

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

1. (a) Write down the important considerations for the reconnaissance survey and the necessary precautions for chain survey. **(5+5=10)**
- (b) 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. **(5+5=10)**
- (c) The scale of aerial photography is  $1 \text{ cm} = 100 \text{ m}$ . The photograph size is  $20 \text{ cm} \times 20 \text{ cm}$ . Determine the number of photographs required to cover an area of  $8 \text{ km} \times 12.5 \text{ km}$ . If the longitudinal lap is 60% and the lateral lap is 30%. **(10)**
- (d) A 50 m tape of standard length has a weight of  $0.05 \text{ kg/m}$ , with a cross-sectional area of  $0.04 \text{ cm}^2$ . It has an E of  $2.10 \times 10 \text{ kg/cm}^2$ . The tape is of standard length under a pull of 5.5 kg when supported throughout its length and a temperature of  $20^\circ\text{C}$ . A distance between two points was measured with this tape and recorded to be 458.65 m. At the time of measurement, the pull applied was 8 kg with the tape supported only at its endpoints and the temperature observed was  $18^\circ\text{C}$ . Assuming coefficient of thermal expansion of the tape is  $0.0000116/\text{ }^\circ\text{C}$ . Compute the true length of the measured line AB due to the combined effects of temperature, tension, and sag. **(16/3)**
2. (a) The vertical photograph of a flat area having an average elevation of 250 m above mean sea level was taken with a camera having a length of 20 cm. A section line AB (Figure 1), 250 m long in the area, measures 8.50 cm in the photograph. A tower TB in the area also appears in the photograph. The distance between the images of the top and bottom of the tower measures 0.46 cm in the photograph. The distance of the image of the top of the tower is 6.46 cm. Determine the height of the tower. **(10)**

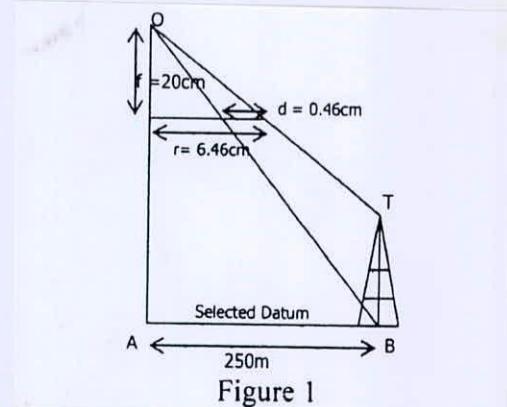


Figure 1

**CE 103/CE**

**Contd.... for Q. No. 2**

(b) Describe three methods with figures to erect a perpendicular line from a point on a chain line. (10)

(c) The following data shows the elevation difference between two points. (10)

Trial No.	Difference in Elevation
1	120.00
2	121.00
3	119.00
4	120.50

Determine:

- (i) The most probable difference in elevation
- (ii) The standard deviation
- (iii) Probable Error of Single Observation
- (iv) The standard error
- (v) The probable error of the mean

(d) Photographs of a certain area were taken from A and B, two camera stations 100 m apart. The focal length of the camera is 150 mm. The axis of the camera makes an angle of  $60^\circ$  and  $40^\circ$  with the baseline at stations A and B, respectively. The image of point C appears 20.2 mm to the right and 16.4 mm above the hair lines on the photograph taken at A and 35.2 mm to the left on the photograph taken at B. Calculate the distance AC and BC and elevation of point C if the elevation of the instrument axis at A is 126.845 m. (16  $\frac{2}{3}$ )

3. (a) The altitude of a known star its upper transit is measured to be  $30^\circ 15'$  on the south side of Zenith. Apply necessary astronomical corrections (if applicable) to obtain the corrected altitude. Hence, determine the latitude of the place of observation. The declination of the star is  $12^\circ$  S. Is this star a circumpolar star? Present a neat sketch of the problem. (16)

(b) A 60 m long road having side hill two level section, has a formation level width of 15 m and side slopes of 1V:2H. The original ground surface has a cross-slope of 1V:5H. Calculate the volume of earthwork. The following data is available: (16  $\frac{2}{3}$ )

Chainage (m)	Ground level at centre line (m)	Formation level (m)
0	12.4	12
30	12.6	12
60	13	12

Given:  $Area\ of\ Cut = \left\{ \frac{(0.5b + rh)^2}{r - s} \right\}$

$Area\ of\ Fill = \left\{ \frac{(0.5b - rh)^2}{r - s} \right\}$

**CE 103/CE**

**Contd.... for Q. No. 3**

(c) Write short notes (with neat sketch when applicable) on the following: **(7×2=14)**

- (i) Mean Solar Time and Standard Time
- (ii) Right Ascension of sun and its variation.

4. (a) Derive an expression for Prismoidal Correction for two-level section. Present neat sketch of the problem. **(15)**

Given: Area for two-level section = 
$$\left[ \frac{r^2bh + s(0.5b)^2 + r^2sh^2}{r^2 - s^2} \right].$$

(b) Describe the method (with neat sketches) you used in your class assignment to determine area of part of Bangladesh. Discuss the accuracy of your method and the challenges you faced. **(10 2/3)**

(c) When do you apply curvature correction for volume computation? What will be the curvature correction for a curved embankment having two end cross-sections with areas  $A_1$  and  $A_2$  at a distance  $L$  (along centre-line) apart. Present neat sketches. **(8)**

(d) Briefly describe in words the procedure how you can determine the direction of north pole using measured observations of a celestial object. What astronomical data you need? You don't need to present any equations or figure. **(8)**

(e) Define diurnal circle. Draw diurnal circle as may be observed at the South Pole. **(5)**

**SECTION – B**

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

5. (a) The following figures were extracted from a level book while performing profile levelling. Calculate the reduced levels of the stations using the Height of Instrument method. Perform the necessary checks. **(22)**

Plot the profile in a plane graph paper.

