BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2   B. Sc. Engineering Examinations 2017-2018

Sub: **MATH 139** (Differential Equations and Statistics)

Full Marks: 210   Time: 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks

SECTION – A

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

Symbols have their usual meaning.

1. (a) A small metal bar, initial temperature of 20 °C, is dropped into a large container of boiling water. How long will it take the bar to reach 90 °C if it is known that its temperature increases 2° in 1 second? How long will it take the bar to reach 98°C?   **(11)**

    (b) Solve   **(12)**
    $$\frac{dP}{dt} + 2tP = P + 4t - 2.$$

    (c) Solve the Bernoulli's equation: **(12)**
    $$x^2 \frac{dy}{dx} - 2xy = 3y^4, \ y(1) = \frac{1}{2}.$$

2. (a) Determine whether the given differential equation is exact. Hence solve it.   **(11)**
    $$\left(2y \sin x \cos x - y + 2y^2 e^{xy^2}\right)dx = \left(x - \sin^2 x - 4xy e^{xy^2}\right)dy$$

    (b) Solve $xdy - ydx = \sqrt{(x^2 + y^2)}dx$.   **(12)**

    (c) Determine the general solution of   **(12)**
    $$y'' - 9y' + 14y = 3x^2 - 5\sin 2x + 7xe^{6x}.$$

3. (a) Solve the following Initial Value Problem: **(11)**
    $$y'' + y = \sqrt{2} \sin \sqrt{2} t, \ y(0) = 10, y'(0) = 0.$$

    (b) Solve $\dfrac{d^2 y}{dx^2} - 4\dfrac{dy}{dx} + 4y = \left(12x^2 - 6x\right)e^{2x}.$ **(12)**

    (c) Transform the following Cauchy-Euler equation   **(12)**
    $$x^2 \frac{d^2 y}{dx^2} - 4x \frac{dy}{dx} + 6y = \ln x^2$$
    to a differential equation with constant coefficients and hence solve it.

4. (a) Form a partial differential equation by eliminating the functions f, g from   **(11)**
    $$y = f(z) + g(x).$$

    (b) Find the integral surface of the partial differential equation   **(12)**
    $$(y - x)p + (x - z - y)q = z$$
    passing through the circle $z = 1, x^2 + y^2 = 1.$

    (c) Find the complete integral of $z = px + qy + 3p^{\frac{1}{3}}q^{\frac{1}{3}}$ using Charpit's method.   **(12)**

MATH 139

SECTION - B

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

5. Solve the following:

(a) $\left(x^2 D_x^2 - 4xy D_x D_y + 4y^2 D_y^2 + 6y D_y\right)z = x^3 y^4$. **(12)**

(b) $\left(2D_x - 3D_y + 1\right)\left(4D_x + 2D_y - 3\right)z = e^{x-2y}x^2 y^2$. **(12)**

(c) $\left(D_x^2 - D_x D_y + D_y - 1\right)z = \cos(x + 2y) + e^y$. **(11)**

6. (a) Eight students were asked to indicate how many hours they had studied before taking their statistics examination. Their responses were then matched with their grades on the exam, which had a maximum score of 100. **(20)**

Hours, X	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25
Scores, Y	57	64	59	68	74	76	79	83

(i) Find the regression equation that will predict a student's score if we know how many hours the student has studied.

(ii) Also comment on the correlation of the above mentioned data. If a student has studied 0.25 hours, what is his predicted score?

(b) Let A, G and H be the Arithmetic mean, Geometric mean and Harmonic mean, respectively, of n positive numbers. Show that $A \geq G \geq H$. **(15)**

7. (a) Following are the runs obtained by two players A and B in 10 innings of a cricket game: **(17)**

Test number	1	2	3	4	5	6	7	8	9	10
Runs obtained by A	55	75	78	49	52	76	85	56	62	46
Runs obtained by B	51	71	59	52	73	69	77	64	59	85

Compute: (i) Pearson's coefficient of skewness and Bowley's coefficient of skewness and comment on the shape of the runs obtained by B only.

(ii) If the consistency of performance is the criterion for awarding a prize, who should get the prize?

(b) In testing a certain kind of truck tire a rugged terrain, it is found that 15% of the trucks fail to complete the test run without a blowout. Of the next 16 trucks tested, find the probability using (both binominal and Posisson distribution) that **(18)**

(i) from 3 to 6 have blowouts;

(ii) fewer than 4 have blowouts;

(iii) more than 6 have blowouts.

MATH 139

8. (a) An electrical system consists of 4 components as shown in the following figure. The system works if the components A and D work and either of the components B or C work. The reliability (the probability of working) of each component is also shown in the following figure. Find the probability that (i) the entire system works, (ii) the component C does not work, given that the entire system works. Assume that the 4 components work independently.

(10)
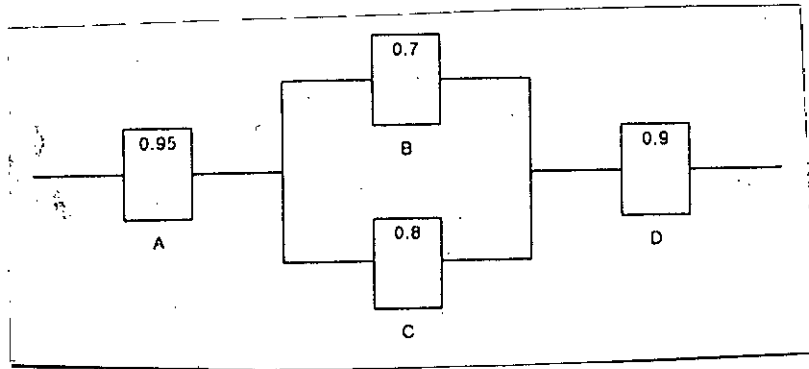
(b) The NAT company claims that the NAT brand USB drive has an average life of 5000 hours with a standard deviation of 45 hours. To test this claim, 49 new USB drives were tested. The average life of NAT brand USB drive was found to be 4850 hours. Does this indicate that NAT brand USB drive is of inferior quality? Use a 5% level of significance.

