

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Mid Semester Examination
Course No.: ME 4407
Course Title: Measurement, Instrumentation and Control

Summer Semester, A. Y. 2021-2022
Time: 1 Hours 30 Min(s)
Full Marks: 75

There are 3 (Three) questions. Answer all the questions.

Marks of each question and corresponding CO and PO are written in the brackets.

Do not write on this question paper.

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1. a) To get a measured value from a true value, what are the elements involved in a measurement system? Describe them briefly. (13)
(CO1)
(PO1)
- b) Briefly describe the following dynamic characteristics of any measurement systems: (12)
(CO1)
(PO1)
- i) Speed of response and Response time, ii) Lag, iii) Fidelity, iv) Dynamic error
2. a) Design a weighing scale setup for measuring up to 100 kg weight. For this design, you have to use a load cell (Fig 1) and HX711 load cell amplifier with other necessary sensors/tools, if necessary. Explain the calibration process step by step of such designed weighing scale. (15)
(CO1)
(PO3)
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- Fig 1: Load Cell
- b) What are different sources of random error for a measurement system? How can you reduce this kind of error? (10)
(CO1)
(PO2)
3. a) Suppose that an engineer has installed a chromel-constantan thermocouple but has incorrectly used copper-constantan extension leads (such that the two constantan wires were connected together and the copper extension wire was connected to the chromel thermocouple wire). If the thermocouple was measuring a hot fluid whose real temperature is 153°C, the junction between the thermocouple and the extension leads was at 88°C and the reference junction was at 0°C: (13)
(CO2)
(PO2)
- (i) Calculate the emf (voltage) measured at the open ends of the extension wires.
(ii) What fluid temperature would be deduced from this measured emf (assuming that the error in using the incorrect leads was not known about)?
- b) If you need to measure both wind speed and direction of wind flow using rotary/optical encoders, then how will you design the measurement setup? Explain with required diagram. (12)
(CO2)
(PO3)

Thermocouple Table

Type E: chromel—constantan

Type J: iron—constantan

Type K: chromel—alumel

Type N: nicrosil—nasil

Type S: platinum/10% rhodium—platinum

Type T: copper—constantan

Temperature (°C)	Type E	Type J	Type K	Type N	Type S	Type T
20	1.192	1.019	0.798	0.525	0.113	0.789
30	1.801	1.536	1.203	0.793	0.173	1.196
40	2.419	2.058	1.611	1.064	0.235	1.611
50	3.047	2.585	2.022	1.339	0.299	2.035
60	3.683	3.115	2.436	1.619	0.365	2.467
70	4.329	3.649	2.850	1.902	0.432	2.908
80	4.983	4.186	3.266	2.188	0.502	3.357
90	5.646	4.725	3.681	2.479	0.573	3.813
100	6.317	5.268	4.095	2.774	0.645	4.277
110	6.996	5.812	4.508	3.072	0.719	4.749
120	7.683	6.359	4.919	3.374	0.795	5.227
130	8.377	6.907	5.327	3.679	0.872	5.712
140	9.078	7.457	5.733	3.988	0.950	6.204
150	9.787	8.008	6.137	4.301	1.029	6.702
160	10.501	8.560	6.539	4.617	1.109	7.207
170	11.222	9.113	6.939	4.936	1.190	7.718
180	11.949	9.667	7.338	5.258	1.273	8.235
190	12.681	10.222	7.737	5.584	1.356	8.757
200	13.419	10.777	8.137	5.912	1.440	9.286
210	14.161	11.332	8.537	6.243	1.525	9.820
220	14.909	11.887	8.938	6.577	1.611	10.360
230	15.661	12.442	9.341	6.914	1.698	10.905
240	16.417	12.998	9.745	7.254	1.785	11.456
250	17.178	13.553	10.151	7.596	1.873	12.011
260	17.942	14.108	10.560	7.940	1.962	12.572
270	18.710	14.663	10.969	8.287	2.051	13.137
280	19.481	15.217	11.381	8.636	2.141	13.707
290	20.256	15.771	11.793	8.987	2.232	14.281
300	21.033	16.325	12.207	9.340	2.323	14.860
310	21.814	16.879	12.623	9.695	2.414	15.443
320	22.597	17.432	13.039	10.053	2.506	16.030
330	23.383	17.984	13.456	10.412	2.599	16.621
340	24.171	18.537	13.874	10.772	2.692	17.217
350	24.961	19.089	14.292	11.135	2.786	17.816
360	25.754	19.640	14.712	11.499	2.880	18.420
370	26.549	20.192	15.132	11.865	2.974	19.027
380	27.345	20.743	15.552	12.233	3.069	19.638
390	28.143	21.295	15.974	12.602	3.164	20.252
400	28.943	21.846	16.395	12.972	3.260	20.869
410	29.744	22.397	16.818	13.344	3.356	
420	30.546	22.949	17.241	13.717	3.452	
430	31.350	23.501	17.664	14.091	3.549	
440	32.155	24.054	18.088	14.467	3.645	
450	32.960	24.607	18.513	14.844	3.743	
460	33.767	25.161	18.938	15.222	3.840	
470	34.574	25.716	19.363	15.601	3.938	