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Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

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

END SEMESTER
May 2017

Program: S.Y.B.Tech Mech/ Elect
Course code: BTM / BTE232
Name of the Course: PCT/ OCIS
Semester: IV

Date: 19/05/2017
Duration: 2 hours
Maximum Marks: 50

Master file.

Question No.	• All questions are compulsory	Maximum Marks	CO	Mod. NO
Q1. A				
	In modern times, working women are facing problems like Eve teasing, Sexual Harassment, and Gender Discrimination at the time of promotions, salary fixation, Dowry deaths etc. You as the Head of Women Welfare committee have been asked to write a report of gender discrimination and sexual harassment at work places. Write a letter report presenting your recommendations to overcome the problems. Minimum 3 recommendations are mandatory.	08	02	04
Q1.B.	Your friend is invited for an official dinner at a restaurant with a foreign delegate, his wife and his boss. What dining Etiquette tips will you give to your friend to leave a good impression?	02	04	02
Q.2.A.	Imagine you are the General secretary of Sardar Patel College of Engineering. The 55th Annual day celebration is to be held on 25th May, 2017. Draft the Notice, Agenda and minutes of the meeting assuming the agenda as follows: Also decide the members who will be attending the meeting and the list of invited members. Agenda: 54.01 Confirmation of minutes of the previous meeting 54.02 Matter from previous minutes 54.03 list of events to be organized 54.04 Chief guest for the event 54.05 Budget for the event 54.06 Mementoes and certificates 54.07 List of invitees 54.08 Degree distribution ceremony 54.09 Date for the next meeting 54.10 Any other matter with the permission of the chairperson.	08	01	01
Q.2. B.	Define Leadership. Explain the functions of a leader and list out any 5 qualities of a good leader.	02	3,5	06
Q.3. A.	Draft an application letter along with a one page Resume for the post of a Senior supervisor at Mahindra & Mahindra in Mumbai. Attach a suitable Resume showing about 2 internships and good Interpersonal skills with fluency in English and Marathi. List your personal attributes and core skills separately.	08	4,5	07
Q.3. B.	What are the various Do's and Dont's for an interview? List 5 each	02	4,5	07
Q.4. A.	List any 5 major reasons for stress in a student's life and tips to overcome it.	05	03	05
Q.4.B	Case Study	05	02	06

	In 1990, Sanjay Katariya, a Chartered Accountant, was elected as the chairman of promising Life Insurance Company, which was at that time, the third Life Insurance Company in the country. During the next 5 years, however, while its business increased, it did not grow as fast as its major competitors, and Promising Company dropped from third to sixth place. This naturally perturbed Sanjay Kataria as it did the Board of Directors of the Company. Finally, after deliberations, the Board of Directors concluded that the lack of leadership in the sales of both ordinary life policies and group life insurance was the major cause of company's comparative slow progress. It was also generally concluded that the two Directors in charge of sales in these two major areas of business were competent executives and leaders but the regional and the district managers working under them were not very competent leaders. Sanjay Kataria called these two Directors and asked them to ensure strong leadership at the regional and district levels or else quit their jobs. As these Directors left the meeting with the Chairman, one Director told the other. " Now, just how do we make people leaders? How can we be sure whether or not a person is a Leader? You know this is a tough job". **Read and analyze the above case and answer the following questions**: a. If you were one of the Directors, how would you have answered the questions that the other Director had raised? b. What would you do about developing strong leaders?			
Q.5. A.	Mr. Gautam Ghosh founded a small radio manufacturing plant in Western India in the late sixties. From this small beginning came one of the country's largest radio, television and allied products companies. By 1996, it had recorded annual sales of Rs. 800 million, with 25,000 employees and 8 manufacturing locations. Throughout its growth, the founder remained an active, imaginative and driving force behind his company. In earlier days, every manager and worker knew him, and he was able to call most of them by their first names; so even after the company grew fairly large, people felt they knew the founder and chief executive, and their strong feeling of personal loyalty had much to do with the fact the company's workers never formed a union. However, as the company prospered and grew, Mr. Ghosh thought that it was losing its "small company" spirit. He also felt that communications were suffering, that his objectives and philosophy were not being understood in the company that much wasteful duplication was occurring through poor knowledge of what others in the company were doing, and that new product development and marketing were suffering as a result. Likewise, he was concerned that he had lost touch with the people. To solve the communication problem, he hired a Director of communications reporting directly to him. The issues were discussed in detail between the two. They then put into effect every communication device they found in other large companies, namely: (a) Bulletin boards in every office and plant throughout the country. (b) A revitalised company newsletter carrying detailed company and personal news affecting all locations. (c) "Company Facts Book" for every employee, giving significant information about the company. (d) Regular profit-sharing letters. [redacted] courses to teach communication	05	01	01

	methods, (f) Monthly one-day meetings at headquarters for the top 100 executives, (g) Annual three-day meetings of 900 executives at all levels, at a resort town, and (h) A large number of special committees to discuss company matters. After much time, effort and expense spread over a year, Mr. Ghosh was disappointed to find that his problems of communication and of the "small company" feeling still existed and that the results of his programmes did not seem to be significant. **Read the above case carefully and answer the following questions after analyzing it in the light of your knowledge about the subject-matter of communication.** (a) Why do you think Mr. Ghosh was disappointed? Should he have been? (b) What do you see as the company's real communication problem? (c) What would you suggest to improve communication in the company? (d) Was Mr. Ghosh right in believing that communication would help him maintain the 'small company' spirit?			
Q.5.B.	Case Study: When Bianca joined MADE (www.made.org.uk) she was in an administrative role, and rarely found it necessary to be client-facing, or even to present in front of colleagues. Most of her external communication was done over the phone in an informal manner, and she tended to be in the background of meetings. This situation was partially intentional, due to her fear of public speaking, which she admitted 'made her feel physically ill' at just the thought of it. However, the restructuring of the company lead to Bianca being offered a promotion to a management position – a brilliant opportunity, but one which she accepted with some trepidation due to the fact that this new role would require increased networking, and the need to present to the board. There was an obvious issue here: that her concerns over public speaking may hold her back from being effective in a management position. It was suggested that she and another member of MADE facing a similar situation attend Presentation Skills Training with You. The session, entitled 'Killer Presentation Skills' Q. How do you plan to teach effective presentations to Bianca and what tips will you give to Bianca to become a good presenter?	05	03	05

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ReExamination Semester Exam

June 2017

Duration: 3 hours

Max. Marks: 100 marks

Class:S.Y.B.Tech. Semester: Fourth (4th) Program:**Manufacturing Science II**

Name of the Course: Mechanical EngineeringCourse Code : **BTM 405**

Instructions:

1.**Question No 1 is compulsory.**

2.Attempt any four questions out of remaining six questions.

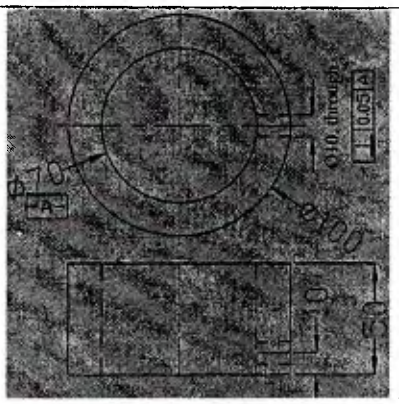
3.Draw neat schematic diagrams wherever is necessary, **highlight** important points of answer.

4.Assume suitable data if necessary and mention it.

Master file.

Q. No		Max. Mark	CO No.	Module No.
Q1 A)	Explain working principle of *Milling dynamometer* with the help of neat schematic sketch?	5 M	2	3
B)	With the help of neat schematic sketch explain in brief *spring back, spring back estimation.* Draw and explain in brief graph of "spring back factor versus fraction of radius of bend to the thickness of blank"?	5 M	4	7
c)	A cylindrical rod (material 1020 steel) having outer diameter *(O.D.) 120 mm* is turned orthogonally on lathe with single point cutting tool having *rake angle of 15^0. Cutting speed is 6 meter/min, feed 0.3 mm/rev, depth of cut 0.35mm, length of continuous chip in one revolution is 100, cutting force (F_C) 250 kg, feed force (F_T) 65 kg.* Draw neat sketch showing force components and chip feature. Calculate- Coefficient of friction, Shear plane angle, and velocity of chip along tool face, chip thickness, shear strain, shear stress, and shear energy?	10 M	3	2
Q2. A)	What are different primary, secondary functions and process effects of cutting fluid?	5 M	3	3
B)	Explain any five important points related to design principles common to jigs & fixtures?	5 M	1	1
C)	An *'70-30 Brass annealed'* strip 185 mm wide & 30 mm thick is rolled to 13.720 mm thickness in one pass. Roller radius is 150 mm and roller rotates at 80 rpm. Calculate the roll forces and power required to run individual roller and roll mill? Draw necessary sketch of rolling operation and show the different parameters like forces and dimensions on it. Neglect	10 M	4	6

	the spreading phenomenon of sheet?(Refer figure no. 02 last page)**			
Q3. A)	Explain "Flat rolling process of metal" with the help of neat schematic sketch? Give significance of draft phenomenon in flat rolling process?	5 M	4	6
B)	i) In a single point turning operation with a Ceramic tool and steel combination having a Taylor exponent of 0.33, if the cutting speed is reduced to 0.33 times previous speed, then new tool life will become…(show calculations) a) 16 b) 81 c) d) 625 ii) Write in brief different type of clearance provided on drill tool? (2M)	5 M	3	4
C)	A hole of diameter 110 mm is to be punched in steel plate of 4 mm thickness with normal clearance on tool as 8% of thickness of sheet. Cutting is completed at 40 % of penetration of punch. Give suitable dimensions of punch and die. Ultimate shear stress for sheet metal is 3600 kg/cm^2. Determine shear angle of punch for double shear in order to bring work within the capacity of 10 tones.	10 M	4	7
Q4. A)	Sketch and explain working of "O" ring strain gauge type dynamometers? Why Extended "O" ring strain gauge type dynamometers are used for specific application? Give its application?	5 M	3	3
B)	Write short note on Indexable jig with neat schematic sketch and their specific application?	5 M	1	1
C)	A shell having 40 mm diameter and 140 mm length with 1.2 mm is to be manufactured from 1.5 mm thick blank. Calculate-i) Blank diameter, ii) Drawing force (Assume yield strength of material as 3000 kg/cm^2, K is 0.54) iii) Punch and Die opening size?	10 M	4	5
Q5. A)	Explain the different design requirement of tool force dynamometer?	5 M	3	3
B)	Explain the relationship between plowing force and size effect? Draw well labeled schematic sketch of contact regions on tool face and related forces acting on them?	5 M	2	2
C)	Give significance of orthogonal rake angle 'γ' (larger and smaller magnitude/value) with respect to its advantages and disadvantages during machining operation?	5 M	4	4
D)	Write short note on following terms i) Rate sensitivity, ii) Planar anisotropy in a sheet metal specimen with necessary sketch?	5 M	4	7
Q6. A)	Explain in brief Box Jig with schematic sketch? Component having a drilled hole shown in figure no. 01, Justify- what should be the locating surface (of workpiece), & type of Jig system can be used to drill hole in workpiece component?	5 M	1	1

