1.943	2.447	3.143	5.707
7	1.415	1.895	2.365	2.998	5.499
8	1.397	1.860	2.306	2.896	5.355
9	1.383	1.833	2.262	2.821	5.250
10	1.372	1.812	2.228	2.764	5.169
11	1.363	1.796	2.201	2.718	5.106
12	1.356	1.782	2.179	2.681	5.055
13	1.350	1.771	2.160	2.650	5.012
14	1.345	1.761	2.145	2.624	4.977
15	1.341	1.753	2.131	2.602	4.947
16	1.337	1.746	2.120	2.583	4.921
17	1.333	1.740	2.110	2.567	4.898
18	1.330	1.734	2.101	2.552	4.878
19	1.328	1.729	2.093	2.539	4.861
20	1.325	1.725	2.086	2.528	4.845
21	1.323	1.721	2.080	2.518	4.831
22	1.321	1.717	2.074	2.508	4.818
23	1.319	1.714	2.069	2.500	4.807
24	1.318	1.711	2.064	2.492	4.797
25	1.316	1.708	2.060	2.485	4.787
26	1.315	1.706	2.056	2.479	4.779
27	1.314	1.703	2.052	2.473	4.771
28	1.313	1.701	2.048	2.467	4.763
29	1.311	1.699	2.045	2.462	4.756
30	1.310	1.697	2.042	2.457	4.750
40	1.303	1.684	2.021	2.423	4.704
60	1.296	1.671	2.000	2.390	4.660
120	1.289	1.658	1.980	2.358	4.617
	1.282	1.645	1.960	2.325	4.576



Example

For $\Phi = 10$ d. o. f.

$$P(\chi^2 > 15.99) = 0.10$$

P	0.99	0.95	0.50	0.10	0.05	0.02	0.01
1	0.00157	.00393	.455	2.706	3.841	5.214	6.635
2	.0201	.103	1.386	4.605	5.991	7.824	9.210
3	.115	.352	2.366	6.251	7.815	9.837	11.341
4	.297	.711	3.357	7.779	9.488	11.668	13.277
5	.554	1.145	4.351	9.236	11.070	13.388	15.086
6	.872	1.635	5.348	10.645	12.592	15.033	16.812
7	1.339	2.167	6.346	12.017	14.067	16.622	18.475
8	1.646	2.733	7.344	13.362	15.507	18.168	20.090
9	2.088	3.325	8.343	14.684	16.919	19.679	21.666
10	2.558	3.940	9.340	15.987	18.307	21.161	23.209
11	3.053	4.575	10.341	17.275	19.675	22.616	24.716
12	3.571	5.226	11.340	18.549	21.026	24.054	26.217
13	4.107	5.892	12.340	19.812	22.362	25.472	27.688
14	4.660	6.571	13.339	21.064	23.685	26.873	29.141
15	5.223	7.261	14.338	22.307	24.996	28.259	30.578
16	5.802	7.962	15.338	23.542	26.296	29.633	32.000
17	6.403	8.672	16.338	24.769	27.587	30.995	33.409
18	7.015	9.390	17.338	25.989	28.869	32.346	34.805
19	7.633	10.117	18.338	27.204	30.144	33.687	36.191
20	8.260	10.851	19.337	28.412	31.410	35.020	37.566
21	8.897	11.591	20.337	29.615	32.671	36.349	38.932
22	9.542	12.338	21.337	30.813	33.924	37.659	40.289
23	10.196	13.091	22.337	32.007	35.172	38.968	41.638
24	10.856	13.848	23.337	32.196	36.415	40.270	42.980
25	11.524	14.611	24.337	34.382	37.652	41.566	44.314
26	12.198	15.379	25.336	35.363	38.885	41.856	45.642
27	12.879	16.151	26.336	36.741	40.113	44.140	46.963
28	13.565	16.928	27.336	37.916	41.337	45.419	48.278
29	14.256	17.708	28.336	39.087	42.557	46.693	49.588
30	14.953	18.493	29.336	40.256	43.773	47.962	50.892

Area Under Standard Normal Curve



The table gives the area under the standard normal curve from $z = 0$ to $z = z_1$, which is the probability that z will lie between $z = 0$ and $z = z_1$.

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	0752
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	2703	2734	2764	2794	2823	2852
0.8	2881	2910	2939	2967	2995	3023	3051	3078	3106	3133
0.9	3160	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	3829
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	4728	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



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Munshi Nagar, Andheri (W) Mumbai – 400058



END-SEM/RE-EXAM EXAMINATION-MAY / JUNE 2025

Program: MECHANICAL

Course Code: BS-BTM401

Course Name: Statistics, Probability & LT

- Attempt any five out of seven questions
- Use of scientific calculator is allowed.

Duration: 03 Hours

Maximum Points: 100

Semester: IV

QNO	QUESTION	PO IN TS	C O	B L	Mo dul e no.																				
Q1a)	The experiment is repeated 128 times and following distribution is obtained. <table><tr><td>No.of heads</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>Total</td></tr><tr><td>Frequency</td><td>7</td><td>6</td><td>19</td><td>35</td><td>30</td><td>23</td><td>7</td><td>1</td><td>128</td></tr></table> Fit a Binomial distribution if the nature of coins is unknown.	No.of heads	0	1	2	3	4	5	6	7	Total	Frequency	7	6	19	35	30	23	7	1	128	06	3	2	4
No.of heads	0	1	2	3	4	5	6	7	Total																
Frequency	7	6	19	35	30	23	7	1	128																
Q1b)	Two cards are drawn simultaneously from a well – shuffled deck of 52 cards. Compute the variance for the number of aces	06	2	2	4																				
Q1c)	Obtain laplace transform of $f(t) = \sin^4 t$	08	1	1	1																				
Q2 a)	‘A’ and ‘B’ throw alternately with a single die, A having the first throw. The person whose first throws ace is to win. What are their respective chances of winning?	06	3	2	3																				
Q2 b)	1000 students are graded according to their I.Q. & their economic conditions. Use chi-square test to find out whether there is any association between economic conditions and the level of I.Q. <table><tr><td>Economic</td><td></td><td>I.Q.</td><td></td></tr><tr><td>Conditions</td><td>High</td><td>Medium</td><td>Low</td></tr><tr><td>Rich</td><td>160</td><td>300</td><td>140</td></tr><tr><td>Poor</td><td>140</td><td>100</td><td>160</td></tr></table>	Economic		I.Q.		Conditions	High	Medium	Low	Rich	160	300	140	Poor	140	100	160	06	3	2	6				
Economic		I.Q.																							
Conditions	High	Medium	Low																						
Rich	160	300	140																						
Poor	140	100	160																						

**END SEM/RE-EXAM EXAMINATION MAY/ JUNE 2025**

Q2c	Evaluate $\mathcal{L} \left\{ \frac{\cos 2t \sin t}{e^t} \right\}$	08	1	3	1
Q3a	Evaluate $\mathcal{L} \left\{ \frac{d}{dt} \left(\frac{\sin t}{t} \right) \right\}$	06	3	2	1
Q3 b)	In an examination marks obtained by students in mathematics, physics and chemistry are normally distributed with means 51,53 and 46 with standard deviations 15,12,16 respectively. Find the probability of securing total marks (i) 180 or more (ii) 90 or below	06	2	4	5
Q3c)	Find the Laplace transforms of $f(t)$, where $f(t) = \begin{cases} 0, & 0 < t < \pi \\ \sin^2(t - \pi), & t > \pi \end{cases}$	08	1	4	1
Q4 a)	Verify whether the following functions can be looked upon as probability density function? $f(x) = \frac{1}{2} e^{- x }, -\infty < x < \infty$	06	2	3	5
Q4 b)	Evaluate $\int_0^{\infty} \frac{\cos 6t - \cos 4t}{t} dt$ using Laplace transforms.	06	1	2	2
Q4c)	Of the three men, the chances that a politician, a businessman and an academician will be appointed as a vice chancellor of a university are 0.50, 0.30 & 0.20 respectively. Probability that research is promoted by these people if they are appointed as vice chancellor are 0.3, 0.7 & 0.8 respectively. Determine the probability that research is promoted in the university. Also find if research is promoted in the university what is the probability that the VC is an academician	08	2	1	4
Q5 a)	In an examination it is laid down that a student passes if he secures 30% or more marks. He is placed in Ist, IInd or IIIrd division according as he secures 60% or more marks, between 45% & 60% and between 30% & 45% respectively. He gets distinction in case he secures 80% or more marks. It is noticed from the result that 10% of the students failed in the examination where as 5% of them obtained distinction. Calculate the percentage of students placed in the second division.	06	2	2	5
Q5b)	Find $\mathcal{L}^{-1} \left\{ \frac{2s^2 - 4}{(s+1)(s-2)(s-3)} \right\}$	06	1	2	2