(10)

(c) The mark in a test is assumed to be normally distributed. It is known that 20% of the students have marks under 35 and 25% exceed 80, what percentage of students have marks between 70 and 90? (Necessary chart is attached).
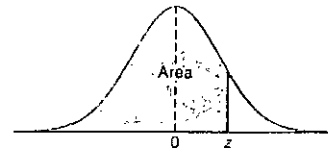
(15)

Table A.3 Areas under the Normal Curve

z	.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

Chart for Q. no. 8(c)

(4)
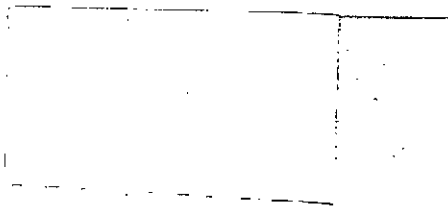
Table A.3 (continued) Areas under the Normal Curve

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2   B. Sc. Engineering Examinations 2017-2018

Sub: **PHY 151** (Structure of Matter, Electricity and Magnetism & Modern Physics)

Full Marks: 210   Time: 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks

SECTION – A

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

1. (a) What do you mean by the flux of an electric field?   **(5)**

    (b) State and explain Gauss's law in electrostatics and use it to deduce coulomb's law.   **(10)**

    (c) What is Gaussian surface? Applying Gauss's law show that electric field at a point

    due to an infinite line of charge with uniform charge density λ is $E = \dfrac{\lambda}{2\pi\varepsilon_0 r}$,   **(14)**

    where 'r' is the perpendicular distance from the line of charge to the point.

    (d) A thin-walled metal sphere has a radius of 25 cm and carries a charge of 2.0×10^{-7}C.

    Find $\overline{E}$ for a point (i) inside the sphere, (ii) just outside the sphere, and (iii) 3.0 meters

    from the centre of the sphere.   **(6)**

2. (a) What are dielectrics? Distinguish between polar and non-polar dielectrics with

    examples.   **(7)**

    (b) Define dielectric constant of a material and explain its physical significance.   **(5)**

    (c) Show that the capacitance of a parallel plate capacitor with a compound dielectric is **(18)**

    $$C = \frac{k\varepsilon_0 A}{t + k(d - t)}$$

    where k is the dielectric constant of the slab, ε_0 is the permittivity of air, t is the

    thickness of the slab and d is the separation between the plates.

    (d) A capacitor is charged through a potential difference of 200 V, when 0.1 C charge

    is stored in it. How much energy will it release, when it is discharged?   **(5)**

3. (a) What do you mean by the drift velocity of an electron?   **(4)**

    (b) Obtain a relation between current density and drift velocity of electrons in a

    conductor.   **(8)**

    (c) Write down the circuit equation for a series L-R circuit. Derive an expression for

    the growth of current when a source of constant *emf* is connected to an L-R circuit in

    series.   **(16)**

    (d) Explain the hysteresis curve of a ferromagnetic material. What is the significance of

    the area of the hysteresis loop?   **(7)**

PHY 151

4. (a) Show that the density of nuclear matter is independent of mass number. Obtain an estimate of the nuclear density. **(10)**

   (b) Sketch the curve of the binding energy per nucleon for the most stable nucleus against the corresponding mass number and discuss its nature. What information can you obtain from this curve? **(17)**

   (c) A piece of wood weighs 50 grams and shows ^{14}C activity of 320 disintegrations per minute. Estimate the length of time which has elapsed since this piece of wood was part of a living tree. Assume that a living plant shows a ^{14}C activity of 12 disintegrations per minute per gram. Half life of ^{14}C is 5730 yrs. **(8)**

SECTION - B

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

5. (a) What do you mean by simultaneity? With a suitable example show that simultaneity is a relative concept. **(8)**

   (b) Derive an expression for the relativistic kinetic energy of a particle and also obtain an expression relativistic energy (E) of a particle having rest mass m_0 and relativistic momentum (P). **(19)**

   (c) The elementary particle known as the positive kion (k^+) has, on average, a lifetime of 0.1237 μs when stationary, that is, when the lifetime is measured in the rest frame of the kion. If positive kion with a speed of 0.99c relative to a laboratory reference frame are produced, how for can they travel in that frame during their lifetime? **(8)**

6. (a) Explain the phenomenon of photoelectric effect. **(8)**

   (b) Discuss the experimental observations of photoelectric effect which could not be explained by classical theory. Establish Einstein's equation of photoelectric effect. **(19)**

   (c) A certain metal has a threshold wavelength of 6000 Å. Find the stopping potential when the metal is irradiated with **(8)**

   (i) monochromatic light of wavelength 4000 Å.

   (ii) light having twice the intensity and frequency.

PHY 151

7. (a) Draw a typical unit cell for NaCl crystal. Describe its crystal structure. Calculate packing factor for this crystal if radius of Cl and Na ions are 0.187 and 0.097 nm, respectively. Is there any deviation of the values of packing factor for NaCl and an ideal FCC crystal? If so why? **(15)**

    (b) What are Miller indices? What is interplaner distance? Derive a relationship between Miller indices and interplaner distance in terms of unit cell edge lengths for a typical crystal. **(15)**

    (c) Given that the radius of lead (Pb) atom is 0.1750 nm. Calculate (i) d_{1101} (ii) d_{111} and (iii) d_{100}. **(5)**

8. (a) Briefly describe various types of bonds in solids. **(10)**

    (b) Define the terms 'cation' and 'anion'. What is an ionic bond? Distinguish between lattice energy and cohesive energy of an ionic crystal. Derive an expression for lattice energy for a typical ionic crystal. **(20)**

    (c) The ionization energy of the potassium is 4.34 eV and the electron affinity of chlorine is 3.61 eV. The Madelung constant for the KCl structure is 1.748 and the distance between ions of opposite sign is 0.314 nm. If n = 9, calculate cohesive energy for KCl crystal. **(5)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA
L-1/T-2   B. Sc. Engineering Examinations 2017-2018
Sub: HUM 185 (English)
Full Marks: 140   Time: 3 Hours
USE SEPARATE SCRIPTS FOR EACH SECTION
The figures in the margin indicate full marks

SECTION – A
There are **FOUR** questions in this section. Answer Q. No. 1 and any **TWO** from the rest.

1.   (a) Explain with reference to the context any <u>one</u> of the following: **(8)**

   (i) The geniuses of all ages and of all lands speak different languages, but the same flame burns in them all.

   (ii) "Isn't life," she stammered, "isn't life–" But what life was she couldn't explain.

(b) Answer any <u>one</u> of the following: **(10)**

   (i) How did Chekhov depict two different perceptions of the ultimate meaning of life in "The Bet"? Elucidate.

   (ii) Do you think "The Diamond Necklace" is a cynical story? Why or why not? Explain.

(c) Answer any <u>three</u> of the following: **(12)**

   (i) Why did the lawyer renounce the two million rubles?

   (ii) What does the diamond necklace symbolize?

