B.E. Mech. Sem-VII

UB
20/11/17

Bharatiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to University of Mumbai)

EXAM NOV 2017
Duration : 3 Hours

Subject Code ME 404
Total Marks: 100
Class/Sem.: B.E. Mechanical Engineering Sem.-VII

Master file.

Subject: IE-PM

- Attempt any Five questions out of Seven questions
- Figures to the right indicate full marks.
- **Assume any suitable data if necessary.**

Que. No. Q1A — **Marks: 10** | **Module: M6** | **CO: CO1, CO4**

Question Statement

The time estimates for the activities of a PERT network is given below.

Activity	t_o	t_m	t_p
1-2	1	1	7
1-3	1	4	7
1-4	2	2	8
2-5	1	1	1
3-5	2	5	14
4-6	2	5	8
5-6	3	6	15

- Draw the project network and identify all paths through it.
- Find project duration and CP.
- Compute standard deviation and variance of project length.
- What is probability that the project will be completed at least 4 weeks earlier than expected?
- If the project due date is 19 weeks what is the probability of not meeting the due date?
- What should be scheduled completion time for the probability of completion to be 90%

Q1B — **Marks: 10** | **Module: M6, M7** | **CO: CO3, CO4**

Refer the following Project details. Crash the project to optimum value if the indirect cost is Rs100 per day. State the factors affecting project crashing decisions.

Activity	Normal		Crash	
	Time in days	Cost in Rs	Time in days	Cost in Rs
1-2	3	300	2	400
2-3	6	480	4	520
2-4	7	2100	5	2500
2-5	8	400	6	600
3-4	4	320	3	360
4-5	5	500	4	520

Q2A — **Marks: 10** | **Module: M7** | **CO: CO1, CO3**

A refrigerator manufacturing company launched a new energy efficient refrigerator. The new product development project manager has three options for its product to meet the demand.

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	1.Arrange overtime working 2.Give subcontracting 3.Carry out expansion of existing unit The correct choice largely depends upon future demand which may be low, medium, and high with probabilities as shown in table. The cost analysis reveals effect upon the payoffs [profits] as shown in table. The payoffs are thousand of rupees. Draw the decision tree. Recommend your decision to project manager with appropriate justification.			

Demand	Probability	Courses of action		
		Overtime	Sub Contract	Expansion
Low -L	0.10	-25	15	-180
Medium-M	0.40	50	45	40
High-H	0.50	80	55	160

Q2B	Refer the following case study. As a project manager develop the strategies for better cash flow in the given situation. Sales per month for a shop are forecast to be Rs.1,53,000 except in the run up to Christmas when October sales are forecast at Rs1,55,000 and November and December sales are anticipated to be Rs.1,60,000. The Shop receives Rs 5000 per month interest on an investment it has in another business. Rent on the shop unit is Rs.25,800 per month although the landlord has advised the shop keeper that the rent will increase to Rs.30,000 in December. Bills are paid quarterly in January, April, July and October. Shop keeper pays Rs.25,000 each quarter. Salaries usually cost Timmy Rs20,000 per month however in the last three months of the year he will take on temporary staff during the busy Christmas period and this will cost him an extra Rs.5,000 per month. Between January and August shopkeeper expects to pay Rs50,100 per month for stock. In September that will rise to Rs 58,000 and in October and November it will be Rs 60,000. In December stock costs will fall to Rs.50,000. Theft has been a problem at the shop so additional security equipment is going to be installed in May. This will cost Rs50,000 and shop keeper is hoping to get a loan to pay for this for which repayments of Rs. 5000 per month will start immediately from next month. The opening balance for the shop in January is Rs.10000.	10	M7	CO3
Q3A	A factory can manufacture products A and B by using either of two materials P and Q. Unit sale prices of A and B are Rs.70 and Rs. 30.Refer the following table Compare the productivity of material labour and electrical energy in using	10	M2	CO1

Subject	**Material P**	**Material Q**
Output A	200 units	400 units
Output B	300 units	200 units
Quantity of raw material usage	1000 kg	1000 kg
Labour usage	300 man hrs	250 man hrs
Electric energy consumption	1000KWh	1500KWh
Cost of raw material /kg	Rs 20	Rs 30
Labour per man hr	Rs 5	Rs 5
Electrical energy / KWhr	Rs 1.5	Rs 1.5

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<table>
<tr><td></td><td>material P and Q Comment on relative advantage of using materials.</td><td></td><td></td><td></td></tr>
<tr><td>Q3B</td><td>The following are the mean and ranges of 20 samples of each . The data pertain to overall length of a fragmentation bomb manufactured by US. The measurements are in inches.
<table>
<tr><th>Sample No.</th><th>X BAR</th><th>R</th></tr>
<tr><td>1.</td><td>0.8372</td><td>0.010</td></tr>
<tr><td>2.</td><td>0.8324</td><td>0.009</td></tr>
<tr><td>3.</td><td>0.8318</td><td>0.008</td></tr>
<tr><td>4.</td><td>0.8344</td><td>0.004</td></tr>
<tr><td>5.</td><td>0.8346</td><td>0.005</td></tr>
<tr><td>6.</td><td>0.8332</td><td>0.011</td></tr>
<tr><td>7.</td><td>0.8340</td><td>0.009</td></tr>
<tr><td>8.</td><td>0.8344</td><td>0.003</td></tr>
<tr><td>9.</td><td>0.8308</td><td>0.002</td></tr>
<tr><td>10.</td><td>0.8350</td><td>0.006</td></tr>
<tr><td>11.</td><td>0.8380</td><td>0.006</td></tr>
<tr><td>12.</td><td>0.8322</td><td>0.002</td></tr>
<tr><td>13.</td><td>0.8356</td><td>0.013</td></tr>
<tr><td>14.</td><td>0.8322</td><td>0.005</td></tr>
<tr><td>15.</td><td>0.8304</td><td>0.008</td></tr>
<tr><td>16.</td><td>0.8372</td><td>0.011</td></tr>
<tr><td>17.</td><td>0.8282</td><td>0.006</td></tr>
<tr><td>18.</td><td>0.8346</td><td>0.006</td></tr>
<tr><td>19.</td><td>0.8360</td><td>0.004</td></tr>
<tr><td>20.</td><td>0.8374</td><td>0.006</td></tr>
</table>
From the above data set up the X bar chart and R chart of control, for the length of bomb.
Draw the above control chart and compute their limits and comment on process stability. For subgroup size of 5, A_2 =0.58, D_4 = 2.11, D_3=0</td><td>10</td><td>M7</td><td>CO3</td></tr>
<tr><td>Q4A</td><td>Refer the following Project and carry out sensitivity analysis. ABC company proposes to start a new venture for manufacture of fluorescent bulbs. The estimates of the new venture are as follows.
Output of bulbs per annum : 300000 NOS.
Expected sales revenue per annum Rs 150,00,000
Fixed cost Rs 35,00,000
Variable cost Rs.66,00,000
If sale price is reduced to Rs 40 per unit find out its effect on Break Even point.
If Fixed cost is increased to Rs40,00,000, find out its effect on BEP.
If variable cost increases by 10 % find out its effect on BEP</td><td>10</td><td>M5</td><td>CO1
CO3</td></tr>
</table>