	 Figure No-01			
B)	Draw detailed schematic sketch of punched hole and slug showing their characteristic feature? Explain how punch speed affects the burr formation in case of shearing operation?	5 M	4	5
C)	Explain flat rolling process (mechanics) with the help of neat schematic sketch? Give significance of "Draft"?	5 M	4	6
Q7. A)	Derive expression, to estimate value of back rake, side rake angle of cutting tool (in ASA system) as a function of orthogonal rake, inclination, principal cutting edge angle (in ORS system). With the help of master line principle and related schematic diagram?	10 M	4	4
B)	Write short note on Ceramics and Cermets?	5 M	2	2
C)	Explain following sheet metal shearing operation along with one combined sketch?a)Notching, b) Trimming, c) Nibbling operations	5 M	3	5

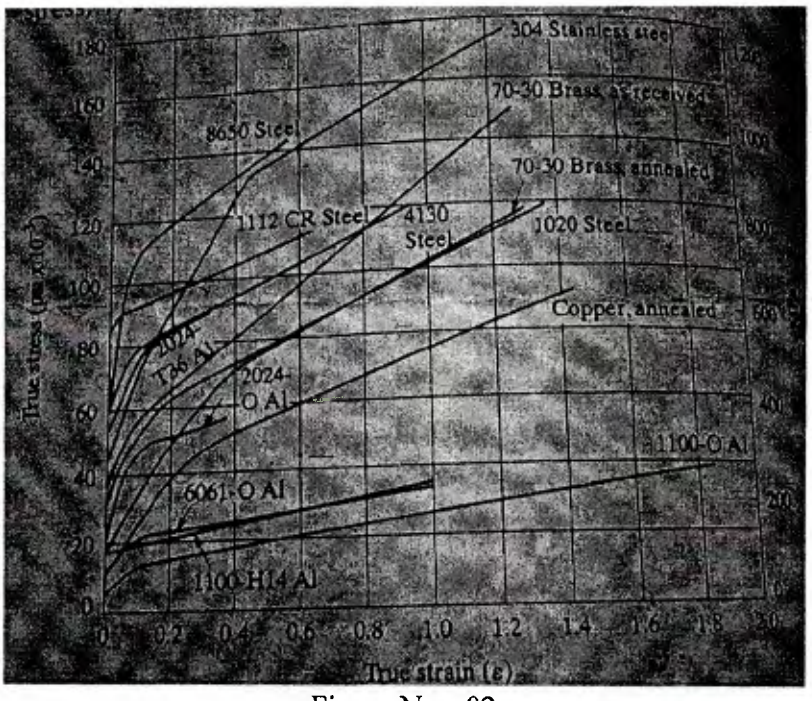


Figure No - 02

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End semester Re-Examination

June 2017

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

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

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

Master file.

Instructions:

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

Q		Marks	CO	Module no.
1(a)	Obtain the equation of line of regression of Y an X and given an estimate of Y when x = 9. X: 3 6 5 4 4 6 7 5 Y: 3 2 3 5 3 6 6 4	5	1	1
(b)	Two independent samples of 8 & 7 items gave the following Sample A: 9 11 13 11 15 9 12 14 Sample B: 10 12 10 14 9 8 10 Examine whether the difference between the mean of five samples is significant at 5% los?	5	1	4
(c)	Solve $\frac{\partial^2 z}{\partial x^2} - 2\frac{\partial z}{\partial x} + \frac{\partial z}{\partial y} = 0$ using method of separation of variables.	5	3	6
(d)	Obtain the Fourier Series for $f(x) = x$ in $(-\pi, \pi)$	5	1	5
2 (a)	If the mean of the following probability distribution is 16, find m, n & variance X: 8 12 16 20 24 P(X): 1/8 m n 1/4 1/12	6	1	2
(b)	Obtain Fourier Series for $f(x) = \begin{cases} -\pi & -\pi < x < 0 \\ x & 0 < x < \pi \end{cases}$	6	2	5
(c)	The probability that a smoker aged 25 years will die before	8	1	3

	reaching the age of 30 years may be taken a 0.018. Out of a group of 400 smokers, now aged 25 years, what is the probability that 2 smokers will die within the next 5 years?			
3 (a)	Compute spearman's rank coorelation coefficient for the following data X: 10, 12, 18, 18, 15, 40 Y: 12, 18, 25, 25, 50, 25	**6**	**1**	**1**
(b)	Find the Fourier series of the function $f(x)=\begin{cases}-1 & \text{for} \quad -\pi<x<-\frac{\pi}{2}\\ 0 & \text{for} \quad -\frac{\pi}{2}<x<\frac{\pi}{2}\\ +1 & \text{for} \quad \frac{\pi}{2}<x<\pi\end{cases}$	**6**	**2**	**5**
(c)	If X is a crv with probability density function $f(x)=\begin{cases}kx, 0\le x\le 1\\ k, 1\le x\le 2\\ k(3-x), 2\le x\le 3\end{cases}$ Find k.Also find $P(x\le 1.5)$	**8**	**1**	**2**
4 (a)	Find the Fourier series corresponding to the function f (x) defined in $(-2,2)$ as follows $f(x)=2$ in $-2\le x\le 0$ $=x$ in $0<x<2$	**6**	**2**	**5**
(b)	Ten individuals are chosen at random from a population and their heights are found to be (in inches): 63, 63, 66, 67, 68, 69, 70, 70, 71 & 72. In the light of the data discuss the suggestion that the mean height in the population is 66 inches	**6**	**1**	**4**
(c)	There are 50 fishes in a pool,out of which 10 are golden.5 fishes are taken at random from the pool.What is the probability that exactly 2 fishes are golden?	**8**	**3**	**7**
5 (a)	Tests to made on the breaking strengths of 10 pieces of metal gave the following results in kg. 578, 572, 570, 568, 572, 570,570, 572, 596, 584 test at 5% los if the mean breaking strength of the metal wire can be assumed as 577 kg	**6**	**1**	**3**

(b)	Given the following information about the marks of 60 students estimate the marks of a student in mathematics who scored 60 marks in physics & the marks of a student in physics who scored 70 in mathematics. Correlation coefficient is 0.4	**6**	**1**	**1**
(c)	Obtain the half range sine series $f(x)=x(\pi-x) \quad 0<x<\pi$	**8**	**2**	**5**
6(a)	In an experiment on pea – breading mendel obtained the following frequencies of seeds. 315 Round and Yellow 101 Wrinkled and Yellow 108 Round and Green 32 Wrinkled and Green According to his theory of heredity the numbers should be in population 9:3:3:1. Is there any evidence to doubt the theory at 5% Los?	**6**	**1**	**4**
(b)	Prove that the set of functions $\{1, \sin x, \cos x, \sin 2x, \cos 2x, -----\}$ is orthogonal over $(0, 2\pi)$ and construct a corresponding orthonormal set.	**6**	**2**	**5**
(c)	A string is stretched and fastened to two point's *l* apart. Motion is started by displacing the string in the form $y = a \sin \frac{\pi x}{\ell}$ from which it is released at time t = 0, show that the displacement of any point at a distance x from one end at time t is given by y (x, t) = $y = a \sin \frac{\pi x}{\ell} \cos \frac{\pi ct}{\ell}$.	**8**	**3**	**7**
7(a)	Obtain all possible solutions of one dimensional wave equation	**6**	**3**	**7**
(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**	**1**	**2**
(c)	Show that the Karl pearson's correlation coefficient r lies between -1 and 1.	**8**	**1**	**1**

Mathematics	Physics
Mean	80	50
Standard Deviation	15	10

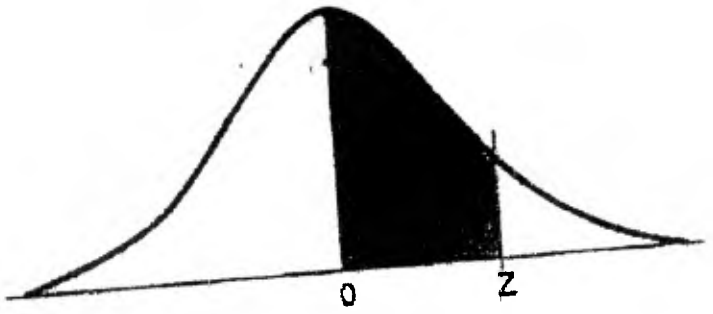
TABLE of CRITICAL VALUES for STUDENT'S *t* DISTRIBUTIONS

Column headings denote probabilities (α) *above* tabulated values.

d.f.	0.40	0.25	0.10	0.05	0.04	0.025	0.02	0.01	0.005	0.0025	0.001	0.0005
1	0.325	1.000	3.078	6.314	7.916	12.706	15.894	31.821	63.656	127.321	318.289	636.578
2	0.289	0.816	1.886	2.920	3.320	4.303	4.849	6.965	9.925	14.089	22.328	31.600
3	0.277	0.765	1.638	2.353	2.605	3.182	3.482	4.541	5.841	7.453	10.214	12.924
4	0.271	0.741	1.533	2.132	2.333	2.776	2.999	3.747	4.604	5.598	7.173	8.610
5	0.267	0.727	1.476	2.015	2.191	2.571	2.757	3.365	4.032	4.773	5.894	6.869
6	0.265	0.718	1.440	1.943	2.104	2.447	2.612	3.143	3.707	4.317	5.208	5.959
7	0.263	0.711	1.415	1.895	2.046	2.365	2.517	2.998	3.499	4.029	4.785	5.408
8	0.262	0.706	1.397	1.860	2.004	2.306	2.449	2.896	3.355	3.833	4.501	5.041
9	0.261	0.703	1.383	1.833	1.973	2.262	2.398	2.821	3.250	3.690	4.297	4.781
10	0.260	0.700	1.372	1.812	1.948	2.228	2.359	2.764	3.169	3.581	4.144	4.587
11	0.260	0.697	1.363	1.796	1.928	2.201	2.328	2.718	3.106	3.497	4.025	4.437
12	0.259	0.695	1.356	1.782	1.912	2.179	2.303	2.681	3.055	3.428	3.930	4.318
13	0.259	0.694	1.350	1.771	1.899	2.160	2.282	2.650	3.012	3.372	3.852	4.221
14	0.258	0.692	1.345	1.761	1.887	2.145	2.264	2.624	2.977	3.326	3.787	4.140
15	0.258	0.691	1.341	1.753	1.878	2.131	2.249	2.602	2.947	3.286	3.733	4.073
16	0.258	0.690	1.337	1.746	1.869	2.120	2.235	2.583	2.921	3.252	3.686	4.015
17	0.257	0.689	1.333	1.740	1.862	2.110	2.224	2.567	2.898	3.222	3.646	3.965
18	0.257	0.688	1.330	1.734	1.855	2.101	2.214	2.552	2.878	3.197	3.610	3.922
19	0.257	0.688	1.328	1.729	1.850	2.093	2.205	2.539	2.861	3.174	3.579	3.883
20	0.257	0.687	1.325	1.725	1.844	2.086	2.197	2.528	2.845	3.153	3.552	3.850
21	0.257	0.686	1.323	1.721	1.840	2.080	2.189	2.518	2.831	3.135	3.527	3.819
22	0.256	0.686	1.321	1.717	1.835	2.074	2.183	2.508	2.819	3.119	3.505	3.792
23	0.256	0.685	1.319	1.714	1.832	2.069	2.177	2.500	2.807	3.104	3.485	3.768
24	0.256	0.685	1.318	1.711	1.828	2.064	2.172	2.492	2.797	3.091	3.467	3.745
25	0.256	0.684	1.316	1.708	1.825	2.060	2.167	2.485	2.787	3.078	3.450	3.725
26	0.256	0.684	1.315	1.706	1.822	2.056	2.162	2.479	2.779	3.067	3.435	3.707
27	0.256	0.684	1.314	1.703	1.819	2.052	2.158	2.473	2.771	3.057	3.421	3.689
28	0.256	0.683	1.313	1.701	1.817	2.048	2.154	2.467	2.763	3.047	3.408	3.674
29	0.256	0.683	1.311	1.699	1.814	2.045	2.150	2.462	2.756	3.038	3.396	3.660
30	0.256	0.683	1.310	1.697	1.812	2.042	2.147	2.457	2.750	3.030	3.385	3.646
31	0.256	0.682	1.309	1.696	1.810	2.040	2.144	2.453	2.744	3.022	3.375	3.633
32	0.255	0.682	1.309	1.694	1.808	2.037	2.141	2.449	2.738	3.015	3.365	3.622
33	0.255	0.682	1.308	1.692	1.806	2.035	2.138	2.445	2.733	3.008	3.356	3.611
34	0.255	0.682	1.307	1.691	1.805	2.032	2.136	2.441	2.728	3.002	3.348	3.601
35	0.255	0.682	1.306	1.690	1.803	2.030	2.133	2.438	2.724	2.996	3.340	3.591
36	0.255	0.681	1.306	1.688	1.802	2.028	2.131	2.434	2.719	2.990	3.333	3.582
37	0.255	0.681	1.305	1.687	1.800	2.026	2.129	2.431	2.715	2.985	3.326	3.574
38	0.255	0.681	1.304	1.686	1.799	2.024	2.127	2.429	2.712	2.980	3.319	3.566
39	0.255	0.681	1.304	1.685	1.798	2.023	2.125	2.426	2.708	2.976	3.313	3.558
40	0.255	0.681	1.303	1.684	1.796	2.021	2.123	2.423	2.704	2.971	3.307	3.551
60	0.254	0.679	1.296	1.671	1.781	2.000	2.099	2.390	2.660	2.915	3.232	3.460
80	0.254	0.678	1.292	1.664	1.773	1.990	2.088	2.374	2.639	2.887	3.195	3.416
100	0.254	0.677	1.290	1.660	1.769	1.984	2.081	2.364	2.626	2.871	3.174	3.390
120	0.254	0.677	1.289	1.658	1.766	1.980	2.076	2.358	2.617	2.860	3.160	3.373
140	0.254	0.676	1.288	1.656	1.763	1.977	2.073	2.353	2.611	2.852	3.149	3.361
160	0.254	0.676	1.287	1.654	1.762	1.975	2.071	2.350	2.607	2.847	3.142	3.352
180	0.254	0.676	1.286	1.653	1.761	1.973	2.069	2.347	2.603	2.842	3.136	3.345
200	0.254	0.676	1.286	1.653	1.760	1.972	2.067	2.345	2.601	2.838	3.131	3.340
250	0.254	0.675	1.285	1.651	1.758	1.969	2.065	2.341	2.596	2.832	3.123	3.330
inf	0.253	0.674	1.282	1.645	1.751	1.960	2.054	2.326	2.576	2.807	3.090	3.290