   (iii) What did Laura realize after seeing Mr. Scott's dead body?

   (iv) Why did the Banker feel contempt for himself?

   (v) Comment on the character of Mr. Loisel.

2.   Recast and correct any <u>ten</u> of the following sentences: **(20)**

   (i) They are leaving to England soon.

   (ii) She has no difficulty to do it.

   (iii) The reason is because I believe it.

   (iv) Joe hasn't come also.

   (v) We made a walk along the river.

   (vi) Hundred years make a century.

   (vii) I asked him for some paper and he gave me.

   (viii) Never I have heard of such a thing.

   (ix) I am persuaded of Robin's innocence.

   (x) A sandstorm dusted our cloths.

   (xi) The ship drowned in the ocean.

   (xii) Oliver cares about his brother's investments.

3.   Give the meanings of and make sentences with any <u>ten</u> of the following words: **(20)**
Bucolic, Charlatan, Sojourn, Transcendent, Ulterior, Vernacular, Hamartia, Suffragist, Relic, Misdemeanour, Polyglot, Accolade.

HUM 185

4. Write a précis of the following passage with a suitable title: **(20)**

    Aestheticism can be defined broadly as the elevation of taste and the pursuit of beauty as chief principles in art and in life. In the context of British literature there is considerable controversy about when and where aestheticism occurs; but a line can be traced from the art criticism of John Ruskin in the 1850s, through the artists and writers of the Pre-Raphaelite movement and the writings of Walter Pater, to the works of Oscar Wilde and the flowering of decadent poetry of the 1890s. The movement drew upon the formula of "art for art's sake" – articulated most memorably by the French novelist Théophile Gautier in his 1836 preface to Mademoiselle de Maupin. Gautier was one of a number of French writers and artists of the period who argued that art should be evaluated with reference to its own criteria. In aestheticism the subjective view of beauty becomes the primary means of judging value: when considering whether a poem or a painting is good, aestheticism merely asks if it is beautiful or meaningful as a work of art in itself. This forms a stark contrast to the long-standing custom of judging art and literature either on the basis of the moral lessons it might teach to readers or viewers (its social usefulness) or in terms of its correspondence to real life (its realism). It is this refusal to acknowledge the primacy of morality within art that made aestheticism such a controversial movement from the mid 19th century onward: its proponents were the subjects of vituperative attacks from mainstream writers and critics and were consistently satirized throughout this period. The category of aestheticism is a notoriously slippery one and can overlap with and encompass the categories of decadence, symbolism, and early modernism.

SECTION - B

There are **FOUR** questions in this section. Answer any **THREE** including Q. No. 5 as compulsory.

5. Read the following passage carefully and answer the questions that follow: **(30)**

    Whenever I remember my grandmother, I see myself tip-toeing around her in afternoons at our stretched veranda of Jafrabad, flooded with orange-coloured lights of the dying sun. She would sit in the south-east corner of it while crushing her post-lunch betel leaves and areca nuts in a stone curved mortar with gentle thuds of the pestle that would leave the mild smell of elderly people around that corner that always made me feel home.

HUM 185

In one of my earliest autumns, she taught me how to make a garland of 'Sheulies' without a thread, "you can just press the orange stem of one flower and insert it to the centre of the petals of another!" Soon, in late-autumn, when huge 'Marigolds' flooded our alley, she taught me how to make a whole garland out of a single flower --- by weaving the petals of the mature marigolds without a thread. I remember, she never threw away the flowers I picked. She would spread them on a mat braided out of coconut leaves just beside the pickle jars in our rooftop for a week. She, then, made small sachets of cotton cloths and filled them with the sun-dried petals along with some 'Kalijeera' rice and hung them in the dark corner of her bedroom. She called them potpourri. The smell of the once picked flower was no longer overwhelming, yet was strong enough to tickle the nose whenever a sudden gust of wind would ruffle the scented sachets.

The memories of the elderly people of the family are just like the potpourris my grandmother used to hang. We offer forget with how much care and fondness, they had put our childhood together. Let some strong gusts of wind ruffle our memories too, so that the smell of betel leaves and crushed areca nuts find their way, once in while. Amen.

Questions:

(i) Give an appropriate title with justification.

(ii) Give the meanings of the following words:

Tip-toeing, braided, stretched veranda, overwhelming, tickle

(iii) The passage ends with 'amen' which suggests that it is a prayer. What is the author praying about?

(iv) Why do you think the grandmother made potpourri?

(v) Describe the process of making potpourri.

(vi) What does the author associate the smell of betel leaf with?

6. (a) Write a letter to your supplier, complaining against the supply of dented baby-food containers for your general store. (Provide necessary details from your own). **(10)**

(b) Write phonetic transcription of the following words: (any five) **(10)**

measure, jazz, executive, think, about, boat.

7. (a) Write a dialogue between two students about the Ekushey Book Fair. **(10)**

(b) Write a short composition on <u>one</u> of the following topics: **(10)**

(i) Metro Rail Project in Bangladesh

(ii) Brain Drain

(iii) Fake News

HUM 185

8.   (a) Transform any five of the following sentences as directed   **(10)**

(i) He pleaded for his innocence. (Complex)

(ii) I know where he was born (Simple)

(iii) If you do it, you will be punished. (Compound)

(iv) He was sincere, and so he gained prominence. (Simple)

(v) Work hard or, you will fail. (Complex)

(vi) In spite of my annoyance, I kept quiet. (Compound)

     (b) Write short notes on any <u>two</u> of the following: **(10)**

(i) Triphthongs

(ii) Parts of a Paragraph

(iii) Components of Back Matter of a Report.

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2   B. Sc. Engineering Examinations 2017-2018

Sub : **EEE 165** (Basic Electrical Technology)

Full Marks: 210   Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

The symbols have their usual meanings.