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<table>
<tr><td>Q4B</td><td>What do you mean by standard time. What allowances are used in computation of standard time. Draw the relevant diagram. The elemental timings are given in table to produce a component. Compute the standard time. Assume rest and personal allowance as 12% and contingency allowance 2 %. Compute no of units to be produced in 8 hours. All work elements are manual elements.
<table>
<tr><th>Element</th><th>Observed time</th><th>Rating</th><th>Remark</th></tr>
<tr><td>A.</td><td>0.2</td><td>90</td><td>-</td></tr>
<tr><td>B.</td><td>0.05</td><td>80</td><td>-</td></tr>
<tr><td>C.</td><td>0.03</td><td>95</td><td>-</td></tr>
<tr><td>D.</td><td>0.78</td><td>90</td><td>-</td></tr>
<tr><td>E.</td><td>0.06</td><td>110</td><td>-</td></tr>
<tr><td>F.</td><td>0.05</td><td>105</td><td>-</td></tr>
<tr><td>G.</td><td>0.02</td><td>85</td><td>Once in 5 pieces</td></tr>
<tr><td>H.</td><td>0.06</td><td>80</td><td></td></tr>
<tr><td>I.</td><td>0.10</td><td>90</td><td></td></tr>
<tr><td>J.</td><td>0.04</td><td>90</td><td>Once in 20 pieces</td></tr>
</table></td><td>10</td><td>1,2</td><td>M2</td></tr>
<tr><td>Q5A</td><td>Prepare the outline process chart for the manufacturing of the Assembly of nut, bolt and washer with standard specification for M12 threads.</td><td>10</td><td>M2</td><td>CO2</td></tr>
<tr><td>Q5B</td><td>What are the recording techniques? How are they used? What do you mean by MOST? Explain the significance of MOST.</td><td>10</td><td>M2</td><td>CO2</td></tr>
<tr><td>Q6A</td><td>Explain Six Sigma methodology to be used for productivity improvement. State and explain uses of various tools to be used in DMAIC.</td><td>10</td><td>M1</td><td>CO1</td></tr>
<tr><td>Q6B</td><td>Explore Supply Risks in JIT implementation. Prepare the Ishikawa diagram for Supply Risks in JIT implementation as an effect and show various risk factors as causes under different categories.</td><td>10</td><td>M4</td><td>CO1</td></tr>
<tr><td>Q7A</td><td>What do you mean by Ergonomics? Explain methods to improve work environment. Identify at least 20 examples of wrong designs/ poor designs of various products from ergonomics perspective. Draw the sketches and justify your comments.</td><td>10</td><td>M3</td><td>CO1</td></tr>
<tr><td>Q7B</td><td>Explore the factors affecting Lean Manufacturing. Explain the techniques used in Lean implementation. Illustrate value stream mapping tool with suitable example like Training feedback process.</td><td>10</td><td>M4</td><td>CO3, CO4</td></tr>
</table>

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Standard Normal Probabilities

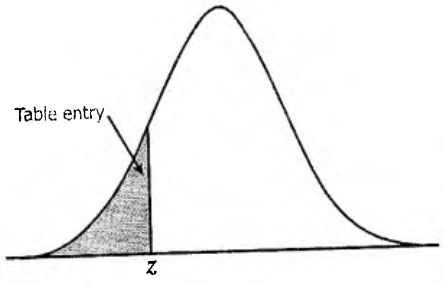

Table entry for z is the area under the standard normal curve to the left of z.

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
−3.4	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0002
−3.3	.0005	.0005	.0005	.0004	.0004	.0004	.0004	.0004	.0004	.0003
−3.2	.0007	.0007	.0006	.0006	.0006	.0006	.0006	.0005	.0005	.0005
−3.1	.0010	.0009	.0009	.0009	.0008	.0008	.0008	.0008	.0007	.0007
−3.0	.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010
−2.9	.0019	.0018	.0018	.0017	.0016	.0016	.0015	.0015	.0014	.0014
−2.8	.0026	.0025	.0024	.0023	.0023	.0022	.0021	.0021	.0020	.0019
−2.7	.0035	.0034	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026
−2.6	.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
−2.5	.0062	.0060	.0059	.0057	.0055	.0054	.0052	.0051	.0049	.0048
−2.4	.0082	.0080	.0078	.0075	.0073	.0071	.0069	.0068	.0066	.0064
−2.3	.0107	.0104	.0102	.0099	.0096	.0094	.0091	.0089	.0087	.0084
−2.2	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.0116	.0113	.0110
−2.1	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
−2.0	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
−1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
−1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
−1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
−1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
−1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
−1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
−1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
−1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
−1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
−1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
−0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
−0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
−0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
−0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
−0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
−0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
−0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
−0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
−0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
−0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641

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Standard Normal Probabilities

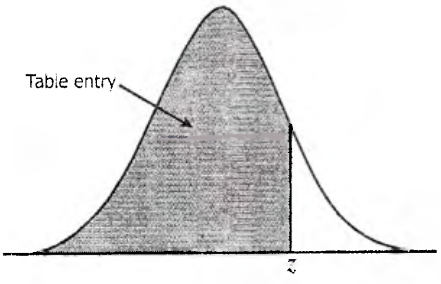

Table entry for z is the area under the standard normal curve to the left of z.

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
0.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
0.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9346	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990
3.1	.9990	.9991	.9991	.9991	.9992	.9992	.9992	.9992	.9993	.9993
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.3	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998

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17/11/17

Final year B.Tech. Mech. Sem VII

BHARATIYA VIDYA BHAVAN'S

SARDAR PATEL COLLEGE OF ENGINEERING

Munshi Nagar, Andheri (West), Mumbai 400 058

(A Government Aided Autonomous Institute)

END SEM NOV-2017

BTM703 – Finite Element Method **Marks: 100**

Class/sem: Final year B. Tech. (Mechanical)/ VII **Duration: 3 hours**

Master file.

Note:

- **Question No 1 is compulsory**
- **Attempt any four questions out of remaining six.**
- Assume suitable data if required and state it clearly.
- Answers to all sub-questions should be grouped together.

Q.no		Max. Mar	Module	COs
1	Answer the following:			
	a) Derive the weak formulation equation for simply supported beam.	5	2	1
	b) What do you mean by interpolation/shape function? State the different methods to derive shape function also list the characteristics of the shape function.	5	5	1
	c) Discuss in detail the iso-parametric elements used in FEA.	5	5	1
	d) List various types of elements (based on shape) used in FEA; explain what do mean by CST element.	5	1	1
2	A rectangular plate of 20cm horizontal length, 10cm vertical height and 1cm thick; is subjected to some load at vertical edge on the right side and vertical edge on the left side is fixed. Obtain the stiffness matrix for one of the element if the rectangular plate is divided into two triangular elements by joining left side top corner with right side bottom corner. Take E= 200 GPa, ν= 0.3; assume plane stress formulation.	20	5	2
3	a) Using three linear finite elements, determine the axial displacements in non-uniform rod of length 30cm, fixed at left end and subjected to axial force P=750N at the right end. Take area $A(x)= \{6-(x/10)\}$ cm^2 ; where x is distance from left end in centimeter. E= 207 GPa. Also find the stresses in each elements.	10	4	3
	b) Explain the following w.r.t. FEA: 1) Error 2) Error classification 3) Ill conditioning 4) convergence	10	7	3
4	a) What are the advantages of using natural co-ordinates in FEM.?	4	5	1
	b) What are the mesh revision methods? Discuss	6	7	4
	c) For a simply supported beam subjected to uniform transverse load q_0 obtain one parameter solution for transverse deflection of beam using Galerkin method. (assume trigonometric trial function.)	10	4	3

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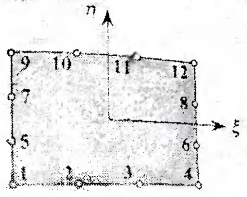
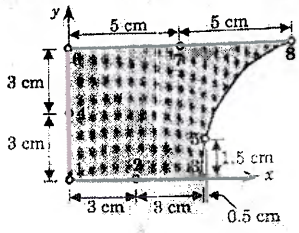
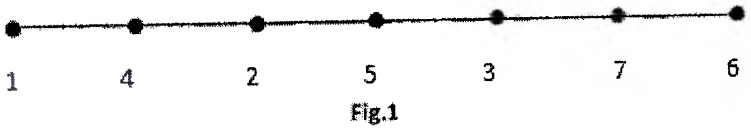
5	Derive the interpolation function for the cubic serendipity element shown in the adjacent fig.		20	5	1
6	Determine the Jaccobian matrix and the transformation equations. What is the determinant of Jacobian Matrix.		20	5	1
7	a) A discretised linear bar element is as shown in fig.1. Give answer to the following: i. Develop stiffness matrix and show the skyline. ii. Show one dimensional array to store the matrix and find the matrix profile iii. Find the semi-bandwidth for each row of the matrix and for the entire matrix.  Fig.1		3 4 3	1	1
	b) What is Numerical integration? Discuss Newton-Cotes and Gauss Quadrature technique of numerical integration.		10	6	3

Final year B.Tech. Mech sem VII

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Sardar Patel College of Engineering

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

END SEM
Nov 2017

Program: **B.Tech. in Mechanical Engineering**
Class: **Final Year B.Tech. (Mechanical)**
Course code: **BTM701**
Name of the Course: **Machine Design - II**

Date: **Nov 2017**
Duration: **3 Hr.**
Max. Points: **100**
Semester: **VII**

Master file.