Table of the chi square distribution

	Level of Significance α								
df	0.200	0.100	0.075	0.050	0.025	0.010	0.005	0.001	0.0005
1	1.642	2.706	3.170	3.841	5.024	6.635	7.879	10.828	12.116
2	3.219	4.605	5.181	5.991	7.378	9.210	10.597	13.816	15.202
3	4.642	6.251	6.905	7.815	9.348	11.345	12.838	16.266	17.731
4	5.989	7.779	8.496	9.488	11.143	13.277	14.860	18.467	19.998
5	7.289	9.236	10.008	11.070	12.833	15.086	16.750	20.516	22.106
6	8.558	10.645	11.466	12.592	14.449	16.812	18.548	22.458	24.104
7	9.803	12.017	12.883	14.067	16.013	18.475	20.278	24.322	26.019
8	11.030	13.362	14.270	15.507	17.535	20.090	21.955	26.125	27.869
9	12.242	14.684	15.631	16.919	19.023	21.666	23.589	27.878	29.667
10	13.442	15.987	16.971	18.307	20.483	23.209	25.188	29.589	31.421
11	14.631	17.275	18.294	19.675	21.920	24.725	26.757	31.265	33.138
12	15.812	18.549	19.602	21.026	23.337	26.217	28.300	32.910	34.822
13	16.985	19.812	20.897	22.362	24.736	27.688	29.820	34.529	36.479
14	18.151	21.064	22.180	23.685	26.119	29.141	31.319	36.124	38.111
15	19.311	22.307	23.452	24.996	27.488	30.578	32.801	37.698	39.720
16	20.465	23.542	24.716	26.296	28.845	32.000	34.267	39.253	41.309
17	21.615	24.769	25.970	27.587	30.191	33.409	35.719	40.791	42.881
18	22.760	25.989	27.218	28.869	31.526	34.805	37.157	42.314	44.435
19	23.900	27.204	28.458	30.144	32.852	36.191	38.582	43.821	45.974
20	25.038	28.412	29.692	31.410	34.170	37.566	39.997	45.315	47.501



This table presents the area between the mean and the Z score . When Z=1.96, the shaded area is 0.4750.

Areas Under the Standard Normal Curve

Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
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
3.6	.4998	.4998	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.9	.5000									

Source: Adapted by permission from *Statistical Methods* by George W. Snedecor and William G. Cochran, sixth edition © 1967 by The Iowa State University Press, Ames, Iowa, p. 548.

Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)

Munshi Nagar, Andheri (West), Mumbai – 400058.

Re-Examination, June 2017

S.Y.B.Tech., Sem-IV **B.Tech. in Mechanical Engineering**

Course: **FLUID MECHANICS (BTM 403)** Master file.

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

Instructions:

- Answer any **FIVE** from seven questions,
- Answers to all sub questions should be grouped together,
- Make suitable assumption if needed with proper reasoning,
- Figures on right in square bracket shows maximum marks for a particular sub-question,
- Figures on the extreme right show **CO** and **Module Number** respectively as per syllabus of the course.

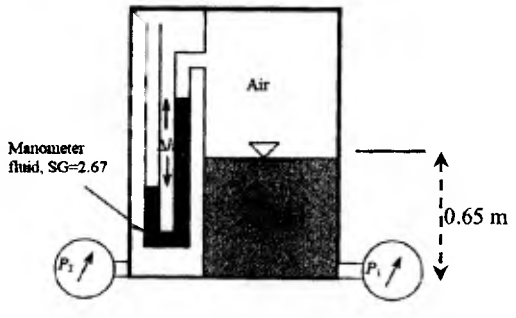
1. (A) Differentiate between: **[10]** 1,4, 1&4
   a. Compressible and Incompressible flow;
   b. Dimensionality of the flow;
   c. Steady and Uniform flow,
   d. Newtonian and Non-Newtonian fluids,,
   e. Minor and major losses in pipes.

   (B) For a given flow field $\vec{V} = (z+xy)\vec{i} + 3.4x^3\,\vec{j} + (3xt^2 + z)\vec{k}$, interpret the situation and answer following questions: **[10]** 3, 3
   a. What is the dimension of flow?
   b. Does the flow exist?
   c. Is this flow steady or unsteady?
   d. Is this a rotational flow?
   e. Find an expression for acceleration of flow.

2. (A) For a certain incompressible 2D flow field the velocity field in the y direction is given by the equation $v = x^2 + 2xy$. Estimate the component of velocity in the x-direction. **[10]** 3, 3

   (B) A 45° reducing pipe bend in horizontal plane, taper from 600mm diameter to at inlet to 300mm diameter at the outlet. The pressure at inlet is 140kPa gauge and rate of flow of water through the bend is 0.425 m^3/s. Neglecting friction, calculate the net resultant horizontal force exerted by the water on the bend by using **Reynolds Transport Equation** with any other suitable assumption. **[10]** 4, 2&3

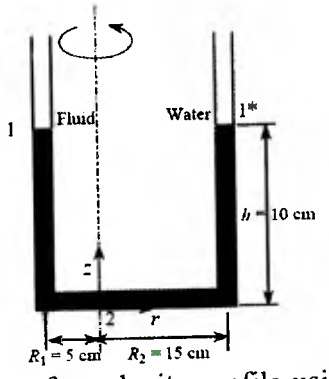
3. (A) Derive a general hydrostatic equation of fluid. Refer adjacent figure to calculate gauge pressure difference (P_2 - P_1) for $\Delta h = 0.08$ m. **[10]** 2, 2



(B) Characterize boundary layer and derive Von Karmọn's Momentum Integral equation for its analysis. **[10]** 4, 2

4. (A) Write differential and integral form of complete mass and momentum equation. Simplify the differential form to obtain (i) Stokes flow equation, (ii) Euler flow equation and (iii) Incompressible flow equation. **[10]** 3, 1&2

(B) A U-tube shown in adjacent figure contains water in right arm and another liquid in the left is rotated about an axis closer to the left arm. For a known rotation rate at which the liquid levels in both arms are the same, the density of the fluid in the left arm is to be determined. **[10]** 2,3



5. (A) What is Hagen Poiseulle flow? Derive an equation for velocity profile using first principle and determine expression for following quantities- **[10]** 5,1
   a. Maximum and average velocity,
   b. Volume flow rate
   c. Wall shear stress

(B) Explain and develop boundary layer equation proposed by Prandtl using standard Navier-Stokes equation. Name two methods for its solution and briefly explain one of them. **[10]** 4,4

6. (A) Two big parallel plates with gap 'b' between them (filled with fluid of dynamic viscosityμ) are being pulled in opposite direction with constant speed U under steady condition. Using N-S equation, develop an expression for velocity profile. List all assumption made for the derivation. **[10]** 4, 1

(B) Explain the concept of boundary layer separation. Is it a desirable or undesirable fluid behaviour? Explain your understanding with the help of examples and illustrations. **[10]** 6, 2&3

7. (A) What is turbulence? Explain its features. How does it affect the velocity profile? Explain following terms with reference turbulent flow. **[10]** 5, 3&4
   a) Law of wall
   b) Universal velocity profile
   c) Power law profile
   d) Reynolds stress.

(B) Derive Bernoulli's equation along a streamline starting from N-S equation. Briefly discuss the conditions for its validity. **[10]** 3, 2&3

BHARATIYA VIDYA BHAVAN'S

SARDAR PATEL COLLEGE OF ENGINEERING

(A Government Aided Autonomous Institute)

Munshi Nagar, Andheri (West), Mumbai – 400058.

End Semester Re-examination

June 2017

Maximum Points: 100 **Duration: 3 Hrs**

Class: **S.Y. B. Tech. (Mechanical)** Semester: **IV**

Program: **B. Tech. (Mechanical Engineering)** Master file.