**END SEM/RE-EXAM EXAMINATION MAY / JUNE 2025**

Q5c)	Evaluate: $\mathcal{L}^{-1} \left\{ \tan^{-1} \left(\frac{2}{s^2} \right) \right\}$	08	3	3	3
Q6 a)	The heights of six randomly chosen sailors are in inches; 63, 65, 68, 69, 71 & 72. The heights of ten randomly chosen soldiers are; 61, 62, 65, 66, 69, 69, 70, 71, 72 & 73. Discuss in the light of this data that the soldiers on an average are taller than sailors	06	3	3	7
Q6b)	In a precision bombing attack there is a 50% chance that any one bomb will strike the target. Two direct hits are required to destroy the target completely. How many bombs must be dropped to give at least 99% chance of destroying the target?	06	2	3	4
Q6c)	Evaluate: $\mathcal{L}^{-1} \left\{ \frac{s}{(s^2 + 4)(s^2 + 1)} \right\}$ using convolution theorem.	08	1	1	2
Q7a)	Prices of shares of a company on different days in a month were found to be 66, 65, 69, 70, 69, 71, 70, 63, 64 and 68. Discuss whether the price of shares to be 65.	06	3	3	6
Q7 b)	A die is tossed thrice. A success is getting 1 or 6 on a toss. Find the mean and the variance of the number of successes.	06	2	2	4
Q7c)	Solve using Laplace transforms $y''(t) + y'(t) = 8 \cos t$ Given $y(0) = 1$ $y'(0) = -1$	08	1	1	3



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SARDAR PATEL COLLEGE OF ENGINEERING, MUMBAI
DEPARTMENT OF MECHANICAL ENGINEERING



~~END SEMESTER EXAMINATION~~ / RE-EXAMINATION, ~~2024~~ JUNE 2025

PROGRAM: SY B.Tech. (Mechanical), Semester-IV
COURSE: PE-BTM402 ~ Fluid Mechanics

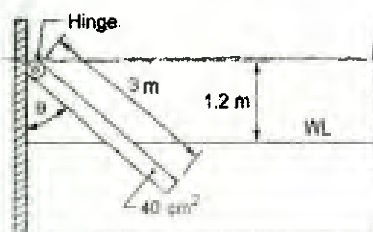
Total points: 100
Duration: 3 HOURS

Note:

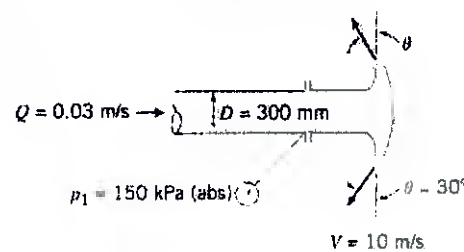
- Answer any 5 questions. **Question 1 is mandatory.**
- Make suitable assumption if required.
- All component of a question must be answered together.
- Data in the last column represents course outcome and Blooms Taxonomy of respective question

m/b/m

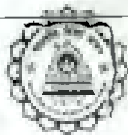
			Points	CO/BT
1	A	How do changes in flow area affect pressure and velocity in compressible flow? Discuss and illustrate with examples.	6	1,2/2
	B	What are the main features of turbulent flow? Briefly explain the significance of the RANS equations.	7	
	C	Explain boundary layer development over a bluff body and its role in flow separation.	7	
2.	A	Discuss following terms with illustration: a) Mach number and its applications b) Hydraulic gradient and energy gradient line c) Laminar and turbulent flow characteristics d) Lift and Drag	10	2/3
	B	Derive an expression for the torque required to overcome the viscous resistance when a circular shaft of diameter D rotating at N rpm in a bearing with the clearance t varying uniformly from t_1 m at one end to t_2 m at the other end. The distance between the ends is L m. The oil has a viscosity of μ .	10	3/4
3.	A	Derive differential form of continuity equation. Write the differential form of the x-momentum equation for incompressible flow in Cartesian coordinates. Explain the physical meaning of each term in the equation.	10	3/3
	B	A pipeline of 0.6 m diameter is 1.5 km long. To increase the discharge, another line of the same diameter is introduced parallel to the first in second half of the length. Neglecting minor losses, find the increase in discharge if Darcy factor $f=0.04$. Head at inlet is 0.3 m.	10	4/4
4.	A	Define choked flow in compressible fluids. What parameters influence it? Derive the condition for its occurrence in a variable-area duct.	10	2,3/1,5
	B	A wooden pole of 45 cm ² section and 3 m length is hinged at 1.2 m above the water surface and floats in water at an angle of θ with vertical. Determine the value of the angle. The pole weighs 90 N.	10	4/3



5. A Provide concise explanations for the following key concepts: 10 1,2/1,2
 (i) Classification and characteristics of Non-Newtonian fluids
 (ii) Nature of drag and lift forces on bluff bodies
 (iii) Distinction between static, dynamic, and stagnation pressures
 (iv) Difference between convective and local acceleration in unsteady flows
- B Using Navier Stokes equation for frictionless fluid flow along a streamline, derive Bernoulli equation and discuss significance of equation with its limitations. 10 3/2
6. A Identify two fluid machines that operate as power-consuming devices and two that function as power-generating devices. For each machine, briefly describe its working principle and list its key components. 10 3,4/2
- B Find the acceleration and vorticity components at (1,1,1) for the flow field give below. 10 4/3
- $$u = 2x^2 + 3y, \quad v = -2xy + 3y^2 + 3zy,$$
- $$w = -\frac{3}{2}z^2 + 2xz - 9y^2z$$
7. A Assume a standard parabolic velocity profile existing in boundary layer. Derive an expression for displacement thickness and momentum thickness. 10 2/4
- B A conical spray head as shown below produces uniform exit stream. Evaluate (a) the thickness of the spray sheet at 400mm radius and (b) the axial force exerted by the spray head on the supply pipe. Use Reynolds transport equation and list all assumption made in calculation. 10 3/4



*****22222*****



Bharatiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING, MUMBAI
DEPARTMENT OF MECHANICAL ENGINEERING



Previous Semester Examination, JUNE 2025
(R18 & R22)

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

24/6/25
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

- Q1.** (A) Explain the concept of the boundary layer. Show a schematic representation of the boundary layer development over a thin flat plate indicating laminar and turbulent zone both. 10 6/2
- (B) Consider a 45° bent reducing elbow on a horizontal plane carrying water with the flow rate of 50 kg/s. The elbow discharges water into the atmosphere. The cross-sectional area of the elbow is 150 cm² at the inlet and 25 cm² at the exit. Calculate the component of force that acts on the bend. 10 4/4
- Q2.** (A) Define following properties of the fluid. 10 2/3
(i) Specific gravity, (ii) Viscosity, (iii) Surface Tension, and (iv) Compressibility
- (B) Consider a shaft revolving in a journal bearing where shaft diameter, $D = 80$ mm, gap between shaft and journal, $h = 0.1$ mm and journal bearing length, $L = 0.3$ m. The lubricating oil of viscosity 0.1 kg/ms and SG. 0.9 is used. 10 2/4
(i) determine the resistive force offered by lubricants if shaft is moved axially at 0.8 m/s.
(ii) If shaft is rotated at 1800 rpm, estimate the resistive torque and power required to rotate the shaft.
- Q3.** (A) Explain the following terms (any five) 10 4/1
(i) Absolute pressure
(ii) Gauge pressure
(iii) Atmospheric pressure
(iv) Barometer
(v) Piezometer
(vi) Manometer
- (B) Convert following pressure units to N/m². 10 4/3
(i) 1.5 bar
(ii) 2 atm.
(iii) 30 cm of mercury
- Q4.** (A) Write the following equations and explain the term involved. 10 4/2,1
(i) Continuity Equation in differential form
(ii) Momentum equation in differential form
(iii) Bernoulli Equation
- (B) Water flows at the rate of 1000 l/s through a horizontal venture-meter with diameter 0.5 m and 0.5 m. The pressure gauge fitted at the entry to the venture-meter reads 2 bar. Barometric pressure is 1.05 bar. Calculate 10 4/3
(i) Static throat pressure
(ii) Stagnation pressure at inlet and throat
(iii) Total energy at inlet and throat

Q5.	(A) List all assumptions of the Bernoulli's equation and derive it.	10	5/4
	(B) Derive an expression for the resultant force acting on an inclined plane submerged in a liquid. Also develop an expression to estimate its point of application,	10	6/3
Q6.	(A) Explain following terms. a. Darcy friction factor b. Developing length of a pipe c. Moody chart d. Major losses e. Minor losses	10	4/2
	(B) A 1.5 km long pipeline ($f = 0.04$) of diameter 0.6m is used to transport drinking water to a city. In order to augment the discharge, another parallel line of same diameter is introduced in the second half of the length. Neglecting minor losses, find % increase / decrease in the discharge. Assume the head at inlet is 30 m over that at the outlet.	10	6/4
Q7.	(A) List down the characteristic features of a compressible flow compared to an incompressible flow. What is the significance of speed of sound in compressible fluid flow? Derive an expression for it.	10	7/1
	(B) A nozzle is designed to expand air isentropically to atmospheric pressure from a large tank in which properties are held constant at 5°C and 304 kPa(abs). The desired mass flowrate is 1 kg/s. Determine following- (i) Stagnation temperature, pressure and density. (ii) Exit pressure, temperature and Mach number (iii) Exit area of the nozzle	10	7/3



Bharatiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING, MUMBAI
DEPARTMENT OF MECHANICAL ENGINEERING



END SEMESTER EXAMINATION / ~~RE-EXAMINATION~~, MAY-JUNE 2025

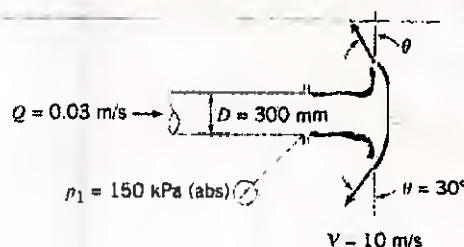
PROGRAM SY B.Tech. (Mechanical), Semester-IV
COURSE: PE-BTM402 – Fluid Mechanics