1.   (a) For the circuit shown in Fig. for Q.1 (a), determine the total circuit resistance seen by the source and the source current I_s.   **(15)**
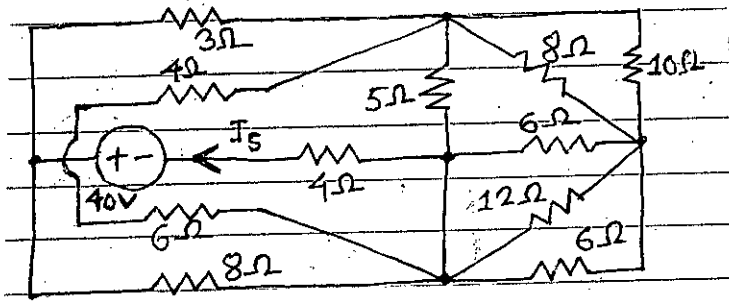
Fig. for Q. 1(a)

   (b) Using mesh analysis, calculate the current i_z of the circuit shown in Fig. for Q. 1(b).   **(20)**
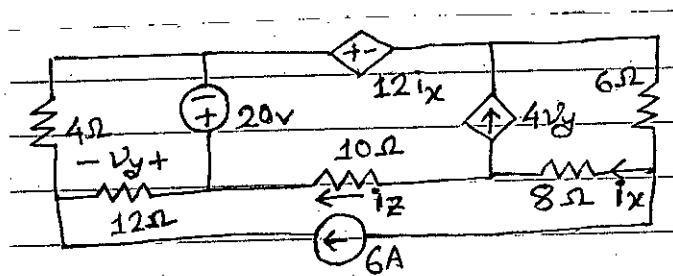
Fig. for Q. 1(b)

2.   (a) Determine the value of R_L that will draw maximum power from the rest of the circuit shown in Fig. for Q. 2(a). Also, calculate the maximum power.   **(20)**
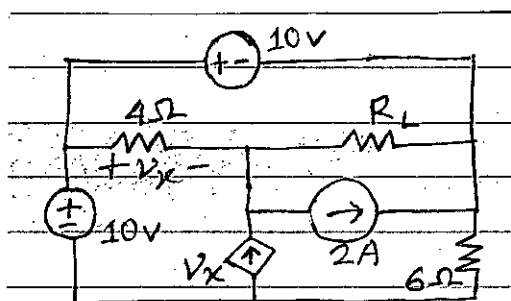
Fig. for Q. 2(a)

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<u>Contd... Q. No. 2</u>

(b) The circuit shown in Fig. for Q. 2(b) has three inputs: v_1, i_2 and v_3. The output of the circuit is the voltage v_0, which is related to the inputs by **(15)**

$$v_0 = av_1 + bi_2 + cv_3,$$

where a, b, and c are constants. Determine the values of a, b, and c by using source transformation in the circuit.
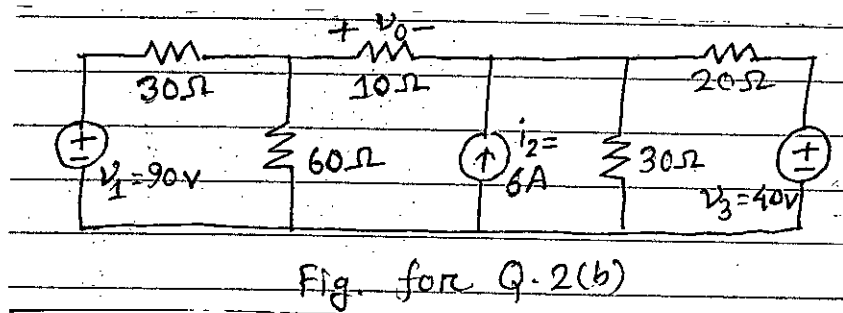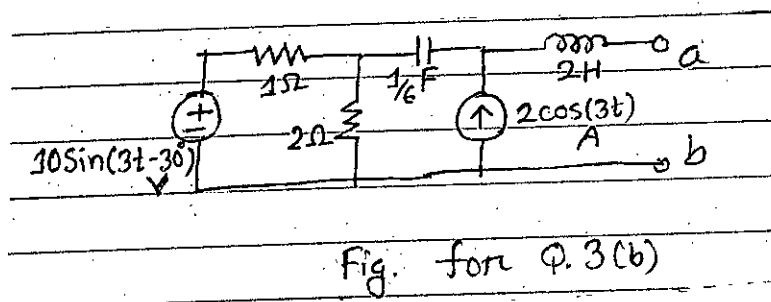
Fig. for Q. 2(b)

3. (a) Using the superposition principle, determine the voltage $v_0(t)$ for the circuit shown in Fig. for Q. 3(a). **(18)**
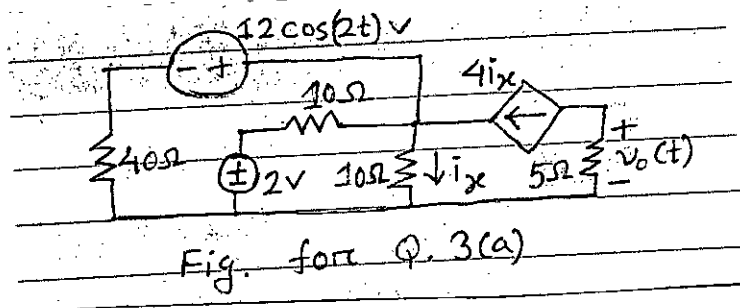
Fig. for Q. 3(a)

(b) For the circuit shown in Fig. for Q. 3(b)., find the Thevenin equivalent between terminals a and b. **(17)**
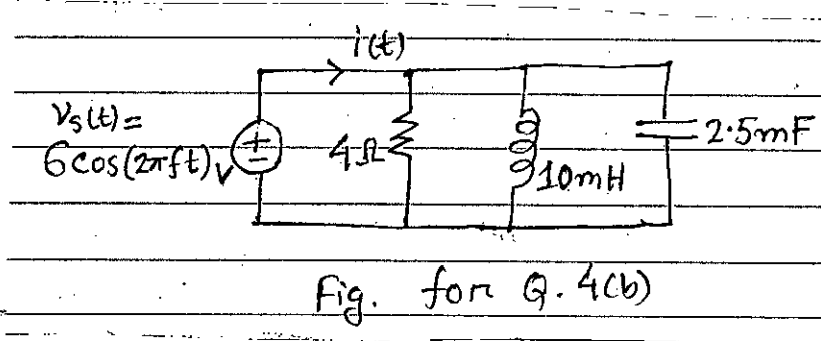
Fig. for Q. 3(b)

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4. Find the value of the impedance Z in the circuit shown in Fig. for Q. 4(a) if $V_g = 100-j50$ V, $I_g = 20+j30$ A, $V_1 = 40+j30$ V. **(18)**
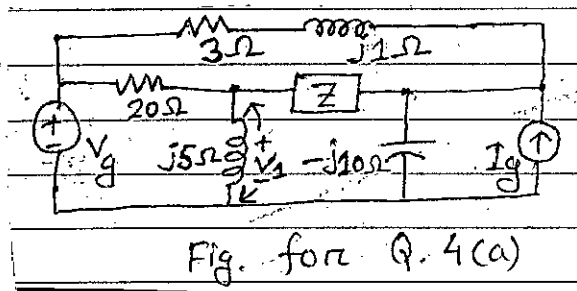
Fig. for Q. 4(a)

