Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai – 400058

End Semester-Examination - June 2024

7/6/24

Program: S.Y.B.Tech (Mechanical) | **Duration: 3 Hours**

Course Code: BS-BTM401 | **Maximum Points: 100**

Course Name: Applied Mathematics-II | **Semester: IV**

Note:

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

		Questions	Points	CO	BL	Module
1	a	Out of 800 families with 4 children each, how many families would be expected to have (i) 2 boys and 2 girls (ii) at least one girl (iii) at most two boys? Assume equal probability for boys and girls.	6	CO1	BL5	2
	b	The equations of the lines of regression are $3x+2y=26$ and $6x+y=31$ Find $\bar{x},\bar{y}$ and r. Also, find the variance of y if the variance of x is 25.	6	CO1	BL5	1
	c	Evaluate $(i)\ L\left\{e^{-3t}\int_0^t \frac{\sin 3u}{u}du\right\}$ $(ii)L\{t\cdot\sin^3 t\}$	8	CO3	BL3	6
2	a	The mean height and the S.D of the height of eight randomly chosen soldiers are 166.9 cm and 8.29 cm respectively. The corresponding values of six randomly chosen sailors are 170.3 cm and 8.50 cm respectively. Based on this data, can we conclude that soldiers are, in general, shorter than sailors?	6	CO2	BL5	5
	b	Evaluate $L^{-1}\left\{\frac{s}{(s^2+1)(s^2+4)(s^2+9)}\right\}$	6	CO3	BL2	7
	c	Given the following information about the marks of 60 students Correlation coefficient = 0.4	8	CO1	BL3	5

	Mathematics	Physics
Mean	80	50
Standard Deviation	15	10

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		Estimate (i) The marks of a student in mathematics who scored 60 in physics (ii) The marks of a student in physics who scored 70 in mathematics.				
3	a	An automatic machine makes paper clip from coils of wire. On an average 1 in 400 clips is defective. If the paperclips are packed in boxes of 100, what is the probability that any given box of clips will contain (i) no defective (ii) one or more defective (iii) less than two defective clips?	6	CO1	BL4	2
	b	A potential buyer of light bulbs bought 50 bulbs each of 2 brands. Upon testing the bulbs, he found that brand A had a mean life of 1282 hours with S.D of 80 hours, brand B had a mean life of 1208 hours with S.D of 94 hours. Can the buyer be quite certain that the mean of the two brands differ?	6	CO2	BL5	4
	c	In the usual notation, prove the Spearman's formula for Rank correlation $R = 1 - \frac{6}{n(n^2-1)} \sum_{i=1}^{n} d_i^2$, where $d_i = x_i - y_i$	8	CO1	BL5	1
4	a	Compute spearman's rank correlation coefficient for the following data	6	CO1	BL5	1
	b	An aptitude test for selecting officers in a bank is conducted on 1000 candidates. The average score is 42 and standard deviation of score is 24. Assuming normal distribution for the scores, find (i) The numbers of candidates whose scores exceed 60. (ii) The numbers of candidates whose score lie between 30 and 60.	6	CO2	BL3	3

X	36	56	20	42	33	44	50	15	60
Y	50	35	70	58	75	60	45	80	38

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	c	Find constant k such that the function $f(x)=\begin{cases}k(1-x^2), & \text{if } 0\le x\le 1\\ 0 & \text{elsewhere}\end{cases}$ is a density function. Also find $P(0.1\le X\le 0.2)$ and $P(X\ge 0.5)$	8	CO1	BL3	1
5	a	Certain pesticide is packed into bags by a machine. A random sample of 10 bags is drawn and their contents are found to weigh (in kg) as follows 50, 49, 52, 44, 45, 48, 46, 45, 49, 45 Test if average packing can be taken to be 50 kg at 5% LOS.	6	CO2	BL4,5	4
	b	Prove that $\int_0^\infty \frac{\sin 2t+\sin 3t}{te^t}dt=\frac{3\pi}{4}$	6	CO3	BL4	6
	c	Calculate the correlation coefficient between x and y from the following data $n=10$, $\sum x=140, \sum y=150$, $\sum(x-10)^2=180$, $\sum(y-15)^2=215$, $\sum(x-10)(y-15)=60$.	8	CO1	BL2, BL4	1
6	a	If θ is the acute angle between the two regression lines, then prove that $\tan\theta=\frac{1-r^2}{r}\cdot\frac{\sigma_x\sigma_y}{\sigma_x^2+\sigma_y^2}$, where r,σ_x,σ_y have their usual meanings.	6	CO1	BL5	2
	b	A machine is set to produce metal plates of thickness 1.5 cms with standard deviation 0.2 cm. A sample of 100 plates produced by the machine gave an average thickness of 1.2 cms. Is the machine fulfilling the purpose?	6	CO2	BL3	4

