USN | | | | | | | | | | |

10EE61

Sixth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Power System Analysis and Stability

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Define per unit quantity? What are the advantages of PU systems? **(06 Marks)**

b. Show that the per unit impedance of a transformer is the same irrespective of the side of which it is calculated. **(04 Marks)**

c. Obtain the impedance diagram of the electrical power system shown in the Fig.Q1(c). The one line diagram of an unloaded generator is as shown in the Fig.Q1(c) choose a base of 50MVA, 13.8KV in the circuit of generator G_1.

The generators and transformers ratings are :

G_1 : 20MVA, 13.8KV, x" = 0.2p.u

G_2 : 30MVA, 18 KV, x" = 0.2p.u

G_2 : 30MVA, 20 KV, x" = 0.2p.u

T_1 : 25MVA, 220KV, Y/13.8ΔKV, x = 10%

T_2 : three single phase units each rated 10MVA, 127/18 KV, x = 10%

T_3 : 35MVA, 220KV Y/22KV, x = 10%. **(10 Marks)**

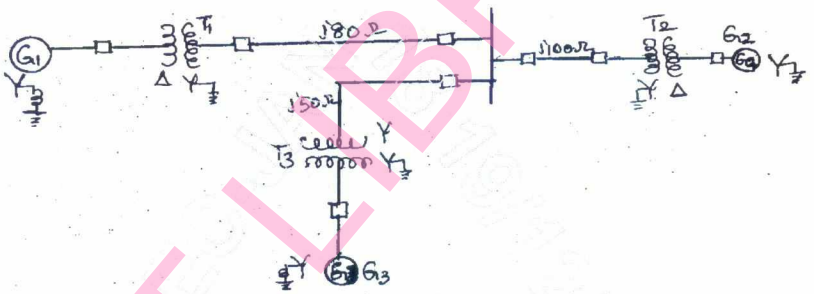
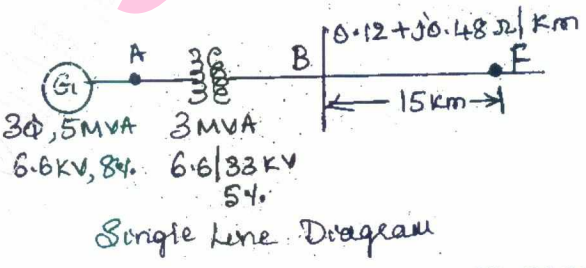


Fig.Q1(c)

2 a. With the oscillogram of the short circuit current of synchronous machine, define direct axis synchoronous reactance, transient and subtransient reactance. **(08 Marks)**

b. A 3-phase, 5MVA, 6.6KV alternator with a reactance of 8% connected to a feeded of series impedance of 0.12 + j0.48Ω/phase/km. The transformer is rated at 3MVA, 6.6KV/33KV and has a reactance of 5%. Determine the fault current supplied by the generator operating under no load with a voltage of 6.9KV, when a 3-phase symmetrical fault occurs at a point 15km from the feeder. **(12 Marks)**



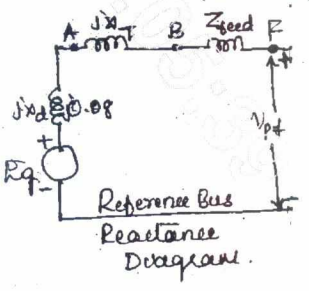


Fig.Q2(b)

3 a. Prove that a balanced set of three phase voltages will have only positive sequence components of voltages only. **(06 Marks)**

b. A balanced delta connected load is connected to a symmetrical supply. The line currents are each 10A in magnitude. If fuse in one of the lines blows out, determine the sequence components of line current. **(08 Marks)**

