Bengal Engineering and Science University, Shibpur

M.E. (Mechanical) 1st Semester Examination, December 2011

NON TRADITIONAL MACHINING

(ME – 919)

Time: 3 hours **Full marks: 70**

Answer any FIVE questions
The questions are of equal value.

1. (a) Discuss the reasons behind the rapid growth of nontraditional production processes during the last few decades.

   (b) State the differences between traditional and nontraditional machining processes.

   (c) Classify nontraditional production processes according to the type of energy used. Name the processes under each group.

2. (a) Enumerate the different categories of Chemical Machining process and state their industrial applications.

   (b) Draw a neat sketch of Chemical Machining (CHM) set-up and describe the procedural steps followed.

   (c) State the advantages and disadvantages of Chemical Machining process.

3. (a) Draw the schematic diagram of Abrasive Jet Machining (AJM) set-up and label its various components.

   (b) With the help of necessary figures describe the effect of nozzle tip distance (NTD) on material removal rate and machining accuracy in AJM process.

   (c) State the limitations of AJM process.

4. (a) Write down the assumptions made for modelling the material removal rate in Abrasive Jet Machining (AJM) process.

   (b) Prove that the material removal rate for brittle work material in AJM process is given by $MRR_{brittle} = 1.04 \dfrac{MV^{3/2}}{\rho^{1/4} H^{3/4}}$. The notations carry their usual meanings.

   (c) Show that in AJM process material removal rate for both ductile and brittle material becomes equal when the velocity of abrasive particles is $V = 4.355 \sqrt{\dfrac{H}{\rho}}$.

5. (a) Discuss the theories on mechanism of material removal in Electro-Discharge Machining (EDM) process.

   (b) Why polarity reversal is sometime necessary in EDM operation ?

   (c) State the advantages that make EDM so widely used in practice.

6. (a) State the Faraday's Laws of electrolysis.

(b) Show the chemical reactions that take place in electrolyte, anode and cathode during Electro-Chemical Machining process.

(c) Show that the material removal rate for dissolution of an alloy in Electro-Chemical Machining is given by $MRR = \frac{1}{\rho \cdot F} \cdot \frac{I}{\sum_{i=1}^{i=n} \frac{\alpha_i . V_i}{A_i}}$. The notations have usual meanings.

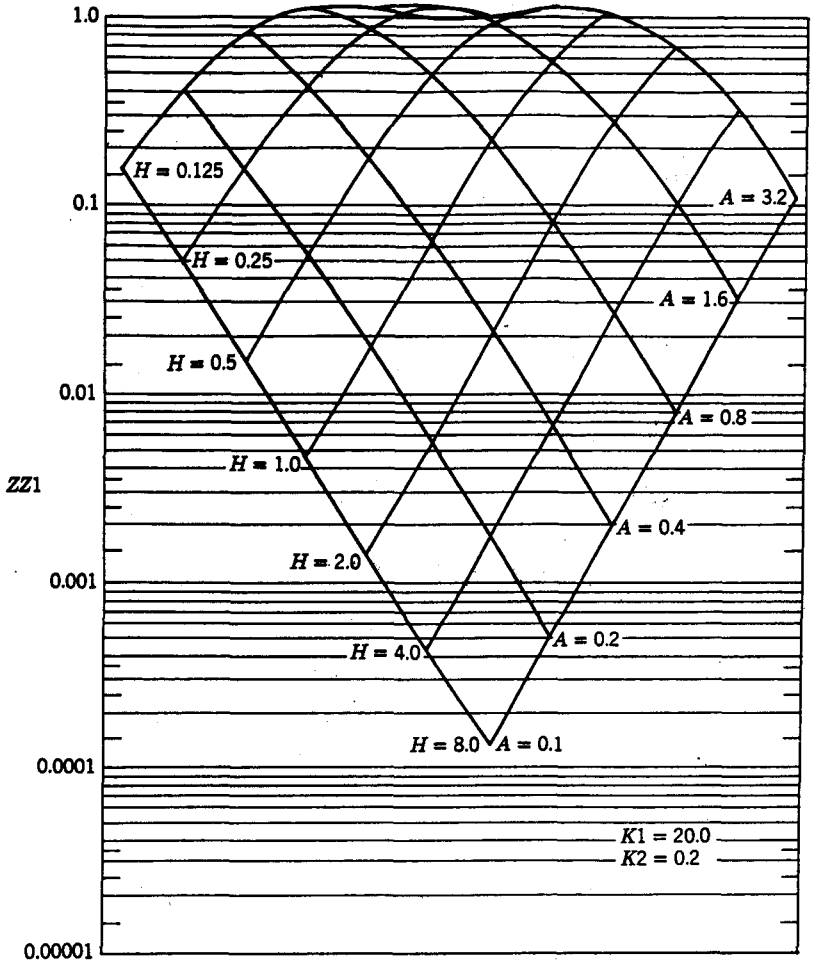
7. Write short notes on **any three** of the followings:

(i) Working principle of USM

(ii) EDM gap flushing techniques

(iii) Non-metallic electrodes in EDM

(iv) Photo Chemical Machining (PCM) process.


1.0
0.1
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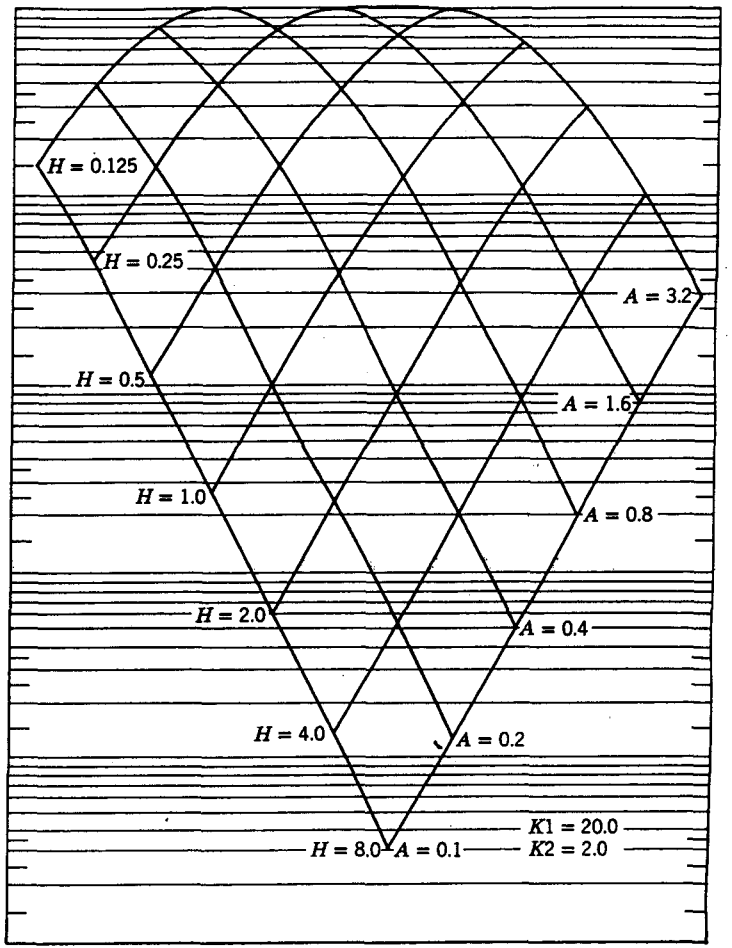
ZZ1
H = 0.125
H = 0.25
H = 0.5
H = 1.0
H = 2.0
H = 4.0
H = 8.0
A = 3.2
A = 1.6
A = 0.8
A = 0.4
A = 0.2
A = 0.1
K1 = 20.0
K2 = 0.2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(c)