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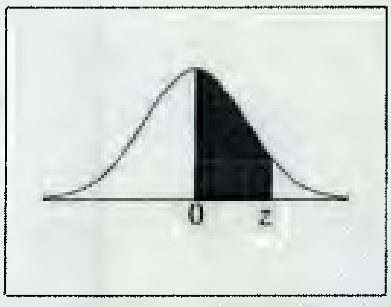
	c	Using Convolution Theorem, Evaluate $L^{-1}\left\{\frac{s^2+s}{(s^2+1)(s^2+2s+2)}\right\}$	8	CO3	BL3, BL5	7
7	a	Two random sample gave the following data Sample No | Size | Mean | Variance 1 | 1500 | 67.42 | 2.58 2 | 2000 | 67.25 | 2.5 Is the difference between standard deviation significant?	6	CO2	BL2, BL3	4
	b	The marks obtained by students in a certain examination follow a normal distribution with mean 45 and standard deviation 10. If 1000 students appeared at an examination, calculate the number of students scoring (i) less than 40 marks (ii) more than 60 marks.	6	CO1	BL5	3
	c	Using Laplace Transform, solve the following Differential Equation $\frac{d^2y}{dt^2}-3\frac{dy}{dt}+2y=4e^{2t}$, where $y(0)=-3$ *and* $y'(0)=5$	8	CO3	BL1, BL3	7

Standard Normal Distribution Table

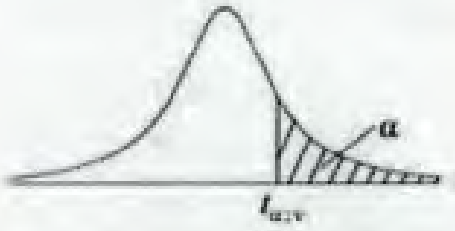


z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4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

Gilles Cazelais. Typeset with LaTeX on April 20, 2006

Table of the Student's *t*-distribution

The table gives the values of $t_{\alpha,\nu}$ where
$\Pr(T_\nu > t_{\alpha,\nu}) = \alpha$, with ν degrees of freedom



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

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SARDAR PATEL COLLEGE OF ENGINEERING, MUMBAI

DEPARTMENT OF MECHANICAL ENGINEERING

END SEMESTER EXAMINATION, JUNE 2024

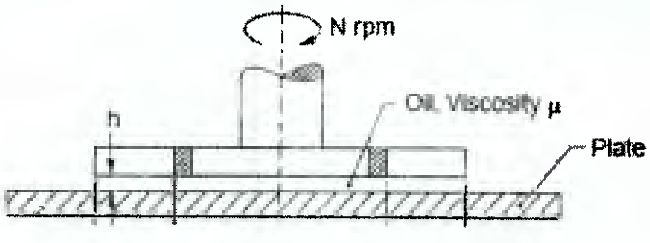
11/6/24

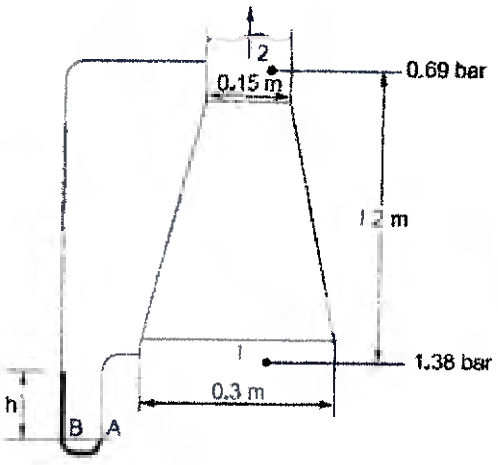
PROGRAM: SY B.Tech. (Mechanical), Semester-IV
COURSE: PE-BTM403 – Fluid Mechanics