<b>Station</b>	<b>Chainage (m)</b>	<b>B.S. (m)</b>	<b>I.S. (m)</b>	<b>F.S. (m)</b>	<b>R.L. (m)</b>
B.M.		1.02			20
1	0		1.35		
2	20		1.24		
3	40		1.48		
4	60		1.37		
5	80		1.01		
T.P.		2.72		1.54	
6	100		2.66		
7	125		2.42		
8	150		2.38		
9	175		2.59		
10	200			2.98	

**CE 103/CE**

**Contd.... for Q. No. 5**

(b) Describe 5 characteristics of contours. (10  $\frac{2}{3}$ )

(c) The following bearings were observed while traversing with a compass. Only station D is free from local attraction. Station C must be adjusted by adding 10' and station A must be adjusted by subtracting 25' from the erroneous readings. Determine the correct bearings. Also, determine the missing values in the table. (14)

Line	Fore Bearing	Back Bearing
AB	240°5'	59°55'
BC	?	110°15'
CD	?	245°55'
DA	145°40'	?

6. (a) A building has a window 50' above the ground. There is a lighthouse close to this building. The angle of elevation and depression of the top and bottom of this lighthouse from the window are 45° and 21°2.25' respectively. From the top of the lighthouse, a ship is observed with an angle of depression of 10°. Calculate the distance of the ship from the lighthouse. Assume, the ship, the bottom of the building, and the bottom of the lighthouse are at the same horizontal plane. (15)
- (b) The survey data of the traverse ABCDA is given below. The length and bearing of the side BC were not recorded during the survey. Calculate the length and bearing of the line BC. (14)

Line	Length (m)	Bearing
AB	180	130°
BC	?	?
CD	210	340°
DA	240	210°

(c) The elevations of certain points of a land are shown in Figure 6c. Draw contour lines of the elevations 10m, 11m, 12m, 13m, 14m, and 15m in the Figure. Remove the sheet with the Figure from the question paper and attach it with the answer script. (17  $\frac{2}{3}$ )

7. (a) Describe the function of a transition curve. (6  $\frac{2}{3}$ )
- (b) Determine the factors influencing the location and configuration of the alignment of a horizontal curve. (10)
- (c) Calculate the polar deflection angle and X-Y coordinates for setting out a transition curve in the field using the following data: length of transition curve = 60 m, radius of circular curve = 250 m, and number of chords = 6. (12)

CE 103/CE

Contd.... for Q. No. 7

(d) A tacheometer was set up at station A, and the readings on a vertically held staff at B were 1.255, 1.605, and 1.955, the line of sight being at an inclination of  $8^{\circ}24'$ . Another observation on the vertically held staff at B.M. gave the readings 0.640, 0.920, and 1.200, the inclination of the line of sight being  $1^{\circ}6'$ . Estimate the horizontal distance between A and B, and the elevation of B, if the R.L. of B.M., is 518.685 meters. The constants of the instruments were 100 and 0.3.

(18)

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

8. (a) Explain the term "super-elevation" of roadway. (3  $\frac{2}{3}$ )  
(b) Write the difference between the fixed hair method and the subtense method of the stadia survey. (9)  
(c) Derive the equation of an ideal transition curve and hence show that spiral angle,

(14)

$$\Delta_s = \frac{L}{2R}$$

(d) An equal tangent crest vertical curve is to be set out connecting two uniform grades of +1.5% and -3.5%. The chainage and reduced level of the point of vertical curve (PVC) are 1670 meters and 30 meters, respectively. The rate of vertical curvature, k is 35. Calculate the chainage and reduced levels of PVI and PVT and mid-point of the curve. Note: k is the length of the curve per percent algebraic difference in intersecting grades.

(20)

= 6 =       

**Figure 6c (To be attached with the answer script)**

14.335	14.724	14.603	15.338	15.831
13.405	13.512	13.312	14.334	15.045
12.505	12.684	12.409	13.245	13.823
11.687	11.835	11.387	12.575	12.988
10.541	10.653	9.899	11.285	11.032

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

1. (a) Develop the differential equation of which  $y = A \sin 2x + B \cos 2x + x \sin 2x$  is a solution. Identify the order and degree of the differential equation. (11)  
 (b) Solve the problem  $(2x - 5y)dx + (4x - y)dy = 0$ ,  $y(1) = 6$ . (12)  
 (c) Define linear differential equation. Solve the following differential equation (12)

$$x(x^2 - 1) \frac{dy}{dx} + (2x^2 - 1)y = ax.$$

2. (a) A large tank initially contains 60 gallons of pure water. Brine containing 2 pounds of dissolved salt per gallon flows into the tank at the rate of 5 gal/min. The mixture is kept uniform by stirring and the well-stirred mixture simultaneously flows out of the tank at the same rate. (12)  
 (i) Formulate the corresponding ordinary differential equation from the above data.  
 (ii) How much salt is in the tank at any time  $t$ ?  
 (b) Test whether the differential equation  $(y^4 + 2y)dx + (xy^3 + 2y^4 - 4x)dy = 0$  is exact or not. If not then find an integrating factor of the form  $f(y)$  and hence solve the resulting exact equation. (13)  
 (c) Solve:  $x^2 \left( \frac{dy}{dx} \right)^2 + 3xy \frac{dy}{dx} + 2y^2 = 0$ . (10)

3. (a) Find the particular solution of the following differential equation: (11)

$$\frac{d^2y}{dx^2} - 4 \frac{dy}{dx} + 4y = \cos 2x, \text{ given that } y = 1/8 \text{ and } \frac{dy}{dx} = 4 \text{ when } x = 0.$$

- (b) Find the general solution of the following higher order differential equation: (12)

$$\frac{d^2y}{dx^2} + 4y = x \sin 2x.$$

- (c) Reduce the differential equation  $x^2 \frac{d^2y}{dx^2} - x \frac{dy}{dx} + 4y = x^2 \cos(\log x)$  into linear form

with constant coefficients and then solve. (12)

**MATH 139/CE**

4. (a) Define arbitrary function with example. Form a partial differential equation by eliminating the arbitrary functions  $f$  and  $h$  from  $z = f(x^2 - y) + h(x^2 + y)$ . (12)  
(b) Apply Lagrange's method to solve  $2y(z-3)p + (2x-z)q = y(2x-3)$ . (10)  
(c) Using Charpit's method find the complete integral and singular integral (if exists) of the following partial differential equation: (13)

$$yzp^2 - q = 0$$

**SECTION – B**

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

5. Solve the following:
- (a)  $(12D_x^2 - 5D_x D_y - 3D_y^2)z = y^2 \sin(x - 3y)$  (11)  
(b)  $(D_x^2 - 3D_x + 3D_y - D_y^2)z = 2xy - 3e^{2x-3y}$  (12)  
(c)  $(x^2 D_x^2 - xy D_x D_y - 2y^2 D_y^2 + x D_x - 2y D_y)z = \ln(\sqrt{x})$ . (12)
6. (a) Fifteen 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. (15)

Hours, X	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75
Scores, Y	57	64	59	68	74	76	79	83	85	86

- (i) Find the regression equation that will predict a student's score if we know how many hours the students have 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) Define Poisson process and derive the mean and variance of the frequency function for the Poisson distribution. (8)
- (c) In a certain city district, the need for money to buy drugs is stated as the reason for 45% of all thefts. Find the probability (using both binomial and Poisson Distribution) that among the next 10 theft cases reported in this district,(12)
- (i) exactly 3 resulted from the need for money to buy drugs;  
(ii) at most 5 resulted from the need for money to buy drugs.