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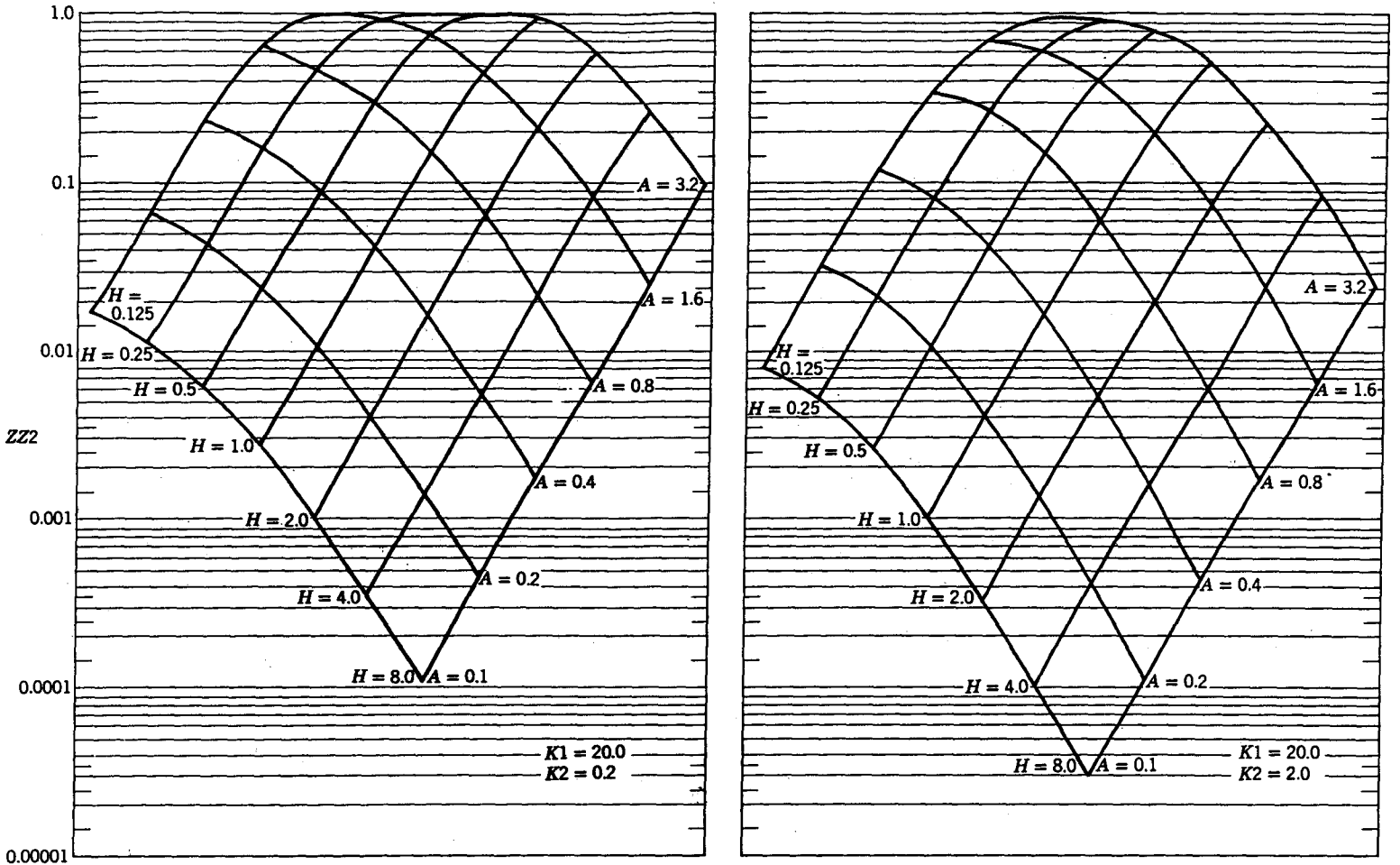
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K2 = 2.0

(g)

TABLE 2.3. (continued)

