

The figures in the margin indicate full marks.

Symbols used have their usual meaning and interpretation.

Students may use Heat Transfer Data Book

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION-A

There are **FOUR** questions in this section. Answer any **THREE**

1. (a) The outer pipe of a double pipe heat exchanger is 4-in schedule 40 commercial steel. The inside tube is 3 std type M copper. Water at an average temperature of 30°C is flowing in the annulus at a rate of 20 m³/h. Determine the Reynolds numbers of the annular flow for use in hydraulic analysis and heat transfer analysis. (15)
- (b) Air free saturated steam at P = 30 kPa condenses on the outer surface of a 2.5 cm OD, 3-m long vertical tube maintained at constant temperature of 40°C by the flow of the cooling water. Estimate average heat transfer coefficient and the rate of condensate flow at the bottom of the tube. (15)
2. DPHX Rating: Oil is to be heated from 30°C using hot water at 100°C. Oil flow rate is 0.06 kg/s in the annulus, while water flow rate is 0.5 kg/s. The heat exchanger is made of 2 x 1 1/4 std type M copper tubing that is 5.0 m long. Use appropriate fouling factors, rate the DPHX. (30)
3. (a) A heat exchanger is to be designed to cool 9.0 kg/s an engine oil [$C_p = 2100 \text{ J/kg}^\circ\text{C}$] from 90°C to 60°C with cooling water [$C_p = 4200 \text{ J/kg}^\circ\text{C}$] entering the tube side at 30°C at a rate of 4.5 kg/s. Given, $U_o = 500 \text{ W/m}^2^\circ\text{C}$. Estimate heat transfer area, for cross-flow heat exchanger where one fluid is unmixed. (15)
- (b) Saturated water at 75°C with a quality 0.95 and a mass flow rate of 10 kg/s is to be cooled to 30°C with a water flow of 40 kg/s at 20°C. If for liquid water, $h_w = 8000 \text{ W/m}^2\text{K}$, and for condensing vapour, $h_v = 24000 \text{ W/m}^2\text{K}$, estimate the heat transfer surface area. (15)

4. STHX Rating: 20.0 kg/s water at 50°C is to be cooled using 20.0 kg/s water available at 25°C. If (30)
 $N_t = 200$, $N_p = 2$, $L = 5.0$, $N_b = 15$, $B = 304.8$ mm, $D_s = 438.2$ mm, $ID_t = 16.55$ mm, $OD_t = 19.07$ mm. Assume 25.4 mm triangular pitch.

SECTION-B

There are **FOUR** questions in this section. Answer any **THREE**

5. (a) A heat exchanger is designed to extract waste heat from a boiler exhaust. The boiler consumes fuel of 1,00,00,000 taka per year. Manufacturing and installation cost of the heat exchanger would be 15,00,000 taka and expected life of the heat exchanger is 10 years. The heat exchanger would reduce fuel consumption by 5% and 50,000 taka will be required every year for its maintenance. If MARR is 15%, is the heat exchanger an attractive investment? (20)
- (b) To select material for designing a thermal system, what are the issues you need to consider. List them according to their order of importance. (10)
6. (a) What are the benefits of calculating critical thickness of insulation and economic thickness of insulation? (10)
- (b) An Aluminum pot is used to boil water as shown below. The handle of the pot is 30- cm long, 2.5-cm wide, and 0.5-cm thick. The pot is exposed to room air at 15°C, and the convection coefficient is 12 W/m²°C. Can you touch the handle when the water is boiling? (k for aluminum is 237 W/m °C). (20)

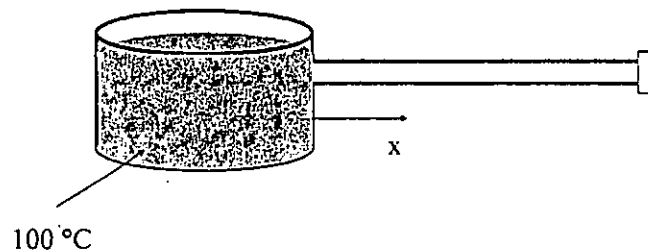


Fig. for Q No. 6(b)