Total points: 100
Duration: 3 HOURS

Note:

- Answer any 5 questions. **Question 7 is mandatory.**
- Make suitable assumption if necessary.
- All component of a question must be answered together.
- Data in the last column represents course outcome and Blooms Taxonomy of respective question

	Points	CO/BT
1. A. Briefly discuss the following points: (i) Types of Non-Newtonian fluids and their characteristics (ii) Drag and lift of bluff body (iii) Static, Dynamic and Stagnation pressure, (iv) Convective and local acceleration, (v) Minor losses in pipe flow.	10	2/1,2
B. For a given flow field $\vec{V} = xy\vec{i} - 0.5y^2\vec{j}$ (i) Find equation of streamline and sketch it in first and second quadrant. (ii) Find position of a particle at $t = 6$ s, if it is located in flow at (2, 8).	10	2/3
2. A. Derive differential form of continuity equation. Write the differential form of the x-momentum equation for incompressible flow in Cartesian coordinates. Explain the physical meaning of each term in the equation.	10	2/4
B. A Newtonian fluid ($\mu = 0.9 \text{ Pa}\cdot\text{s}$, $\rho = 850 \text{ kg/m}^3$) is confined between two large horizontal plates spaced $h = 2.0 \text{ mm}$ apart. The bottom plate is stationary; the top moves at $U = 0.5 \text{ m/s}$. Assume steady, incompressible, laminar flow with no pressure gradient and no-slip at both plates. Answer following questions. a) Derive and sketch the velocity profile $u(y)$. b) Calculate the shear stress on both plates. c) Compute the Reynolds number and identify the flow regime. d) If the top plate area is 0.2 m^2 , find the power required to maintain motion.	10	3/3,4
3. A. Derive an expression for the forces on a thin plate of given arbitrary shape immersed in a liquid at an angle α to the free surface. Obtain simplified expressions for the centre of pressure of vertical planes. (i) square and (ii) circle.	10	3/4
B. A conical spray head as shown below produces uniform exit stream. Evaluate (a) the thickness of the spray sheet at 400mm radius and (b) the axial force exerted by the spray head on the supply pipe. Use Reynolds transport equation and list all assumption made in calculation.	10	3,4/3,4



- | | | | | |
|----|----|--|----|---------|
| 4. | A. | Discuss following terms with illustration:
(i) Characteristics of a compressible flow
(ii) Moody chart
(iii) Hagen Poiseuille flow
(iv) Boundary layer | 10 | 1,2/1.2 |
| | B. | Using Navier Stokes equation for frictionless fluid flow along a streamline, derive Bernoulli equation and discuss significance of equation with its limitations. | 10 | 2,3/4 |
| 5. | A. | Identify two fluid machines that operate as power-consuming devices and two that function as power-generating devices. For each machine, briefly describe its working principle and list its key components. | 10 | 1/1.2 |
| | B. | Two reservoirs 5.2 km apart are connected by a pipeline which consists of a 225 mm diameter pipe for the first 2.6 km, sloping at 5.7 m per km. For the remaining distance, the pipe diameter is 150 mm laid at the slope of 1.9 m per km. The level of water above the pipe opening are 6 m in the upper reservoir and 3.7 in the lower reservoir. Taking the friction factor $f = 0.024$ for both the pipes and contraction coefficient, $C_c = 0.6$, calculate the rate of discharge through pipeline. | 10 | 3,4/3 |
| 6. | A. | Assume a parabolic velocity profile in boundary layer $\frac{u}{U} = 2\frac{y}{\delta} - \left(\frac{y}{\delta}\right)^2$.
Derive an expression for its i) displacement thickness and ii) momentum thickness. | 10 | 2/4 |
| | B. | Deriving following relation $\frac{dA}{A} = -\frac{dP}{\rho V^2} (1 - M^2)$, and discuss the effect of area variation on properties of isentropic. | 10 | 3,4/5 |
| 7. | A. | Briefly explain the development of the boundary layer over a bluff body and its impact on flow separation. | 6 | 1,2/1.5 |
| | B. | Outline the characteristics of turbulent flow and write the RANS equations and explain its significance. | 6 | |
| | C. | Define choked flow and derive the condition for its occurrence. | 8 | |

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End Semester/~~Re-examination~~ May-June 2025 SET 1Program: S.Y.B. Tech. (Mechanical Engineering) *Sem IV*

Duration: 3 Hrs

Course Code: PC-BTM403

Maximum Points: 100

Course Name: Mechanical Measurement and Control

Semester: IV

Notes:

1. Question number 1 is compulsory
2. Solve any 4 questions from question number 2 to 7
2. If necessary assume suitable data with justification
3. Draw neat labeled sketches wherever required.

19/5/25

Q. No.	Questions	Points	CO	BL	M.N.												
1	Following table list the measuring instruments (left hand side column of the table) for measuring mechanical properties (right hand side column of the table) of the system. Students shall match the measuring instrument with the corresponding mechanical property. <table><tr><th>Measuring Instruments</th><th>Measurand</th></tr><tr><td>Radiation pyrometer</td><td>Temperature</td></tr><tr><td>Pirani gauge</td><td>Liquid Level</td></tr><tr><td>Rotameter</td><td>Pressure</td></tr><tr><td>Float Gauges</td><td>Flow rate</td></tr><tr><td>Thermistor</td><td>Acceleration</td></tr></table>	Measuring Instruments	Measurand	Radiation pyrometer	Temperature	Pirani gauge	Liquid Level	Rotameter	Pressure	Float Gauges	Flow rate	Thermistor	Acceleration	05	1 to 4	4	2 to 7
	Measuring Instruments	Measurand															
Radiation pyrometer	Temperature																
Pirani gauge	Liquid Level																
Rotameter	Pressure																
Float Gauges	Flow rate																
Thermistor	Acceleration																
	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															
2 (a)	A single strain gauge having resistance of $130\ \Omega$ is mounted on a steel cantilever beam at a distance 0.12 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 $0.145\ \Omega$, calculate the gauge factor. Deflection of the free end $\delta = FL^3/3EI$. Take Young's modulus for steel as $200 \times 10^9\ \text{N/m}^2$	10	2,3	5	4												
2 (b)	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, $\tau = 35\ \text{s}$; In water, $\tau = 2\ \text{s}$; In air, probe wet, $\tau = 15\ \text{s}$; For	10	2,3	5	5												

01/03



	$t < 0$, $T = 25^{\circ}\text{C}$ (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).				
3 (a)	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	4	5	6
3 (b)	A small cantilever beam is constructed for measurement of force F. It is made of spring steel having modulus of elasticity $E = 200 \times 10^9 \text{ N/m}^2$. The beam is 4.75 mm wide and 0.9 mm thick, with a length of $25 \pm 0.025 \text{ mm}$. An LVDT is used for displacement sensing. It is estimated that the limiting error in displacement is $\pm 0.025 \text{ mm}$. Calculate the value of force and the limiting error if the displacement of LVDT is 2.5 mm. The limiting error in bar dimensions (in width and thickness) is $\pm 0.0075 \text{ mm}$. Given force $F = \frac{3EI}{L^3} x$ where I = MOI of beam, m^4 L = Length of beam, m; and x = displacement of LVDT, m	10	3	5	2
4 (a)	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	1	4	2
4 (b)	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	2,3	4	5,6
5 (a)	With scientific justification explain desirable properties for liquid for liquid in glass thermometer. Also explain significance of time constant in thermometer. Explain with scientific justification how response of the thermometer can be improved?	10	3,4	5	5

**End Semester/Re-examination - May-June-2025 SET 1**

5 (b)	Following is the calibration data of a pressure transducer:	10	3,4	3	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																							
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	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.																										
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	3,4	5	4,5,6																						
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	3	4	3																						
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	3	7																						
The speed of a shaft rotating at 5400 rpm is measured using stroboscope. The stroboscope dial is slowly turned within flashing rates of 220 to 24 per second. Indicate the flash rate setting which give single, double steady images.	10	1,3	4	3,4																						



Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai – 400058



~~End Semester~~ / Re-examinations – ~~May~~ June 2025 SET 2

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 is compulsory
2. Solve any 4 questions from question number 2 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	Following table list the measuring instruments (left hand side column of the table) for measuring mechanical properties (right hand side column of the table) of the system. Students shall match the measuring instrument with the corresponding mechanical property. <table><tr><th>Measuring Instruments</th><th>Measurand</th></tr><tr><td>Radiation pyrometer</td><td>Temperature</td></tr><tr><td>Pirani gauge</td><td>Liquid Level</td></tr><tr><td>Rotameter</td><td>Pressure</td></tr><tr><td>Float Gauges</td><td>Flow rate</td></tr><tr><td>Hot Wire Anemometer</td><td>Acceleration</td></tr></table> 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)	Measuring Instruments	Measurand	Radiation pyrometer	Temperature	Pirani gauge	Liquid Level	Rotameter	Pressure	Float Gauges	Flow rate	Hot Wire Anemometer	Acceleration	05 15	1 to 4	4	2 to 7
Measuring Instruments	Measurand																
Radiation pyrometer	Temperature																
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Hot Wire Anemometer	Acceleration																
2 (a)	A single strain gauge having resistance of $130\ \Omega$ is mounted on a steel cantilever beam at a distance 0.12 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 $0.145\ \Omega$, calculate the gauge factor. Deflection of the free end $\delta= FL^3/3EI$. Take Young's modulus for steel as $200\times10^9\text{ N/m}^2$	10	2,3	5	4												
2 (b)	A temperature probe is transferred from air at 25^0C to air at 35^0C, then to water at 70^0C, and back to air at 35^0C. Assume that in each case the transfer is "instantaneous". The effective time constants and the timing sequence are as follows: In air, probe dry, $\tau =35\text{ s}$; In water, $\tau =2\text{ s}$; In air, probe wet, $\tau =15\text{ s}$; For	10	2,3	5	5												