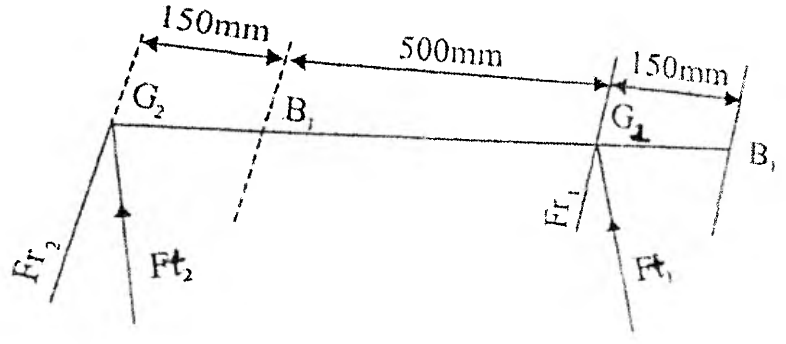
Instructions:

- Question No 1 is **compulsory**. Attempt any four questions out of remaining six.
- Answers to all sub questions should be grouped together.
- Use of PSG Design Data Book is permitted.
- Assume suitable data if necessary.

			Max. Points	CO No.	Module No.
Q1	a)	Define the following terms: i. Static load carrying capacity ii. Dynamic load carrying capacity	(3)	1	3
	b)	Draw the displacement, velocity and acceleration profile for cycloidal motion of roller follower	(3)	1	5
	c)	Describe the principle of operation of pump and explain concept of priming in centrifugal pump	(3)	3	7
	d)	Explain principle of hydrodynamic lubrication in journal bearing with neat sketches	(3)	1	4
	e)	What are the assumptions made in Lewis equation applied to gear design and justify them	(5)	1	1
	f)	Derive condition for self energizing block brake with short shoe	(3)	1	6
Q2	a)	Determine the main dimensions of cone clutch. It is to be faced with leather and is to transmit 30kW at 750 rev/min from an electric motor to a compressor. Find the axial force that must be produced by the spring. Take coefficient of friction as 0.2 and average pressure 0.105 N/mm^2. Shear strength of shaft is 42 N/mm^2 and factor of safety is 1.5	(15)	1	6
	b)	Compare between rolling and sliding contact bearing	(5)	1	4
Q3	a)	Describe important components of a centrifugal pump with neat sketch. Explain the design procedure of impeller shaft, impeller, volute casing and selection of electric motor.	(15)	3	7
	b)	Explain the thermal considerations employed in the design of worm gear drive	(5)	1	1

Final year B.Tech. Mech. Sem VII

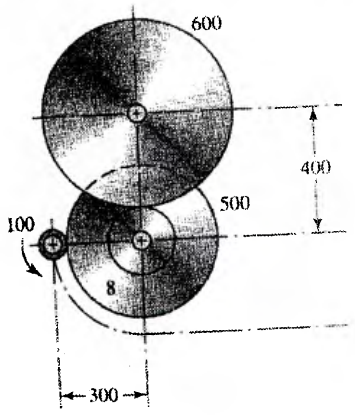
Q4	a)	It is required to design a pair of spur gear for a compressor running at 250 rpm driven by 75 kW motor at 1000rpm. The centre distance is exactly 250mm. the starting torque of motor is 150 % of rated torque. The allowable stress in gear is 233 N/mm^2. The pressure angle is 20 and factor of safety is 2. Design the gears and specify their dimensions assuming velocity factor accounts dynamic load.	(15)	*1*	*1*
	b)	Discuss different types of failures and the associated remedies for sliding contact bearings.	(5)	*1*	*4*
Q5	a)	A shaft transmitting 60 kW at 150 rpm from gear G1 to gear G2 and mounted on two single row deep groove ball bearings B_1 and B_2 as shown below. The various forces are F_{t1} = 16000 N, F_{r1} = 6000 N, F_{t2} = 10000 N, F_{r2} = 4000 N. The diameter of shaft at bearings B_1 and B_2 is 75 mm. The expected life for 90% of the bearings is 10000 hr. Select suitable ball bearing	(17)	*1*	*3*



	b)	For a two stage compound reverted gear train with input speed of 1750 rpm and output speed of 85 rpm, calculate minimum number of teeth of all four gears and speed of an intermediate shaft	(3)	*2*	*2*
Q6	a)	Draw (freehand) two views of a snatch block assembly for an EOT crane and tag main components such as, rope, pulley, cross-block, hook, thrust bearing, side-plates, etc. Explain with necessary equations, the procedure used to select size of rope, hook and sheave for a given load capacity of snatch block.	(15)	*3*	*7*
	b)	A ball bearing operates on a working cycle consist of three parts i. Radial load of 3000N at 720rpm for 30% of the cycle ii. Radial load of 7000N at 1440rpm for 40% of the cycle iii. Radial load of 5000N at 900rpm for the remaining part of the cycle The basic dynamic capacity of the bearing is 30700N calculate i. The rating life of the bearing in hours	(5)	*1*	*3*

Final year B. Tech. Mech. Sem VII

Q7 a) In the double reduction gear train shown, Sketch a general shaft layout, including means to locate the gears and bearings, and to transmit the torque. Assume necessary dimensions (10) *2* *2*



b) A cam consists of a circular disc of diameter 75 mm with its centre displaced 25 mm from the camshaft axis. The follower has a flat surface (horizontal) in contact with the cam and the line of action of the follower is vertical and passes through the shaft axis as shown in Fig. 20.50. The mass of the follower is 2.3 kg and is pressed downwards by a spring which has a stiffness of 3.5 N/mm. In the lowest position the spring force is 45 N. (10) *1* *5*

a. Derive an expression for the acceleration of the follower in terms of the angle of rotation from the beginning of the lift.

b. As the cam shaft speed is gradually increased, a value is reached at which the follower begins to lift from the cam surface. Determine the camshaft speed for this condition

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Final year B.Tech, Mech - Sem VII

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Sardar Patel College of Engineeri

(A Government Aided Autonomous Institute)
Munshi Nagar, Andheri (West), Mumbai – 400058.

End Semester Exam
November 2017

Max. Marks: 100 marks Duration: 3 hours

Class: FINAL YEAR B.TECH. Semester: VII Program: Mechanical Engineering

Name of the Course: **RENEWABLE ENERGY SOURCES AND UTILIZATION**

Course Code : BTM 702

Master file.

Instructions:

1. Question No 1 is compulsory.
2. Attempt any four questions out of remaining six.
3. Draw neat diagrams
4. Assume suitable data if necessary

Q No		Max. Mark	CO#	Module no.
Q1 (a)	Explain the following solar application in details with suitable figure: I. Solar refrigeration and air-conditioning. II. solar drier.	10	CO1	M2
(b)	A PV cell has open ckt voltage capacity of 0.6 V, Short ckt current density 250 A/m^2 at a cell temperature of 40^o C. Calculate voltage and current density that maximizes the power of cell. Also calculate maximum power output per unit cell area?	10	CO2	M3
Q2 (a)	A propeller blade type windmill installled in following environmental conditions in kerala state- Wind at 1 std atmospheric pressure and 15^o C has velocity of 10 km/hr. Calculate i) Total power density in wind stream, ii) Maximum obtainable power density, iii) reasonally obtainable power density considering actual power coefficient of turbine 0.38, iv)Total power available, v) Maximum torque and axial thrust experienced by wind rotor? Given data- Turbine diameter 100 m, turbine operating speed 40 rpm at maximum efficiency, for air value of gas constant 287 J/kg.K.	10	CO2	M4
(b)	Describe different types of turbines are in use for hydroelectric plant. A small hydro plant is to be developed on a canal stream where head available is 16.5m and flow is 5.8 m^3/s. assuming the plant efficiency of 85%, find out the power generating capacity at the site	10	CO2	M5
Q3 (a)	Define Coincidence factor. Describe at least four DSM techniques in details.	10	CO3	M1
(b)	What are the different factors affecting biogas production & Explain in detail factors among them?	10	CO1	M7
Q4 a	Why concentrating solar collector has more energy generatrion capacity than flat plate solar collector? Calculate the heat loss for a flat plate collector with two glass covers. Given the following data. Size of absorber plate(L_1X L_2) : 2.20M x 0.90M Height of collector casing (L_3) :18cm Emissivity of the absorber plate :0.82 Emissivity of the glass cover : 0.70 Mean plate temperature : 69^0C Ambient air temperature : 25^0C	10	CO2	M2