7. (a) A mathematical model is to be developed to simulate a cylindrical resistive heater. For a simple (20)
 model, list the approximations, simplifications and idealizations you would employ to obtain the model. Also derive the expression for temperature distribution for the resistive heater.
- (b) What are the effects of range, approach and fill media in selecting a cooling tower. (10)
8. (a) What are the steps you will take to design a boiler? (10)

- (b) A double-pipe counter-flow heat exchanger is to cool ethylene glycol ($C_p = 2560 \text{ J/kg}\cdot^\circ\text{C}$) (20) flowing at a rate of 3.5 kg/s from 80°C to 40°C by water ($C_p = 4180 \text{ J/kg}\cdot^\circ\text{C}$) that enters at 20°C and leaves at 55°C . The overall heat transfer coefficient based on the inner surface area of the tube is $250 \text{ W/m}^2\cdot^\circ\text{C}$. Determine the rate of heat transfer

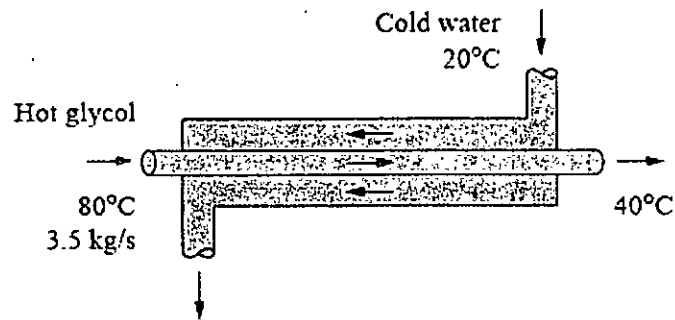


Fig. for Q No. 8 (b)

Appendix-A

1. Temp. distribution equation for fins

Tip Condition	Temp. Distribution
Convection heat transfer: $h\theta(L) = -k(d\theta/dx)_{x=L}$	$\frac{\cosh m(L-x) + (h/mk) \sinh m(L-x)}{\cosh mL + (h/mk) \sinh mL}$
Adiabatic $(d\theta/dx)_{x=L} = 0$	$\frac{\cosh m(L-x)}{\cosh mL}$
Given temperature: $\theta(L) = \theta_L$	$\frac{(\theta_L/\theta_b) \sinh m(L-x) + \sinh m(L-x)}{\sinh mL}$
Infinitely long fin $\theta(L) = 0$	e^{-mx}

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations (January 2020 Term)

Sub: **IPE 381** (Measurement and Quality Control)

Full Marks: 180 Section Marks: 90 Time: 2 Hours (Sections A + B)

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **THREE** questions in this section. Answer any **TWO**.

1. (a) A stereo manufacturing company X buys a specific small electronic part from another company Y. The company Y has claimed that the defective rate of this part of theirs' is 5%. If the inspectors from company X randomly picks 30 items from the shipment from company Y, what is the probability that there will be at least 1 defective item in that shipment from company Y? (9)
- (b) A certain switching device occasionally malfunctions. The device is considered satisfactory, if it makes, on average, no more than 0.20 error per hour. A particular 5-hour period is chosen for the testing of the device. If no more than 1 error occurs during that time period, the device will be considered to be satisfactory. (8+8)
- What is the probability that a satisfactory device will be considered unsatisfactory on the basis of the test? Assume a Poisson process.
 - What is the probability that a device will be accepted as satisfactory when, in fact, the mean number of errors is 0.25? Again, assume a Poisson process exists.
- (c) The average life span of an electrical kettle machine is 6 years, with a standard deviation of 10 month. Assuming that the lives of these machines follow approximately a normal distribution, find (12+8)
- the probability that the mean life of a random sample of 9 such machines falls between 6.4 and 7.2 years.
 - the value of x to the right of which 15% of the means computed from random samples of size 9 would fall.
2. (a) A certain ball bearing manufacturer produces ball bearings of mean dia of 42 mm. The manager of the company is suspecting that a certain defect in a production machinery might have shifted the mean dia. So to confirm his suspicion, he wishes to investigate the current mean dia of the produced bearings. For this purpose, he has taken a random sample of 15 ball bearings and has measured each of their diameter, which are as following (20)

Diameters (mm)	45	40	39	42	41	42	43	38	41	42	40	43	42	41	43
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Based on the managers investigation, is it reasonable to assume that there has been a change in the mean dia of the produced ball bearings, if the level of significance is 0.01?

