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THAPAR INSTITUTE OF ENGINEERING AND TECHNOLOGY-PATIALA

ELECTRICAL & INSTRUMENTATION ENGINEERING DEPARTMENT

END SEMESTER EXMAMITATION OF IST SEMESTER OF 2006-07

Time 3hrs MEASUREMENT SCIENCE (IN-001) MM 45

78

Note :

1. Attempt **ANY** five questions
2. All parts of one question must be done at one place otherwise only first part will be evaluated
3. Only first five questions will be evaluated
4. Assume missing data , if any

1	a)	A manometer has a well of 20 mm in diameter and a tube of 4 mm of inner bore . It is proposed to use a scale graduated accurately in mm to measure the pressure directly i.e. 1mm scale division indicates a 1mm pressure head change . Calculate the angle at which the tube must be inclined to the vertical to do so. The density of mercury is 13.56×10^3 kg/m^3 .	
	b)	What are the different methods with which liquid in a tank can be measured ? Explain any two methods in detail	5,4
2	a)	Define error . What are the different types of errors present in a measurement system ? Explain these errors by giving suitable examples also discuss the means adopted to minimize them .	
	b)	Why the measurement of pH is required? Describe the construction and working of pH meter.	5,4
3	a)	Three resistance have the following ratings R_1= 200 ohm ± 5%, R_2 = 100 Ω ± 5% and R_3 = 50ohm±5%. Determine the magnitude of resultant resistance and the limiting error in %age and in ohm if the above resistances are connected in a) Series b) Parallel.	
	b)	Define the term telemetry . What are the different types of telemetry systems ? Explain the land line telemetry system in detail and describe its advantages.	5,4
4	a)	The open loop transfer function of a unity feedback control system is given by $G(s)=\frac{25}{s(s+5)}$ Calculate : (i) Natural Frequency of oscillation (ii) Damped frequency of oscillation (iii) Damping ratio (iv) Rise time (v) Maximum overshoot The input applied is unit step.	
	b)	Describe the method of measuring torque of rotating shafts using strain gauges.	6,3
5		The coefficient of friction between glass sheet and wood was measured in the laboratory by a technique, which is free from systemic errors. The data obtained was as follows:	

Coefficient of friction	0.44 -0.46	0.46 -0.48	0.48 -0.5	0.5 – 0.52	0.52 – 0.54	0.54 – 0.56	0.56 – 0.58
Observed frequency	3	10	12	16	10	6	3

Determine whether the values of the coefficient of friction follow the Gaussian distribution or not. Test chi-square values up to 20% level. 9

6	a)	Why veturimeter is used in industries? Describe the principle, construction, working and advantages of veturimeter. Derive the expression for the actual flow rate for incompressible fluids. Clearly mention the assumptions used.	
	b)	What are the different parameters that can be measured in vibration measurement? Discuss the piezo-electric accelerometer in detail.	6,3
7	a)	A thermistor of resistance 1kilo ohm, temperature coefficient of resistance 4.5 percent/degree Centigrade and an internal temperature rise of 0.2 degree centigrade per mW around 27 degree centigrade is included in a d.c. bridge with three fixed resistors each of value of 1 kilo ohm. A d.c. amplifier of high input impedance is connected across the bridge output and an indicating device connected to the amplifier output. Calculate the maximum voltage sensitivity of the bridge if the internal temperature rise is not to exceed 0.1 degree centigrade.	
	b)	Describe the construction and working of disappearing filament optical pyrometers. Also list its fields of application, advantages and disadvantages.	6,3

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Integral Guassian Probability Table.

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	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2258	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2518	0.2549
0.7	0.2580	0.2612	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2996	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936

Table 18.3 gives values of χ^2 which have various probabilities of being exceeded by a sample taken from the given parent distribution. The number of degrees of freedom is F. To illustrate: for a sample with 6 degrees of freedom, the probability, $P(\chi^2)$ is 0.95 if $\chi^2 = 1.635$ and 0.1 if $\chi^2 = 10.645$.

χ^2) 0.99	0.95	0.90	0.80	0.70	0.50	0.30	0.20	0.10	0.05	0.01	0
0.000157	0.00393	0.0158	0.0642	0.148	0.455	1.074	1.642	2.706	3.841	6.635	10
0.0201	0.103	0.211	0.446	0.713	1.386	2.408	3.219	4.605	5.991	9.210	13
0.115	0.352	0.584	1.005	1.424	2.366	3.665	4.642	6.251	7.815	11.341	16
0.297	0.711	1.064	1.649	2.195	3.357	4.878	5.989	7.779	9.488	13.277	18
0.554	1.145	1.610	2.343	3.000	4.351	6.064	7.289	9.236	11.070	15.086	20

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