	Temperature of glass cover 1 : 62^0C Temperature of glass cover 2 : 34^0C Wind velocity : 2.5m/s Convective heat transfer coefficient between the absorber plate and the first cover : 2.683W/m^2k Convective heat transfer coefficient between the first and the second cover : 2.803 W/m^2k. Back insulation thickness : 8cm Side insulation thickness : 4cm Thermal conductivity of insulation : 0.05W/m-K.			
b	Explain in brief terms used to express surface wind data with sketch? For wind energy estimation explain velocity duration curve and frequency duration curve with sketch?	5	CO1	M4
c	Sketch the different types of Gasifier? Give the advantages and disadvantages of individual gasifier?	5	CO1	M7
Q5 a	Give applications of PV system with following points i) Grid connected applications and ii) Off grid connected applications?	5	CO3	M3
b	Explain tidal barrage system with suitable figure. For a proposed tidal site the observed difference between high and low water tide is 9 M. the basin area is about 0.45 sq.km which can generate power for 3 hours in each cycle. The average available head is assume to be 8.5m , and overall efficiency of the generation is 72 percentage. Assume density of sea water as 1025 kg/m^3. Calculate: I. Power at any instant II. Yearly power output.	10	CO3	M5
c	Describe water power production in India with the help of graph showing installed capacity and electricity production by assuming approximate data. Also write about Potential of Small Hydropower in india.	5	CO1	M1
Q6 a	Write short note on solar cell array and module system? Draw necessary sketch showing module and array system?	5	CO1	M3
b	With neat sketch describe a binary cycle system for liquid dominated system to extract geothermal energy. What are the main applications of geothermal energy?	10	CO1	M6
c	What are the different wet processes for biomass conversion?	5	CO1	M7
Q7 a	Describe geothermal energy, classify geothermal sources and explain each source in details.	10	CO1	M6
b	Explain it with the help of neat sketch "annual load factor of energy production plant"? Give its significance? With the help of neat sketch explain relation between coefficient of performance of wind mill and rotor velocity (Cut in speed, design speed and furling speed)? Give its significance?	10	CO3	M4

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End-Semester Examination
Nov 2017

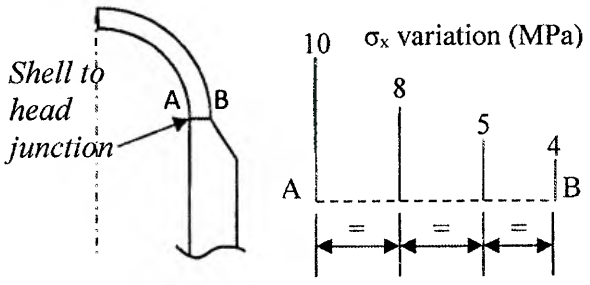
Program: **B.Tech. in Mechanical Engineering**
Class: **Final Year B.Tech. (Mechanical)**
Course code: **BTM710**
Name of the Course: **Process Eqpt. Design and Piping Engineering**

Date: **Nov 2017**
Duration: **3 Hr.**
Max. Points: **100**
Semester: **VII**

Master file.

Instructions:

- Assume suitable data if necessary.

		Max. Points	CO No.	Moc No.
Q1 A)	Calculate required thickness of conical section of a pressure vessel joining two shell sections of 3200 mm and 2700 mm inside diameters. The straight length of cone is 2500 mm. The weld joint is of butt type with backing strip removed and no radiography is performed on welds. Design pressure is 3 MPa and allowable stress of material is 200 MPa. Corrosion allowance is 3 mm (internal) and 1 mm (external).	**(5)**	*2*	*3*
B)	Explain procedure for performing plastic collapse check by elastic analysis for a typical shell to head junction shown in the figure. Also determine the membrane stress component $(\sigma_x)_m$ for the variation of σ_x shown along SCL 'AB'. 	**(5)**	*2*	*4*
C)	A 600 NB pipe has internal design pressure of 2.5 MPa and design temperature of 530°C. The pipe material is seamless carbon steel pipe with allowable stress of 35 MPa. Corrosion allowance is 1.5 mm. Factor W = 1.0 for T< 510°C and W = 0.5 for T>815°C. Calculate required schedule of the pipe.	**(5)**	*2*	*6*
D)	Select constant spring hanger from catalogue (refer Annexure 1) for total pipe movement of 10 mm (cold) to 70 mm (hot). The operating load is 9500 N.	**(5)**	*3*	*7*
Q2 A)	As a part of an engineering team from a process equipment manufacturer, you will be visiting an important customer to discuss an order for a critical high-pressure heat exchanger for chemical plant located in South Australia. Your manager has instructed you to carefully prepare an exhaustive list of all design parameters and loading conditions which should be obtained from the customer during the meeting. Compose the list and briefly explain significance of each term from the list.	**(5)**	*1*	*1*
B)	A carbon steel pressure vessel has shell of 1800 mm inside diameter, '*t*' thickness and 6000 mm unsupported length. The shell is subjected to external pressure of 0.16 MPa at 300° C due to fluid in its external jacket. Calculate the required thickness '*t*' of the shell. Calculate the size of the stiffeners. Corrosion allowance is zero.	**(10)**	*2*	*3*
C)	Following figure shows part of P&ID for a process plant. Sketch the diagram and describe function/type of instrument/valve symbols, nature of connection lines, interpretation of pipeline tag and other relevant information.	**(5)**	*1*	*1*

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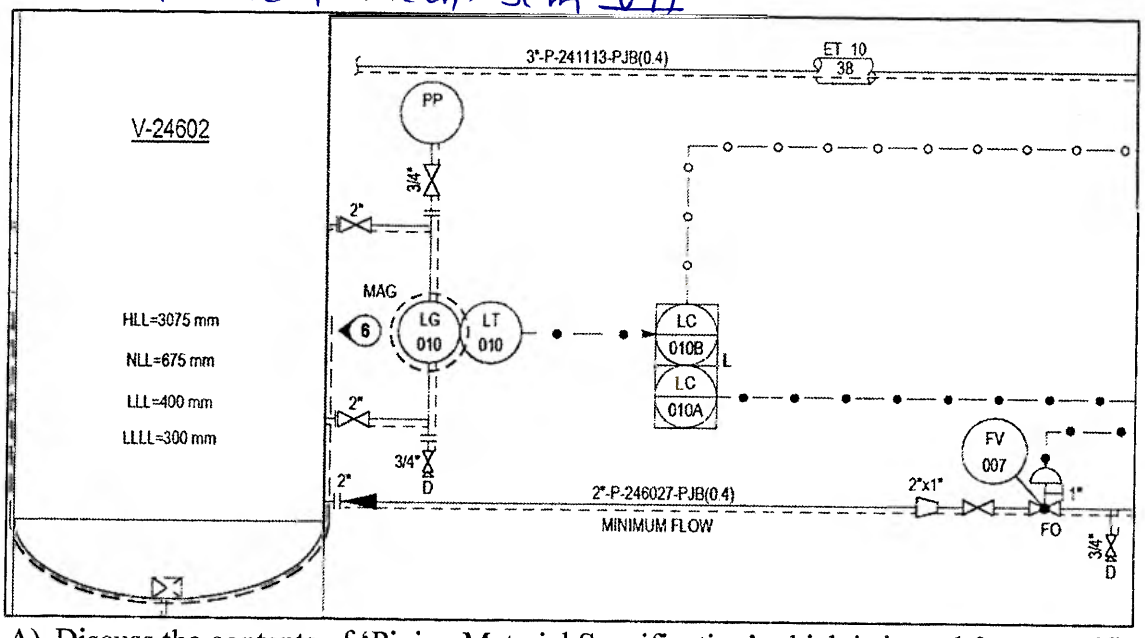

Q3 A) Discuss the contents of 'Piping Material Specification' which is issued for a specific project by EPC consultant. How this document is used during design phase of a project? **(5)** *4* *2*

B) Design flange with flat face as per following data. **(10)** *2* *4*

Design pressure = 6.8 MPa	Flange inside diameter= 1050 mm
Allowable flange stress = 250 MPa	Gasket = PTFE (m=2.75, y=25.5 MPa)
Allowable bolt stress: operating =220 MPa, gasket seating condition = 200 MPa	

C) Describe various types of supports used for vertical and horizontal process equipment. Support your answer with neat sketches and preferred use of each support type. **(5)** *3* *5*

Q4 A) You have been hired by an engineering consultant to advise about selection of codes and standards which are typically used for design of pressure equipment and piping. Prepare a list of major codes and standards and include a brief description about salient features of each of these. **(5)** *1* *1*

B) You shall be visiting manufacturing facility of a reputed supplier in Europe which supplies important welded, forged and bolted subassemblies for your organization. Prepare a checklist listing all the machines/inspection devices which you would like to inspect, mentioning features to be checked for each machine/device (for example, if machine is plate rolling machine, one of the feature you need to check is maximum plate width and thickness which can be rolled). **(5)** *3* *2*

C) A vertical tower vessel of welded construction has following design specification. **(10)** *2* *3*

Inside diameter = 1600 mm	Material = Carbon steel
Straight length of shell = 19,000 mm	Liquid level = 12,000 mm from bottom straight line
Type of heads = 2:1 ellipsoidal at top and hemispherical at bottom end	Liquid specific gravity = 1.50
Design internal pressure = 4.4 MPa	Allowable stress = 145 MPa
Design temperature = 280° C	Corrosion allowance = 3 mm
Joint efficiency = 0.90	Hydrotest pressure = nil

Calculate as per pressure vessel design code: (i) Thickness of shell and top/bottom heads, (ii) Pressure-temperature rating class of flanges fitted on the vessel and (iii) suitable schedule for 550 mm nominal diameter nozzle pipe for the vessel.