Name of the Course: **Mechanical Engineering Measurements**

Course Code: **BTM404**

Instructions:

1. **Question number 1 is compulsory; attempt any four questions from remaining questions.**
2. **Draw neat diagrams wherever necessary.**
3. **Assume suitable data if necessary.**

Q. No.		Max. Points	CO No.	Module. No.
1. (a)	Explain generalized measurement system with neat schematic diagram. Further map the different constituents of generalized measurement system with the physical elements of bourdon pressure gauge (draw neat labeled sketches).	10	1,3	1
(b)	Draw only neat labeled sketches illustrating working principle of (i) Piezoelectric Accelerometer (ii) Mechanical Tachometer	05	3	3
(c)	Plot rough nature of control response of second order system excited by a unit step input for the cases when damping ratio is (i) 0 (ii) less than 1 (iii) greater than 1. (Draw plot of response of C(t) Vs time t only for the mentioned cases).	05	3	4
2. (a)	A measurement system having unity feedback system has gain in Laplace domain as $G(s) = \frac{K}{s(s+1)(1+0.45s)}$ If reference input r(t)=4t and K=2, find steady state error.	10	1,2	1,2
(b)	Explain working of laser doppler anemometer with neat labeled sketch	10	3	7
3 (a)	The flow of cooling water in a manufacturing process is measured by a horizontal venturimeter with 200 mm inlet and 100 mm throat diameter. The U-tube mercury manometer connected between inlet and throat of venturi shows a differential pressure of 220 mm mercury column. Calculate the water flow rate if coefficient of discharge is 0.98, specific gravity of mercury 13.6.	10	4	7
(b)	Explain with neat sketches the input-output configurations of measuring instruments and measuring systems	10	2	1
4 (a)	Explain working of hot wire anemometer with neat labeled sketch also draw sketches of various probes and explain their significance. Explanation shall provide classical energy balance equations.	10	3	7

(b)	A thermometer, idealized as a first-order system with a time constant of 2.2 seconds, is suddenly given an input of 160^0C from 0^0C. What will be the reading of the thermometer after 1.2 seconds?	**05**	**2**	**1**
(c)	List working of LVDT with neat labeled sketch and illustrate its areas of application	**05**	**1,4**	**3**
5(a)	With neat sketch explain working of (i) hygrometer (ii) drag and cup type tachometer (iii) Bimetallic thermometer and its applications	**15**	**3,4**	**7,6**
(b)	A Mcleod gauge has volume of bulb and measuring capillary equal to $110x10^{-6}$ 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. (ii) What is the error if the exact formula is used for pressure measurement?	**05**	**3**	**5**
6 (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 $\delta = FL^3/3EI$, where F= Force, L=Length, E= Youngs modulus, I=Moment of Inertia, Take Young's modulus for steel as $200x10^9$ N/m^2	**10**	**3**	**7**
(b)	With neat sketch explain working of (i) bellow type pressure gauges (ii) rotameter	**10**	**1,3**	**5,7**
7 (a)	A small cantilever beam is constructed for measurement of force F. It is made of spring steel having modulus of elasticity $E=200X10^9$ N/m^2. The beam is 4.75 mm wide and 0.9 mm thick, with a length of 25±0.025 mm. An LVDT is used for displacement sensing. It is estimated that the limiting error in displacement measurement is ±0.025 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 ±0.0075 mm. Given force $F = \frac{3EIx}{L^3}$ where I= Moment of inertia of beam, m^4; L=Length of beam, m; and x= displacement of LVDT, m.	**10**	**2**	**2**
(b)	With neat labeled sketches explain working of (i) Optical encoder (ii) Radiation pyrometer. Also suggest areas of common applications of these devices	**10**	**3,4**	**3,6**

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Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to University of Mumbai)

END-SEM _MAY2017

BTM402 – Theory of Machines-I

Class/sem: Second year B.Tech. (Mechanical-Engg)/ IV

Duration: 4 hours **Marks: 100**

Master file.

Note:

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

MM= Max. Marks, MN= Module No., CO= course outcome

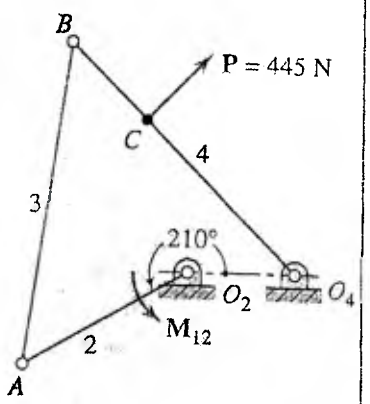
Q. no		MM	MN	CO
1	a) What is the interference in case of gear meshing? State the methods to eliminate it.	5	7	1,3
	b) What are different types of pulleys? Explain briefly with sketch.	5	6	1,3
	c) What do you mean by applied and constraint forces? What are the conditions for a body to be in equilibrium under the action of two forces, and three forces?	5	4	1,4
	d) State and prove Kennedys theorem.	5	1	1
2	The dimensions (in mm) for a four bar chain is as given in the table below. The angular velocity ω_2 is constant for each configuration and a negative sign is used to indicate clockwise direction.	10+10	3	1

Configuration no.	Frame-1	Crank-2	Coupler-3	Follower-4	Θ_2 deg.	ω_2 rad/s
1	250	100	500	400	70	-6
2	400	125	300	300	210	-18

Determine: Θ_3, Θ_4, ω_3, ω_4, α_3, α_4, for each configuration. (use relative velocity and acceleration method)

3	a) A standard 20^0 pressure angle full-depth 25mm module, 20-teeth pinion drives a 48-teeth gear. The speed of the pinion is 500rev/min. Using the position of the point of contact along the line of action as abscissa, plot a curve showing the sliding velocity at all point of contact. (sliding velocity will change the sign at pitch point)	08	7	1,3

	b) Derive the expression for path of contact when two gears are in mesh, draw a sketch to assist the expression. Define the contact ratio.	07	7	1,3
	c) A pair of spur gears has 16 teeth and 18 teeth, a module of 10mm, an addendum10mm, and a pressure angle 14.5^0. Prove that gears have interference. Determine the minimum number of teeth and velocity ratio to avoid the interference.	05	7	1,3
4	a) Deduce the expression for the ratio of tight and slack side tensions in case of a V-belt drive. Draw suitable sketch showing force equilibrium, also show that for flat belt, expression for tension ratio is a special case of above expression.	5+3+2	6	1,3
	b) Two pulleys mounted on two parallel shafts that are 2 meters apart are connected by a crossed belt drive. The diameters of two pulleys are 500 mm and 240 mm. Find the length of the belt (exact and approx.) and angle of contact between the belt and pulley. Also find the power transmitted if the larger pulley rotates at 180 rpm and maximum permissible tension in the belt is 900 N. Take $\mu = 0.28$.	4+2+4		1,3
5	a) The following particulars relate to tangent cam with roller follower: minimum radius of the cam=40mm; lift 20mm; roller diameter=20mm; speed=360 rpm; angle of ascent = 60 deg.; Calculate the acceleration of a follower at the beginning of the lift, also find its values when the roller just touches the nose and is at the apex of the circular nose.	08	5	1,2
	b) Draw the displacement, velocity and acceleration w.r.t. time or angle diagram for follower motion during ascent for the data given below: Lift = 60mm, angle of ascent= 60^0, angle of dwell= 40^0, angle of descent = 90^0, speed of cam= 200 rpm, motion of follower is Cycloidal during ascent.	12		1,2
6	a) Find the frame reactions and torque M_{12} necessary to maintain equilibrium of the four bar linkage as shown in adjacent figure. Data: O_2A= 88mm, BA= O_4B= 150mm, O_2O_4= 50mm.	08	4	4
	b) In the adjacent linkage if link 2 is having uniform angular velocity of 1 rad/sec, find angular velocity and angular acceleration of link 4. Use analytical- complex algebra method.	12	3	1
7	a) Give the diagramatic sketches of three mechanisms which are inversion of each of single slider crank and double slider crank chain, also state the purpose for which each mechanism is used.	6	1	2,1
	b) Sketch the Hart's straight-line generating mechanism and prove that the tracing point describes a straight-line path.	6	2	2
	c) In a four bar linkage (100-25-90-75) longest link is frame and shortest link is crank, coupler is of 90 units. Find the maximum and minimum values of transmission angle. Locate both toggle positions and record the corresponding crank angles and transmission angles.	8	1	1



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Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)
Munshi Nagar, Andheri (West), Mumbai – 400058.
End Semester Exam
May 2017

Max. Marks: 100 marks — Duration: 3 hours
Class: S.Y.B.Tech. Semester: Fourth (4th) Program: **Manufacturing Science II**
Name of the Course: Mechanical Engineering — Course Code : **BTM 405**

Instructions:
1.Question No 1 is compulsory.
2.Attempt any four questions out of remaining six questions.
3.Draw neat schematic diagrams wherever is necessary, **highlight** important points of answer.
4.Assume suitable data if necessary and mention it.

Master file.

Q. No		Max Mark	CO No	Module No.
Q1 A)	Give classification of locating devices based on mutual relation between work piece and pin with neat schematic sketch?	5 M	1	1
B)	i) In a single point turning operation with a Ceramic tool and steel combination having a Taylor exponent of 0.25, if the cutting speed is reduced to 0.33 times previous speed, then new tool life will become…(show calculations) a) 16 b) 125 c) 81 d) 625 ii) Write in brief different type of clearance provided on drill tool? (2M)	5 M	3	4
C)	A "8650 Steel" plate of 37 mm thickness is to be rolled to 32 mm thickness in one pass. If this plate is having width of 600 mm is rolled with the help of two roll mill, which is having rollers of 700 mm diameter each. These rolls are rotating at speed of 75 rpm. Calculate contact length between roll and plate, roller force required, coefficient of friction. Neglect the spreading phenomenon of sheet. What are the undesirable effects of excessive roll forces on rolled product and roll mill?	10 M	4	6

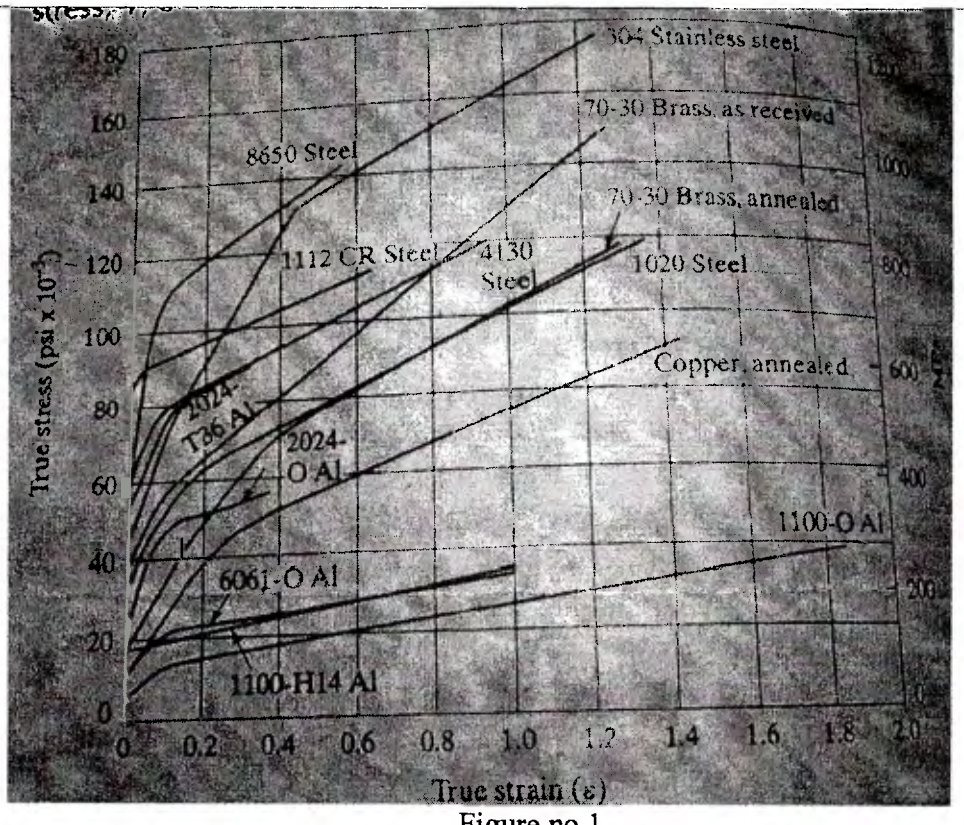


Figure no.1

Q2. A)	Explain working principle of *strain gauge type 3D Milling dynamometer* with the help of neat schematic sketch?	5 M	3	3
B)	Draw detailed schematic sketch of punched hole and slug showing their characteristic feature? Explain how punch speed affects the burr formation in case of shearing operation?	5 M	4	5
C)	A Cup has height (h) of 80 mm and diameter (d) 70 mm, corner radius is 3 mm, thickness is 1 mm, work piece material is medium carbon steel (having yield strength of 3600 kg/cm^2). Assume radius of punch is equal to 3 times thickness, radius of die is twice the thickness, clearance is 1.09 times thickness of stock, value of constant 'k' for drawing pressure of material is 0.65, force of friction and blank holder force required is one third of drawing force. **Calculate-** i) Blank diameter (with trimming allowance), ii) Number of draw passes required, punch diameter (d_{ip}) and die opening (d_{id}) for different pass and percentage reduction during each pass, iii) Drawing force ,blank holder and frictional force, Press capacity required? (Refer table 1)	10 M	4	7

Table 1.