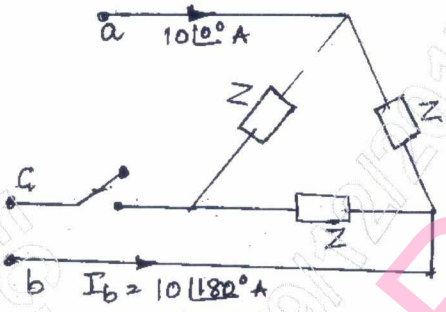


Fig.Q3(b)

c. Derive an extraction for complex power interms of the symmetrical components. **(06 Marks)**

4 a. Draw the zero sequence equivalent circuit for the following conditions of transformer. **(10 Marks)**

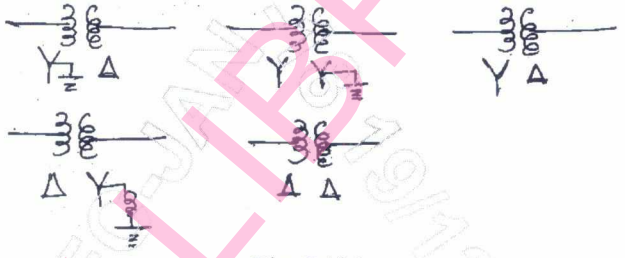


Fig.Q4(a)

b. The one-line diagram of a power system is as shown is the Fig.Q4(b). The ratings of the devices are as follows :

G_1 and G_2 : 104MVA, 11.8V, $x_1 = x_2 = 0.2$p.u, $x_0 = 0.1$p.u

T_1 and T_2 : 125MVA, 11Y – 220YKV, $x_1 = x_2 = x_0 = 0.1$p.u

T_3 and T_2 : 120MVA, 230Y – 6.9YKV, $x_1 = x_2 = x_0 = 0.12$p.u

M_1 : 175MVA, 6.6KV, $x_1 = x_2 = 0.3$p.u $x_0 = 0.15$ p .u

M_2 : 50MVA, 6.9KV, $x_1 = x_2 = 0.3$p.u $x_0 = 0.1$p.u

Transmission line reactance : $x_1 = x_2 = 30\Omega$ $x_0 = 60\Omega$.

Draw the sequence impedance diagram in p.u on a base of 200MVA, 220KV in transmission **(10 Marks)**

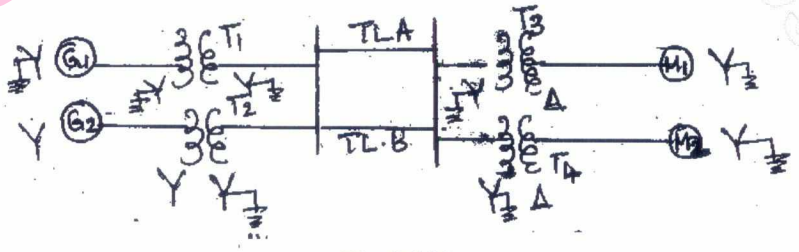


Fig.Q4(b)

PART – B

5 a. Derive an expression for fault current when an line to line (LL) fault occurs on the terminals of an unloaded generator. **(08 Marks)**

b. A synchronous motor is receiving 10MW of power at 0.8pu. lag at 6KV. An LG fault takes place at the middle point of the transmission line as shown in the Fig.Q5(b). Find the fault current. The ratings of the generator, motor and transformer are as given :

Generator : 20MVA, 11KV, $x_1 = 0.2$p.u, $x_2 = 0.1$p.u, $x_0 = 0.1$ p.u
Transformer : T_1 : 18MVA, 11.5Y – 34.5YKV, x = 0.1p.u
Transmission line : $x_1 = x_2 = 5\Omega$, $x_0 = 10\Omega$
Transformer T_2 : 15MVA, 6.9Y – 34.5YKV, x = 0.1p.u
Motor : 15MVA, 6.9KV, $x_1 = 0.2$p.u, $x_2 = x_0 = 0.1$p.u. **(12 Marks)**