(b) For the circuit shown in Fig. for Q. 4(b), determine the value of operating frequency f for which the current i(t) lags the voltage $v_s(t)$ by 45°. **(17)**

Fig. for Q. 4(b)

SECTION - B

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

5. (a) Draw the Phasor diagram of a series RLC Circuit and Using phasor approach, determine c(t) of the following equation : **(15)**

$$\frac{d^3 i}{dt^3} + 3\frac{di}{dt} - 5i + 4\int i\,dt = 20\sin(10t + 20°)$$

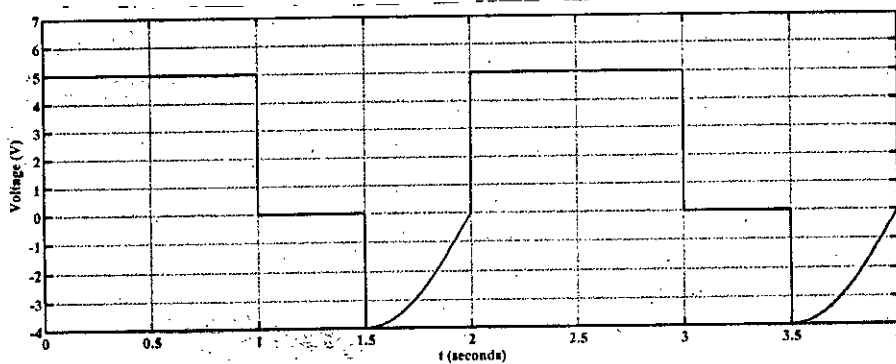(b) Find the effective voltage of the Figure given for Question No. 5(b) **(15)**

Fig. for Question No. 5(b)

(c) What is the difference between a static and a rotating magnetic field? **(5)**

6. (a) Draw the conduit layout and the corresponding Switch Board Diagram for the Fitting and Fixtures layout for Q. No. 6(a). **(20)**
Draw the conduit layout on the provided fitting and fixtures layout and attach it with the answer script. For switch board diagram, draw it on the main answer script.

(b) Define Voltage Regulation **(3)**

(c) Draw the Torque-speed characteristics of an induction motor and identify-starting torque, pullout torque, full load torque. Write four comments on it. What is plugging? Also show the effect of changing rotor resistance on Torque-speed characteristics. **(12)**

7. (a) Let in the low tension side of an ideal transformer, 10V dc is given as input. Turns ratio is 10. What is the output voltage in the high tension side? **(5)**

(b) Draw phasor diagrams of transformer operating at unity, lagging and leading power factor. · **(12)**

(c) A 1-kVA. 230/115-V, 60-Hz distribution transformer is tested with the following results: **(18)**

Open-circuit test	Short-circuit test
$I_{oc} = 0.11A$	$V_{sc} = 19.1V$, $I_{sc} = 8.7A$
$P_{oc} = 3.9W$	$P_{sc} = 42.3W$

(i) Find the equivalent circuit for this transformer referred to low voltage side.
(ii) Find the voltage regulation at the rated conditions and 0.8 PF lagging.
(iii) Find the efficiency at the rated conditions and 0.8 PF lagging.

8. (a) Draw the power flow diagram of an Induction motor. **(5)**

(b) Show that for power distribution, the three-phase system uses a lesser amount of wire than the single-phase system for the same line voltage and the same absorbed power. **(12)**

(c) Assume that the two balanced loads in Fig. for Question No. 8(c) are supplied by an 840V rms 60-Hz line. Load 1 is Y-connected with $30 + j40$ Ω per phase, while load 2 is a balanced three-phase motor drawing 48kW at a power factor of 0.8 lagging. Assuming the *abc* sequence, calculate: **(18)**

(i) the complex power absorbed by the combined load,
(ii) the kVAR rating of each of the three capacitors Δ-connected in parallel with the load to raise the power of factor to unity,
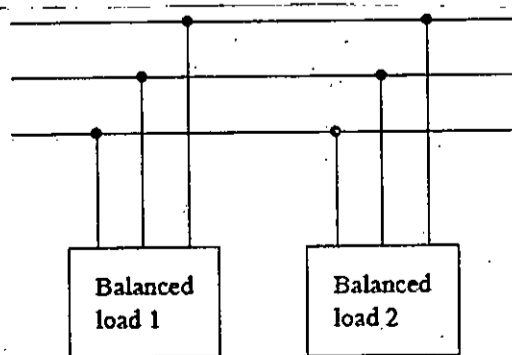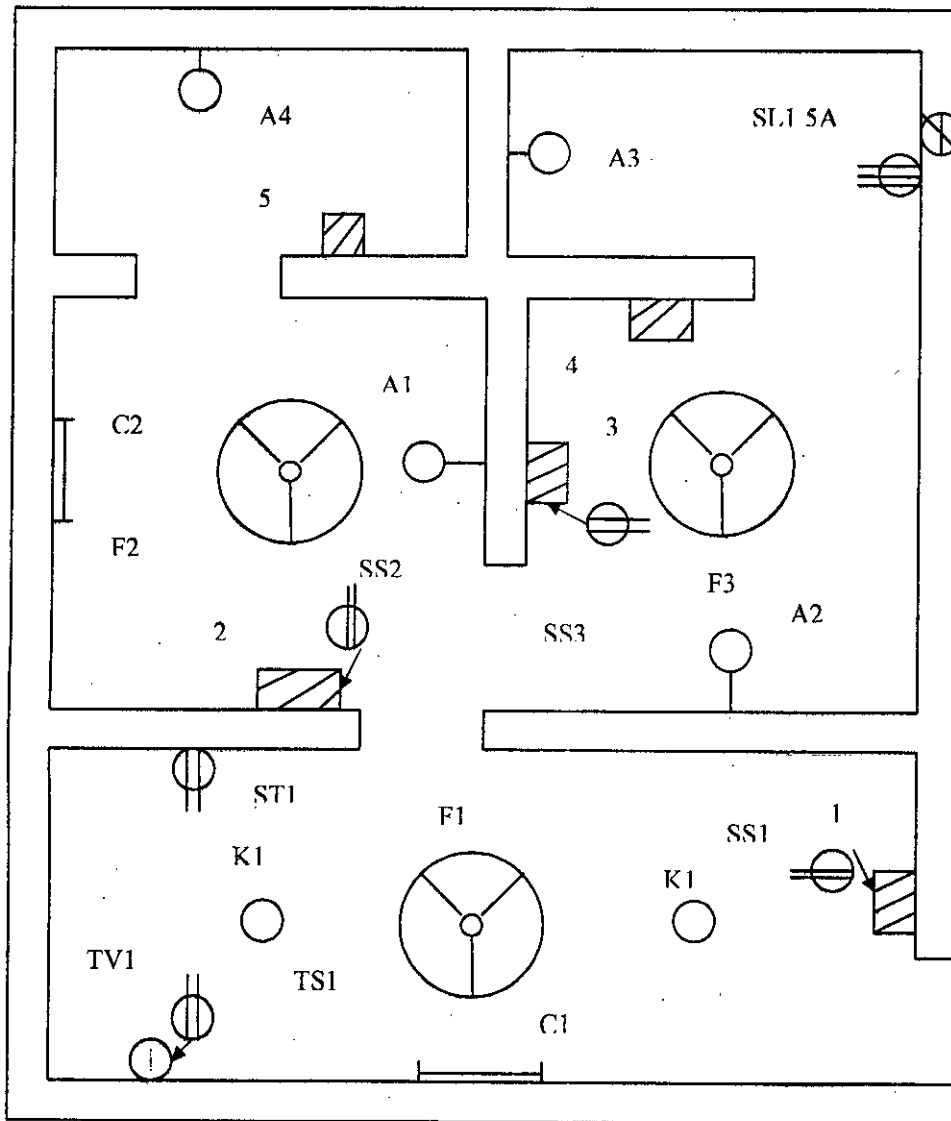(iii) the current drawn from the supply at unity power factor condition.