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Q5 A) A cylindrical vessel of 3200 mm ID is subjected to an internal pressure of 1.5 MPa. Design the reinforcing pad for a nozzle opening with following data. The nozzle axis makes an angle of 75° with the axis of shell. **(10)** *2* *4*

Internal dia. Of nozzle = 500 mm	Noz. height above vessel = 300 mm
Thickness of vessel = calculate and round to the nearest even integer value	Permissible stress for shell and nozzle = 150 MPa
Thk. of nozzle wall = calculate and round to the nearest even integer value	Corrosion allowance = 1 mm

B) Design skirt support for a vertical vessel with the data given below. **(10)** *3* *5*

Vessel ID/thickness = 2000 / 12 mm Skirt ID = 2000 mm	Permissible stress, skirt = 130 MPa (tension), 80 MPa (compression)
Total height of vessel = 30 m	Permissible bending stress, base plate = 160 MPa
Operating weight of vessel = 3500 kN	Permissible stress, bolts = 150 MPa
Empty weight of vessel = 2000 kN	Permissible compressive stress, foundation = 21 MPa
Wind pressure, H>20m = 1600 N/m^2 Wind pressure, H<20m = 800 N/m^2	Seismic factor, C = 0.10

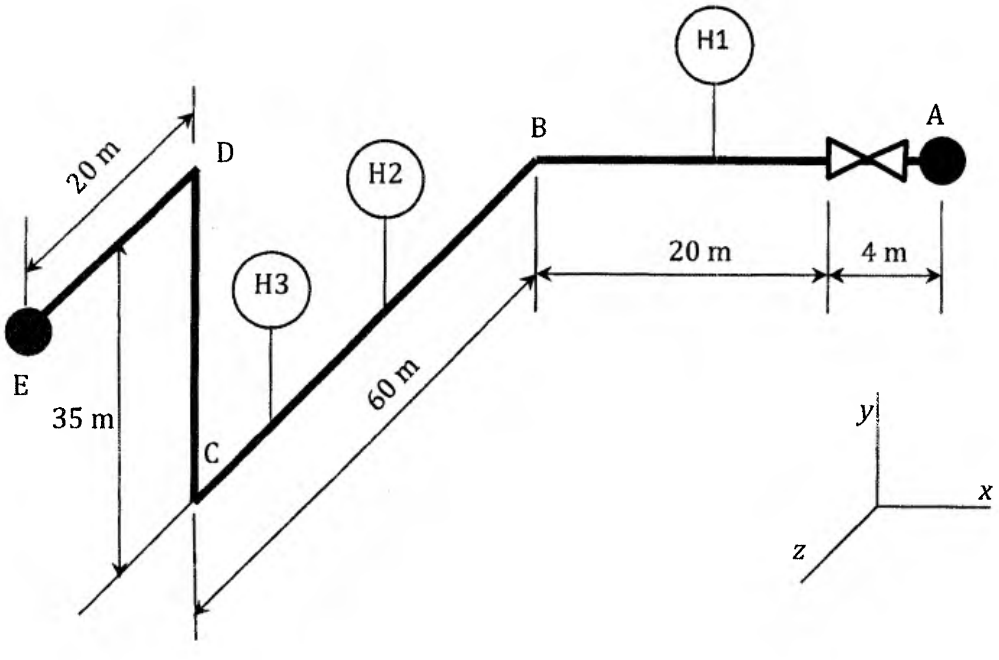
Determine thickness of skirt and base plate and number/size of anchor bolts.

Q6 A) A single pass fixed-tubesheet heat exchanger has following specification. **(10)** *3* *5*

Number of tubes = 393	Outside dia. of tubes = 25 mm
Tube side design pressure = 1.0 MPa	Shell side design pressure = 0.6 MPa
Pitch = triangular	Corrosion allowance = nil
Allowable stress (shell/tube) = 95 MPa	Tubesheet design factor, F = 1.0

Determine thickness of tubesheet. Write a short not about baffle arrangement.

B) Figure shows pipeline ABCDE connecting two process equipment. **(10)** *4* *7*



Design data is as follows.

- Pipe size: 600 NB sch STD; Pipe material: SA106 Gr B; Elbows: LR type
- Allowable stress (cold/hot) = 150/140 MPa; Modulus of elasticity = 210,000 MPa, Corrosion allowance = nil
- Thermal expansion at operating temperature = 2.875 mm/m

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- Suggested maximum span between supports = 50 m
- Displacement at point A in x,y,z directions = +10, -8, +8 mm
- Displacement at point E in x,y,z directions = 0, 0, 0 mm

(i) Write short note on different types of piping supports and guidelines to locate these.

(ii) Select suitable locations for supports H1, H2 and H3.

(iii) Check the need for performing flexibility analysis. Consider factor K1 = 208300SA/Ea

Q7 A) Find minimum required pipe schedule of 500 NB short radius elbow for internal pressure of 0.8 MPa. Consider design temperature, allowable stress and corrosion allowance same as that given for Q1(C) of this question paper. **(5)** *3* *6*

B) A 100 NB sch 40 pipeline (114.3 mm OD, 6.0 mm wall thickness) has equivalent length of 200 m for the purpose of pressure drop calculations. The pipe inside surface has surface roughness of 0.05 mm. The fluid flowing through pipeline has density of 950 kg/m^3, viscosity of 1.6 cP and mass flow rate of 115,000 kg/hr. Calculate the pressure drop inside the pipeline. **(5)** *4* *5*

C) Explain different methods of selecting pipe size for a process plant. **(5)** *4* *6*

D) Discuss the procedure to perform piping flexibility analysis using a typical commercial software. Highlight important software features that will aid the analyst during the modelling and evaluation of flexibility. Define following terms: (i) Stress Intensification Factor, (ii) Flexibility factor. **(5)** *4* *7*

Annexure 1

Pipe Schedule

NPS inches	N.D.	O.D. mm	10	20	30	STD	40	60	XS	80	100	120	140	160
20	500	508	6.35	9.53	12.70	9.52	15.08	20.62	12.7	26.19	32.54	38.1	44.45	50.01
22	550	558.8	6.35	9.53	12.70	9.52	15.87	22.22	12.7	28.57	34.92	41.27	47.62	53.97
24	600	609.6	6.35	9.53	12.70	9.52	17.47	24.61	12.7	30.96	38.89	46.02	52.37	59.54

Weld Joint Efficiency

Type No.	Joint Description	Joint Category	Degree of Radiographic Examination (a) Full [Note (1)]	(b) Spot [Note (2)]	(c) None
(1)	Butt joints as attained by double welding or by other means which will obtain the same quality of deposited weld metal on the inside and outside weld surfaces to agree with the requirements of UW 35. Welds using metal backing strips which remain in place are excluded.	A, B, C & D	1.00	0.85	0.70
(2)	Single welded butt joint with backing strip	A, B, C & D	0.90	0.80	0.65
	other than those included under (1)	A, B & C	0.90	0.80	0.65

Factor Y

Materials	Temperature, °C (°F) ≤ 482 (900 & Lower)	510 (950)	538 (1000)	566 (1050)	593 (1100)	≥ 621 (1150 & Up)
Ferritic steels	0.4	0.5	0.7	0.7	0.7	0.7
Austenitic steels	0.4	0.4	0.4	0.4	0.5	0.7