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/Bl
Q1.	A	Answer the following with sufficient explanation. a) What is fluid? b) Difference between shear thinning and shear thickening fluids. c) Name any two high densities and two low density fluid with reference to water. d) Give any four examples where the effect of viscosity is significantly observed. e) Define the compressibility of a fluid flow? How is it measured?	10	1/1,3
	B.	Derive an expression for torque (T) and power (P) for a circular disk of diameter D rotating at N rpm as shown in the figure below. The gap (h) between the plate and disk is filled with an lubricating oil of dynamic viscosity, μ. 	10	1/3
Q2.	A.	Write differential form of mass and momentum equation for a Newtonian fluid. Explain the significance of each term involved in the equation. Further, simplify it for the following. a) Euler's flow b) Creeping flows	10	3/2,3
	B.	Oil flows steadily in a thin layer (h) down an inclined plane (θ). The velocity profile is given by $u = \frac{\rho g \sin\theta}{\mu}\left[hy - \frac{y^2}{2}\right]$, Develop equation for unit width of the plate a) Mass flow rate b) Wall shear stress Here 'y' is the dimension normal to inclined plane and μ is the viscosity of fluid.	10	4/3,4
Q3.	(A)	Derive Bernoulli' equation along a streamline. State is limitations. Write its different form. Also explain the following terms. a) Static, dynamic and hydrostatic pressure b) Stagnation pressure c) Hydraulic and energy gradient line.	10	4/2,3
	(B)	Petrol of relative density 0.82 flows in a pipe shown in the following figure. The pressure value at locations 1 and 2 are given as 138 kPa and 69 kPa respectively and point 2 is 1.2m vertically above point 1. Determine the flow rate. Also calculate the reading of the differential manometer connected as shown. Mercury with S = 13.6 is used as the manometer fluid.	10	5/3,4

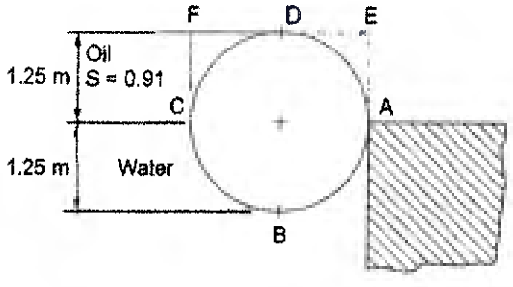


Q4. A. List all assumptions and derive a general equation of hydrostatics. Analyse the equation and simplify it to use for a non-accelerated system. 10 2/3

B. Consider a drum of diameter 1m and height 2m filled with a liquid of density 740 kg/m³. It is rotating about its axis at 90RPM and moving up with an acceleration of 5 m/s². Determine (a) the difference between the pressures at the centers of the bottom and top surfaces and (b) the difference between the pressures at the center and the edge of the bottom surface. 10 2/4,5

Q5. A. Derive an expression for the force on a thin plate of given arbitrary shape immersed in a liquid at an angle θ to the free surface. Also, explain how force on curved surfaces due to fluid pressure is determined. 10 3/2,3

B. Determine the vertical and horizontal forces on the cylinder shown in the following figure. The cylinder is in equilibrium. 10 3/4



Q6. (A) Explain your understanding about following points. 10 5/2,1

a) Moody Chart
b) Characteristics of a turbulent flow
c) Developed and developing flow
d) Coefficient of drag and lift

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

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. 5 7/1

B. Consider following hypothetical velocity vector. 15 3/4,5

$$\vec{V} = (xy + 2t)\vec{i} + 6x^3\vec{j} + (3xt^2 + z)\vec{k}$$

Observe it and answer the following-

a) Find local, convective and total acceleration at a point located at (1,4,-2) and at time t=5s.
b) Find the location of a fluid particle located at (0,1,1) after 4 seconds.
c) Is it a compressible flow? Prove.
d) Is it a rational flow? Prove.
e) Develop an expression for linear or angular deformation, if any.