Fig. for Question No. 8(c)

Fittings and Fixtures layout for Question No. 6(a)

A4

5

SL1 5A

A3

A1

4

C2

3

F2

F3 A2

SS2

2 SS3

ST1

F1

SS1 1

K1

TV1 K1

TS1

C1

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2   B. Sc. Engineering Examinations 2017-2018

Sub : **CE 103** (Surveying)

Full Marks: 280   Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

1.   (a) Discuss some of the possible reasons that may be responsible for errors in tacheometric surveys. $(6\frac{2}{3})$

(b) The table below displays the field data for a tacheometric survey using a tacheometer fitted with an anallactic lens for a vertically held staff.   **(22)**

Instrument station	Height of instrument (meter)	Staff station	Vertical angle	Staff Readings
O	1.45	B	(-)5° 30'	1.75, 1.95, 2.15
O	1.45	P	9° 30'	1.50, 1.65, 1.80
P	1.3	Q	12° 00'	1.89, 2.05, 2.21

Calculate the horizontal distances OP, OB and PQ. Also, calculate the elevations of Q, P and O if the elevation of B is 500 meter.

Assume reasonable values for the tacheometric constants.

$$\left[D = ks\cos^2\theta + C\cos\theta;\ V = ks\frac{\sin 2\theta}{2} + C\sin\theta\right]$$

(c) For Figure 1, show the whole process of levelling in a level book. Use rise and fall method.   **(18)**

2.   (a) Explain the term super-elevation of roadways. Express the fundamental requirement of a transition curve. $(6\frac{2}{3})$

(b) Determine the length of a transition curve for a 4 lane rural highway with the following available information-   **(15)**

(i) Width of a single lane = 4 meter.

(ii) Design Speed = 70 km/hr.

(iii) $e_{max} = 0.07$; $f_{max} = 0.12$

(c) Discuss the factors influencing location and configuration of the alignment of a horizontal curve.   **(10)**

(d) A parabolic vertical curve is to be set out connecting two uniform grades of +2.0% and -3.5%. Chainage and reduced level of the point of vertical curve (PVC) are 1250 meters and 32.5 meters respectively. The rate of vertical curvature (k) is 20. Calculate the chainage and reduced levels of PVI and midpoint of the curve.   **(15)**

3.   (a) Discuss the effects of curvature and refraction on levelling and explain how to obtain the corrected readings. $(9\frac{2}{3})$

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SECTION - B

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

Assume reasonable value for any missing data (only.

5. (a) Calculate the earthquake for an embankment using the following data: **(18)**

Chainage (m)	0	30	60
Ground Level (m)	6.2	9.4	12.4
Formation Level (m)	10.4	10.4	10.4

Formation level width = 25m, Side Slope = 2 horizontal to 1 vertical. Ground is level across the embankment width.

(b) What do you mean by curvature correction for volume computation? How would you apply curvature correction for curved embankment with end cross-section A_1 and A_2. **(10⅔)**

(c) A tower is located on a hilltop at T. Angular readings are taken with a theodolite from two instrumentation stations A and B, which are 50 m apart. Given the following data, determine the R.L. of hilltop at T and the tower height. Height of instrument (R.L. of instrumental centre) = 10 m. Vertical angles from A to the top and bottom of the tower at T is 35° and 28° (upward) respectively. Whole circle bearing of line AT, AB and BT is 25°, 110°, 5° respectively. **(18)**

6. (a) Determine the shortest distance travelling from X (120° W, 20° N) to Y (40° E, 10°S) on the surface of earth. **(12)**

[Given: $cos\ c = cos\ C\ sin\ a\ sin\ b + cos\ a\ cos\ b$]

(b) Distinguish between (answer any two), show figures where necessary: **(6×2=12)**

    (i) Standard Time and Mean Solar Time

    (ii) Azimuth and Whole Circle Bearing

    (iii) Apparent Solar Day and Mean Solar Day

(c) With neat sketch, describe the independent coordinate system used in star catalogues. **(6⅔)**

(d) The altitude of the sun's lower limb at local apparent moon was measured to be 40°45′30″. Apply all necessary astronomical corrections to determine the corrected altitude of the sun. Hence, determine the latitude of the place of observation. Nautical Almanac gives the following information for the time of observation: **(16)**

Declination of sun = 5°30′ N, semi-diameter of sun = 16′0″, Horizontal parallax of sun = 8.8″.