F.Y.B.Tech. Mech. Sem VII

Pressure-temperature rating class for carbon steel flanges

	Working Pressure by Classes, bar						
Class Temp., °C	150	300	400	600	900	1500	2500
−29 to 38	19.8	51.7	68.9	103.4	155.1	258.6	430.9
50	19.5	51.7	68.9	103.4	155.1	258.6	430.9
100	17.7	51.5	68.7	103.0	154.6	257.6	429.4
150	15.8	50.2	66.8	100.3	150.5	250.8	418.1
200	13.8	48.6	64.8	97.2	145.8	243.2	405.4
250	12.1	46.3	61.7	92.7	139.0	231.8	386.2
300	10.2	42.9	57.0	85.7	128.6	214.4	357.1

Useful expressions for tubesheet design

$$D_{bundle} \approx d_0\left(\frac{N_t}{0.319}\right)^{1/2.142}$$

Useful expressions for support skirt design against wind and seismic load

$T = 6.35 \times 10^{-5}(H/D)^{1.5}(W/t)^{0.5}$ where W is in kN; wind load $P = k_1 k_2 p H D_0$, wind shape factor k_1=0.7 to 0.85, wind factor related to period, k_2 = 1 if T<0.5 sec, else k_2 = 2

Useful expressions for flange design

Factor $Y = \frac{1}{K-1}\left[0.66845 + 5.71690\frac{K^2 \log_{10} K}{K^2-1}\right]$, K = (flange OD)/(flange ID)

Pressure Drop Calculations

$f_D = 0.3164 R_e^{-0.25}$

Colebrook White equation: $\frac{1}{\sqrt{f_D}} = -2\log_{10}\left(\frac{e}{3.7D} + \frac{2.51}{R_e\sqrt{f_D}}\right)$

Constant Support Size Selection Table

Loads in kgs

Size		Total Travel in mm										
		40	50	60	70	80	90	100	110	120	130	140
3	A	70.1	56.1	46.7	40.1	35.0	31.2	28.0	25.5	23.4	21.6	20.0
	B	107.2	85.8	71.5	61.3	53.6	47.7	42.9	39.0	35.7	33.0	30.6
	C	157.0	125.6	104.7	89.7	78.5	69.8	62.8	57.1	52.3	48.3	44.9
	D	237.5	190.0	158.3	135.7	118.7	105.5	95.0	86.3	79.2	73.1	67.8
4	A	302.6	242.0	201.7	172.9	151.3	134.5	121.0	110.0	100.9	93.1	86.4
	B	451.2	361.0	300.8	257.8	225.6	200.5	180.5	164.1	150.4	138.8	128.9
	C	621.2	497	414	355	311	276	248	226	207	191	177
	D	927.5	742	618	530	464	412	371	337	309	285	265
5	A		1118	932	799	699	621	559	508	466	430	399
	B		1705	1421	1218	1066	947	853	775	710	656	609
	C		2401	2001	1715	1501	1334	1200	1091	1000	923	857
	D		3388	2824	2420	2118	1882	1694	1540	1412	1303	1210
	E		4706	3922	3361	2941	2614	2353	2139	1961	1810	1681
6	A				4099	3587	3188	2869	2609	2391	2207	2050
	B				5060	4428	3936	3542	3220	2952	2725	2530
	C				5815	5089	4523	4071	3701	3392	3131	2908
	D				6695	5858	5207	4686	4260	3905	3606	3347
	E				7801	6826	6068	5461	4964	4551	4201	3901
	F				8893	7782	6917	6225	5659	5188	4789	4447

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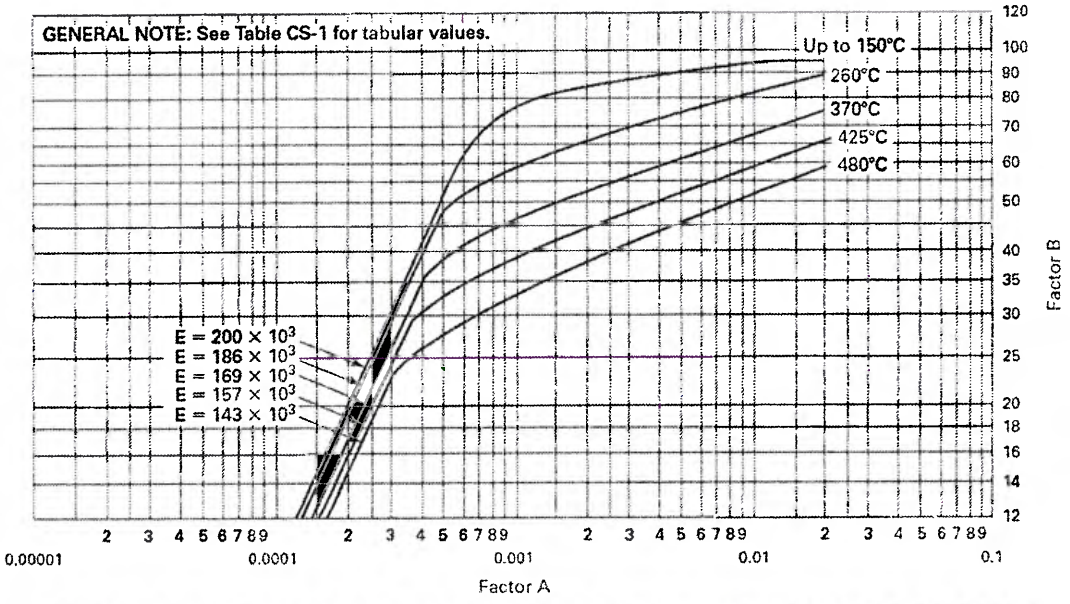
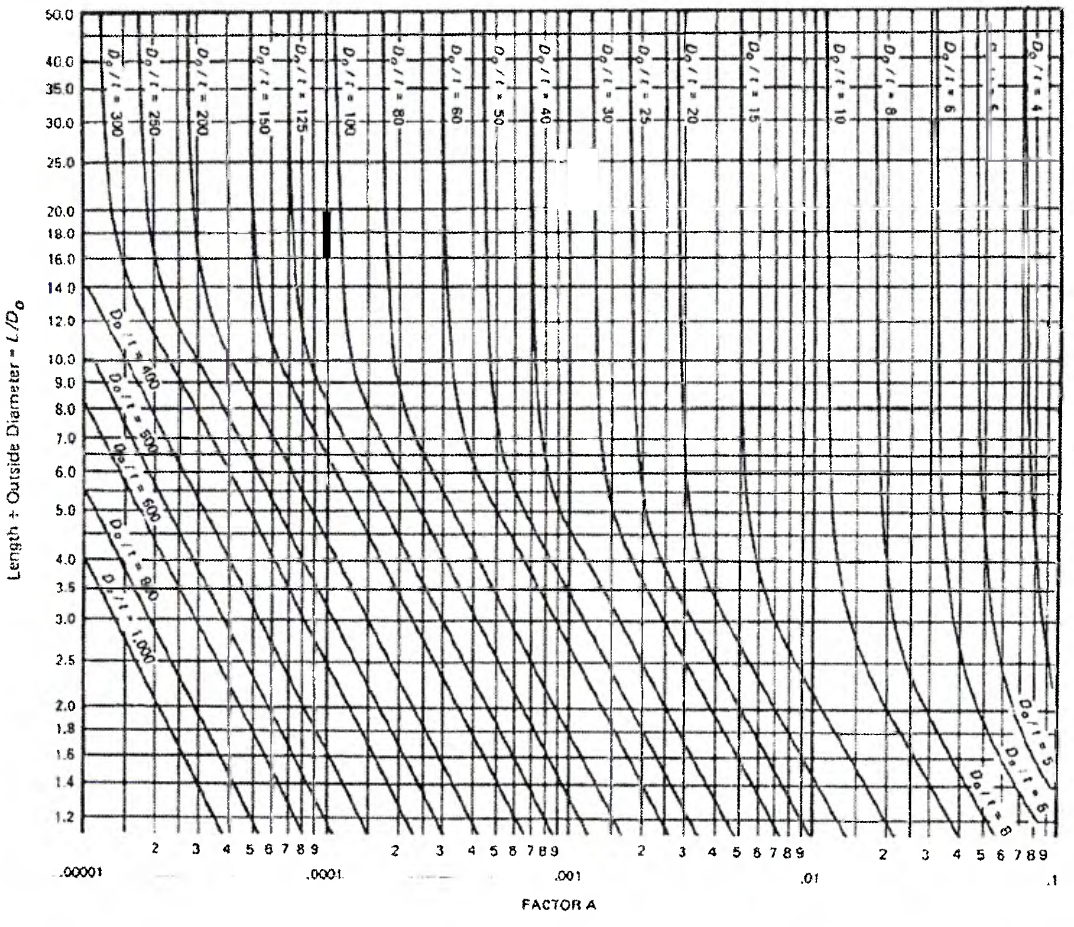
External pressure design charts for carbon steel





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B. Tech. Mech - Sem VII

Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)
Munshi Nagar, Andheri (West), Mumbai – 400058.