Draw ratio e= (h/d)	No. of reduction passes	% reduction			
		1st Draw	2nd Draw	3rd draw	4th Draw
0.75	1	40			
0.75-1.5	2	40	25		
1.5-3	3	40	25	15	

Q3. A)	Write short note on "Multi-station jig", with necessary schematic sketch?	5 M	1	1

B)	Explain *Mechanism of chip formation* during machining of Ductile materials with the help of neat schematic sketch? Also give significance of *primary deformation* and *secondary deformation* zone with sketch?	5 M	2	2
C)	During machining of "EN 10277" material using single point cutting tool whose geometry defined in ASA system as: (5°) – (18°) – (10°) – (5°) – (10°) – (40°) – 0.25 inch. Calculate inclination rake, orthogonal rake, and orthogonal clearance angle of tool. Draw tool geometry in ASA system and ORS system.	10 M	3	4
Q4. A)	What are different primary, secondary functions and process effects of cutting fluid?	5 M	3	3
B)	Explain "Flat rolling process of metal" with the help of neat schematic sketch? Give significance of draft phenomenon in flat rolling process?	5 M	4	6
C)	During O.D. turning of cylindrical workpiece having outer diameter *(O.D.) 190 mm* is turned orthogonally on lathe with single point cutting tool having *rake angle of 15^0. Cutting speed is 18 meter/min, feed 0.35 mm/rev, cutting ratio(r_c) is 0.45, normal friction force on chip tool interface was measured as 60 kgf, depth of cut 0.6mm*, coefficient of friction is 0.55. Draw neat sketch showing force components (Merchant circle) and chip feature. Also sketch the outer diameter grooving operation along with tool (showing back engagement, feed engagement, major cutting edge angle and other terms) Calculate- Shear plane angle, magnitude of cutting force and cutting normal force, shear strain?	10 M	2	2
Q5. A)	Sketch and explain working of "O" ring strain gauge type dynamometers? Why Extended "O" ring strain gauge type dynamometers are used for specific application? Give its application?	5 M	3	3
B)	Prove that specific cutting pressure in an ideal orthogonal cutting is "$2*\tau*\cot(\phi)$", If $2\phi + \beta - \gamma = \Pi/2$	5 M	2	2
C)	Draw neat schematic sketch of single point cutting tool to show different geometric angles of normal rake system (NRS) with proper nomenclature? State difference between free cutting and non-free cutting of ductile metal material?	5 M	3	4
D)	Write short note on following terms i) Dent resistance, ii) Planar anisotropy in a sheet-metal specimen?	5 M	4	7
Q6. A)	Explain following methods of cutting fluid application a) Flooding b) High pressure system?	5 M	3	3
B)	Explain defects observed in rolled sheets and plates with the help of neat schematic sketch?	5 M	4	6
C)	i) Sketch and design punch and die size, ii) punch length and die block size iii) press capacity? For manufacturing of hard steel washer having outer diameter 35mm, inner diameter 20 mm, thickness 2.5 mm. Ultimate shear strength of punch and workpiece material is 35 kg/mm^2 & 32 kg/mm^2 respectively. Assume efficiency of press 65%, shrinkage and expansion allowance 0.06 mm each, and clearance for hard steel washer material is 4% of stock thickness. Critical distance 1.25 times die block thickness, Table 2.	10 M	4	5

Die block thickness (in mm)	Total perimeter of washer to be sheared off (in mm)
15	75 mm
25	75-250 mm

	30 For larger perimeter values 'E' Young modulus of elasticity for punch material = 2.1 X 10^3 Kg/cm^2.			
Q7. A)	Write short note on Progressive dies along with sketch of its process setup?	5 M	4	5
B)	What are the different Factors affecting Bendability and Enlist the remedies for this? Explain spring back phenomenon and enlist the methods for compensate the spring back?	5 M	4	7
C)	A manufacturer receives a purchase order to manufacture the components as shown in figure no.2. Given data-Batch size = 300 no's, material= cast iron, raw material= cast component with machining allowance of 1 mm on each surfaces. i) Explain sequence of machining processes (machine tool used, cutting tool used and accuracy maintained in brief), ii) Select and design jig bush from data table, iii) Design and mention important manufacturing points for jig plate, iv) Do the selection of locating, clamping and supporting elements, v) Draw assembly view of workpiece and jigs-fixture system.vi) In tabular form enlist the bill of material required.	10 M	1	1

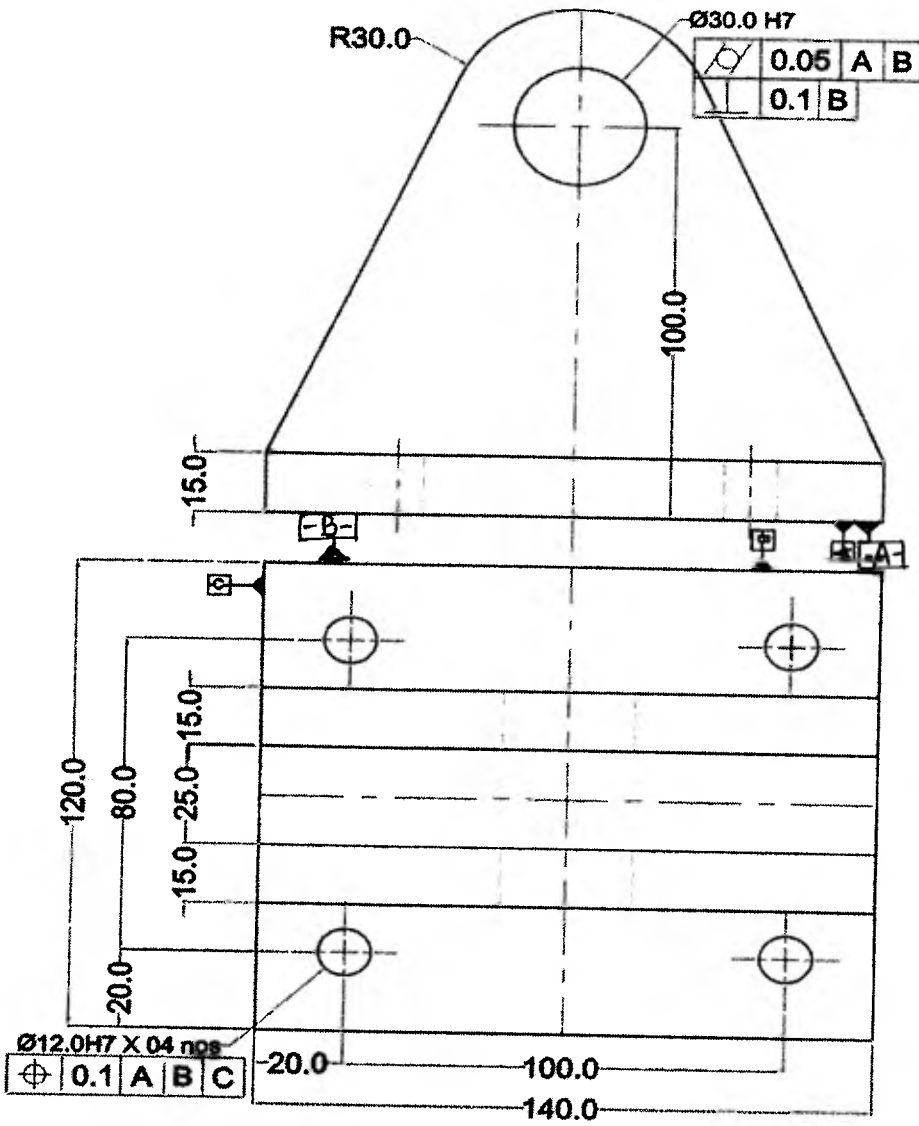
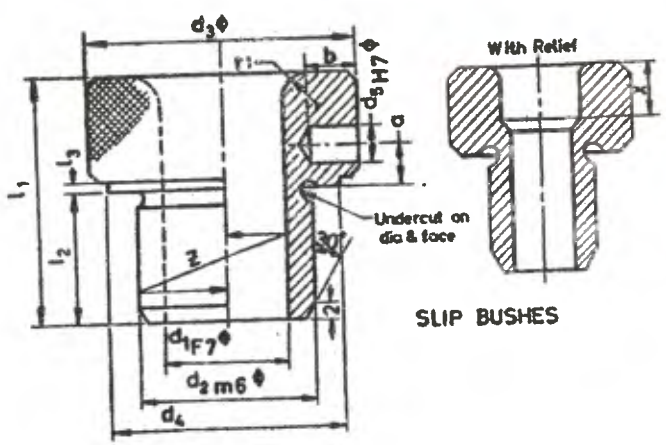
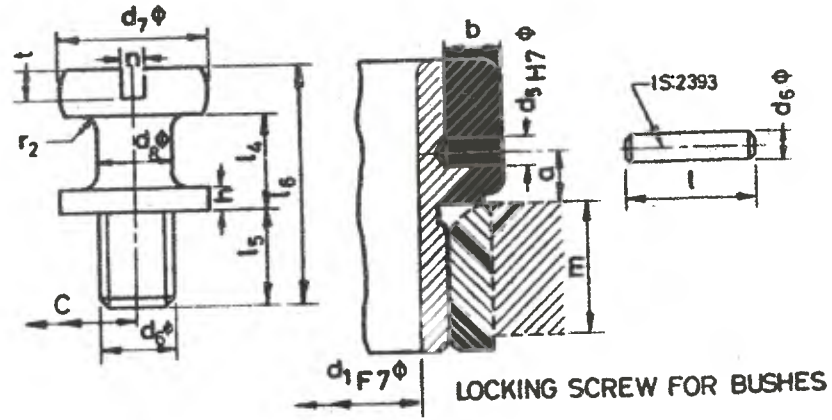


Figure no. 2





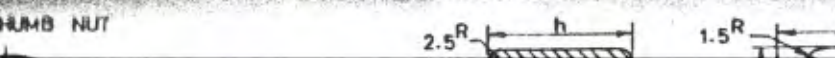
SLIP BUSHES AND LOCKING SCREWS

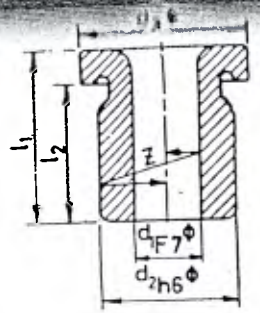
chamfer 1×45°
Material C 45; Hardness HRC 50

All dimensions in millimetres.