7. (a) Determine the volume of landfill with best accuracy to raise the ground in Fig. 2 to an elevation of 12 m. The R.L. (m) at corner points of square grids is given Fig. 2 **(10)**

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(b) Define closing error of a closed traverse. Describe the graphical method of balancing the closing error. Present neat sketches. $(9\frac{2}{3})$

(c) Describe the basic principles of determining the position of an object in global positioning system (GPS) using neat sketches. Give a list of applications of remote sensing in civil engineering. **(11)**

(d) In conducting a traverse survey, length of line BC and bearing of EA is missing. Determine the missing data. **(16)**

Line	Length (m)	Bearing
AB	282.2	61°30′
BC	Missing	151°24′
CD	324.7	201°2′
DE	381.6	280°14′
EA	210.6	Missing

8. (a) With neat sketches, describe briefly the process of reciprocal ranging during chaining. $(8\frac{2}{3})$

(b) Differentiate between direct and indirect methods of contouring. Draw typical contours of an overhanging cliff, a hill, a vertical cliff. **(5+9)**

(c) Write short notes on: (i) check line (ii) reconnaissance survey (iii) conditions to be fulfilled by the main stations and survey lines during chain survey. **(3+4+5)**

(d) The length of a survey line AB was measured with a 30 m chain in two segments due to different slope at 25°C by applying a pull of 150 N. The length of the two segments are 165 m and 240 m, the gradient of the first segment is 1:12 and slope of the second segment is 3°. Determine the horizontal distance AB, if the chain was standardized at 20°C with a pull of 100 N. The cross-sectional area of the chain is 5 mm^2, co-efficient of thermal expansion of the chain material is 12×10^{-6}/°C and $E = 2 \times 10^5$ N/ mm^2. **(12)**

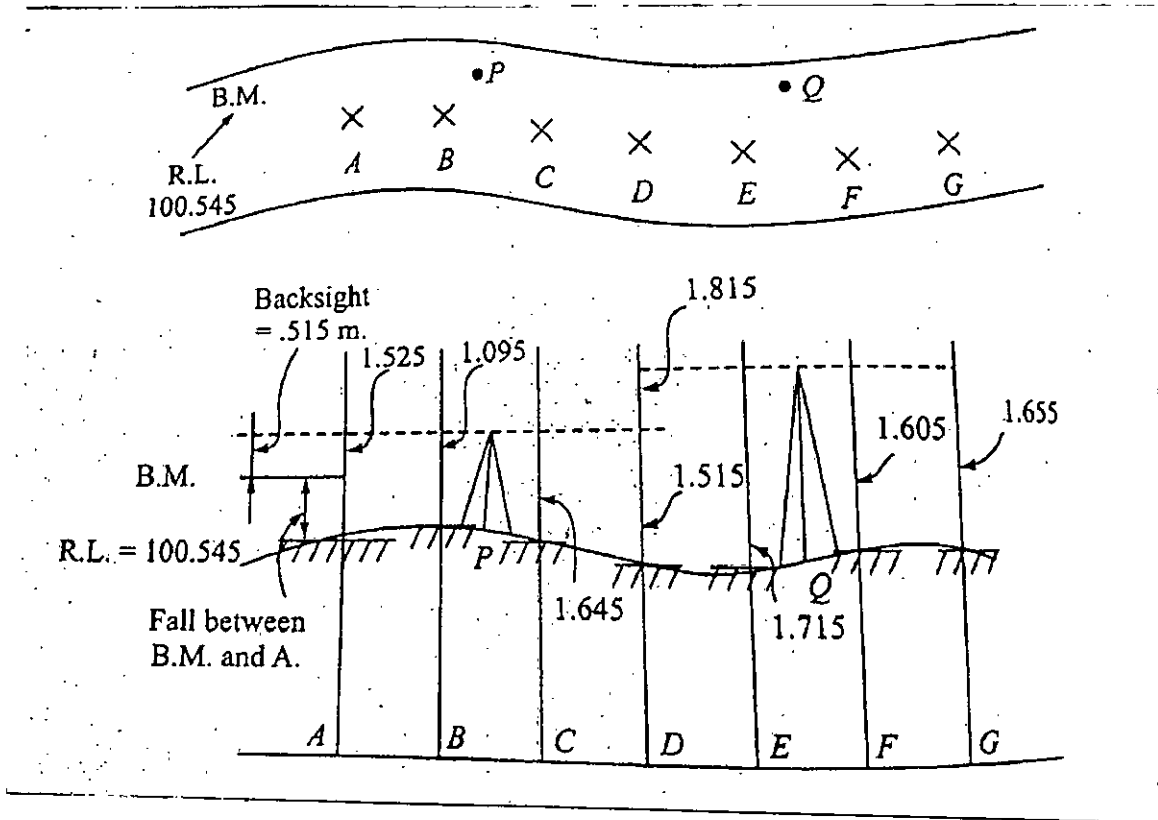--
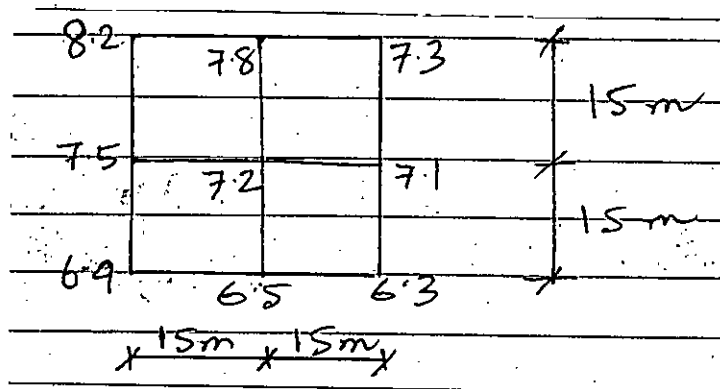
Fig. 1 for Question 1 (c)

Fig. 2: plan View for Question 7(a)

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Contd... Q. No. 3

(b) Illustrate the following-   **(9)**

(i) Reciprocal levelling;

(ii) Barometric levelling:

(iii) Trigonometric levelling.

(c) A page of an old level book had been damaged by white ants and the readings "?" are missing. Compute the missing readings with the help of available readings and arithmetic check.   **(20)**

Distance (in m)	Back-Sight	Inter-sight	Fore-sight	Height of instrument	R.L	Remarks
	?			?	209.510	B.M
0		1.675			?	
30		?			210.425	
60		3.355			209.080	
?	0.840		?	209.52	?	Changing point
120		?			208.275	
150		?			210.635	Underside of bridge girder
?	?		2.630	?	?	?
210		?			206.040	
240		1.920			205.895	
270			?		205.690	

(d) Sketch typical contour maps of the following-   **(8)**

(i) Pond, (ii) River, (iii) Valley line, (iv) Ridge line

4.   (a) Describe with neat sketches the general steps involved in a typical house setting project.   **(10)**

(b) Explain relief displacement? Why the relief displacement of the point vertically below the exposure station is zero?   **($6\frac{2}{3}$)**