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End Semester - June 2024 Examinations

17/6/24

Program: S.Y.B. Tech. (Mechanical Engineering) **Duration: 03 Hrs**
Course Code: PC-BTM404 **Maximum Points: 100**
Course Name: Mechanical Engineering Measurement **Semester: IV**

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

Q. No.	Questions	Points	CO	BL	M
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.	05	1,2, 3,4	4	3-7
	Measuring Instruments / **Measurand** Radiation pyrometer / Temperature Pirani gauge / Liquid Level Rotameter / Pressure Float Gauges / Flow rate Thermistor / Acceleration				
	Further student shall **only draw the neat labelled sketch** of the measurement instrument listed on left hand side column of the table in order to understand the working principle of the instrument through schematic arrangements. **(Note: Credits will be given only if match is perfect)**	15			
2 (A)	A temperature probe is transferred from air at 25^{0}C to air at 35^{0}C, then to water at 70^{0}C, and back to air at 35^{0}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, τ =35 s; In water, τ =2 s; In air, probe wet, τ =15 s; For $t < 0$, T=25^{0}C (initial temperature) $0 < t < 7$, T=35^{0}C (dry probe in air) $7 < t < 15$, T=70^{0}C (probe in water), $15 < t < 30$, T=35^{0}C (wet probe in air). Calculate the indicated temperature at the end of each time interval and sketch the rough appropriate indicated temperature (time relationship between t=0 and t=30 s).	10	2,3	2	

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2 (B)	What are the desirable characteristics of liquid in liquid in glass thermometer?	05	1,2	3	6
2 (C)	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.	03	2,3	4	5
2 (D)	Find resolution of an eight-bit A/D converter with +10V input.	02	1	3	1,2
3 (A)	The transfer function of a system is given as $\frac{361}{\left(S^2+16S+361\right)}$ 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	2,3	4	2
3 (B)	Explain working principle of Mcleod gauge with neat diagram. A Mcleod gauge has volume of bulb and measuring capillary equal to 110×10^{-6} m^3 and measuring capillary diameter of 1.1 mm. (i) Calculate the pressure indicated when the reading of measuring capillary is 28 mm in case approximate formula is used What is the error if the exact formula is used for pressure measurement?	10	3	5	6,7
4 (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 capture the data from system and controlled it remotely using internet network system. Students shall present architecture of such network integrated measurement and control system (explain with neat schematic diagram).	10	3,4	2	1,6,7
4 (B)	Following are the different applications/systems/processes wherein the temperature measurement is essential; (i) Processor of the computing system (ii) Temperature of human beings entering institute campus under COVID-19 type 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	1, 3,4	6	1,6,7