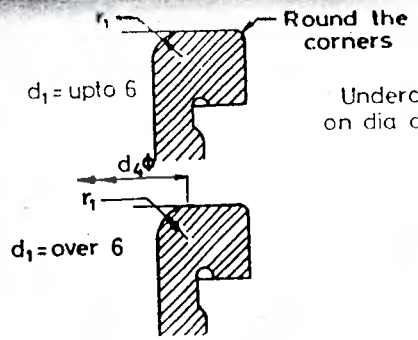
d_1	d_2	d_3	d_4	d_5	l_1	l_2	l_3	a	b	r_1	z	x
Upto 4	8	16	11	2.5	20	10	1	3	4	3	0.01	14
4— 6	10	19	14	2.5	22	12	1	3	4	3	0.01	12
6— 8	12	22	17	2.5	25	12	1	3	4	4	0.01	10
8—10	16	26	21	3.0	28	16	1	4	5	5	0.01	12
10—12	18	30	24	3.0	28	16	1	4	5	5	0.01	10
12—15	22	35	29	5.0	36	20	1	5	7	5	0.01	12
15—18	25	40	35	5.0	36	20	1	5	7	5	0.01	8
18—22	30	47	41	5.0	36	20	1	5	7	6	0.01	0
22—26	36	56	47	6.0	45	25	2	6	8	6	0.02	0
26—30	42	62	54	6.0	45	25	2	6	8	6	0.02	0
30—35	48	69	61	6.0	50	32	2	6	11	8	0.02	0
35—42	56	78	69	6.0	50	32	2	6	11	8	0.02	0
42—48	63	85	78	6.0	56	36	2	6	14	8	0.02	0

d_6	d_7	d_8	l_4	l_5	l_6	h	d_6 m6$\Phi \times l$	m	n	t	r_2	c
M 5							2.5×14	10				15
M 5							2.5×14	12				16
M 5	10	5	6	6	15	2	2.5×14	12	1.6	2.0	0.6	18
M 5							3.0×14	16				20
M 5							3.0×14	16				22
M 6							5 ×20	20				26
M 6	13	6	8	8	20	2	5 ×20	20	2.0	2.5	1.0	29
M 6							5 ×20	20				33
M 8							6 ×24	25				38
M 8							6 ×24	25				41
M 8	16	8	10	10	25	2.5	6 ×24	30	2.5	3.0	1.6	45
M 8							6 ×24	30				48
M 8							6 ×28	35				55

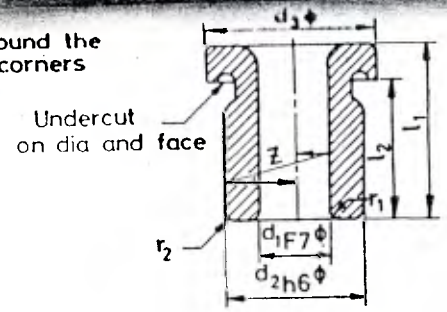




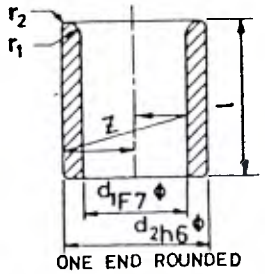
Bore rounded on top only



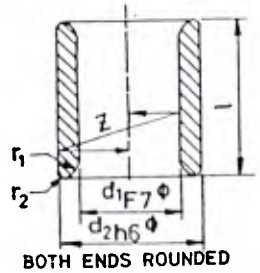
Detail of rounding



Bore rounded on both ends



ONE END ROUNDED



BOTH ENDS ROUNDED

FIXED BUSH

d_1	Short l_1	Short l_2	Long l_1	Long l_2	d_2	d_3	d_4	r_1	r_2	z
Upto 1	6	4	9	7	3	6	—	1.2	0.2	0.005
1.0—1.8	6	4	9	7	4	7	—	1.2	0.2	0.005
1.8—2.6	6	4	9	7	5	8	—	1.2	0.3	0.005
2.6—3.3	8	6	12	9	6	10	—	1.6	0.3	0.005
3.3—4.0	8	6	12	9	7	11	—	1.6	0.4	0.005
4.0—5.0	8	6	12	9	8	12	—	2.0	0.4	0.005
5.0—6.0	10	7	16	13	10	14	—	2.0	0.4	0.01
6.0—8.0	10	7	16	13	12	16	10	2.0	0.6	0.01
8.0—10	12	8	20	16	16	20	13	2.5	0.8	0.01
10—12	12	8	20	16	18	22	16	2.5	0.8	0.01
12—15	16	12	28	24	25	26	20	4.0	0.8	0.01
15—18	16	12	28	24	25	30	24	4.0	0.8	0.01
18—22	20	15	36	31	30	35	28	6.0	1.0	0.01
22—26	20	15	36	31	36	41	33	6.0	1.0	0.02
26—30	20	15	36	31	42	47	40	6.0	1.0	0.02
30—35	25	20	45	40	48	55	46	8.0	1.0	0.02
35—42	25	20	45	40	56	63	52	8.0	1.0	0.02
42—48	32	25	56	50	63	70	59	8.0	1.6	0.02
48—55	32	25	56	50	70	77	67	8.0	1.6	0.02
55—63	36	30	72	66	80	87	75	8.0	1.6	0.02

All dimensions in millimetres

LINER BUSH

63 to 65 HRC

d_1	Short	Long	d_2	r_1	r_2	z
Upto 1	6	9	3	1.2	0.2	0.005
1.0—1.8	6	9	4	1.2	0.2	0.005
1.8—2.6	6	9	5	1.2	0.3	0.005
2.6—3.3	8	12	6	1.6	0.3	0.005
3.3—4.0	8	12	7	1.6	0.4	0.005
4.0—5.0	8	12	8	2.0	0.4	0.005
5.0—6.0	10	16	10	2.0	0.4	0.01
6.0—8.0	10	16	12	2.0	0.6	0.01
8.0—10	12	20	16	2.5	0.8	0.01
10—12	12	20	18	2.5	0.8	0.01
12—15	16	28	22	4.0	0.8	0.01
15—18	16	28	25	4.0	0.8	0.01
18—22	20	36	30	6.0	0.8	0.01
22—26	20	36	36	6.0	1.0	0.02
26—30	20	36	42	6.0	1.0	0.02
30—35	25	45	48	8.0	1.0	0.02
35—42	25	45	56	8.0	1.0	0.02
42—48	30	56	63	8.0	1.6	0.02
48—55	30	56	70	8.0	1.6	0.02
55—63	36	70	80	8.0	1.6	0.02

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BHARATIYA VIDYA BHAVAN'S

SARDAR PATEL COLLEGE OF ENGINEERING

(A Government Aided Autonomous Institute)

Munshi Nagar, Andheri (West), Mumbai – 400058.

End Semester Examination

May 2017

Maximum Marks: 100 **Duration: 3 Hrs**

Class: **S.Y. B. Tech. (Mechanical)** Semester: **IV**

Program: **B. Tech. (Mechanical Engineering)**

Name of the Course: **Mechanical Engineering Measurements**

Course Code: **BTM404**

Master file.

Instructions:

1. **Question number 1 is compulsory; attempt any four questions from remaining questions.**
2. **Draw neat diagrams wherever necessary.**
3. **Assume suitable data if necessary.**

Q. No.		Max. Marks	CO No.	Module. No.
1. (a)	Draw only neat labeled sketches illustrating working principle of (i) Psychometer (ii) Ultrasonic liquid level gauge	05	3	7
1. (b)	A 0-150 Pa manometer has guaranteed limiting error of 1% of full scale reading. The Pressure measured by this instrument is 50 Pa. Calculate the percentage relative limiting error at the measured value. The manometer is proposed in an application having maximum pressure of 30 Pa with maximum permitting error to be ±3%. Comment on suitability of manometer in an application.	05	2,4	2
(c)	Transfer function of a measurement system under study is of second order. If for such a measurement system under study natural frequency, ω_n= 10 rad/sec, damping ratio, ζ=0.8. tolerance = 4% and reference input in Laplace domain, R(s)=1/s, then find (a) Rise time (b) Peak Overshoot (c) time for second undershoot (d) Peak time (e) settling time (f) Number of oscillations before it settles.	10	1,2	1,2
2. (a)	With neat sketches explain the working of angular speed measurement using Stroboscope. Further also explain how the speed can be measured if the stroboscope flash frequency range cannot capture the speed?	05	3	4
(b)	A thermometer, idealized as a first-order system with a time constant of 2.2 seconds, is suddenly given an input of 160^{0}C from 0^{0}C. What will be the reading of the thermometer after 1.2 seconds?	05	2	1

(c)	In a heat treatment process, a metal cube is heated by convection from a hot fluid at temperature T_f 220^{0}C. The initial temperature of the cube is T_i 20^{0}C. If the temperature T within the cube may be taken as uniform, write down the equation that governs the temperature as a function of time τ (General form of equation is $Td = A\exp(-a\tau)$ where T_d is dimensionless temperature give as $T_d = \frac{T - T_f}{T_i - T_f}$ and A and a are the constants). The measured temperature values at different time intervals are given as Time, τ (min): 0, 0.5, 1, 2, 3, 6 Temperature, T_d: 1, 0.85, 0.72, 0.5, 0.4, 0.14 Obtain a best fit to these data using least square method.	**10**	**1**	**2**
3 (a)	Explain generalized measurement system with neat schematic diagram. Further map the different constituents of generalized measurement system with the physical elements of bimetallic type of thermometer (draw neat labeled sketches).	**10**	**1,3**	**1**
3(b)	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 =30 s; In water, τ =5 s; In air, probe wet, τ =20 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 indicated temperature at the end of each time interval and sketch the appropriate indicated temperature (Temperature time graph between t=0 and t=30 s).	**10**	**1,2**	**6**
4 (a)	List the types of sources of error and methods to avoid the same in measurement using strain gauges	**5**	**2**	**3**
(b)	Air compressor is used to purge the pressurised air to estimate the water level using bubbler or purge method. Air compressor used in measurement such system is having pressure range of 0-5 bar. 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.	**5**	**2**	**7**
(c)	Explain working of McLeod gauge; with step by step neat labeled diagram (explain working in at least three steps supported by sketch). Derive the equation for measuring the pressure by Mcleod gauge in terms of design and process parameters	**10**	**3**	**5**
5 (a)	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. **Measuring Instruments** | **Properties** Piezoelectric Accelerometer | Acceleration at high frequency Laser Doppler Anemometer | Flow rate LVDT accelerometer | Acceleration at low frequency Brideman Gauge | Pressure Further student shall explain only the working principle of the measurement instrument listed on left hand side column of the table with neat sketch.	04 12	3,4	4,5,7
(b)	With neat sketch explain working principle of drag and cup type tachometer	**4**	**3**	**4**
6(a)	A Venturimeter is to fitted in a horizontal pipe of 0.15m diameter to measure a flow of water which may be anything up to 240m^3/hour. The pressure head at the inlet for this flow is 18m above atmospheric and the pressure head at the throat must not be lower than 7m below atmospheric. Between the inlet and the throat there is an estimated frictional loss of 10% of the difference in pressure head between these points. Calculate the minimum allowable diameter for the throat.	**08**	**1**	7
(b)	Following are the different applications/systems/processes wherein the temperature measurement is essential; i) Processor of the computing system ii) Temperature (900^0 C) of alloy in heat treatment process iii) Cryogenic systems Students shall select the appropriate thermometers for the above applications and explain their working principle with neat sketches.	**12**	**4**	6
7(a)	With neat sketch explain principle of operation of hot wire anemometers and modes of operation. Also draw neat sketches showing different types of anemometer probes.	**05**	3	7
(b)	Smartness in the utilities and system is presently been possible due to technological growth. Concept to implement smartness is being promoted by the various government initiatives such as smart cities etc. Based on the knowledge gain in the course 'Mechanical Engineering Measurement" and from its prerequisite courses students shall propose at least one sensor and one measurement system that can be used in the home in a step to make smart home. Also provide a brief architecture of use of the sensor and measurement system and benefits that can be attained with its use. Support your idea with neat sketches and explanation.	**5**	**4**	1,3,4,5,6,7
(c)	The output power of a rotating shaft is measured by a dynamometer. The relationship for output power is P measured in KW is as follows $$P = \frac{2\pi \times 9.81FLR}{t \times 10^6}$$ Where F=force at the end of torque arm, kg; L=length of torque arm, mm; R=Number of revolution during time t; t=time for test run, s. and the test data are: F=4.58±0.02 kg, L=397 ±1.3mm. R=1202±1 revolution, t=60±0.5 s Find measured power P and possible error.	**10**	**2**	2