(c) The ground length of a line AB is known to be 44227 m. The scale of the object A and B are 1.46×10^{-5} and 1.57×10^{-5} respectively. On a vertical photograph taken with a camera includes the images A and B of these points and their photographic co-ordinates are: (x_a = +200 mm, y_a = +150 mm, x_b = -320 mm, y_b = ??). Estimate the y_b co-ordinates.   **(15)**

(d) Photographs of a certain area were taken from A and B (two camera stations) 130 m apart. The focal length of the camera was 100 mm. The whole circle bearing angles of the camera axis for station A and B were 50° and 290°. The line joining AB had a whole circle forward bearing of 110°. The image of a point C appears 20.2 mm to the right and 16.4 mm above the hair lines on the photograph taken at station A and 35.2 mm to the left on the photograph taken at B. Calculate the distance AC and BC. If the elevation of point C is 131.820 m, find the elevation of the instrument axis at A.   **(15)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1   B.Sc. Engineering Examinations 2017-2018

Sub : **CHEM 103** (Chemistry - I)

Full Marks: 210   Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

1. (a) Derive an equation for the energy of an electron in the n th orbit of Hydrogen atom.   **(10)**

   (b) Explain the significance of each quantum number. How are they related to each other?   **(6)**

   (c) Explain Heisenberg's uncertainty principle. Calculate the uncertainty in position (ΔX) of an electron, if ΔV is 0.1 percent. Take velocity of electron = 2.2×10^6 m/s, mass of electron = 9.1×10^{-31} Kg and h = 6.6×10^{-34} J.s. Comment on the result.   **(3+5)**

   (d) Derive the Schrodinger wave equation. Discuss the meaning and significance of ψ and ψ^2 with reference to this equation.   **(8+3)**

2. (a) How does molecular orbital theory (MOT) differ from valence-bond theory (VBT)?   **(6)**

   (b) Sketch the cross sections of the shapes of each of the bonding and antibonding molecular orbitals: (i) σ_{2p} (ii) σ^*_{2p} (iii) π_{2p} (iv) π^*_{2p}.   **(8)**

   (c) Draw the molecular orbit energy level diagram of Nitric oxide, NO. Calculate the bond order of NO and NO^+, and predict the magnetic property of them.   **(5+4+4)**

   (d) Write the important uses of Halogen elements.   **(8)**

3. (a) Discuss the mechanism of dissolution of sodium chloride in water.   **(8)**

   (b) What is Henry's law? Write a mathematical expression for Henry's law using mass, volume and mole fraction of dissolved gas.   **(10)**

   (c) Explain the following terms: (i) Ideal solution (ii) Salting out effect (iii) Critical Solution Temperature (CST).   **(9)**

   (d) An aqueous solution containing 10.0 g of sodium hydroxide and 90.0 g of water has a density of 1.12 kg/dm^3. Find (i) w/v % of NaOH, (ii) Molality, (iii) Mole fraction and (iv) Molarity of NaOH.   **(8)**

4. (a) What are colligative properties? Thermodynamically prove that the lowering of freezing point of a solvent produced by a dissolved non-volatile substance is proportional to molality of the substance in the solution.   **(3+9)**

   (b) Derive a relation between the osmotic pressure and vapor pressure of dilute solution.   **(8)**

   (c) A 1.50 g sample of an unknown compound was dissolved in 35.0 g of camphor. The freezing point of the solution was 164.4°C. The freezing point of pure camphor is 178.4°C and its molal freezing point constant is 40.0°C/m. Calculate the molar mass of the unknown substance.   **(8)**

   (d) Define enthalpy change for a system. Derive a relation between enthalpy and internal energy of a system.   **(3+4)**

CHEM 103/CE

SECTION - B

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

5. (a) What is retarder? Why is it essential ingredient of Portland cement? Give an example of a retarder. **(2+5+1=8)**

    (b) Discuss the chemical changes that occur in different sections of rotary kiln. **(12)**

    (c) Write down the important process parameters for manufacturing of a good cement clinker. **(6)**

    (d) Write short notes on any three: (i) sulphate resisting cement (ii) white cement (iii) pozzolana cement (iv) expansive cement (v) fly ash. **(9)**

6. (a) Define micelle. How shampoo can clean the dandruff? **(2+5=7)**

    (b) How does a sol differ from a gel? Explain. **(6)**

    (c) What is zeta potential? What is the effect of electrolyte concentration on zeta potential? **(3+5=8)**

    (d) What is Emulsion? Discuss the role played by an emulsifier in the process of emulsification. Describe briefly Bredig's Arc method for preparation of colloids. **(2+5+7=14)**

7. (a) How does the common ion effect influence solubility equilibria? Use Le Châtelier's principle to predict the solubility of $CaCO_3$ in a Na_2CO_3 solution. **(6+3=9)**

    (b) What is a buffer solution? Which of the following solutions can act as a buffer? (i) $NaClO_4/HClO_4$, (ii) $KHSO_4/H_2SO_4$, (iii) Na_2HPO_4/NaH_2PO_4, (iv) KNO_2/HNO_2, (v) KCN/HCN. Give reason of your answer. **(2+5=7)**

    (c) You are asked to prepare a buffer solution at pH = 8.60, using one of the following weak acids: HA ($Ka = 2.7 \times 10^{-3}$), HB ($Ka = 4.4 \times 10^{-6}$), HC ($Ka = 2.6 \times 10^{-9}$). Which acid should you choose? Why? **(4)**

    (d) A solution contains 0.020 M Cl^- ions and 0.020 M Br^- ions. To separate the Cl^- ions from the Br^- ions, solid $AgNO_3$ is slowly added to the solution without changing the volume. What concentration of Ag^+ ions (in mol/L) is needed to precipitate as much AgBr ($K_{sp} = 7.7 \times 10^{-13}$) as possible without precipitating AgCl ($K_{sp} = 1.6 \times 10^{-10}$)? **(10)**

    (e) What do you mean by diffusion of a colloidal solution? Write down the expression of Fick's first law. **(3+2=5)**

8. (a) What is zeolite? Discuss the principle of softening hard water using zeolite process. Mention the role of brine in zeolite process. **(2+6+2=10)**

    (b) What do you mean by coagulation of water? Write down the complex ions formed during the hydrolysis of aluminum sulphate at different pH. **(2+6=8)**

    (c) What is available chlorine in Bleaching powder? How water can be sterilized by bleaching powder method? Mention the disadvantages of this method. **(2+6+3=11)**

    (d) What do you mean by gold number? "The gold number of gelatine is 0.005 but starch is 25" – comment on their protective action of sols. **(2+4=6)**