01/03



	$t < 0, T=25^{\circ}\text{C}$ (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).																						
3 (a)	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	4	5	6																		
3 (b)	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: $W=390\pm 0.25$ kg, $t=600\pm 2$ s, $d=12\pm 0.03$ mm, $\rho=1050\pm 0.1\%$ kg/m ³ ; $A=\pi d^2/4$, $h=3.6\pm 0.03$ m, $g=9.81\pm 0.1\%$ m/s ²	10	3	5	2																		
4 (a)	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	1	4	2																		
4 (b)	An accelerometer has a seismic mass of 0.05 Kg and a spring constant of 3×10^3 N/m. Maximum mass displacement is ± 0.02 m (before mass hits the stop). Calculate (a) maximum measurable acceleration and (b) natural frequency.	10	2,3	4	3,4																		
5 (a)	With scientific justification explain desirable properties for liquid for liquid in glass thermometer. Also explain significance of time constant in thermometer. Explain with scientific justification how response of the thermometer can be improved?	10	3,4	5	5																		
5 (b)	Following is the calibration data of a pressure transducer: <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></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	10	3,4	3	1,2
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~~End Semester~~/Re-examinations - ~~May~~-June 2025 SET 2

	50	49	49				
	Find out: (i) The equation for the best-linear fit. (ii) The standard deviation of input q_i , output q_0 , slope and intercept. (ii) q_i if the instrument reads $q_0=30$ after calibration.						
6 (a)	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	3,4	5	4,5,
6 (b)	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	3	4	3
7 (a)	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. (ii) What is the error if the exact formula is used for pressure measurement?			10	2,3	3	4,5
7 (b)	The speed of a shaft rotating at 4800 rpm is measured using stroboscope. The stroboscope dial is slowly turned within flashing rates of 200 to 24 per second. Indicate the flash rate setting which give single, double steady images.			10	1,3	4	3,4

03/03



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 2025_V1

Program : B.Tech Mechanical engg Sem IV Duration: 3.00 hr

Course Code: PC-BTM 404

Maximum Points: 100

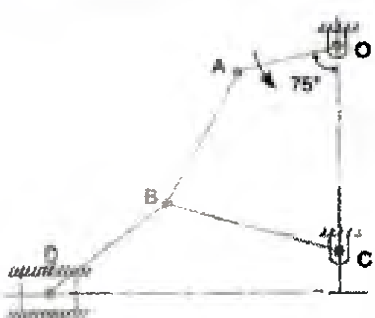
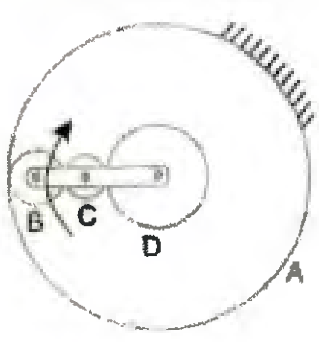
Course Name: Kinematics of Machinery

Semester: IV

Notes:

1. Question number ONE is compulsory solve any four out of remaining
2. Question nos. 1,2,3 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

Q	Description	Pts	Cos	BL	Md
1	a) Define the terms link, lower pair and higher pair illustrating with suitable sketches. b) Describe with neat sketch a quick return motion mechanism (slotted lever-crank) suitable for shaping machine. Define QRR related to sketched. c) Name and sketch different types of followers which are used with disc cam. d) Draw neat sketch of toothed spur gear with at least two teeth and show the following terms on the sketch: circular pitch, addendum, dedendum, flank, face, top and bottom land.	4x5	1 2	2,3	1,2,4 5,6
2	a) A crank-rocker linkage has a 65 mm frame, a 28 mm crank, a 44 mm coupler and a 49 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 55° with horizontal in ccw direction and rotating with the uniform angular velocity of 10 rad/sec in cw direction.	10 10	1,2,3	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 <i>knife-edge</i> follower is raised with SHM and is lowered with SHM: least radius of cam 20 mm, lift 60	10	4	3	5

	mm, angle of ascent 90° , angle of descent 120° , dwell between ascent and descent 30° , cam rotation 180 rpm. Determine the maximum velocity and acceleration during ascent and descent. b) Draw the cam profile for the above details.	10			
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 8	4	3,4	3
5	a) State the fundamental law of gearing, deduce the expression for the same. b) A 4 mm module 24-tooth pinion is to drive a 36-tooth 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 12	4	3,4	6
6	a) An epicyclic gear train as shown in fig., is composed of annular wheel A having 150 teeth. The wheel A is meshing with wheel B which drives wheel D through an idle wheel C, D being concentric with A. The wheels B and C are carried on an arm which revolves clockwise at 100 r.p.m. about the axis of A and D. If the wheels B and D have 25 teeth and 40 teeth respectively, find the number of teeth on C and the speed and sense of rotation of C.  b) Deduce the expression for minimum number of teeth on gear wheel.	10 10	4	3,4	6
7	a) State the advantages of gear drive over the belt drive. b) State and prove condition for correct steering. c) State the conditions for straight line generating mechanism. Sketch the Peaucellier mechanism and prove that the tracing point 'P' describes the straight line.	5 5 10	1,2	2,3	2,4,6



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Previous- SEM EXAMINATIONS June- 2025(R18/R22)

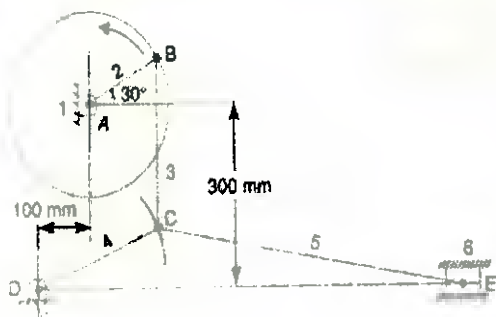
Program : S.Y. BTech Mechanical engg Sem IV Duration: 3.00 hr
Course Code: PC-BTM 412 Maximum Points: 100
Course Name: Kinematics of Machinery Semester: IV

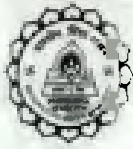
Notes:

1. Question number ONE is compulsory solve any four out of remaining
2. Question nos. 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

27/6/25

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 <i>roller</i> 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 the cam profile for the above details.	10	4	3	5
Q4	Locate all the instantaneous centers of the mechanism as shown in Fig. The lengths of various links are: AB = 150 mm; BC = 300 mm; CD = 225 mm; and CE = 500 mm. When the crank AB rotates in the anticlockwise direction at a uniform speed of 240 rpm. Find: Velocity of the slider E, and angular velocity of the links BC and CE. Using: a) IC method (take 1:10 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



Marathi Vidyapeeth

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~~END SEM~~ EXAMINATIONS (Even SEM) ~~May~~ 2025_V2

Re-S.Y.

June

Program : BTech Mechanical engg

Duration: 3.00 hr

Course Code: PC-BTM 404

Maximum Points: 100

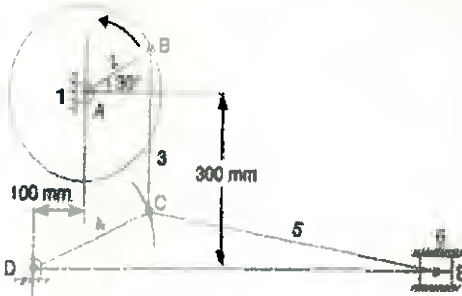
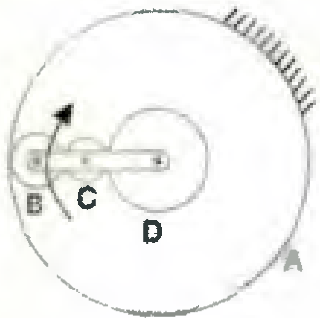
Course Name: Kinematics of Machinery

Semester: IV

Notes:

1. Question number ONE is compulsory solve any four out of remaining
2. Question nos. 1,2,3 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

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 the cam profile for the above details.	10	4	3	5
Q4	Locate all the instantaneous centers of the mechanism as shown in Fig. The lengths of various links are: AB = 150 mm; BC = 300 mm; CD = 225 mm; and CE = 500 mm. When the crank AB rotates in the anticlockwise direction at a uniform speed of 240 rpm. Find: Velocity of the slider E, and angular velocity of the links BC and CE. Using: a) IC method (take 1:10 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) An epicyclic gear train as shown in fig., is composed of annular wheel A having 144 teeth. The wheel A is meshing with wheel B which drives wheel D through an idle wheel C. D being concentric with A. The wheels B and C are carried on an arm which revolves clockwise at 100 r.p.m. about the axis of A and D. If the wheels B and D have 24 teeth and 36 teeth respectively. find the number of teeth on C and the speed and sense of rotation of C. 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

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**END SEM/RE-EXAM EXAMINATION MAY / JUNE 2025**Program: S.Y. B. Tech. Mechanical

Duration: 03 Hr.