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13/5/2017

Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)

Munshi Nagar, Andheri (West), Mumbai – 400058.

End Semester Examination, May 2017

S.Y.B.Tech., Sem-IV **B.Tech. in Mechanical Engineering**

Course: **FLUID MECHANICS (BTM 403)**

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

Master file.

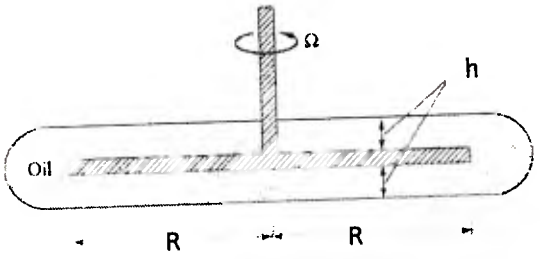
Instructions:

- Answer any **FIVE** from seven questions,
- Answers to all sub questions should be grouped together,
- Make suitable assumption if needed with proper reasoning,
- Figures on right in square bracket shows maximum marks for a particular sub-question,
- Figures on the extreme right show **CO** and **Module Number** respectively as per syllabus of the course.

1. (A) Differentiate among the terms appearing in the following parts: **[12]** 4, 1&4

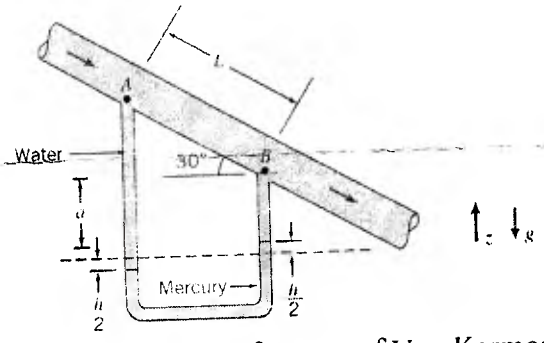
   (a) Dynamic head, static head and total head,
   (b) Dynamic pressure and stagnation pressure,
   (c) Energy gradient line and hydraulic gradient line.

   (B) A disk of radius *R* rotates at an angular velocity Ω inside a disk-shaped container filled with oil of viscosity μ, as shown in adjacent figure. Assuming a linear velocity profile and neglecting shear stress on the outer disk edges, derive a formula to estimate the viscous torque acting on the disk. **[08]** 1, 2



2. (A) Write Archimedes principle and prove that the buoyancy force, $F_{Buoyancy} = \rho g V$, where V is the volume of liquid displace by submerged body. **[10]** 2, 1&2

   With appropriate example, discuss the conditions of stability for completely submerged body and partially submerged body.

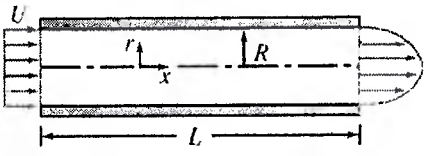


   (B) Water flows downward along a pipe that is inclined at 30° below the horizontal. Pressure difference, P_A-P_B is due partly to gravity and partly to friction. Derive an algebraic expression for the pressure difference in terms of data depicted in figure . Evaluate the pressure difference, if L=150 cm and h=15 cm. **[10]** 1, 3

3. (A) List important features of Von Karmon Momentum Integral equation and derive it **[10]** 5,

for the flow over flat plate with zero pressure gradients. 2
How will you use this equation to estimate boundary layer thickness and viscous drag? Write steps.

(B) Write Reynold's transport equation and explain the meaning of each term. Use this equation to analyze the case where water flows steadily through a pipe of length L and radius R=75 mm as shown in adjacent figure. Calculate the uniform inlet velocity, U, if the velocity distribution across the outlet is given by [10] 4, 2



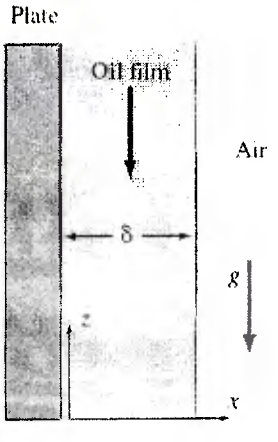
$$u = u_{max}\left[1 - \frac{r^2}{R^2}\right]$$ where u_{max} =3 m/s

4. (A) What do you understand by surface force and body force of fluid? Develop differential form of general linear momentum equation and use it to derive following equation. [10] 4, 1
   (a) Navier-Stoke's Equation
   (b) Euler's Equation
   (c) Stokes Equation

   (B) Consider the velocity field $\vec{V} = \frac{10x}{(x^2+y^2)}\vec{i} + \frac{10y}{(x^2+y^2)}\vec{j}$ in the x-y plane, where x and y are measured in meters. [10] 3, 3
   Is this an incompressible flow field? Derive an expression for the fluid acceleration. Evaluate the velocity and acceleration along the x axis, the y axis, and along a line defined by y = x. What can you conclude about this flow field?

5. (A) Write characteristic features of turbulence in fluids. Explain following terms in this context. [10] 5, 1
   a) RANS equation
   b) Closure problem of turbulent flow
   c) Turbulent velocity profile - viscous layer, buffer layer and outer layer

   (B) An oil film drains steadily down the side of a vertical wall, as shown. After an initial development at the top of the wall, the film becomes independent of z and of constant thickness (δ). Assume that w = w(x) only, and that the atmosphere offers no shear resistance to the film. Investigate the case to evaluate w(x) by using Navier-Stokes equation. [10] 4, 4



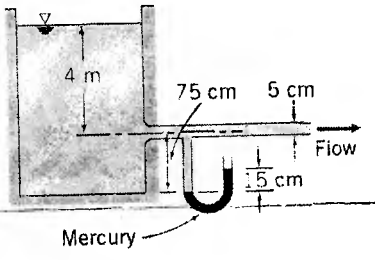
   If film thickness (δ) and $\left(\frac{dw}{dx}\right)_{wall}$ are known, find an expression for viscosity μ which relates $\left(\rho, \delta, g, \left.\frac{dw}{dx}\right|_{wall}\right)$

6. (A) What is Mach Number? State its significance in compressible flow analysis? Classify the flow based on it. Develop an expression for stagnation temperature as a function of Mach Number. [10] 7, 1
   (B) Oil, with ρ = 890 kg/m^3 and μ = 0.07 kg/m.s, flows through a horizontal pipe 15 m [10] 6,

long. The power delivered to the flow is 746 W. Estimate pipe diameter if the flow is at the laminar transition point? For this condition, what are (a) flow rate, Q in m^3/h; and (b) wall shear, τ_w in kPa?
Note: Power lost due to friction, $P = \rho g Q h_f$

2&3

7. (A) Water flows from a very large tank through a 5-cm diameter tube. The dark liquid in the manometer is mercury. Investigate the limitation of Bernoulli' s equation for the present case.
Estimate the velocity in the pipe and the rate of discharge from the tank assuming the flow to be frictionless.



[10] 4, 3&4

(B) Differentiate between:

a. Integral and differential approach
b. Lagrangian and Eulerian approach
c. Developing and developed flow
d. Major and minor losses

[10]

Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)

Munshi Nagar, Andheri (West), Mumbai – 400058.

End semester Examination

May 2017

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

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

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

Instructions:

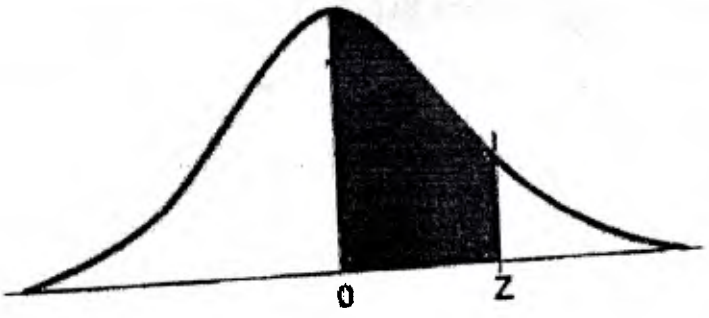
- Attempt any FOUR questions out of remaining SIX questions.
- Question number.1 is **compulsory**.
- Answers to all sub questions should be **grouped** together.

Master file.

Q		Marks	CO	Module no.
1(a)	For the following data X: 1 2 3 4 5 6 7 8 9 Y: 9 8 10 12 11 13 14 16 15 Find the lines of regression. Show that for x = 6.2, the estimated value of Y = 13.14. Also estimate the value of X, for Y = 13.14	5	1	1
(b)	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.	5	1	4
(c)	Solve $\frac{\partial^2 z}{\partial x^2} - 2\frac{\partial z}{\partial x} + \frac{\partial z}{\partial y} = 0$ using method of separation of variables.	5	3	6
(d)	Obtain the Fourier Series for $f(x) = x^2$ in $(-\pi, \pi)$	5	1	5
2 (a)	If the mean of the following probability distribution is 16, find m, n & variance X: 8 12 16 20 24 P(X): 1/8 m n 1/4 1/12	6	1	2