	$H = 0.25$ $k_1 = 0.2$			$H = 0.25$ $k_1 = 2.0$			$H = 0.25$ $k_1 = 20.0$			$H = 0.25$ $k_1 = 200.0$		
a_1	$(ZZ1-RR1)$	$(ZZ2-RR2)$	$(ZZ2-RR3)$	$(ZZ1-RR1)$	$(ZZ2-RR2)$	$(ZZ2-RR3)$	$(ZZ1-RR1)$	$(ZZ2-RR2)$	$(ZZ2-RR3)$	$(ZZ1-RR1)$	$(ZZ2-RR2)$	$(ZZ2-RR3)$
			$k_2 = 0.2$			$k_2 = 0.2$			$k_2 = 0.2$			$k_2 = 0.2$
0.1	0.05598	0.00274	0.01370	0.28658	0.00277	0.01384	0.61450	0.00202	0.01011	0.86644	0.00090	00.0451
0.2	0.12628	0.01060	0.05302	0.72176	0.01075	0.05377	1.76675	0.00793	0.03964	2.71354	0.00357	0.01784
0.4	0.14219	0.03744	0.18722	1.03476	0.03842	0.19211	3.59650	0.02931	0.14653	6.83021	0.01365	0.06824
0.8	0.12300	0.09839	0.49196	0.88833	0.10337	0.51687	4.58845	0.08771	0.43854	13.19664	0.04624	0.23118
1.6	0.10534	0.13917	0.69586	0.66438	0.14102	0.70510	2.31165	0.14039	0.70194	13.79134	0.10591	0.52955
3.2	0.05063	0.11114	0.55569	0.41539	0.09804	0.49020	1.24415	0.07587	0.37934	2.72901	0.08608	0.43037
			$k_2 = 2.0$			$k_2 = 2.0$			$k_2 = 2.0$			$k_2 = 2.0$
0.1	0.05477	0.01409	0.00704	0.28362	0.01353	0.00677	0.63215	0.00962	0.00481	0.96553	0.00407	0.00203
0.2	0.12136	0.05484	0.02742	0.70225	0.05278	0.02639	1.83766	0.03781	0.01891	3.10763	0.01611	0.00806
0.4	0.12390	0.19780	0.09890	0.96634	0.19178	0.09589	3.86779	0.14159	0.07079	8.37852	0.06221	0.03110
0.8	0.06482	0.56039	0.28019	0.66885	0.55211	0.27605	5.50796	0.44710	0.22355	18.95534	0.21860	0.10930
1.6	−0.00519	0.96216	0.48108	0.17331	0.95080	0.47540	4.24281	0.90115	0.45058	31.18909	0.58553	0.29277
3.2	−0.02216	0.87221	0.43610	−0.05691	0.89390	0.44695	1.97494	0.93254	0.46627	28.98500	0.89191	0.44595
			$k_2 = 20.0$			$k_2 = 20.0$			$k_2 = 20.0$			$k_1 = 20.0$
0.1	0.05192	0.03116	0.00156	0.27580	0.02728	0.00136	0.65003	0.01930	0.00096	1.08738	0.00861	0.00043
0.2	0.11209	0.12227	0.00611	0.67115	0.10710	0.00536	1.90693	0.07623	0.00381	3.59448	0.03421	0.00171
0.4	0.08622	0.45504	0.02275	0.84462	0.39919	0.01996	4.13976	0.29072	0.01454	10.30923	0.13365	0.00668
0.8	−0.07351	1.44285	0.07214	0.21951	1.26565	0.06328	6.48948	0.98565	0.04928	26.41442	0.49135	0.02457
1.6	−0.40234	3.37001	0.16850	−1.22411	2.94860	0.14743	6.95639	2.55231	0.12762	57.46409	1.53833	0.07692
3.2	−0.71901	5.10060	0.25503	−3.04320	4.89878	0.24494	6.05854	4.76234	0.23812	99.29034	3.60964	0.18048
			$k_2 = 200.0$			$k_2 = 200.0$			$k_2 = 200.0$			$k_2 = 200.0$
0.1	0.04956	0.04704	0.00024	0.26776	0.03814	0.00019	0.65732	0.02711	0.00014	1.19099	0.01311	0.00007
0.2	0.10066	0.18557	0.00093	0.63873	0.15040	0.00075	1.93764	0.10741	0.00054	4.00968	0.05223	0.00026
0.4	0.04248	0.70524	0.00353	0.71620	0.57046	0.00285	4.26004	0.41459	0.00207	11.96405	0.20551	0.00103
0.8	−0.24071	2.40585	0.01203	−0.28250	1.92636	0.00963	6.94871	1.46947	0.00735	32.97364	0.77584	0.00388
1.6	−1.00743	6.82481	0.03412	−3.09856	5.35936	0.02680	8.55770	4.36521	0.02183	82.77997	2.63962	0.01320
3.2	−2.54264	15.45931	0.07730	−9.18214	12.64318	0.06322	10.63614	10.93570	0.05468	189.37439	7.60287	0.03801