**MATH 139/CE**

7. (a) The following distribution is with regard to weight in grams of mangoes of a given variety. If mangoes of weight less than 445 grams be considered unsuitable for foreign market, what is the percentage of total yield suitable for it? Assume the given frequency distribution to be typical of the variety:

(20)

Weight in grams	No. of mangoes	Weight in grams	No. of mangoes
410–419	10	450–459	45
420–429	20	460–469	18
430–439	42	470–479	7
440–449	54		

Draw an ogive of 'more than' type of the above data and deduce how many mangoes will be more than 445 grams.

- (b) A certain machine makes electrical resistors having a mean resistance of 44 ohms and a standard deviation of 3 ohms. Assuming that the resistance follows a normal distribution and can be measured to any degree of accuracy, what percentage of resistors will have a resistance exceeding 47 ohms? Also find the percentage of resistances exceeding 47 ohms if resistance is measured to the nearest ohm. (Necessary chart 1 is attached).

(15)

8. (a) Suppose that the measured voltage in a certain electric circuit has a normal distribution with mean 120 and standard deviation 4. If 3 independent measurements of the voltage are made, what is the possibility that all three measurements will lie between 115 and 124? (Necessary chart 1 is attached)

(10)

- (b) One bag contains 5 white balls and 4 black balls, and a second bag contains 4 white balls and 3 black balls. One ball is drawn from the first bag and placed unseen in the second bag. What is the probability that a ball now drawn from the second bag is white?

(15)

- (c) The mean monthly sale of the ACS bats was 154.2 per store. After an advertising campaign, the mean sale in 29 stores for a typical month increased to 159.3 and showed a standard deviation of 11.7. Was the advertising successful? Use a 1% level of significance. (Necessary chart 2 is attached)

(10)

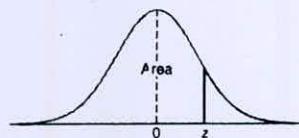


Table A.3 Areas under the Normal Curve

<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

Chart 1 for Q.7 and Q.8

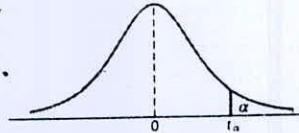


Table A.4 Critical Values of the  $t$ -Distribution

$v$	$\alpha$						
	0.40	0.30	0.20	0.15	0.10	0.05	0.025
1	0.325	0.727	1.376	1.963	3.078	6.314	12.706
2	0.289	0.617	1.061	1.386	1.886	2.920	4.303
3	0.277	0.584	0.978	1.250	1.638	2.353	3.182
4	0.271	0.569	0.941	1.190	1.533	2.132	2.776
5	0.267	0.559	0.920	1.156	1.476	2.015	2.571
6	0.265	0.553	0.906	1.134	1.440	1.943	2.447
7	0.263	0.549	0.896	1.119	1.415	1.895	2.365
8	0.262	0.546	0.889	1.108	1.397	1.860	2.306
9	0.261	0.543	0.883	1.100	1.383	1.833	2.262
10	0.260	0.542	0.879	1.093	1.372	1.812	2.228
11	0.260	0.540	0.876	1.088	1.363	1.796	2.201
12	0.259	0.539	0.873	1.083	1.356	1.782	2.179
13	0.259	0.538	0.870	1.079	1.350	1.771	2.160
14	0.258	0.537	0.868	1.076	1.345	1.761	2.145
15	0.258	0.536	0.866	1.074	1.341	1.753	2.131
16	0.258	0.535	0.865	1.071	1.337	1.746	2.120
17	0.257	0.534	0.863	1.069	1.333	1.740	2.110
18	0.257	0.534	0.862	1.067	1.330	1.734	2.101
19	0.257	0.533	0.861	1.066	1.328	1.729	2.093
20	0.257	0.533	0.860	1.064	1.325	1.725	2.086
21	0.257	0.532	0.859	1.063	1.323	1.721	2.080
22	0.256	0.532	0.858	1.061	1.321	1.717	2.074
23	0.256	0.532	0.858	1.060	1.319	1.714	2.069
24	0.256	0.531	0.857	1.059	1.318	1.711	2.064
25	0.256	0.531	0.856	1.058	1.316	1.708	2.060
26	0.256	0.531	0.856	1.058	1.315	1.706	2.056
27	0.256	0.531	0.855	1.057	1.314	1.703	2.052
28	0.256	0.530	0.855	1.056	1.313	1.701	2.048
29	0.256	0.530	0.854	1.055	1.311	1.699	2.045
30	0.256	0.530	0.854	1.055	1.310	1.697	2.042
40	0.255	0.529	0.851	1.050	1.303	1.684	2.021
60	0.254	0.527	0.848	1.045	1.296	1.671	2.000
120	0.254	0.526	0.845	1.041	1.289	1.658	1.980
$\infty$	0.253	0.524	0.842	1.036	1.282	1.645	1.960

Chart 2 for Q. 8(c)

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

1. (a) How do crystalline and nanocrystalline solids are formed? Explain a quick test from which you can conjecture that the structure of a solid is crystalline or not. (8)
- (b) Define lattice parameters and coordination number. Classify the 14 Bravais lattices in three dimensions. Draw the different Bravais lattices for orthorhombic crystal system mentioning their lattice parameters and coordination number. (17)
- (c) Draw the crystal structures of KCl and ZnS mentioning their lattice points per unit cell. (10)
  
2. (a) What are the differences between density and atomic packing fraction? Show that at room temperature for hexagonal close packed structure  $c/a = 1.633$  and the packing fraction is 0.74, where the symbols have their usual meaning. (20)
- (b) What are Miller indices? Discuss why Miller Indices are valuable in the study of crystal structures and properties? Mention the Miller indices of the shaded planes shown in Fig. 2(b). (9)