(b)	Obtain the Fourier Series for $f(x)=\lvert\sin x\rvert \qquad -\pi \le x \le \pi$.	6	2	5
(c)	An insurance company has discovered that only about 0.1% of the population is involved in a certain type of accident each year. Is its 10,000 policy holders were randomly selected from the population, what is the probability that not more than 5 of clients are involved in such an accident next year?	8	1	3
3 (a)	Compute spearman's rank coorelation coefficient for the following data X: 10, 12, 18, 18, 15, 40 Y: 12, 18, 25, 25, 50, 25	6	1	1
(b)	Find the Fourier Series of $f(x)=\begin{cases}-x & -\pi < x \le 0 \\ x & 0 \le x < \pi\end{cases}$	6	2	5
(c)	A crv X has PDF defined as $f(x)=\begin{cases}A+Bx, 0 \le x \le 1 \\ 0, elsewhere\end{cases}$ If the mean of the distribution is 1/3. Find A & B.	8	1	2
4 (a)	Obtain Half Range Fourier Cosine Series for the function $f(x)=\begin{cases} kx, & 0<x<\frac{l}{2} \\ k(l-x), & \frac{l}{2}<x<l \end{cases}$	6	2	5
(b)	Ten individuals are chosen at random from a population and their heights are found to be (in inches): 63, 63, 66, 67, 68, 69, 70, 70, 71 & 72. In the light of the data discuss the suggestion that the mean height in the population is 66 inches	6	1	4
(c)	If the mean of a binomial distribution is 3 and the variance is $3/2$, find the probability of obtaining atleast 4 success.	8	3	7
5 (a)	The probability of a man hitting the target is ¼.(i)If he fires 7 times what is the probability of his hitting the target atleast targets atleast twice ?(ii)How many times must he fire so that the probability of his hitting the once is greater than 2/3?	6	1	3

(b)	Following Table shows the respective heights x and y (in inches) of a sample of 10 father and their sons. Calculate karl pearson correlation coefficients X: 65, 63, 67, 64, 68, 62, 70, 66, 68, 71 Y: 68, 66, 68, 65, 69, 66, 68, 65, 71, 70	6	1	1
(c)	Obtain the half range cosine series $f(x)=x(\pi-x) \quad 0<x<\pi$ Hence show that $\sum_{n=1}^{\infty}\frac{1}{n^4}=\frac{\pi^4}{90}$,	8	2	5
6(a)	The theory predicts the proportions of bean in the four groups A, B, C & D should be 9:3:3:1. In an experiment among 1600 beans, the number in the four group are 882, 313, 287 & 118. Does the experimental result support the theory?	6	1	4
(b)	Show that $\{\sin(2n+1)x\}$ is orthogonal on $\left[0,\frac{\pi}{2}\right]$ and construct corresponding orthonormal set of functions.	6	2	5
(c)	A string is stretched and fastened to two point's *l* apart. Motion is started by displacing the string in the form $y = a\sin\frac{nx}{\ell}$ from which it is released at time t = 0, show that the displacement of any point at a distance x from one end at time t is given by y (x, t) = $y = a\sin\frac{\pi x}{\ell}\cos\frac{\pi ct}{\ell}$.	8	3	7
7(a)	Obtain all possible solutions of one dimensional heat equation	6	3	7
(b)	The mean weight of 500 male students at a certain college is 151 lb and standard deviation is 15 lb. Assuming that the weights are normally distributed, find how many students weigh i)Between 120 & 155 lb ii)more than 185 lb	6	1	2
(c)	Find the angle between the lines of regression	8	1	1



This table presents the area between the mean and the Z score . When Z=1.96, the shaded area is 0.4750.

Areas Under the Standard Normal Curve

Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
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
3.6	.4998	.4998	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.9	.5000									

Source: Adapted by permission from *Statistical Methods* by George W. Snedecor and William G. Cochran, sixth edition © 1967 by The Iowa State University Press, Ames, Iowa, p. 548.

TABLE of CRITICAL VALUES for STUDENT'S *t* DISTRIBUTIONS

Column headings denote probabilities (α) ***above*** tabulated values.

d.f.	0.40	0.25	0.10	0.05	0.04	0.025	0.02	0.01	0.005	0.0025	0.001	0.0005
1	0.325	1.000	3.078	6.314	7.916	12.706	15.894	31.821	63.656	127.321	318.289	636.578
2	0.289	0.816	1.886	2.920	3.320	4.303	4.849	6.965	9.925	14.089	22.328	31.600
3	0.277	0.765	1.638	2.353	2.605	3.182	3.482	4.541	5.841	7.453	10.214	12.924
4	0.271	0.741	1.533	2.132	2.333	2.776	2.999	3.747	4.604	5.598	7.173	8.610
5	0.267	0.727	1.476	2.015	2.191	2.571	2.757	3.365	4.032	4.773	5.894	6.869
6	0.265	0.718	1.440	1.943	2.104	2.447	2.612	3.143	3.707	4.317	5.208	5.959
7	0.263	0.711	1.415	1.895	2.046	2.365	2.517	2.998	3.499	4.029	4.785	5.408
8	0.262	0.706	1.397	1.860	2.004	2.306	2.449	2.896	3.355	3.833	4.501	5.041
9	0.261	0.703	1.383	1.833	1.973	2.262	2.398	2.821	3.250	3.690	4.297	4.781
10	0.260	0.700	1.372	1.812	1.948	2.228	2.359	2.764	3.169	3.581	4.144	4.587
11	0.260	0.697	1.363	1.796	1.928	2.201	2.328	2.718	3.106	3.497	4.025	4.437
12	0.259	0.695	1.356	1.782	1.912	2.179	2.303	2.681	3.055	3.428	3.930	4.318
13	0.259	0.694	1.350	1.771	1.899	2.160	2.282	2.650	3.012	3.372	3.852	4.221
14	0.258	0.692	1.345	1.761	1.887	2.145	2.264	2.624	2.977	3.326	3.787	4.140
15	0.258	0.691	1.341	1.753	1.878	2.131	2.249	2.602	2.947	3.286	3.733	4.073
16	0.258	0.690	1.337	1.746	1.869	2.120	2.235	2.583	2.921	3.252	3.686	4.015
17	0.257	0.689	1.333	1.740	1.862	2.110	2.224	2.567	2.898	3.222	3.646	3.965
18	0.257	0.688	1.330	1.734	1.855	2.101	2.214	2.552	2.878	3.197	3.610	3.922
19	0.257	0.688	1.328	1.729	1.850	2.093	2.205	2.539	2.861	3.174	3.579	3.883
20	0.257	0.687	1.325	1.725	1.844	2.086	2.197	2.528	2.845	3.153	3.552	3.850
21	0.257	0.686	1.323	1.721	1.840	2.080	2.189	2.518	2.831	3.135	3.527	3.819
22	0.256	0.686	1.321	1.717	1.835	2.074	2.183	2.508	2.819	3.119	3.505	3.792
23	0.256	0.685	1.319	1.714	1.832	2.069	2.177	2.500	2.807	3.104	3.485	3.768
24	0.256	0.685	1.318	1.711	1.828	2.064	2.172	2.492	2.797	3.091	3.467	3.745
25	0.256	0.684	1.316	1.708	1.825	2.060	2.167	2.485	2.787	3.078	3.450	3.725
26	0.256	0.684	1.315	1.706	1.822	2.056	2.162	2.479	2.779	3.067	3.435	3.707
27	0.256	0.684	1.314	1.703	1.819	2.052	2.158	2.473	2.771	3.057	3.421	3.689
28	0.256	0.683	1.313	1.701	1.817	2.048	2.154	2.467	2.763	3.047	3.408	3.674
29	0.256	0.683	1.311	1.699	1.814	2.045	2.150	2.462	2.756	3.038	3.396	3.660
30	0.256	0.683	1.310	1.697	1.812	2.042	2.147	2.457	2.750	3.030	3.385	3.646
31	0.256	0.682	1.309	1.696	1.810	2.040	2.144	2.453	2.744	3.022	3.375	3.633
32	0.255	0.682	1.309	1.694	1.808	2.037	2.141	2.449	2.738	3.015	3.365	3.622
33	0.255	0.682	1.308	1.692	1.806	2.035	2.138	2.445	2.733	3.008	3.356	3.611
34	0.255	0.682	1.307	1.691	1.805	2.032	2.136	2.441	2.728	3.002	3.348	3.601
35	0.255	0.682	1.306	1.690	1.803	2.030	2.133	2.438	2.724	2.996	3.340	3.591
36	0.255	0.681	1.306	1.688	1.802	2.028	2.131	2.434	2.719	2.990	3.333	3.582
37	0.255	0.681	1.305	1.687	1.800	2.026	2.129	2.431	2.715	2.985	3.326	3.574
38	0.255	0.681	1.304	1.686	1.799	2.024	2.127	2.429	2.712	2.980	3.319	3.566
39	0.255	0.681	1.304	1.685	1.798	2.023	2.125	2.426	2.708	2.976	3.313	3.558
40	0.255	0.681	1.303	1.684	1.796	2.021	2.123	2.423	2.704	2.971	3.307	3.551
60	0.254	0.679	1.296	1.671	1.781	2.000	2.099	2.390	2.660	2.915	3.232	3.460
80	0.254	0.678	1.292	1.664	1.773	1.990	2.088	2.374	2.639	2.887	3.195	3.416
100	0.254	0.677	1.290	1.660	1.769	1.984	2.081	2.364	2.626	2.871	3.174	3.390
120	0.254	0.677	1.289	1.658	1.766	1.980	2.076	2.358	2.617	2.860	3.160	3.373
140	0.254	0.676	1.288	1.656	1.763	1.977	2.073	2.353	2.611	2.852	3.149	3.361
160	0.254	0.676	1.287	1.654	1.762	1.975	2.071	2.350	2.607	2.847	3.142	3.352
180	0.254	0.676	1.286	1.653	1.761	1.973	2.069	2.347	2.603	2.842	3.136	3.345
200	0.254	0.676	1.286	1.653	1.760	1.972	2.067	2.345	2.601	2.838	3.131	3.340
250	0.254	0.675	1.285	1.651	1.758	1.969	2.065	2.341	2.596	2.832	3.123	3.330
inf	0.253	0.674	1.282	1.645	1.751	1.960	2.054	2.326	2.576	2.807	3.090	3.290

Table of the chi square distribution

	Level of Significance α								
df	0.200	0.100	0.075	0.050	0.025	0.010	0.005	0.001	0.0005
1	1.642	2.706	3.170	3.841	5.024	6.635	7.879	10.828	12.116
2	3.219	4.605	5.181	5.991	7.378	9.210	10.597	13.816	15.202
3	4.642	6.251	6.905	7.815	9.348	11.345	12.838	16.266	17.731
4	5.989	7.779	8.496	9.488	11.143	13.277	14.860	18.467	19.998
5	7.289	9.236	10.008	11.070	12.833	15.086	16.750	20.516	22.106
6	8.558	10.645	11.466	12.592	14.449	16.812	18.548	22.458	24.104
7	9.803	12.017	12.883	14.067	16.013	18.475	20.278	24.322	26.019
8	11.030	13.362	14.270	15.507	17.535	20.090	21.955	26.125	27.869
9	12.242	14.684	15.631	16.919	19.023	21.666	23.589	27.878	29.667
10	13.442	15.987	16.971	18.307	20.483	23.209	25.188	29.589	31.421
11	14.631	17.275	18.294	19.675	21.920	24.725	26.757	31.265	33.138
12	15.812	18.549	19.602	21.026	23.337	26.217	28.300	32.910	34.822
13	16.985	19.812	20.897	22.362	24.736	27.688	29.820	34.529	36.479
14	18.151	21.064	22.180	23.685	26.119	29.141	31.319	36.124	38.111
15	19.311	22.307	23.452	24.996	27.488	30.578	32.801	37.698	39.720
16	20.465	23.542	24.716	26.296	28.845	32.000	34.267	39.253	41.309
17	21.615	24.769	25.970	27.587	30.191	33.409	35.719	40.791	42.881
18	22.760	25.989	27.218	28.869	31.526	34.805	37.157	42.314	44.435
19	23.900	27.204	28.458	30.144	32.852	36.191	38.582	43.821	45.974
20	25.038	28.412	29.692	31.410	34.170	37.566	39.997	45.315	47.501