5 (A)	A diaphragm pressure gauge is constructed of spring steel to measure differential of 7 MN/m^2. The diameter of diaphragm is 12.5 mm. Calculate the thickness of diaphragm, if the maximum deflection is 0.333 of thickness. Also calculate the natural frequency of diaphragm. Given: Young's modulus=200 GN/m^2, Poisson's ratio=0.28 and density of steel=7800 kg/m^3	10	2	4	6,7
5 (B)	In laboratory mercury in capillary tube temperature measurement system is available. It was proposed to measure humidity present in the laboratory. Explain step-by-step way to measure humidity. Draw appropriate sketches and flow diagram to explain the procedure	10	2,3	5	7
6 (A)	With neat labelled diagram explain working of (i) optical encoder (ii) peizo-electric accelerometer	10	1, 3,4	3	3,4,5
6 (B)	The flow of cooling water in a manufacturing process is measured by a horizontal venturimeter with 200 mm inlet and 100 mm throat. The U-tube mercury manometer connected between inlet and throat of venturi shows a differential pressure of 220 mm mercury. Calculate the water flow rate if coefficient of discharge is 0.98, specific gravity of mercury 13.6 and density of water 1000 kg/m^3	10	2,4		6,7
7(A)	The discharge coefficient C_d of an orifice can be found by collecting the water that flows through during a time interval when it is under a constant head h. The formula is $C_d = \frac{W}{t\rho A\sqrt{2gh}}$ Find C_d and its possible error if: W=390±0.25 kg, t=600±2 s, d=12±0.03 mm, ρ=1050±0.1% kg/m^3; A= $\pi d^2/4$, h=3.6±0.03 m, g=9.81±0.1% m/s^2	10	2,3	4	2,3
7(B)	Following is the calibration data of a pressure transducer: **q_i(Mpa) | q_o (increasing) (Mpa) | q_o (decreasing) (Mpa)** 0 | 2 | -1 10 | 8 | 12 20 | 17 | 23 30 | 26 | 34 40 | 39 | 41 50 | 49 | 49 Find out: (i) The equation for the best-linear fit. (ii) The standard deviation of input qi, output q0, slope and intercept. (iii) qi if the instrument reads q0=30 after calibration. (iv) Plot Hysteresis curve and find Maximum Hysteresis error and dead band	10	2,3	4	2,3,7

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

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

END SEMESTER EXAMINATION JUNE 2024

18/6/24

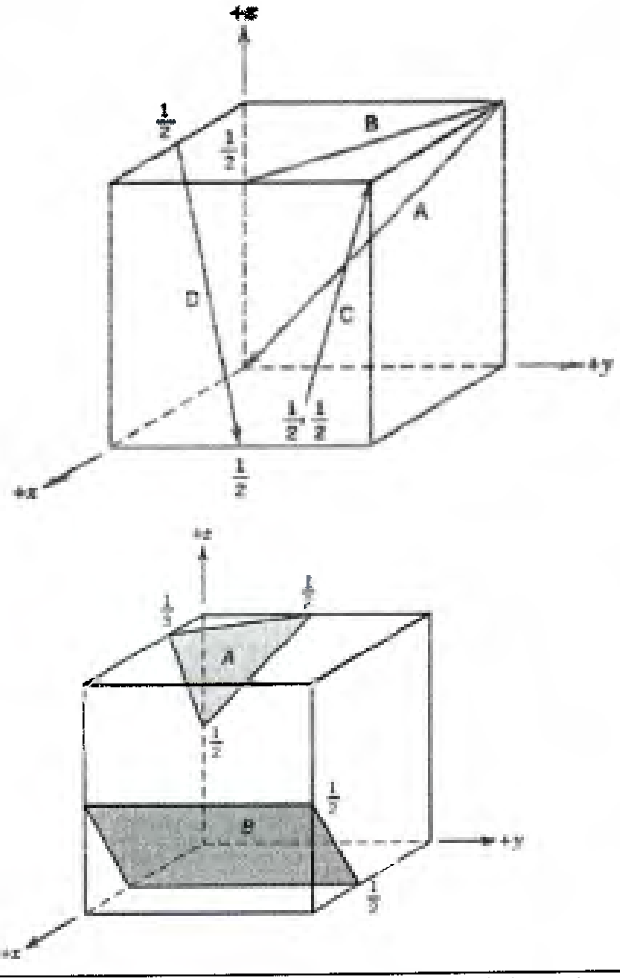
Program: B.Tech Second Year Mechanical | **Duration: 03 Hrs**