Course Code: PC-BTM405

Maximum Points: 100

Course Name: Dynamics of MachinerySemester: IV

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

23/5/25

Q.No.	Questions	Points	CO	BL	Module No.
1 (a)	Derive the expression for Energy stored in Flywheel.	10	1	1	1
1 (b)	The essential features of a transmission dynamometer are shown in Figure. A is the driving pulley which runs at 600 r.p.m. B and C are jockey pulleys mounted on a horizontal beam pivoted at D, about which point the complete beam is balanced when at rest. E is the driven pulley and all portions of the belt between the pulleys are vertical. A, B and C are each 300 mm diameter and the thickness and weight of the belt are neglected. The length DF is 750 mm. Find: 1. the value of the weight W to maintain the beam in a horizontal position when 4.5 kW is being transmitted, and 2. the value of W, when the belt just begins to slip on pulley A. The coefficient of friction being 0.2 and maximum tension in the belt 1.5 kN.	10	1	1	1
2 (a)	A four wheeled motor car of mass 2000 kg has a wheel base 2.5 m, track width 1.5 m and height of centre of gravity 500 mm above the ground level and lies at 1 metre from the front axle. Each wheel has an effective diameter of 0.8 m and a moment of inertia of 0.8 kg-m². The drive shaft, engine flywheel and transmission are rotating at 4 times the speed of road wheel, in	10	1	2	2

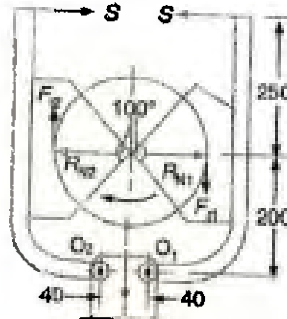


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END SEM/RE-EXAM EXAMINATION MAY/JUNE 2025

	a clockwise direction when viewed from the front, and is equivalent to a mass of 75 kg having a radius of gyration of 100 mm. If the car is taking a right turn of 60 m radius at 60 km/h, find the load on each wheel.				
2 (b)	Explain the effect of gyroscopic couple and centrifugal couple Stability of a two wheel vehicle taking a right turn.	10	1	2	2
3 (a)	A governor of the Proell type has each arm 250 mm long. The pivots of the upper and lower arms are 25 mm from the axis. The central load acting on the sleeve has a mass of 25 kg and the each rotating ball has a mass of 3.2 kg. When the governor sleeve is in mid-position, the extension link of the lower arm is vertical and the radius of the path of rotation of the masses is 175 mm. The vertical height of the governor is 200 mm. If the governor speed is 160 r.p.m. when in mid-position, find : 1. length of the extension link; and 2. tension in the upper arm.	10	1	3	3
3 (b)	Explain Wilson Hartnell Governor.	10	1	3	3
4 (a)	A double shoe brake, as shown in Fig., is capable of absorbing a torque of 1400 N-m. The diameter of the brake drum is 350 mm and the angle of contact for each shoe is 100°. If the coefficient of friction between the brake drum and lining is 0.4 ; find 1. the spring force necessary to set the brake ; and 2. the width of the brake shoes, if the bearing pressure on the lining material is not to exceed 0.3 N/mm ² .	10	1	3	4
					
4 (b)	Explain and Derive the expression for Frictional torque in Centrifugal clutch.	10	1	2	4
5 (a)	Derive an expression for the natural frequency of free transverse and longitudinal vibrations by equilibrium method.	10	3	2	5
5 (b)	Discuss briefly with neat sketches the longitudinal, transverse and torsional free vibrations.	10	3	3	5
6 (a)	A mass suspended from a helical spring vibrates in a viscous fluid medium whose resistance varies directly with the speed. It is observed that the frequency of damped vibration is 90 per minute and that the amplitude decreases to 20 % of its initial value in one complete vibration. Find the frequency of the free undamped vibration of the system.	10	4	3	6

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**END SEM/RE-EXAM EXAMINATION MAY / JUNE 2025**

6 (b)	Explain the terms 'under damping, critical damping' and 'over damping'.	10	4	3	6
7 (a)	Discuss the balancing of V-engines.	10	2	3	7
	A shaft with 3 metres span between two bearings carries two masses of 10 kg and 20 kg acting at the extremities of the arms 0.45 m and 0.6 m long respectively. The planes in which these masses rotate are 1.2 m and 2.4 m respectively from the left end bearing supporting the shaft. The angle between the arms is 60° . The speed of rotation of the shaft is 200 r.p.m. If the masses are balanced by two counter-masses rotating with the shaft acting at radii of 0.3 m and placed at 0.3 m from each bearing centres, estimate the magnitude of the two balance masses and their orientation with respect to the X-axis, i.e. mass of 10 kg.	10	2	4	7



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END SEM/RE-EXAM EXAMINATION MAY / JUNE 2025

Program: S.Y. B. Tech. Mechanical *June IV*

Course Code: PC-BTM405

Course Name: Dynamics of Machinery

Duration: 03 Hr.

Maximum Points: 100

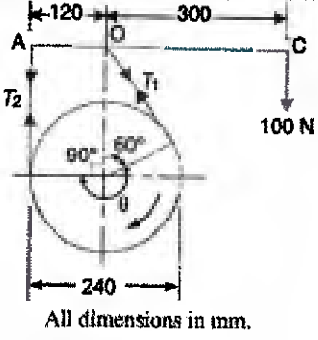
Semester: IV

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

26/6/25

Q.No.	Questions	Points	CO	BL	Module No.
1(a)	Explain Torsion Dynamometer.	05	1	1	1
1(b)	Differentiate between absorption and transmission dynamometers.	05	1	1	1
1(c)	The flywheel of a steam engine has a radius of gyration of 1 m and mass 2500 kg. The starting torque of the steam engine is 1500 N-m and may be assumed constant. Determine: 1. the angular acceleration of the flywheel, and 2. the kinetic energy of the flywheel after 10 seconds from the start.	10	1	1	1
2(a)	Explain the effect of gyroscopic couple and centrifugal couple in case of Four wheel drive moving in a curved path while taking left turn.	10	1	2	2
2(b)	The mass of a turbine rotor of a ship is 8 tonnes and has a radius of gyration 0.6 m. It rotates at 1800 r.p.m. clockwise when looking from the stern. Determine the gyroscopic effects in the following cases: 1. If the ship travelling at 100 km / h steers to the left in a curve of 75 m radius, 2. If the ship is pitching and the bow is descending with maximum velocity. The pitching is simple harmonic, the periodic time being 20 seconds and the total angular movement between the extreme positions is 10°, and 3. If the ship is rolling and at a certain instant has an angular velocity of 0.03 rad/s clockwise when looking from stern. In each case, explain clearly how you determine the direction in which the ship tends to move as a result of the gyroscopic action.	10	1	2	2
3(a)	A Porter governor has all four arms 250 mm long. The upper arms are attached on the axis of rotation and the lower arms are attached to the sleeve at a distance of 30 mm from the axis. The mass of each ball is 5 kg and the sleeve has a mass of 50 kg. The extreme radii of rotation are 150 mm and 200 mm. Determine the range of speed of the governor.	10	1	3	3

**END SEM/RE-EXAM EXAMINATION MAY / JUNE 2025**

3 (b)	Explain Hartnell Governor.	10	1	2	2
4 (a)	The simple band brake, as shown in Fig., is applied to a shaft carrying a flywheel of mass 400 kg. The radius of gyration of the flywheel is 450 mm and runs at 300 r.p.m. If the coefficient of friction is 0.2 and the brake drum diameter is 240 mm, find : 1. the torque applied due to a hand load of 100 N, 2. the number of turns of the wheel before it is brought to rest, and 3. the time required to bring it to rest, from the moment of the application of the brake.  All dimensions in mm.	10	1	3	4
4 (b)	Derive the expression for cone clutch by using uniform pressure theory and uniform wear theory.	10	1	2	4
5(a)	Derive an expression for the natural frequency of free transverse and longitudinal vibrations by equilibrium method.	10	3	2	5
5 (b)	Discuss briefly with neat sketches the longitudinal, transverse and torsional free vibrations.	10	3	3	5
6 (a)	The measurements on a mechanical vibrating system show that it has a mass of 8 kg and that the springs can be combined to give an equivalent spring of stiffness 5.4 N/mm. If the vibrating system have a dashpot attached which exerts a force of 40 N when the mass has a velocity of 1 m/s, find : 1. critical damping coefficient, 2. damping factor, 3. logarithmic decrement, and 4. ratio of two consecutive amplitudes.	10	4	3	6
6 (b)	Derive the differential equation characterising the motion of an oscillation system subject to viscous damping and no periodic external force. Assuming the solution to the equation, find the frequency of oscillation of the system.	10	4	3	6
7 (a)	Write a short note on primary and secondary balancing.	10	2	3	7
7 (b)	A shaft carries five masses A, B, C, D and E which revolve at the same radius in planes which are equidistant from one another. The magnitude of the masses in planes A, C and D are 50 kg, 40 kg and 80 kg respectively. The angle between A and C is 90° and that between C and D is 135°. Determine the magnitude of the masses in planes B and E and their positions to put the shaft in complete rotating balance.	10	2	4	7



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~~END SEM~~ / RE-EXAM EXAMINATION ~~MAY~~ / JUNE 2025 (SET-A)

Program: BTECH (MECH. ENGG.)