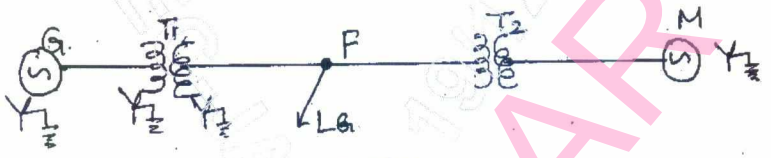


Fig.Q5(b)

6 a. Discuss "open conductor faults". **(10 Marks)**

b. Derive an expression for L–L–G fault occurs through fault impedance (z_f) in a power system. Show the inter connection of sequence networks. **(10 Marks)**

7 a. Derive the expression for swing equation. **(06 Marks)**

b. Explain equal area concept when a power system is subjected to sudden increase in load. **(06 Marks)**

c. A turbo alternator, 6-pole, 50Hz of capacity 80MW working at 0.8p.f has an inertia of 10MJ/MVA. Calculate :

i) The energy stored in the rotor at synchronous speed
ii) Find rotor acceleration if the mechanical input is suddenly raised to 75MW for an electrical load of 60MW
iii) Suppose the above acceleration is maintained for a duration of 6 cycles. Calculate the change in torque angle and the rotor speed at the end of 6 cycles. **(08 Marks)**

8 Write short notes on :

a. Power angle equation of a non salient pole synchronous machine
b. Classification of stability
c. Single phasing of 3 phase induction motor
d. Critical clearing angle and critical clearing time. **(20 Marks)**

* * * * *

USN | | | | | | | | | | |

10EE62

Sixth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Switchgear and Protection

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Explain the role of isolating switch in a power system. **(06 Marks)**

b. With the help of waveform, explain cutoff characteristic of fuse. Also define the term fusing factor. **(06 Marks)**

c. With the help of diagram, explain the construction and working of HRC fuse. **(08 Marks)**

2 a. Discuss the recovery rate theory and energy balance theory of arc interruption in AC circuit breaker. **(06 Marks)**

b. Explain the current chopping phenomenon in circuit breaker. **(06 Marks)**

c. In a 220 KV system, the reactance and capacitance upto the location of circuit breaker is 8Ω and 0.025μF respectively. A resistance of 600Ω is connected across the contacts of the circuit breaker. Determine i) Natural frequency of oscillation ii) Damped frequency of oscillation iii) Critical value of resistance, which will give no transient oscillation. **(08 Marks)**

3 a. Explain the construction and working of air break circuit breaker with the help of neat diagram. **(10 Marks)**

b. Explain various properties of SF_6 gas. **(10 Marks)**

4 a. Explain following tests performed on circuit breaker :
i) Unit test ii) Synthetic test iii) Substitution test iv) Compensation test
v) Capacitance test. **(10 Marks)**

b. With neat figure, explain the working of :
i) Rod gap arrestor ii) Expulsion type arrestor. **(10 Marks)**

PART – B

5 a. With a neat sketch, explain different zones of protection in power system. **(06 Marks)**

b. Explain various methods of backup protection. **(06 Marks)**

c. Explain essential qualities of protective relaying. **(08 Marks)**

6 a. Explain the working of percentage differential relay. **(06 Marks)**

b. Explain three stepped distance protection of transmission line. **(08 Marks)**

c. Write a short note on microprocessor based over current relay. **(06 Marks)**

7 a. With the help of neat diagram, explain Merz –Price protection of star connected alternator stator windings. Mention its advantages. **(10 Marks)**

b. A 11KV, 3 – phase Alternator has full load rated current of 200A. Reactance of armature winding is 15%. The differential protection system is set to operate on earth fault currents of more than 200A. Find the neutral earthing resistance, which gives earth fault protection to 90% of stator winding. **(06 Marks)**

c. Write a short note on Unbalanced loading of alternator and its effects. **(04 Marks)**