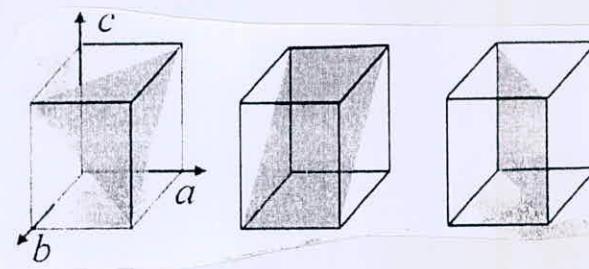


Fig. 2(b)

- (c) Why the ratio of interplanar distances of the (100), (110) and (111) are different for simple cubic, face centered cubic and body centered cubic structure? (6)
  
3. (a) What is the Bragg's condition of X-ray diffraction (XRD) from a crystal plane? Mention the methods of XRD. What is the angle of first order diffraction from (131) planes of garnet with lattice constant 11.46 Å when  $CuK_{\alpha}$  radiation of wavelength 1.5405 Å is used? (12)

**PHY 151**

**Contd.... for Q. No. 3**

(b) Explain any three types of zero-dimensional crystal defects giving practical example and importance of each. What should you consider to substitute an atom or introduce an atom in the interstitial position in a crystal? (13)

(c) Distinguish conductor, semiconductor and insulator in terms of band structure. What happens to the Fermi level when impurities are added to a semiconducting material? (10)

4. (a) Define the following terms: (12)

- (i) Magnetic field,
- (ii) Lorentz force, and
- (iii) Magnetic dipole moment.

(b) State Biot-Savart law and apply this law to find the magnetic field ( $B$ ) due to a circular coil of radius  $R$ , carrying a current  $i$ , at a distance  $x$  on the axis from the center of the coil. What will be the value of  $B$  at the center of a circular coil? (15)

(c) What is a solenoid? A solenoid of  $0.5\text{ m}$  long has 2000 turns. The magnetic induction near the center of the solenoid is  $0.08\text{ T}$ . Find the current in the solenoid. (8)

**SECTION – B**

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

5. (a) Define the following terms: (7)

- (i) Electric dipole moment
- (ii) Electric Potential.

(b) (i) What is an electric flux? What is meant by linear charge density? Write down Gauss' law. Apply it to find the electric field due to a line of charge.

(ii) Suppose the capacitor is fully charged with its maximum charge  $q_0$ . If the emf source is removed from the RC circuit. Find an expression for the charge on the capacitor at any time,  $t$ , during the discharge of a capacitor. (12+8=20)

(c) A  $1\mu\text{F}$  capacitor is allowed to discharge through an unknown resistance. If the charge on the capacitor takes 34.65 sec to drop to half of its original value, what is the value of the resistance? (8)

6. (a) Define the following terms: (7)

- (i) Self-inductance
- (ii) Mutual inductance.

**PHY 151**

**Contd.... for Q. No. 6**

(b) Calculate the self-inductance of a long solenoid of length ' $l$ ' having  $N$  number of turns. Also show that the energy density is given by  $u_B = \frac{B^2}{2\mu_0}$ , where the symbols have their usual meaning. (18)

(c) Write down the differential equation for the oscillations of a LC circuit. Also show that the oscillation frequency is given by  $\omega = \sqrt{\frac{1}{LC}}$ . (10)

7. (a) What do you mean by simultaneity? With a suitable example show that simultaneity is a relative concept. (10)

(b) Derive an expression for the relativistic kinetic energy of a particle and show that for smaller speeds it reduces to the classical expression. (17)

(c) Find the momentum ( $\text{keV}/c$ ) of an electron whose kinetic energy equals its rest energy of 511 keV. (8)

8. (a) What is mean life of a radioactive element? Obtain an expression for the mean life of a radioactive substance. (10)

(b) Discuss graphically what might be the effects on a photoelectric effect experiment if we double the frequency, the wavelength and the intensity of the incident light. (17)

(c) Find the nuclear density of the  $^{12}_6C$ . (8)



BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2021-2022

Sub: **HUM 185** (English)

Full Marks: 140

Time: 3 Hours

The figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

**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 one of the following: (8)
- (i) "You may be proud, wise, and fine, but death will wipe you off the face of the earth as though you were no more than mice burrowing under the floor, and your posterity, your history, your immortal geniuses will burn or freeze together with the earthly globe."
  - (ii) "Isn't life," she stammered, "isn't life?" But what life was she couldn't explain.
- (b) Answer any one of the following: (10)
- (i) In Chekhov's "The Bet", the Banker argues the capital punishment is more humane than life imprisonment. Do you agree with him? Why or why not?
  - (ii) Describe the significance of the title of Guy de Maupassant's short story "The Diamond Necklace"?
- (c) Answer any three of the following: (12)
- (i) What do you lilies signify in "The Garden Party"?
  - (ii) Why did the Banker feel contempt for himself?
  - (iii) Why did the Sheridans overlook their neighbour's death?
  - (iv) Summarize the content of the Lawyer's letter in "The Bet".
  - (v) Comment on the character of Laura Sheridan.
2. Recast and correct any ten of the following sentences: (20)
- (i) James boasted for his strength.
  - (ii) The mountains are covered by snow.
  - (iii) I divided the cake in four parts.
  - (iv) This is an exception of the rule.
  - (v) The jar was full with oil.
  - (vi) This is superior from that.
  - (vii) The rain prevented me to go.
  - (viii) I had the pleasure to meet him.
  - (ix) Since he came, we're happy.
  - (x) The train already left before I arrived.
  - (xi) If he'll ask me, I will stay.
  - (xii) I would wish to know more English.