Duration: 3 hrs

Course Code: MI-BT021

Maximum Points: 100

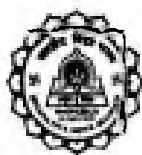
Course Name: Internet of Things (IOT)

Semester: IV

- All questions are compulsory
- Figures to the right indicate full marks
- Provide figures wherever necessary

30/11/25

Q.No.	Questions	Points	CO	BL	PI
1	a) Explain IOT-Block chain integration ecosystem with neat figure	[10]	1,2,3	2	3.2.1, 5.1.2
	b) Explain the following sensors with figures 1) Pressure sensor 2) Temperature sensor	[10]			
2	a) Explain the following two enabling technologies of IOT with figures? • Embedded Systems • Cloud computing	[10]	1,2,3	2	3.2.1, 5.1.2
	b) Explain the following 1) Role of smart material in multi modal sensing 2) Advantages & disadvantages of IOT	[10]			
3	Write short notes on (any three) • ZIGBEE • ZWAVE • SIGFOX • NB-IOT • LORA & LORAWAN	[20]	2,3	2	5.1.2
4	a) Consider a smart city traffic monitoring system with cameras and sensors installed at multiple junctions. Explain how an IOT gateway helps manage data traffic, ensure local processing, and maintain reliable communication with cloud servers. Include a figure to show the data flow architecture	[[10]	2,3	2	5.1.2
	b) As an IoT system architect for a smart agriculture project, you are tasked with designing a system that integrates sensors across vast farmlands to monitor soil moisture, temperature, and weather conditions in real-time. (1) Propose a hybrid architecture using Edge, Fog, and Cloud computing for this application. (2) Justify where and why each computing layer (Edge, Fog, Cloud) should be placed in your architecture. (3) Draw a neat diagram of your proposed architecture	{10]			



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~~EXAM~~/RE-EXAM EXAMINATION ~~MAY~~ / JUNE 2025

	and highlight how latency, bandwidth, and power consumption are optimized across the layers.				
5	a) 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? b) Explain the disadvantages of microcontrollers & microprocessors as compared to an IOT ecosystem?	[15] [05]	2,3	2	5.1.2
	a) Explain the following IOT protocols with neat figure • MQTT • AMQP • COAP • HTTP b) Explain new business & revenue models emerging in the realm of an IOT ecosystem	[15] [05]			
6			3,4	2	5.1.2
7	a) Explain the following in an IOT ecosystem • Data acquisition & storage • Data processing & analytics • Data visualization & reporting b) Write a note on emerging IOT technologies	[15] [05]	3,4	2	5.1.2
***** All the Best *****					



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END SEM/RE-EXAM EXAMINATION MAY / JUNE 2025

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	a) Explain the working of smart sensors along with figure of their architecture and also discuss their key following features • Multi sensing • Multi modal sensing • AI based signal processing for enhancing multi modal detection b) Explain the components of an IOT ecosystem?	[15] [05]	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) Explain Tinkercad Lab in brief	[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 *****					



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PREVIOUS SEM EXAMINATION JUNE 2025

Program: MECHANICAL

Course Code: BS-BTM401

Course Name: Applied Mathematics-II

- Attempt any five out of seven questions
- Use of scientific calculator is allowed.

Duration: 03 Hours

Maximum Points: 100

Semester. IV

R22

QNO	QUESTION	PO IN TS	C O	B L	Mo dul e no.																											
Q1a)	The experiment is repeated 128 times and following distribution is obtained. <table><tr><td>No.of heads</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>Total</td></tr><tr><td>Frequency</td><td>7</td><td>6</td><td>19</td><td>35</td><td>30</td><td>23</td><td>7</td><td>1</td><td>128</td></tr></table> Fit a Binomial distribution if the nature of coins is unknown.	No.of heads	0	1	2	3	4	5	6	7	Total	Frequency	7	6	19	35	30	23	7	1	128	06	3	2	4							
No.of heads	0	1	2	3	4	5	6	7	Total																							
Frequency	7	6	19	35	30	23	7	1	128																							
Q1b)	Ten contestants in a beauty contest are judged by three judges in the following order. <table><tr><td>Ranks by Ist judge</td><td>6</td><td>10</td><td>2</td><td>9</td><td>8</td><td>1</td><td>5</td><td>3</td></tr><tr><td>IInd judge</td><td>5</td><td>4</td><td>10</td><td>1</td><td>9</td><td>3</td><td>8</td><td>7</td></tr><tr><td>IIInd judge</td><td>4</td><td>8</td><td>2</td><td>10</td><td>7</td><td>5</td><td>9</td><td>1</td></tr></table> Using rank correlation coefficient find which pair of judges has the nearest approach to common tastes in beauty	Ranks by Ist judge	6	10	2	9	8	1	5	3	IInd judge	5	4	10	1	9	3	8	7	IIInd judge	4	8	2	10	7	5	9	1	06	2	2	4
Ranks by Ist judge	6	10	2	9	8	1	5	3																								
IInd judge	5	4	10	1	9	3	8	7																								
IIInd judge	4	8	2	10	7	5	9	1																								
Q1c)	Obtain laplace transform of $f(t) = \sin^4 t$	08	1	1	1																											

**PREVIOUS SEM EXAMINATION JUNE 2025**

Q2 a)	'A' and 'B' throw alternately with a single die, A having the first throw. The person whose first throws ace is to win. What are their respective chances of winning?	06	3	2	3																
Q2 b)	1000 students are graded according to their I.Q. & their economic conditions. Use chi-square test to find out whether there is any association between economic conditions and the level of I.Q. <table><tr><td>Economic</td><td></td><td>I.Q.</td><td></td></tr><tr><td>Conditions</td><td>High</td><td>Medium</td><td>Low</td></tr><tr><td>Rich</td><td>160</td><td>300</td><td>140</td></tr><tr><td>Poor</td><td>140</td><td>100</td><td>160</td></tr></table>	Economic		I.Q.		Conditions	High	Medium	Low	Rich	160	300	140	Poor	140	100	160	06	3	2	6
Economic		I.Q.																			
Conditions	High	Medium	Low																		
Rich	160	300	140																		
Poor	140	100	160																		
Q2c	Evaluate $\mathcal{L} \left\{ \frac{\cos 2t \sin t}{e^t} \right\}$	08	1	3	1																
Q3a	Evaluate $\mathcal{L} \left\{ \frac{d}{dt} \left(\frac{\sin t}{t} \right) \right\}$	06	3	2	1																
Q3 b)	In a partially destroyed laboratory record of an analysis of correlation data, the following results only are legible: Variance of X = 9 Regression equations: $8x - 10y + 66 = 0$ $40x - 18y = 214$ What are i. Mean. value of x and y ii. Standard deviation of y. iii. Coefficient of correlation between x and y	06	2	4	5																
Q3c)	Find the Laplace transforms of f(t), where $f(t) = \begin{cases} 0, 0 < t < \pi \\ \sin^2(t - \pi), t > \pi \end{cases}$	08	1	4	1																
Q4 a)	Verify whether the following functions can be looked upon as probability density function? $f(x) = \frac{1}{2} e^{- x }, -\infty < x < \infty$	06	2	3	5																
Q4 b)	Evaluate $\int_0^\infty \frac{\cos 6t - \cos 4t}{t} dt$ using Laplace transforms.	06	1	2	2																
Q4c)	Of the three men, the chances that a politician, a businessman and an academician will be appointed as a vice chancellor of a university are 0.50, 0.30	08	2	1	4																

**PREVIOUS SEM EXAMINATION JUNE 2025**

	& 0.20 respectively. Probability that research is promoted by these people if they are appointed as vice chancellor are 0.3,0.7 7 0.8 respectively. Determine the probability that research is promoted in the university. Also find if research is promoted in the university what is the probability that the VC is an academician																		
Q5 a)	In an examination it is laid down that a student passes if he secures 30% or more marks. He is placed in 1st,2nd or 3rd division according as he secures 60% or more marks, between 45% & 60% and between 30% & 45% respectively. He gets distinction in case he secures 80% or more marks. It is noticed from the result that 10% of the students failed in the examination where as 5% of them obtained distinction. Calculate the percentage of students placed in the second division.	06	2	2	5														
Q5b)	Find $\mathcal{L}^{-1} \left\{ \frac{2s^2 - 4}{(s+1)(s-2)(s-3)} \right\}$	06	1	2	2														
Q5c)	Evaluate: $\mathcal{L}^{-1} \left\{ \tan^{-1} \left(\frac{2}{s^2} \right) \right\}$	08	3	3	3														
Q6 a)	The heights of six randomly chosen sailors are in inches;63,65,68,69,71 & 72.The heights of ten randomly chosen soldiers are;61,62,65,66,69,69,70,71,72&73.Discuss in the light of this data that the soldiers on an average are taller than sailors	06	3	3	7														
Q6b)	In a precision bombing attack there is a 50% chance that any one bomb will strike the target.Two direct hits are required to destroy the target completely.How many bombs must be dropped to give atleast 99% chance of destroying the target?	06	2	3	4														
Q6c)	Evaluate: $\mathcal{L}^{-1} \left\{ \frac{s}{(s^2 + 4)(s^2 + 1)} \right\}$ using convolution theorem.	08	1	1	2														
Q7a)	Find the coefficient of correlation and lines of regression for the following <table><tr><td>X</td><td>62</td><td>64</td><td>65</td><td>69</td><td>70</td><td></td></tr><tr><td>Y</td><td>126</td><td>125</td><td>139</td><td>145</td><td>165</td><td></td></tr></table>	X	62	64	65	69	70		Y	126	125	139	145	165		06	3	3	6
X	62	64	65	69	70														
Y	126	125	139	145	165														
Q7 b)	A die is tossed thrice. A success is getting 1 or 6 on a toss. Find the mean and the variance of the number of successes.	06	2	2	4														
Q7c)	Solve using Laplace transforms $y''(t) + y(t) = 8\cos t$ Given $y(0)=1, y'(0) = -1$	08	1	1	3														