8 a. List the various abnormal operating conditions and how induction motor is protected against these. **(06 Marks)**

b. What is Phase reversal? What are its effects? How it is prevented? **(06 Marks)**

c. A 3 – phase, 11 KV/33 KV, Y - Δ connected power transformer is protected by differential protection. The CTs on LV side have a current ratio of 400/5. What must be the ratio of CTs on HV side? Draw the connection diagram of how CTs are connected on both the sides of the transformer. **(08 Marks)**

*****

USN | | | | | | | | | | |

10EE63

Sixth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Electrical Machine Design

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. ***Missing data if any assume suitably.***

PART – A

1 a. Explain the factors those limit the design of electrical machines. **(08 Marks)**

b. Classify the insulating materials used in electrical machines based on thermal considerations. **(07 Marks)**

c. Derive the output equation of a DC machine with usual notations. **(05 Marks)**

2 a. List the advantages and disadvantages of higher number of poles in DC machines. Hence write the guiding factors for the choice of number of poles. **(08 Marks)**

b. Discuss the factors to be considered while fixing the dimensions of armature slots in a DC machine. **(05 Marks)**

c. A 350 KW, 500 V, 450 rpm, 6 pole DC generator is built with an armature diameter of 0.87 m and core length of 0.32 m. The lap wound armature has 660 conductors. Calculate the specific electric and magnetic loadings. **(07 Marks)**

3 a. Develop the output equation for a three phase core type transformer. **(05 Marks)**

b. Calculate the KVA output of a single phase transformer from the following data:

$$\frac{\text{core height}}{\text{distance between core centres}} = 2.8$$

$$\frac{\text{diameter of circumscribing circle}}{\text{distance between core centres}} = 0.56$$

$$\frac{\text{net iron area}}{\text{area of circumscribing circle}} = 0.7$$

Current density = 2.3 A/mm^2, window space factor = 0.27, frequency = 50 Hz, flux density in the core = 1.2 Wb/m^2, distance between core centres = 0.4 m. **(07 Marks)**

c. A single phase, 400 V, 50 Hz transformer is built with stampings having a relative permeability of 1000. The length of flux path is 2.5 m, the area of cross section of the core is 2.5×10^{-3} m^2 and the primary winding has 800 turns. Estimate the maximum value of flux and no load current of transformer. The iron loss at the working flux density is 2.6 W/kg, iron weights 7.8×10^3 kg/m^3. Stacking factor is 0.9. **(08 Marks)**

4 a. Estimate the main dimensions, turns per phase of primary and secondary winding, primary and secondary conductor cross section of a 3 phase, Δ-Y core type transformer rated at 300 KVA, 6600/400 V 50 Hz. 3-stepped core have circumscribing circle diameter of 0.25 m and a leg spacing of 0.4 m. Given emp/turn = 8.5 V; δ = 2.5 A/mm^2; window space factor = 0.28; iron stacking factor = 0.9.

$$\text{Ratio} = \frac{\text{Gross core area}}{\text{Area of circumscribing circle}} = 0.84 \quad \text{for a 3 stepped core.}$$ **(10 Marks)**

b. The full load efficiency of a 300 KVA transformer is 98.2% at unity power factor. Design the number of cooling tubes necessary, if the temperature rise is 35°C. The tank area may be assumed as 4.92 m^2. Assume tube diameter as 5 cm and average length as 105 cm. Heat dissipation may be assumed as 12.5 $W/m^2/C°$. **(10 Marks)**

PART – B

5 a. Explain the factors affecting the choice of specific loadings in induction motors. **(08 Marks)**

b. Estimate the stator core dimensions, number of stator slots and number of stator conductors per slot for a 100 KW, 3300 V, 50 Hz, 12 pole star connected slip ring induction motor assume:
Average gap density = 0.4 Wb/m^2
Ampere conductors per meter = 25000 A/m
Efficiency = 0.9
Power factor = 0.9
Winding factor = 0.96
Choose main dimensions to give best power factor. The slot loading should not exceed 500 A. **(12 Marks)**