(b) Mr. Frank, president of a Financial Services, believes there is a relationship between the number of client contacts and the dollar amount of sales. To document this assertion, Mr. Frank gathered the following sample information. In the following data table, the X column indicates the number of client contacts last month, and the Y column shows the value of sales (\$ thousands) last month for each client sampled. (18+7)

Number of contracts, X	Sales in \$ 1000, Y
14	24
12	14
20	28
16	30
46	80
23	30
48	90
50	85
55	120
50	110

- i. Determine the regression equation
 - ii. Determine the estimated sales if 40 contacts are made.
3. A company in Michigan produces cast parts for Ford motor company. For a specific cast part, part no. YM 00381, there could be many types of possible defects that might cause the part to fail under high stress condition. Microscopic fracture, bad surface integrity, surface finish, bubbles etc. defects can cause the part to fail, which can be very dangerous for the car safety and performance integrity. The company uses a number of non-conformities chart for quality control, where 40 parts constitute a single inspection unit. Numbers of non-conformities in last 20 days are as following (17+9 +19)

Sample no.	No. of failures
1	16
2	13
3	9
4	11
5	8
6	10
7	12
8	13
9	27
10	10

Sample no.	No. of failures
11	19
12	12
13	16
14	13
15	12
16	10
17	21
18	13
19	9
20	12

- i. Assuming the company uses a 3 sigma limit, find the control lines and draw the control chart
- ii. If some points are out of control, in the control chart drawn in (a), identify those points and mention why do you think they are out of control.
- iii. If in a certain month, the obtained mean number of non-conformities for the company is 15.6, calculate the probability of type 1 and type 2 error for the control chart for that company on that month.

SECTION – B

There are **THREE** questions in this section. Answer any **TWO**.

4. (a) What are the four principles that administer the applications of optics in linear and angular measurement? (10)
- (b) What do you understand by composite method of gear checking? Describe the working principle of Parkinson Gear Tester with neat sketch. (15)
- (c) Effective diameter of a screw thread can be measured using two wire method (Figure 4(c)) as $E_d = T + P$, where T = Dimension under the wires and M = Dimension over the wires. (20)
 - i. If the angle of thread is 45° , derive the expression for P value as a function of pitch p and wire diameter d .
 - ii. Calculate the P value when pitch of the screw is 3.2 mm and wire diameter is 2.05 mm.

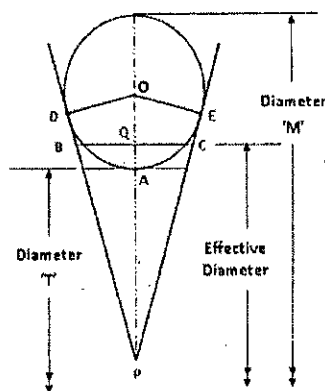


Figure 4(c)

5. (a) What are the functions of secondary lock which is situated at the top of one of the primary legs of Transfer calipers? (5)
- (b) Symbol depicted in Figure 5(b) is used in traditional engineering drawing to represent the information regarding surface finish. Write the name and significance of A, B, C, D and E of the following figure. (10)