HUM 185/CE

3. Give the meanings of and make sentences with any ten of the following words: (20)

Charlatan, Loathe, Meddle, Inexplicable, Reiterate, Trivial, Uncouth, Feeble, Dubious, Coerce, Autonomous, Confiscate

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

Communication is essentially a social affair. Man has evolved a host of different systems of communication which render his social life possible—social life not in the sense of living in packs for hunting or for making war, but in a sense unknown to animals. Most prominent among all these systems of communication is, of course, human speech and language. Human language is not to be equated with the sign systems of animals, for man is not restricted to calling his young, or shouting cries of danger; he can with his remarkable faculties of speech give utterance to almost any thought. Like animals, we too have our inborn instinctive cries of alarm, pain, etc., we have smiles, groans, and tears; we blush, shiver, yawn, and frown. A hen can set her chicks scurrying up to her, by clucking communication established by release mechanism—but human language is vastly more than a complicated system of clucking. The development of language reflects back upon thoughts; for with language thoughts may become organised, new thoughts evolved. Self-awareness and the sense of social responsibility have arisen as a result of organised thoughts. Systems of ethics and law have been built up. Man has become self-conscious, responsible, a social creature. Speech and writing are by no means our only system of communication. Social intercourse is greatly strengthened by habits of gesture—little movements of the hands and face. With nods, smiles, frowns, hand-shakes, kisses and other gestures we can convey most subtle understanding. Also, we have economic systems for trafficking not in ideas but in material goods and services; the tokens of communication are coins, bonds, letters of credit, and so on. We have conventions of dress, rules of the road, social formalities, and good manners; we have rules of membership and function in business, institutions, and families. But life in the modern world is coming to depend more and more upon "technical" means of communication, telephone and telegraph; radio and printing. Without such technical aids the modern city-state could not exist one week, for it is only by means of them that trade and business can proceed; that goods and services can be distributed where needed; that railways can run on a schedule; that law of order are maintained; that education is possible. Communication renders true social life practicable, for communication means organisation. Communications have enabled the social unit to grow from the village to the town, to the modern city-state, until today we see organised systems of mutual dependence grown to cover whole hemispheres.

**HUM 185/CE**

**SECTION – B**

There are **FOUR** questions in this section. Answer **Q. No. 5** and any **TWO** from the rest.

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

Many people who spend a lot of time playing video games insist that they have helped them in areas like confidence-building, presentation skills, and debating. Yet this way of thinking about video games can be found almost nowhere within the mainstream media, which still tend to treat games as an odd mix of the slightly menacing and then alien. This lack of awareness has become increasingly inappropriate, as video games and the culture that surrounds them have become very big business indeed.

Recently, the British government released the Byron report into the effects of electronic media on children. Its conclusions set out a clear and rational basis for exploring the regulation of video games. The ensuing debate, however, has descended into the same old squabbling between partisan factions: the preachers of mental and moral decline, and the innovative game designers. In between are the gamers, busily buying and playing while nonsense is talked over their heads.

Susan Greenfield, a renowned neuroscientist, outlines her concerns in a new book. Every individual's mind is the product of a brain that has been personalized by the sum total of their experiences; with an increasing quantity of our experiences from very early childhood taking place 'on screen' rather than in the world, there is potentially a profound shift in the way children's minds work. She suggested that the fast-paced, second-hand experiences created by video games and the Internet may inculcate a worldview that is less empathetic, more risk-taking, and less contemplative than what we tend to think of as healthy.

Adam Martin, a lead programmer for an online games developer, says: 'Computer games teach and people don't even notice they're being taught.' But isn't the kind of learning that goes on in games rather narrow? 'A large part of the addictiveness of games does come from the fact that as you play you are mastering a set of challenges. But humanity's larger understanding of the world comes primarily through communication and experimentation, through answering the question 'What if?' Games excel at teaching this too.'

Greenfield argues that there are ways of thinking that playing video games simply cannot teach. She has a point. We should never forget, for instance, the unique ability of books to engage and expand the human imagination, and to give us the means of more fully expressing our situations in the world. Intriguingly, the video games industry is now growing in ways that have more in common with an old-fashioned world of companionable pastimes than with a cyber future of lonely and isolated obsessives. Games in which friends and relations gather round a console to compete at activities are growing in popularity. The agenda is increasingly being set by the concerns of mainstream consumers – what they consider acceptable for their children, what they want to play at parties and across generations.

**HUM 185/CE**

**Contd.... for Q. No. 5**

Questions:

- (a) How do the views of mainstream media differ from popular beliefs about video games?
- (b) According to Susan Greenfield, how can video games change children's worldview?
- (c) What are the advantages of playing video games according to Adam Martin?
- (d) How is the video games industry changing?
- (e) Give an appropriate title to the passage and justify it.
- (f) Give the meanings of the following words as used in the passage.  
Contemplative, increasingly, intriguingly, profound, partisan
6. (a) Suppose you are the Sales Manager of Flora Computer Ltd., Dhaka. Xeon Hardware, a long-time client from Savar, has ordered 300 multimedia projectors for immediate supply. (10)  
Write a refusal letter to the Manager of Xeon Hardware. (Full Block)
- (b) Write phonetic transcription of the following words (any five). (10)  
Mother, that, king, healthy, deer, bat
7. (a) Write a dialogue between you and your friend about the effects of inflation. (10)  
(b) Write a short essay on any one of the following topics. (10)  
(i) Effects of Climate Change  
(ii) Soft Skills  
(iii) Generative Artificial Intelligence
8. (a) Transform the following sentences as directed (any five). (10)  
(i) Going to the Science Museum he was surprised. (Compound)  
(ii) She told me the truth. (Complex)  
(iii) The book which is on the table is mine. (Simple)  
(iv) Despite the rain, we decided to go for a walk (Compound)  
(v) They have to save money, or they won't be able to buy a house. (Simple)  
(vi) He was tired, but he still went to the gym. (Complex)
- (b) Write short notes on any two of the following. (10)  
(i) Components of a paragraph  
(ii) Tenders  
(iii) Front matters of a report.

**SECTION - A**

**There are FOUR questions in this section. Answer to Question No. 1 is compulsory. Answer any TWO questions from Question 2-4. The corresponding Course Outcomes (COs) of each part of Question 1 are mentioned on the right most column below the marks. The COs of the Course are mentioned at the end of the question paper.**

1. (a) Using nodal analysis, find  $I_x$  in the circuit of Fig. 1(a). [CO2]

17  
[CO2]

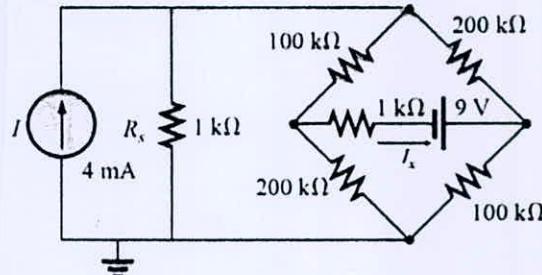


Fig. for Q. No. 1(a)

- (b) A resistance array is connected to a load resistor  $R$  and a 9-V battery as shown in Fig. 1(b). [CO1]

18  
[CO1]

- (i) Find the value of  $R$  such that  $V_o = 1.8$  V.
- (ii) Calculate the value of  $R$  that will draw the maximum power. What is the value of maximum power?