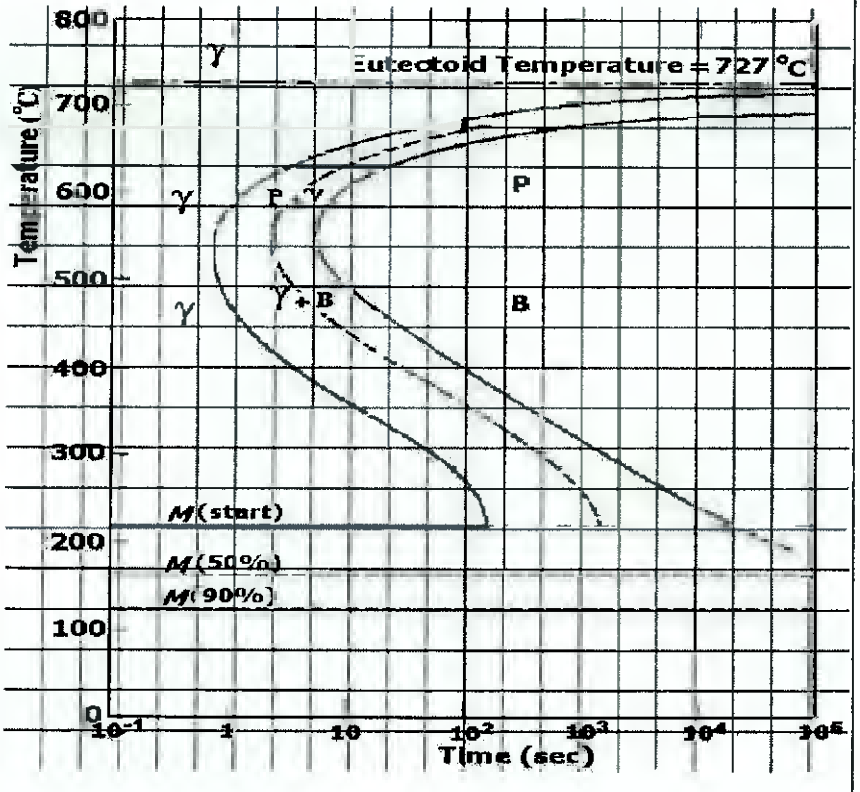
Course Code: PC-BTM406 | **Maximum Points: 100**

Course Name: Material Science | **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	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.	10	3	4	3
1B	Elucidate the mechanism by which heat is extracted from a component when liquid quenching media are employed. With a suitable schematic diagram, explain bainite. Analyze the differences between upper and lower bainite.	10	1,3	4,5	5
2A	Explain the physics of atomization with a suitable diagram in powder metallurgy. Explain the gas atomization process.	06	4	2	7
2B	What determines the properties of materials? What are functionally graded materials?	06	1,2	3	1
2C	From the data given below for the Cu-Ni system, plot the equilibrium diagram to scale and label the diagram. The melting point of Cu: 1,085 °C. the melting point of Ni:1,455 °C Answer the following for 70%Ni alloy composition: A. What is the composition of the first solid crystallizing out from liquid? B. What is the composition of the last liquid present at the end of the solidification process? C. What is the amount of solid and liquid at 1240 °C?	08	3	4,5	3

		Weight % Ni	20	40	60	80	
		Liquidus temp. ^{0}C	1200	1275	1345	1440	
		Solidus Temp ^{0}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

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^{0}C (>727^{0}C) as follows [NOTE: explain, write properties of the final product] 1. Rapidly cool to 630^0 C, hold for 10 s, rapidly cool to 590^0 C hold for 10^3 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 10^4 s and quench to room temperature; 	10	4	4	5
4B	Critically analyze what stainless steel is and write the different types of stainless steel. Identify which type of stainless steel is not heat treatable and explain the reasons behind it.	05	4	3	4
4C	Using a schematic diagram, elucidate the powder bed fusion method of additive manufacturing. Discuss the concept of material flowability in additive manufacturing.	05	2	3	7

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SARDAR PATEL COLLEGE OF ENGINEERING

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

END SEMESTER EXAMINATION JUNE 2024

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	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.	08	3,4	4,5	
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	
7A	Calculate the equilibrium no of vacancies per cubic meter for copper at 1000^0C. The energy for vacancies formation is 0.9ev/atom. The atomic weight and density (at 1000^0C) for copper are 63.5 g/mol and 8.4g/cm3 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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SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai – 400058