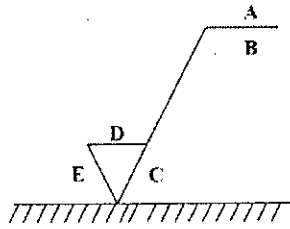
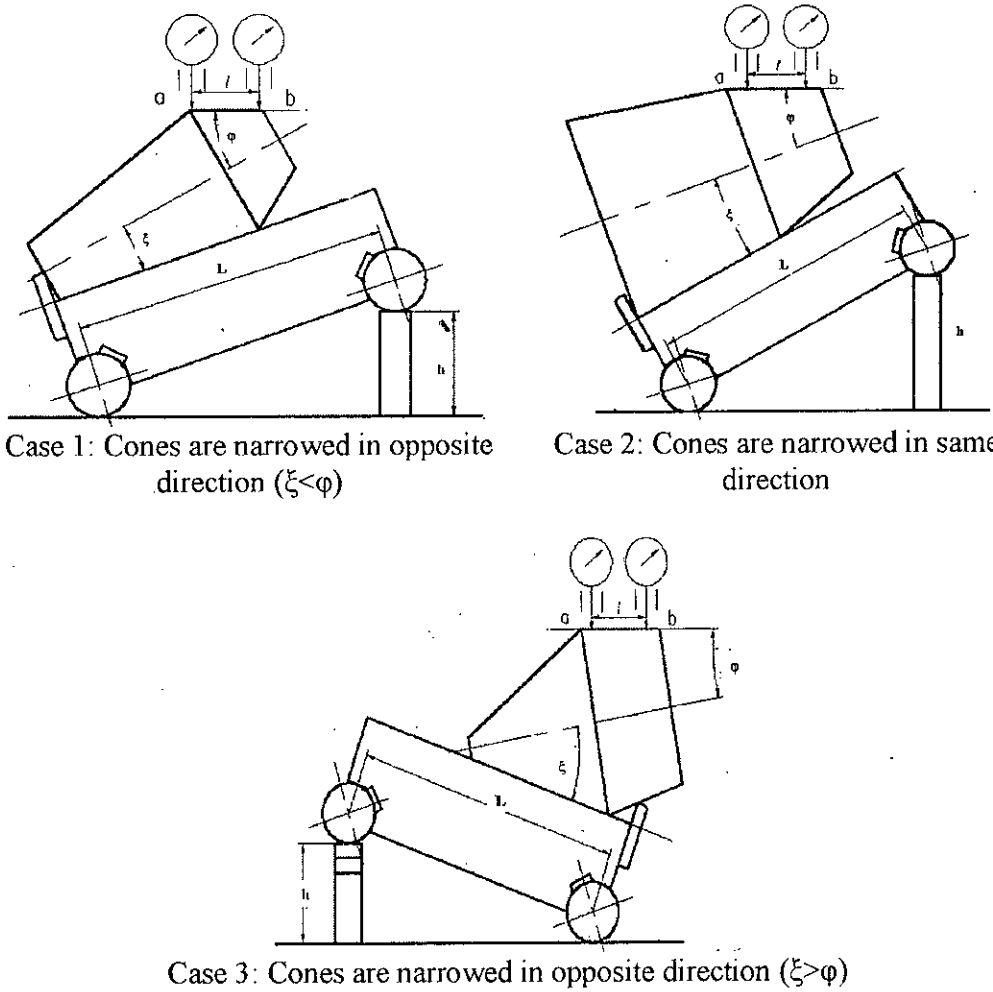


Figure 5(b)

(c) Three practical cases of angle measurement using sine bar in conjunction with slip gauge blocks are shown in Figure 5(c). Derive the equations of block gauge height h as a function of L , ξ and ϕ for each of the three cases, where ξ and ϕ carry meanings as indicated in the Figure. (30)



Case 1: Cones are narrowed in opposite direction ($\xi < \phi$)

Case 2: Cones are narrowed in same direction

Case 3: Cones are narrowed in opposite direction ($\xi > \phi$)

Figure 5(c)

6. (a) Discuss Type I error and Type II error. (10)
- (b) What are the main distinguishing characteristics of Total Quality Management (TQM)? Mention the name of seven basic tools of TQM. (15)
- (c) Schematic of different levels of bias and accompanying dispersion of results is depicted in Figure 6(c). Briefly explain Method bias, Run bias, and Laboratory bias using cited figure, where Accepted Reference Value (ARV) is the result obtained with zero bias. (20)