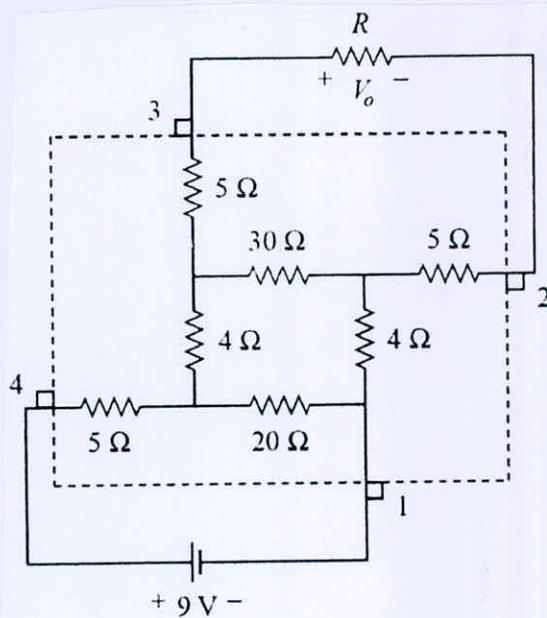


Fig. for Q. No. 1(b)

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2. (a) Find  $v_o$  and  $i_o$  in the circuit of Fig. 2(a) using mesh analysis.

(18)

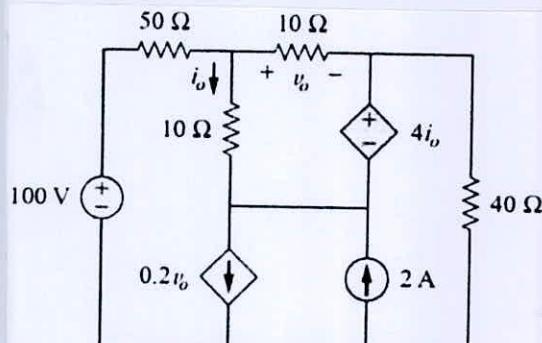


Fig. for Q. No.2 (a)

- (b) For the circuit shown in Fig. 2(b), find the Norton equivalent between terminals a and b.

(17)

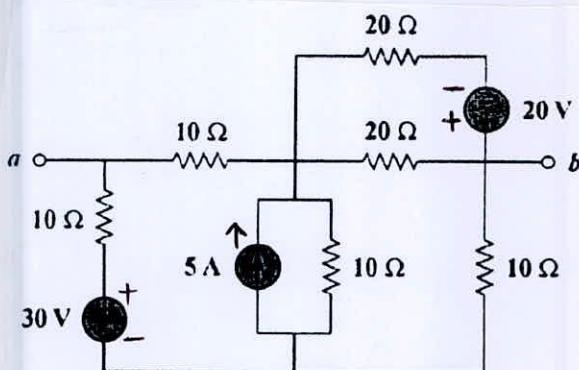


Fig. for Q. No.2 (b)

3. (a) Find the equivalent resistance between the terminals a and b in the circuit shown in Fig. 3(a).

(20)

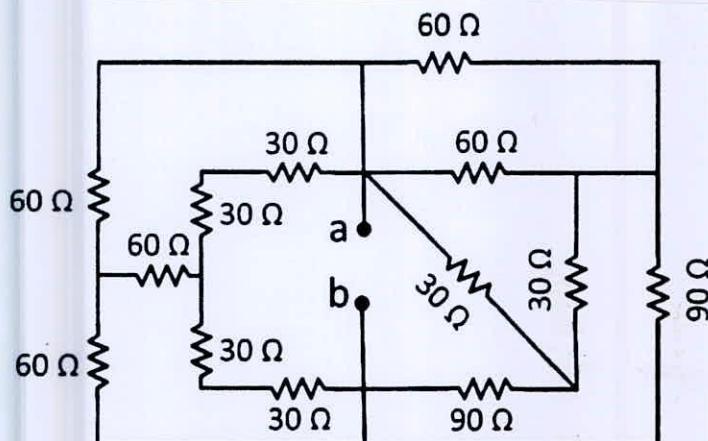


Fig. for Q. No.3 (a)

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**Contd.... for Q. No. 3**

(b) For the circuit shown in Fig. 3(b), find the value of R using source transformation.

(15)

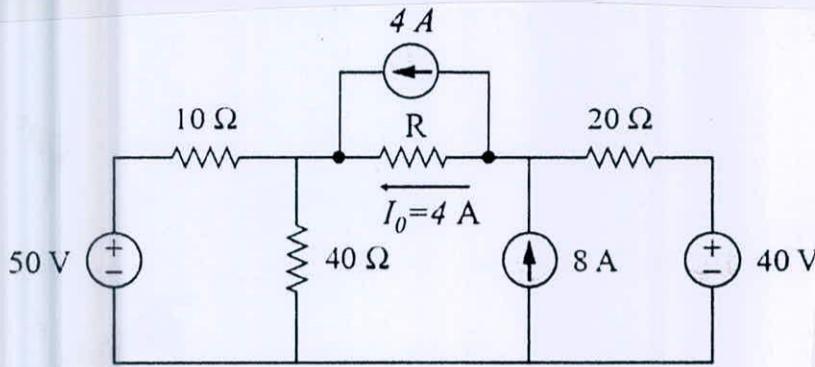


Fig. for Q. No.3 (b)

4. (a) A 15-kVA, 2300/230-V transformer is to be tested. The following test data have been taken from the primary side of the transformer:

(20)

Open-circuit test	Short-circuit test
$V_{oc} = 2300 \text{ V}$	$V_{sc} = 47 \text{ V}$
$I_{oc} = 0.21 \text{ A}$	$I_{sc} = 6 \text{ A}$
$P_{oc} = 50 \text{ W}$	$P_{sc} = 160 \text{ W}$

- (i) Find the equivalent circuit of this transformer referred to the high-voltage side.
  - (ii) Find the equivalent circuit of this transformer referred to the low-voltage side.
  - (iii) Calculate the full-load voltage regulation at 0.8 lagging power factor, 1.0 power factor, and at 0.8 leading power factor.
  - (iv) What is the efficiency of the transformer at full load with a power factor of 0.8 lagging?
- (b) (i) What components compose the excitation current of a transformer? How are they modeled in the transformer's equivalent circuit?