**PREVIOUS SEMESTER EXAM- JUNE 2025 Examinations****Program: S.Y.B. Tech. (Mechanical Engineering)****Duration: 03 Hrs****Course Code: PC-BTM404 (R18 and R22)****Maximum Points: 100****Course Name: Mechanical Engineering Measurement****Semester: IV****Notes:**

1. Question number 1 is compulsory
2. Solve any 4 questions from question number 2 to 7
2. If necessary assume suitable data with justification
3. Draw neat labeled sketches wherever required.

Q. No.	Questions	Points	CO	BL	PI	
1	Following table list the measuring instruments (left hand side column of the table) for measuring mechanical properties (right hand side column of the table) of the system. Students shall match the measuring instrument with the corresponding mechanical property.	04	3	4	1.2.3	
	Measuring Instruments					Measurand
	Orificemeter					Temperature
	Vortex meter					Displacement
	Anemometer					Pressure
	Thermistor					Flow rate
	Further student shall explain only the working principle of the measurement instrument listed on left hand side column of the table with neat sketch. (Note: Credits will be given only if match is perfect)	16				
2 (A)	It is proposed to develop measurement and control system for maintaining temperature and pressure of a reactor chamber in pharmaceutical applications. 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	2	3	1.2.2	
2 (B)	Explain generalized measurement system with neat schematic diagram.	10	1	2	1.6.1	
3 (A)	A single strain gauge having resistance of 130 Ω is mounted on a steel cantilever beam at a distance 0.12 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 changes in gauge resistance is found to be 0.145 Ω, calculate the gauge factor. Deflection of the free end δ= FL ³ /3EI, where F= Force, L=Length, E= Youngs modulus, I=Moment of Inertia, Take	10	4	4	4.6.1	

**PREVIOUS SEMESTER EXAM- JUNE 2025 Examinations**

	Young's modulus for steel as $200 \times 10^9 \text{ N/m}^2$				
3 (B)	Write short note on strain gauges (explain working principle and applications)	10	3	2	3.1.1
4 (A)	Write short note on Bourdon Pressure Gauge (explain working principle and applications)	10	2	2	2.1.2
4 (B)	Following are the different applications/systems/processes wherein the temperature measurement is essential; (i) temperature of forged parts (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	Explain working principle of (i) LVDT (ii) Potentiometer (iii) Viscosity measurement technique (iv) Humidity measurement techniques with neat sketches	20	2	4	4.1.1
6	With neat labeled diagram explain working of (i) optical encoder (ii) stroboscope (iii) eddy current drag-cup tachometer (iv) peizo-electric accelerometer	20	2	3	2.1.2
7(A)	The transfer function of a 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 (tolerance within 2%), peak time, rise time, percentage overshoot.	10	4	4	4.1.2
7(B)	Explain with neat sketches the two different techniques to measure liquid level in tank	10	3	4	2.1.2



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PREVIOUS SEMESTER EXAMINATION JUNE 2025



Program: B.Tech Second Year Mechanical

June IV

Duration: 03 Hrs

Course Code: PC-BTM406

Maximum Points: 100

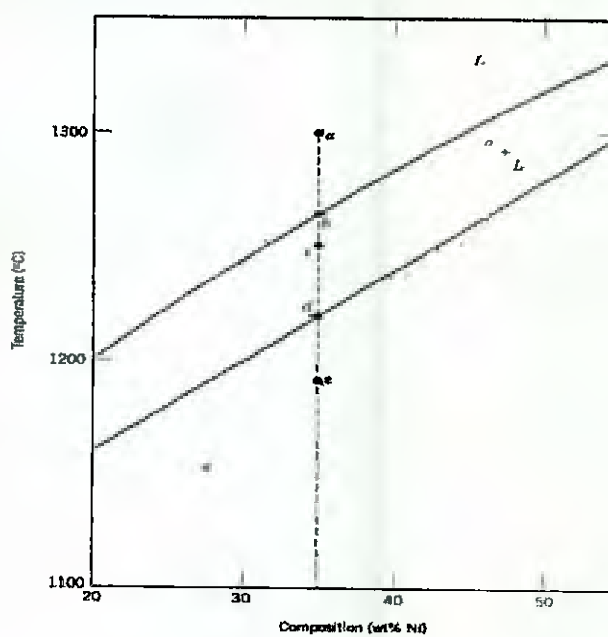
Course Name: Material Science (R18)

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.

26/6/25

Q. No.	Questions	Points	CO	BL	Module No.
1A	Why does diamond stay stable at room temperature and not transform to graphite although it is an unstable phase of carbon at room temperature? Explain with a suitable diagram. .	06	2	3	3
1B	Explain different types of grain structure form at the end of solidification process when eutectoid steel is cool from above 727 ^o C, explain using TTT diagram.	06	3	2	2
1C	Explain the given all points in the phase diagram containing an alloy of composition 35wt% Ni-65 wt% Cu as it is cooled from 1300 ^o C.consider equilibrium cooling condition.(use graph paper) 	08	3	3	2



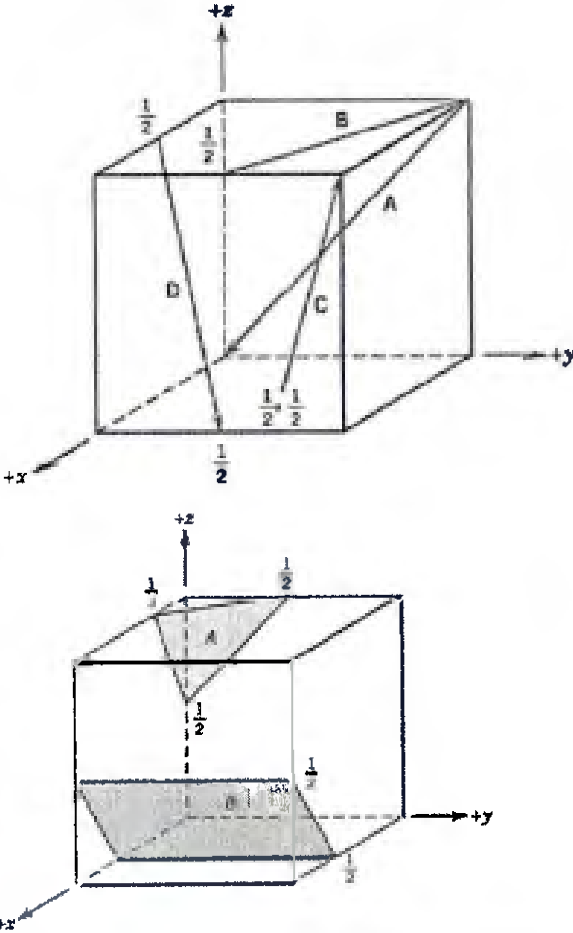
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PREVIOUS SEMESTER EXAMINATION JUNE 2025

2A	Discuss why it is important to consider the entire life cycle rather than just the first stage of materials.	06	1,4	6	7
2B	You are appointed as a material engineer in the medical implant industry. Suggest material for total hip replacement. Select suitable material and explain it. Also explain why a particular material is only selected.	06	1,2	6	1
2C	Draw Fe-C equilibrium diagram and label the temperature, composition, and phases. Explain the phases existing in it.	08	3	4	2
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	3	5	3
3B	Name the material which changes its optical properties. Write an application where such material is used. Explain the working of material with anyone application.	05	1	2	1

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**PREVIOUS SEMESTER EXAMINATION JUNE 2025**

3C	Explain quenching medium. Explain the quenching mechanism when heated components are put in any quenching medium.	05	4,3	5	4
4A	Discuss each case of the heat treatment process of Fe-0.77% C eutectoid steel rapidly cooled from a preheated temperature of 860°C (>727°C) as follows [NOTE: explain, write properties of the final product, use graph paper] 1. Rapidly cool to 650°C, hold for 10⁴ s and quench to room temperature 2. Rapidly cool to 310°C, hold for 70 s and quench to room temperature; 3. Rapidly cool to 650 °C, hold for 20 s, rapidly cool to 400 °C, hold for 10³ s and quench to room temperature;	10	4	6	4
4B	Explain twinning phenomenon and slipping with suitable diagrams.	05	2	5	3
4C	A FCC crystal yield under a normal stress of 2MPa applied in the $[\bar{1} 3 2]$ system. The slip system is (111) $[\bar{1} 0 1]$. Determine critical resolved shear stress. Also draw cubic crystals showing, slip plane and slip direction.	06	2	5	3