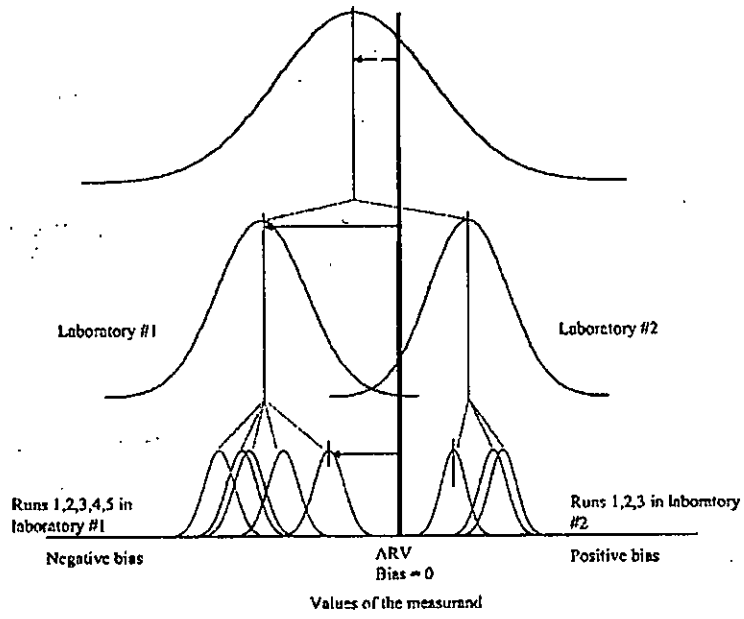
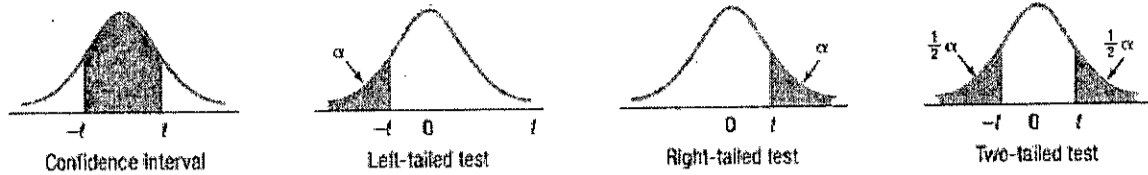


Figure 6(c)

Table: Student's t Distribution



		Confidence Intervals, c					
		80%	90%	95%	98%	99%	99.9%
df	Level of Significance for One-Tailed Test, α						
	0.10	0.05	0.025	0.01	0.005	0.0005	
	Level of Significance for Two-Tailed Test, α						
	0.20	0.10	0.05	0.02	0.01	0.001	
1	3.078	6.314	12.706	31.821	63.657	636.619	
2	1.886	2.920	4.303	6.985	9.925	31.598	
3	1.638	2.353	3.182	4.541	5.841	12.924	
4	1.533	2.132	2.776	3.747	4.604	8.610	
5	1.476	2.015	2.571	3.365	4.032	6.869	
6	1.440	1.943	2.447	3.143	3.707	5.959	
7	1.415	1.895	2.365	2.998	3.499	5.408	
8	1.397	1.860	2.306	2.896	3.355	5.041	
9	1.383	1.833	2.262	2.821	3.250	4.781	
10	1.372	1.812	2.228	2.764	3.169	4.587	
11	1.363	1.796	2.201	2.718	3.106	4.437	
12	1.356	1.782	2.179	2.681	3.055	4.318	
13	1.350	1.771	2.160	2.650	3.012	4.221	
14	1.345	1.761	2.145	2.624	2.977	4.140	
15	1.341	1.753	2.131	2.602	2.947	4.073	
16	1.337	1.746	2.120	2.583	2.921	4.015	
17	1.333	1.740	2.110	2.567	2.898	3.965	
18	1.330	1.734	2.101	2.552	2.878	3.922	
19	1.328	1.729	2.093	2.539	2.861	3.883	
20	1.325	1.725	2.086	2.528	2.845	3.850	
21	1.323	1.721	2.080	2.518	2.831	3.819	