(15)

- (ii) What is the leakage flux in a transformer? Why is it modeled in a transformer equivalent circuit as in inductor?

Course Outcomes of EEE 165

COs	CO Statement
CO1	explain the behavior of circuit operation based on the understanding of circuit elements, laws, analysis methods and theorems.
CO2	apply the fundamental laws and theorems of circuit analysis to solve electrical circuits.
CO3	analyze the operation of electrical machines based on the underlying physics.

**EEE 165/CE**

**Contd.... for Q. No. 7**

**SECTION – B**

There are **FOUR** questions in this section.

Answer **Question No. 5** (as compulsory) and any **TWO** questions from Question No 6 to 8.

5. (a) Draw the Steinmetz Equivalent Circuit of a three-phase induction motor. From  
that circuit shown that

$5+5+5=15$   
[CO2]

(b) A 50-kW 440-V 50-Hz two-pole induction motor has a slip of 6 percent when operating at full-load conditions. At full-load conditions, the friction and windage losses are 520 W, and the core losses are 500 W. Find the following values for full-

load conditions:

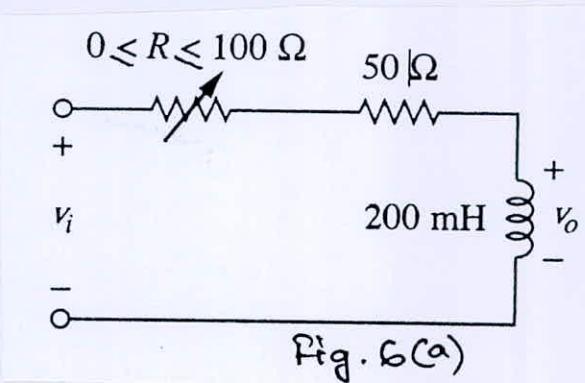
$4+4+4+4+2+2=20$   
[CO3]

- (i) The shaft speed,
- (ii) The output power in watts,
- (iii) The load torque in newton-meters,
- (iv) The induced torque in newton-meters,
- (v) The rotor frequency in hertz,
- (vi) Draw the power flow diagram.

6. (a) Consider the phase-shifting circuit in Fig. for Q. 6(a). Let  $V_i = 120$  V operating at 60 Hz. Find:

$(5+5+5=15)$

- (i)  $V_o$  when  $R$  is maximum
- (ii)  $V_o$  when  $R$  is minimum
- (iii) the value of  $R$  that will produce a phase shift of  $45^\circ$



- (b) A coupling capacitor is used to block dc current from an amplifier as shown in Fig. for Q. 6(b). The amplifier and the capacitor act as the source, while the speaker is the load.

$(10+10=20)$

- (i) At what frequency is maximum power transferred to the speaker?
- (ii) If  $V_s = 4.6$  V rms, how much power is delivered to the speaker at that frequency?

**EEE 165/CE**  
**Contd.... for Q. No. 6(b)**

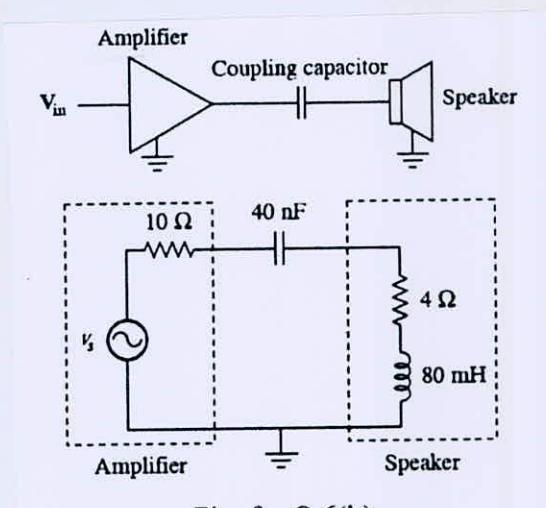


Fig. for Q 6(b)

7. (a) The secondary winding of a transformer has a terminal voltage of  $v_s(t) = 282.8 \sin 377t$  V. The turns ratio of the transformer is 50:200 ( $a = 0.25$ ). If the secondary current of the transformer is  $i_s(t) = 7.07 \sin(377t - 36.87^\circ)$  A, what is the primary current of this transformer? What are its voltage regulation and efficiency? The impedances of this transformer referred to the primary side are (10+10=20)

$$R_{eq} = 0.05 \Omega \quad R_C = 75 \Omega \\ X_{eq} = 0.225 \Omega \quad X_M = 20 \Omega$$

- (b) The core shown in Fig. for Q 7(b)-1 has the flux shown in Fig. for Q 7(b)-2. Estimate and sketch the voltage present in the terminals of the coil. (15)