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PREVIOUS SEMESTER EXAMINATION JUNE 2025

5A	Write the effect of alloying elements on the properties of materials when they are added to the material composition. 1. Cobalt 2. Tungsten 3. Titanium 4. lead	06	4		5
5B	Explain metallurgical classes of stainless steel. Explain which stainless steel are not heat treatable and the reason behind it.	05	4	2	5
5C	Which heat treatment process used to improve the machinability of the annealed hypereutectoid steel? This heat treatment process used cyclic heating around the eutectoid point. Explain it with a schematic diagram. Explain properties of materials before and after the heat treatment process.	08	4	2,6	4
6A	Classify composite based on the type of matrix material. Explain MMC and carbon matrix composite. Differentiate between composite materials and alloy materials.	08	4	4	6
6B	Write a composition of the following materials and their application. 1. yellow metal 2. Nickel gun-metal 3. Deoxidized copper 4. Dow metal	06	3,4	3	5
6C	Explain the reason behind the Properties changes when engineering Materials are in Bulk and Fiber Forms. [Note: explain by taking some properties and materials]	06	4	3	6
7A	Explain in detail about nucleation, growth rate, and overall transformation. give the proper reason of the following with suitable diagram(consider solidification process): 1. low transformation rate at initial period 2. At the end of the transformation rate is slow.	08	2,3	4	2
7B	Discuss the recycling issue in the materials. Suggest other consumer action for minimal environmental impact than just recycling.	07	1,4	6	7
7C	Classify ceramics based on application. Explain magnetic ceramics in detail.	06	4	4	6



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PREVIOUS SEMESTER EXAMINATION JUNE 2025

Program: B.Tech Second Year Mechanical

Duration: 03 Hrs

Course Code: PC-BTM406

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.

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	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
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?	08	3	4,5	3

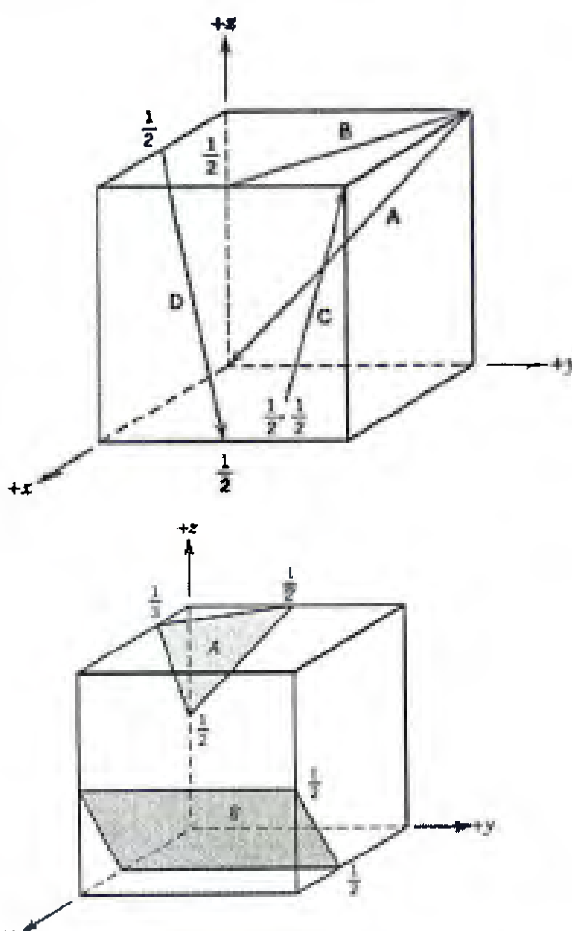


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PREVIOUS SEMESTER EXAMINATION JUNE 2025

	<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															



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PREVIOUS SEMESTER EXAMINATION JUNE 2025

3C	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	05	4,3	4	5
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	Explain the physics of atomization with a suitable diagram in powder metallurgy. Explain the gas atomization process.	06	4	2	7
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



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PREVIOUS SEMESTER EXAMINATION JUNE 2025

5A	Write the effect of alloying elements on the properties of materials when they are added to the material composition. 1. Nickel 2. Molybdenum 3. Vanadium 4. Cobalt 5. lead	06	4	4	04
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	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.	07	2	3	2



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Previous Sem Exam SEM-IV - June 2025

Program: B.Tech. in Mechanical Engineering *Sem IV*

Duration: 3 Hour

Course Code: PC-BTM415

Max. Points: 100

Course Name: Solid Mechanics

Semester: IV

Notes:

- Question no. 1 is compulsory, solve any 4 out of the remaining 6 questions.
- Assume suitable data if necessary.

Q. No.	Questions	Points	CO	BL
Q1	a) Describe the three modes of fracture with neat sketch. Give two examples of each mode from real life situations.	10		
	b) Describe the relation between the true and engineering stress/strain. Discuss the need of these concepts in engineering analysis.	10	1	2
Q2	Given the stress matrix τ_{ij} , determine: Magnitude of the normal and shear stress on a plane which has its normal which is inclined to the x axis by 60 degrees and is inclined to the y axis also by 60 degrees. $\tau_{ij} = \begin{bmatrix} 1 & 3 & 10 \\ 3 & 1 & 1 \\ 10 & 1 & -1 \end{bmatrix}$	20	2	2
Q3	a) Briefly explain the physical meaning of the compatibility equations and write all compatibility equations.	10		
	b) Explain the principle of superposition with two examples of its application.	10	1	2
Q4	The rectangular components of stress at a point are given by the following matrix. Determine the principal stresses and the direction of the maximum principal stress. $[\tau_{ij}] = \begin{bmatrix} 10 & 1 & 2 \\ 1 & 3 & -1 \\ 2 & -1 & 5 \end{bmatrix}$	20	1	1
Q5	Derive the differential equations of equilibrium in 3-D.	20	2	3
Q6	a) The displacement field for a body is given by: $\vec{u} = [(yz^2 + 10xy^2z)\vec{i} + (2xyz)\vec{j} + (x^3y^3 + z^2)\vec{k}]10^{-5}$ What are the strain components at (1, -1, 1)?	10		
	b) Discuss the importance of the constitutive equations in solid mechanics. Explain how the nature of these equations change for	10	2,3	2,3

the isotropic and anisotropic materials.

- Q7 A) A thick-walled pipe has internal radius of $(100+a)$ mm. It is subjected to internal pressure of 2.0 MPa and external pressure of 0.25 MPa. If $E = 200$ GPa and $\nu = 0.3$, determine the thickness as per the maximum principal stress theory of failure. Consider tensile strength as 350 MPa and factor of safety as 3.5. Also determine the changes in internal and external radii for the pipe with the calculated thickness.
- B) A rectangular bar with transverse hole is subjected to bending moment. The geometry parameters and the stress concentration factor for the bar are as shown in the figure.

(10)

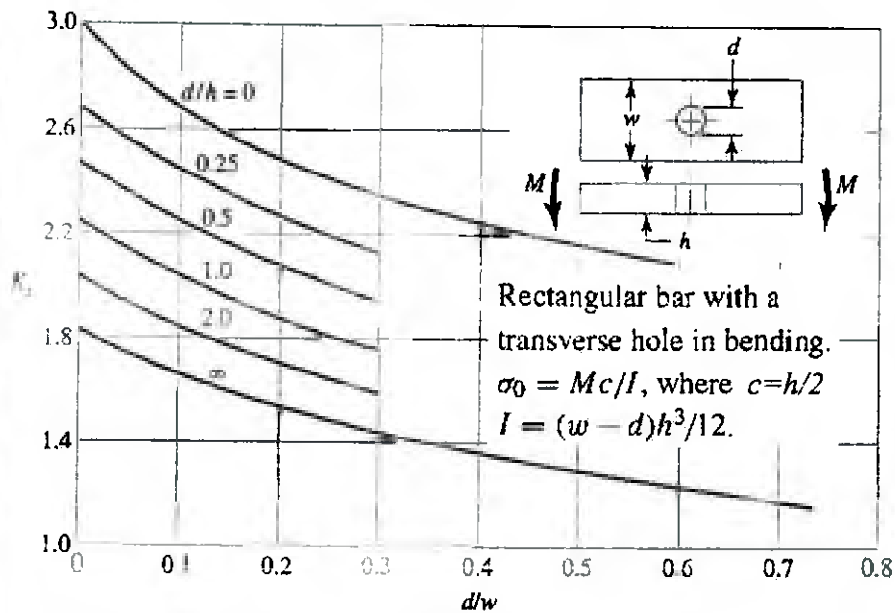
2

3

10

2

3



Calculate the maximum stress induced around the hole if the bar subjected to bending moment of 100 Nm. The dimensions of the bar in mm are: $d = 10$, $w = 100$ and $h = 10$.

ANNEXURE: USEFUL FORMULAE

Stresses for two cylinders in contact with each other

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

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

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

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

Stresses in thick pressurized cylinders

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

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

$$\sigma_z = 0 \text{ with both ends open}$$

$$\sigma_r = \nu(\sigma_r + \sigma_\theta) \text{ with both ends closed}$$

Stresses in rotating solid disks

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

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

Stresses in rotating disks with central hole

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

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

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

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

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

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

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