		Confidence Intervals, c					
		80%	90%	95%	98%	99%	99.9%
df	Level of Significance for One-Tailed Test, α						
	0.10	0.05	0.025	0.01	0.005	0.0005	
	Level of Significance for Two-Tailed Test, α						
	0.20	0.10	0.05	0.02	0.01	0.001	
36	1.306	1.688	2.028	2.434	2.719	3.582	
37	1.305	1.687	2.025	2.431	2.715	3.574	
38	1.304	1.686	2.024	2.429	2.712	3.566	
39	1.304	1.685	2.023	2.426	2.708	3.558	
40	1.303	1.684	2.021	2.423	2.704	3.551	
41	1.303	1.683	2.020	2.421	2.701	3.544	
42	1.302	1.682	2.018	2.418	2.698	3.538	
43	1.302	1.681	2.017	2.416	2.695	3.532	
44	1.301	1.680	2.015	2.414	2.692	3.526	
45	1.301	1.679	2.014	2.412	2.690	3.520	
46	1.300	1.679	2.013	2.410	2.687	3.515	
47	1.300	1.678	2.012	2.408	2.685	3.510	
48	1.299	1.677	2.011	2.407	2.682	3.505	
49	1.299	1.677	2.010	2.405	2.680	3.500	
50	1.299	1.676	2.009	2.403	2.678	3.496	
51	1.298	1.675	2.008	2.402	2.676	3.492	
52	1.298	1.675	2.007	2.400	2.674	3.488	
53	1.298	1.674	2.006	2.399	2.672	3.484	
54	1.297	1.674	2.005	2.397	2.670	3.480	
55	1.297	1.673	2.004	2.396	2.668	3.476	
56	1.297	1.673	2.003	2.395	2.667	3.473	

Table: Areas under the Normal Curve

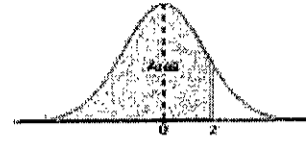


Table A.3 Areas under the Normal Curve

<i>z</i>	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
-3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
-3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
-3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
-3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
-3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
-2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
-2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
-2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
-2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
-2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
-2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
-2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
-2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
-2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
-2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
-1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
-1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
-1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
-1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
-1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
-1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
-1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
-1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
-1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
-1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
-0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
-0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
-0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
-0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
-0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
-0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
-0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
-0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
-0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
-0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B.Sc. Engineering Examination- January 2020

Sub: **HUM 201** (Sociology)

Full Marks: 180

Time 2 Hours

The Figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

There are 2 page(s) in this question paper.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) What is social inequality? Explain caste system and class system of social stratification with examples. (15)
(b) Explain different types of social mobility. (15)
2. (a) Write down the properties of absolute poverty and relative poverty. (15)
(b) Explain 'feminization of poverty' with suitable examples. (15)
3. (a) 'Ethnocentrism is a habit to judge other ways of life by the standards of our own group'- explain. (15)
(b) What do you understand by social norms? Explain different types of social norms. (15)
4. Write short notes on any **THREE** of the following: (30)
 - (a) Functionalist perspective.
 - (b) Sub culture and counter culture.
 - (c) Looking glass-self theory of socialization.
 - (d) Agents of socialization.

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Define environment and pollution. Explain global warming. (15)
(b) Briefly discuss the relationship between physical environment and social environment. (15)
6. (a) Write down the important characteristics of capitalism. (15)
(b) Describe the social consequences of industrial revolution. (15)
7. (a) Discuss how the technological developments have changed our social and family life. (15)
(b) Explain the various stages of demographic transition theory. (15)
8. Write short notes on any **THREE** the following: (30)
(a) Functions of the family.
(b) Push-pull factor of migration.
(c) The sources of social change.
(d) The 4 Rs.

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T2 B.Sc. Engineering Examinations- January 2020

Sub: **HUM 203** (Government)

Full Marks: 180

Time 2 Hours

The Figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

There are 02 (Two) pages in this question paper.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Make a brief discussion on the increasing factors of internationalism. (15)
(b) Explain the safeguards of citizen rights. (15)
2. (a) What are the different types of sovereignty? (15)
(b) Briefly examine the strengths of parliamentary government. (15)
3. (a) Write an analytical note on the rule of law. (15)
(b) Briefly describe the functions of the Legislature in a state. (15)
4. (a) Classify democratic types of government with examples. (15)
(b) Analyze the constraints of good governance in developing countries. (15)

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Discuss major amendments of the constitution of Bangladesh. (15)
(b) Write the functions of local government in Bangladesh. (15)
6. (a) Discuss briefly Max Weber's ideal type of bureaucracy. (15)
(b) Write an essay on Public Service Commission (PSC) of Bangladesh. (15)

7. (a) Write a note on the political system of UK. (15)
(b) Describe the determinants of the foreign policy of Bangladesh. (15)
8. (a) What are the conditions for the success of democracy? (15)
(b) Briefly discuss the disadvantages of dictatorship. (15)