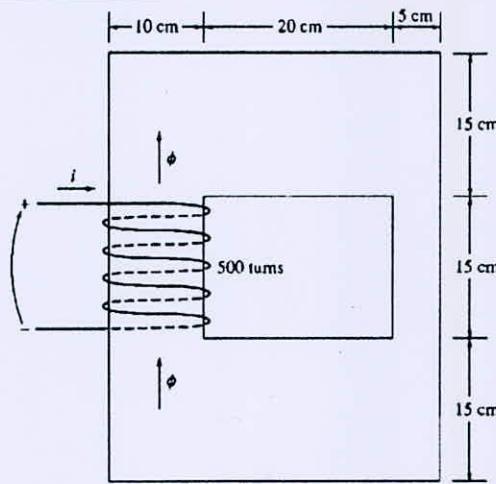


Fig. for Q 7(b)-1

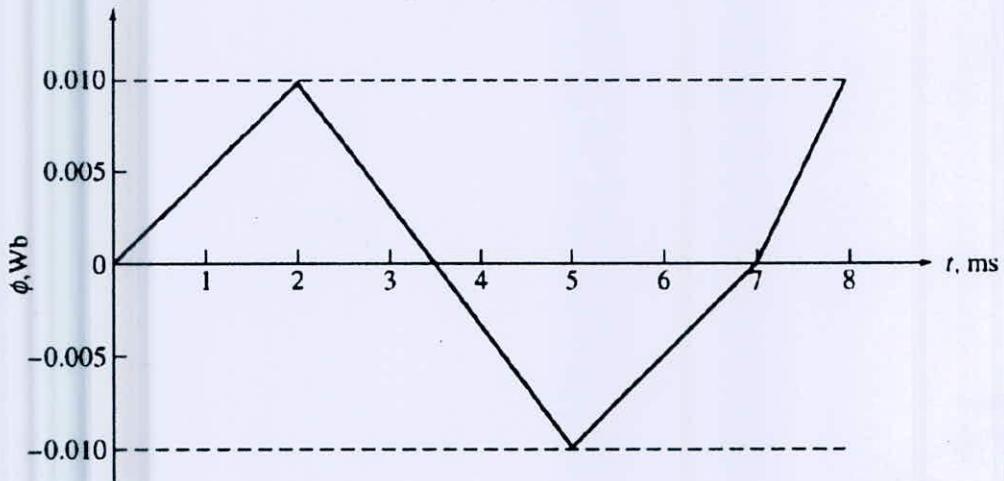


Fig. for Q 7(b)-2

EEE 165/CE

8. (a) A Y-connected balanced three-phase generator with an impedance of  $0.4 + j0.3 \Omega$  per phase is connected to a Y-connected balanced load with an impedance of  $24 + j19 \Omega$  per phase. The line joining the generator and the load has an impedance of  $0.6 + j0.7 \Omega$  per phase. Assuming a positive sequence for the source voltages and that  $V_{an} = 120\angle 30^\circ$  V, find: (i) the line voltages at load end (ii) the line currents. **(7+8=15)**
- (b) For the fittings and fixture layout shown in Fig. for Q. 8(b). (i) Draw the conduit layout. (ii) SB connection diagram (iii) SDB connection diagram. **(20)**

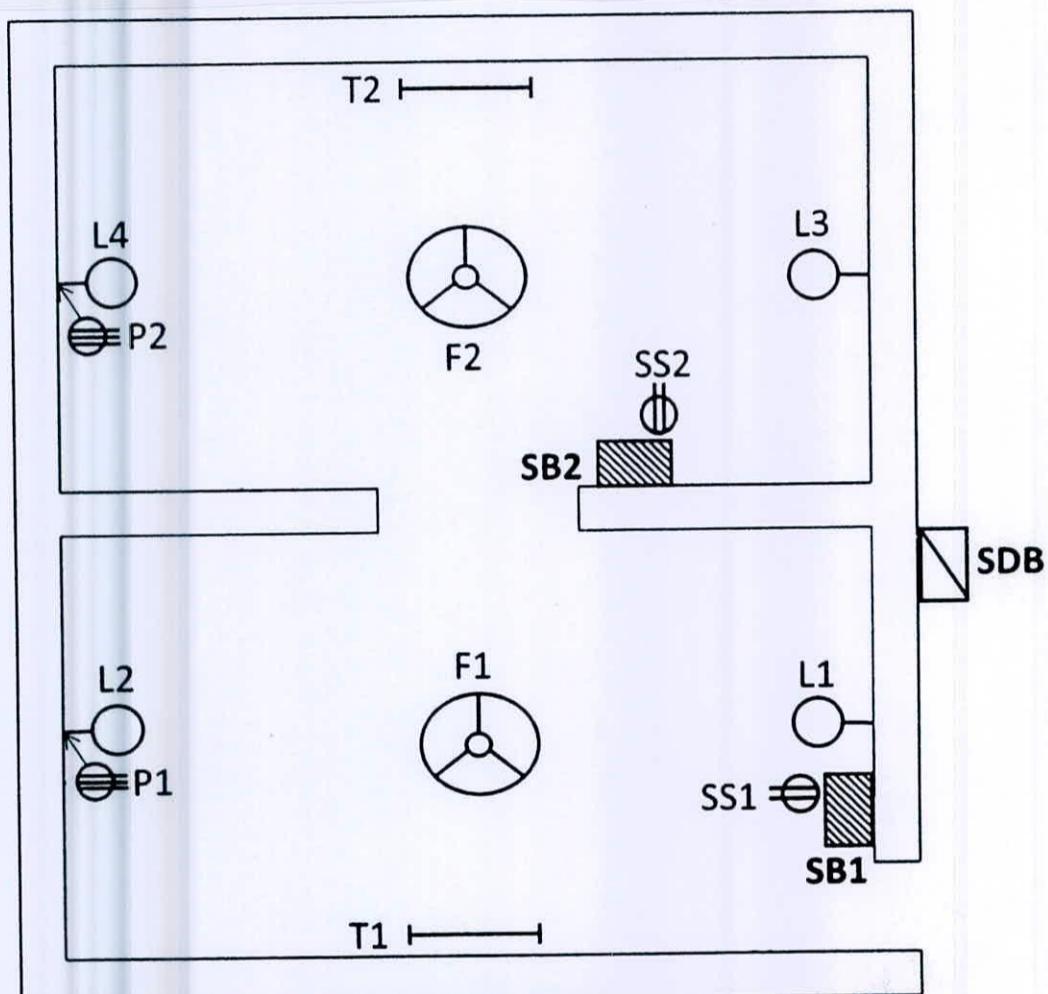


Fig. 8(b)(i)

=7=

### Legend

Description	Fitting-Fixture Symbol
Sub distribution board	
Switch board	
Wall light fitting	
Wall bracket light fitting	
Ceiling Fan	
2pin 5A socket at SB level	
3pin 15A socket at skirting level	

Fig. for Q 8 (b) (i)

CO No.	CO Statement	Corresponding PO(s)*	Domains Taxonomy level(s)**	Delivery Method(s) and Activity(-ies)	Assessment Tool(s)
1	explain the behavior of circuit operation based on the understanding of circuit elements, laws, analysis methods and theorems	PO(a)	C2,	Lectures, Discussions	Assignment, Class test, Final exam
2	apply the fundamental laws and theorems of circuit analysis to solve electrical circuits.	PO(a)	C3	Lectures, Discussions	Assignment, Class test, Final exam
3	analyze the operation of electrical machines based on the underlying physics	PO(b)	C4	Lectures, Discussions	Assignment, Class test, Final exam