End Semester Examination, November 2017

B.Tech. (Mechanical Engineering), Sem-VII

BTM 708: COMPUTATIONAL FLUID DYNAMICS

Master file.

Max. Marks: 100 **Duration: 3 Hours**

Instructions:

- **Question no. 1 is compulsory.** Answer any **FOUR** from remaining six questions.
- Answers to all sub questions of a particular question must be grouped together for their evaluation.
- Make suitable assumption if needed with proper reasoning
- Figures on right in square bracket shows maximum marks for a particular sub-question.
- Figure on the extreme right shows **course outcome number** and **module number** respectively as per the syllabus of the course.

1. A. Answer following: **[10]** 1,1

(i) Distinguish between following approaches of mathematical modeling:
(a) Lumped and distributed parameters, (b) Transient and steady operating condition.
Give one example for each with necessary and sufficient explanation.

(ii) Define terms with example:
(a) absolute error, (b) approximation error, (c) truncation error.

(iii)When do we terminate an iterative solution of a system? Which method, Jacobi method or Gauss-Seidel method converges faster for linear system of algebraic equation? Give reason.

B. A solid cube of dimension L is originally at a temperature T_0. The cube is then dropped into a large bath where the cube rapidly settles flat on the bottom. The fluid in the bath provides convective heat transfer coefficient h(W/m^2K) from the fluid at constant temperature T_∞. Analyze the case and answer following. **[10]** 2,1

(a) Develop a mathematical model to obtain transient temperature of cube with all significant assumptions.
(b) List initial condition and show boundary condition with appropriate sketch.
(c) Formulate for a numerical calculation and state the numerical techniques which can be used to capture transient variation of cube temperature.

2. A. Discuss about the range of applications, advantages and limitation of computational fluid dynamics as a tool to solve real life problems. **[10]** 1,4

B. A copper sphere of diameter 5 cm is initially at temperature 200°C. It cools in air by convection and radiation. The temperature T of the sphere is governed by the energy equation **[10]** 3,4

$$\rho CV\frac{dT}{dt} = -\left[\varepsilon\sigma(T^4 - T_a^4) + h(T - T_a)\right]A$$

All terms carries their usual meaning.
Analyze the case and formulate the problem to estimate the evolution of sphere temperature numerically. Determine the time needed for the temperature to drop below 100°C.
The following values may be used for the physical variables: $\rho = 9000$ kg/m3, $C = 400$ J/(kg·K), $\varepsilon = 0.5$, $\sigma = 5.67 \times 10^{-8}$ W/(m²·K⁴), $T_a = 25$°C, and $h = 15$ W/(m²·K).

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3. A. Derive differential form of thermal energy equation for an open system with heat conduction and without any heat generation. Represent all energy interaction on a cubical differential element. **[10]** 2,4

B. Determine the temperature distribution in a plane wall of thickness 60 mm, which has an internal heat source of $0.3 MW/m^3$ and the thermal conductivity of the material is 21 W/m °C. Assume that the surface temperature of the wall is 40 °C. Model the problem to obtain steady state temperature at least 6 internal points.
If the left-hand face wall is insulated and the right-hand face is subjected to a convection environment at 93 °C with a surface heat transfer coefficient of $570 W/m^2$ °C. Determine the temperature distribution within the wall. **[10]** 2,5

4. A. Assume one dimensional transient convection-diffusion heat transfer problem under uniform flow field. **[10]** 3,2
(a) Simplify generalized energy equation to obtain required mathematical model.
(b) Using FVM discretization scheme, develop stability restrictions arising due central difference interpolation of convective term.
(c) Suggest two methods to avoid convergence and stability restrictions.

B. An insulated steel (thermal conductivity, k=50 W/m.K) rod of length 0.2 m, is heated electrically by passage of electric current generating energy at a rate of 10^5 W/m^3. One end of the rod is maintained at constant temperature of 100°C and other end is insulated. **[10]** 3,4
(a) Develop integral and differential form of the governing equation and state the boundary condition to be imposed.
(b) Discuss about the dimensionality and computational domain to obtain the desired solution.
(c) Assuming 6 nodes along the rod length develop discretized equation using FDM.
(d) Calculate temperatures at 6 nodes using an iterative method. Write name of the method used for calculation

5. A. The mathematical model of most of the thermo-fluid problem are partial differential equations. Discuss mathematical nature of such PDE and write their characteristic features. **[10]** 1,4

B. Name an efficient numerical algorithim to solve a tri-diagonal matrix and use it solve following **[10]** 2,2

$$\begin{bmatrix} 4 & -1 & 0 & 0 & 0 \\ -1 & 4 & -1 & 0 & 0 \\ 0 & -1 & 4 & -1 & 0 \\ 0 & 0 & -1 & 4 & -1 \\ 0 & 0 & 0 & -1 & 4 \end{bmatrix} \begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \\ y_5 \end{bmatrix} = \begin{bmatrix} 100 \\ 200 \\ 200 \\ 200 \\ 100 \end{bmatrix}$$

6. A. What do you understand by following terms: **[10]** 2,5
a. Staggered mesh, b. Semi-staggered mesh
c. Collocated mesh, d. Conformal mesh
e. Orthogonal mesh

B. Discuss the complexities associated with flow problem. How does SIMPLE algorithm handle it? Discuss and derive. **[10]**

7. Consider a 2D steady heat diffusion through a rectangular lamina (size:20cm×40cm) of thermal conductivity 25 W/mK. *Boundary conditions: Left* - Insulated, *Right* - h(50 W/m^2K), 25°C, *Top*: constant temperature(500°C) and *Bottom*- constant heat flux (2000 W/m^2). **[20]** 3, (4,3)
Discretize the computational domain into a mesh with 4 row of horizontal cells and 3 row of vertical cells.
Use FVM to develop descretized cell equations. List all cell equations with proper cell numbers. Select an appropriate iterative method for computation. Prepare a table of data showing calculated cell temperature for initial 4 iterations after initial guess.

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Final year B. Tech. Mech. Sem VII

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Sardar Patel College of Engineering

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END SEM EXAMINATION

Program: **B. Tech. in Mechanical Engineering**
Class: **Final Year B. Tech. (Mechanical)**
Course code: **BTM 725**
Name of the Course: **Introduction to Cryogenics**

Date: **Nove mber-2017**
Duration: **3 Hr.**
Max. Points: **100**
Semester: **VII**

Master file.

Instructions:

- Attempt **ANY 05** questions.
- Assume suitable data wherever necessary and state the same.
- Draw **neat** and lebelled system diagram **and/or** process diagram wherver necessary.
- **Legible hand writing**, proper figures and tidy work carry weightage.
- Refer **T-s Diagram** for Cryogens wherever necessary.
- Answers to theory questions should be **brief and prescise**.