END SEM EXAMINATIONS (Even SEM) June 2024 20/6/24

S.Y. B.Tech

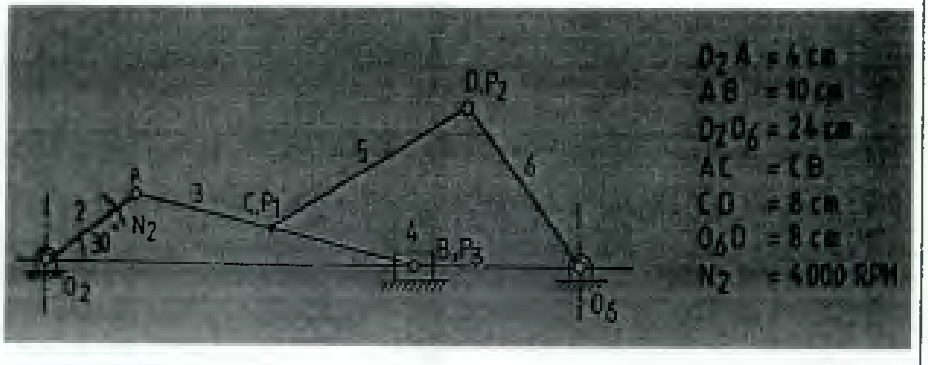
Program: **BTech Mechanical engg** **Duration: 3.00 hr**

Course Code: **PC-BTM412** **Maximum Points: 100**

Course Name: **Kinematics of Machinery** **Semester: IV**

Notes:

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

Q.No.	Questions	Pts	Cos	BL	PI
1	a) State the conditions for straight line generating mechanism. Sketch the Peaucellier mechanism b) Define mechanical advantages, min./max. transmission angle, toggle position of a mechanism with suitable sketch c) Sketch cam profile with roller follower. Also define and show terms like base circle, prime circle, trace point, pitch point, pitch circle and pressure angle on the sketch. d) Sketch two teeth of a involute spur gear and show the following: face, flank, top land, bottom land, addendum, dedendum, face width, circular pitch, pitch circle and base circle.	4x5	1 2 3	2,3	2.4.
2	Locate all possible IC's in mechanism given below. Calculate angular velocity of link 5 and velocity of points P_1, P_2, P_3. 	20	1, 2	3,4	2.3. 1

3	a) In a slider crank mechanism, determine angular velocity of connecting rod which is 7cm long and velocity of piston; if crank a of 4 cm having clock-wise uniform angular velocity 25 rad/sec, and making an angle of 45^0 with horizontal(sliding axis). Also find velocity and acceleration of point 'G' which is center point of connecting rod. (***Relative velocity and acceleration method)*** b) Solve the above problem with analytical method.(complex algebra).	10 10	1,2		
4	A disk cam (300 rpm) lifts a radial follower with SHM through 6 cm. The follower then dwells and returns with SHM. The lift, dwell and return periods are equal. Draw displacement, velocity, acceleration diagram of the follower; and also cam profile. Take base circle radius of 20 mm.	20	3	3	2.3.1
5	a) State the fundamental law of gearing. Deduce the expression for the same supporting with line diagram. b) Determine the addendum of the teeth and angle turned by each wheel of an equal spur gear pair with a module of 2 mm/tooth. It has 30 involute teeth with 20° pressure angle and having minimum contact ratio 2. Take the circular pitch 2.5 cm.	10 10	3	3	2.3.1
6	a) A 2mm module 24 tooth spur gear drives a 36 tooth gear using 14.5^0 full-depth involute system. Determine arc of approach, recess and the contact ratio of gear pair. b) Deduce the expression for minimum number of teeth on gear wheel, supporting with line diagram.	10 10	3	4	2.2.3
7	a) Deduce expression for the displacement, velocity and acceleration of the follower when it moves with SHM. b) Deduce an expression for velocity of sliding in a gear drive. c) What is Coriolis acceleration component? How it is determined? Deduce the expression. d) A driving shaft of a Hooke's joint rotates at a uniform speed of 600 rpm. If the maximum variation in the driven shaft is ±2.5% 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?	4x5	1,2,3,	3	2.3.1