		Max. Points	CO No.	Module No.
Q 1	A) **Explain:**-What is Cryogenics? How it differs from Refrigeration? **Discuss:-** Various applications of Cryogenic Engineering.	(08)	1	1
	B)**Compare**:-Advantages and Limitattions of Isenthalpic and Isentropic Expansion process. **Derive**:- Expression for i) Liquid yield and ii) Work required per unit mass of gas compressed. for basic Claude Liquefaction System. **Comment**:-About performance of Basic Claude System with respect to various Linde-Hampson systems.	(12)	3,4	1,3
Q 2.	A) **Discuss:-** Ortho and Para Hydrogen and effect of conversion from O-H to P-H.**Explain:-**Methods and arrangements practiced in Hydrogen liquefaction system for taking care of O-H to P-H conversions and **Compare.**	(10)	2,3,4	2,4
	B) **Enlist:**-Normal Boiling Point of cryogen gases.**Explain**:-Why various Linde-Hampson systems with JT Valve alone are not capable for liquefaction of gases like Neon, Hydrogen and Helium.	(10)	2,3,4	2,3,4
Q.3	A)**Explain:-**Precooled Linde Hampson System describing the necessity, advantages and limitations of precooling.	(08)	3	3
	B) **Dscuss**:-Necessity and advantages of Linde Dual Pressure system. A Linde Dual Pressure system using Nitrogen operates between $1\ atm, 300\ K$ to $200\ atm$ .The intermediate pressure is $50\ atm$ and the intermediate- pressure flow ratio is 0.8.**Evaluate:**-i) Liquid yield ii) Work requirement per unit mass of gas liquefied iii) Work requirement per unit mass of gas compressed and iv) Figure of Merit	(12)	3,4	3

Final year B.Tech. Mech. Sem VII

Q.4	A) **Enlist**:-Systems for liquefaction of Helium. **Explain**:-Collins Helium Liquefcation system.	(08)	3	4
	B)**Discuss**:-Effect of heat exchanger effectiveness on performance of simple Linde-Hampson liquefaction system. In a Simple Linde Hampson system for Nitrogen, the compressor inlet pressure is 101.3 kPa and compressor exit conditions are 200 atm and 300K.Heat Exchanger effectiveness is 96.5%. **Evaluate:-** i) Liquid yield ii) Work requirement per unit mass of gas liquefied iii) Work requirement per unit mass of gas compressed and iv) Figure of Merit.	(12)	3,4	3,4
Q.5	A)**Explain**:-Necesity of insulation in Cryogenic applications with illustrative example.**Discuss:**-Comparative of advantages and disadvantages of various types of Cryogenic Insulations.	(10)	2	1,5
	B) **Enlist:**-Systems for liquefaction of Neon and Hydrogen and **Explain**:- Precooled Claude System for liquefaction of Neon or Hydrogen.	(10)	3	4
Q.6	A)**Explain:-**Necessity of vacuum in Cryogenics with illustrative example.**Discuss:**-Various vacuum gauges used in Cryogenics describing operating range, features and principle of working.	(10)	2	1,6
	B) **Explain**:- Safety aspects in Cryogenics related to Physiological Hazards and personal exposure.	(10)	2	7
Q.7	**Explain:-**in brief with neat sketches as applicable. A) Diffusion Pump B) Multilayer Insulation C) Special safety consideration for Hydrogen	(20)	2	5,6,7

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END SEM
Nov 2017

Program: **B.Tech. in Mechanical Engineering**
Class: **Final Year B.Tech. (Mechanical)**
Course code: **BTM701**
Name of the Course: **Machine Design - II**

Date: **Nov 2017**
Duration: **3 Hr.**
Max. Points: **100**
Semester: **VII**

Master file.

Instructions:

- Question No 1 is **compulsory**. Attempt any four questions out of remaining six.
- Answers to all sub questions should be grouped together.
- Use of PSG Design Data Book is permitted.
- Assume suitable data if necessary.

			Max. Points	CO No.	Module No.
Q1	a)	Define the following terms: i. Static load carrying capacity ii. Dynamic load carrying capacity	(3)	1	3
	b)	Draw the displacement, velocity and acceleration profile for cycloidal motion of roller follower	(3)	1	5
	c)	Describe the principle of operation of pump and explain concept of priming in centrifugal pump	(3)	3	7
	d)	Explain principle of hydrodynamic lubrication in journal bearing with neat sketches	(3)	1	4
	e)	What are the assumptions made in Lewis equation applied to gear design and justify them	(5)	1	1
	f)	Derive condition for self energizing block brake with short shoe	(3)	1	6
Q2	a)	Determine the main dimensions of cone clutch. It is to be faced with leather and is to transmit 30kW at 750 rev/min from an electric motor to a compressor. Find the axial force that must be produced by the spring. Take coefficient of friction as 0.2 and average pressure 0.105 N/mm^2. Shear strength of shaft is 42 N/mm^2 and factor of safety is 1.5	(15)	1	6
	b)	Compare between rolling and sliding contact bearing	(5)	1	4
Q3	a)	Describe important components of a centrifugal pump with neat sketch. Explain the design procedure of impeller shaft, impeller, volute casing and selection of electric motor.	(15)	3	7
	b)	Explain the thermal considerations employed in the design of worm gear drive	(5)	1	1

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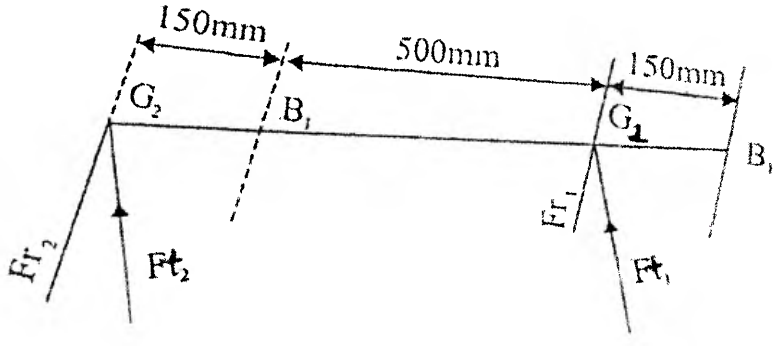
Q4	a)	It is required to design a pair of spur gear for a compressor running at 250 rpm driven by 75 kW motor at 1000rpm. The centre distance is exactly 250mm. the starting torque of motor is 150 % of rated torque. The allowable stress in gear is 233 N/mm^2. The pressure angle is 20 and factor of safety is 2. Design the gears and specify their dimensions assuming velocity factor accounts dynamic load.	(15)	*1*	*1*
	b)	Discuss different types of failures and the associated remedies for sliding contact bearings.	(5)	*1*	*4*
Q5	a)	A shaft transmitting 60 kW at 150 rpm from gear G1 to gear G2 and mounted on two single row deep groove ball bearings B_1 and B_2 as shown below. The various forces are F_{t1} = 16000 N, F_{r1} = 6000 N, F_{t2} = 10000 N, F_{r2} = 4000 N. The diameter of shaft at bearings B_1 and B_2 is 75 mm. The expected life for 90% of the bearings is 10000 hr. Select suitable ball bearing	(17)	*1*	*3*



	b)	For a two stage compound reverted gear train with input speed of 1750 rpm and output speed of 85 rpm, calculate minimum number of teeth of all four gears and speed of an intermediate shaft	(3)	*2*	*2*
Q6	a)	Draw (freehand) two views of a snatch block assembly for an EOT crane and tag main components such as, rope, pulley, cross-block, hook, thrust bearing, side-plates, etc. Explain with necessary equations, the procedure used to select size of rope, hook and sheave for a given load capacity of snatch block.	(15)	*3*	*7*
	b)	A ball bearing operates on a working cycle consist of three parts i. Radial load of 3000N at 720rpm for 30% of the cycle ii. Radial load of 7000N at 1440rpm for 40% of the cycle iii. Radial load of 5000N at 900rpm for the remaining part of the cycle The basic dynamic capacity of the bearing is 30700N calculate i. The rating life of the bearing in hours	(5)	*1*	*3*

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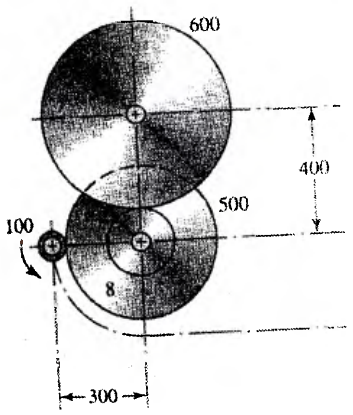
Q7 a) In the double reduction gear train shown, Sketch a general shaft layout, including means to locate the gears and bearings, and to transmit the torque. Assume necessary dimensions (10) 2 2



b) A cam consists of a circular disc of diameter 75 mm with its centre displaced 25 mm from the camshaft axis. The follower has a flat surface (horizontal) in contact with the cam and the line of action of the follower is vertical and passes through the shaft axis as shown in Fig. 20.50. The mass of the follower is 2.3 kg and is pressed downwards by a spring which has a stiffness of 3.5 N/mm. In the lowest position the spring force is 45 N. (10) 1 5

a. Derive an expression for the acceleration of the follower in terms of the angle of rotation from the beginning of the lift.

b. As the cam shaft speed is gradually increased, a value is reached at which the follower begins to lift from the cam surface. Determine the camshaft speed for this condition

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