6 a. Explain Crawling and Cogging of induction motor. **(10 Marks)**

b. A 90 KW, 500 V, 50 Hz, 3 phase, 8 pole induction motor has a star connected stator winding accommodated in 63 slots with 6 conductors per slot. If the slip ring voltage on open circuit is to be about 400 V. Design a suitable rotor winding with the following details:
i) Number of rotor slots if $q_r = 3$ (slots/pole/phase)
ii) Number of conductors/rotor slot
iii) Coil span
iv) Slip ring voltage on open circuit if rotor is Y connected
v) Approximate full load current per phase in rotor
Assume efficiency = 0.9 and power factor = 0.86. **(10 Marks)**

7 a. From first principles derive the output equation of a synchronous machine. **(05 Marks)**

b. Describe the various factors to be considered while selecting the number of slots in the armature of a 3-phase synchronous machine. **(07 Marks)**

c. Find the main dimensions of 100 MVA, 11 KV, 50 Hz, 1500 rpm, 3 phase water wheel generator. The average gap density is 0.65 Wb/m^2 and ampere conductors/m are 40000. The peripheral speed should not exceed 65 m/sec, at normal running speed, in order to limit the runaway speed. Suggest type of pole construction used. Given $\frac{L}{\psi} = 0.65$ for circular pole and $\frac{L}{\psi} = 4$ for rectangular pole. **(08 Marks)**

8 a. For a 250 KVA, 1100 V, 12 pole, 500 rpm, 3 phase alternator. Determine air gap diameter, core length, number of stator conductors, number of stator slots and cross section of stator conductors. Assume average gap density as 0.6 Wb/m^2 and specific electric loading as 30000 A/m $\frac{L}{\psi} = 1.5$, stator winding factor = 0.955 and stator slots/pole/phase = 3, current density $\delta_s = 3.5$ A/mm^2. **(10 Marks)**

b. Define short circuit ratio and explain the factors affecting SCR in a synchronous generator. **(10 Marks)**

* * * * *

USN | | | | | | | | | | |

10EE64

Sixth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Digital Signal Processing

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Perform circular convolution of two sequences using DFT & IDFT method. **(12 Marks)**
$x_1(n) = (1, 1, 2, 1)$ and $x_2(n) = (1, 2, 3, 4)$.

b. Find the DFT of the sequence
$x(n) = 1$ for $0 \le n \le 2$.
0 otherwise
For N = 8. Plot magnitude and Phase spectrum of X(k). **(08 Marks)**

2 a. 14 – point DFT of 14 real time sequences is X(k). The first 8 samples of X(k) are given by $X(0) = 12$, $X(1) = -1 + j3$, $X(2) = 3 + j4$, $X(3) = 1 - j5$, $X(4) = -2 + j2$, $X(5) = 6 + j3$, $X(6) = -2 - j3$, $X(7) = 10$. Find the remaining samples of X(k). Also find $\sum_{n=0}^{7} |x(n)|^2$. **(05 Marks)**

b. Compare Linear convolution with circular convolution. **(03 Marks)**

c. Compute y(n) of a FIR filter with impulse response h(n) = (3, 2, 1) and x(n) = (2, 1, -1, -2, -3, 5, 6, -1, 2, 0,2, 1). Use only 8 – point circular convolution in your approach. Compare the result by solving problem using i) Overlap Save method ii) Overlap Add method. **(12 Marks)**

3 a. What are FFT Algorithms? Show comparison between DIT, DIF – FFT Algorithms. **(08 Marks)**

b. Compute 8 – point DFT of the sequence x(n). Using DIT & DIF – FFT Algorithms.
x(n) = (1, 1, 1, 1, 1, 1, 1, 1). **(12 Marks)**

4 a. Calculate the number of multiplications needed in the calculation of DFT & FFT with N = 4, 16, 64, 256 and also find the speed improvement factor. **(12 Marks)**

b. Compute IDFT of the sequence X(k).
X(k) = {4, 1 - j2.414, 0, 1 - j0.414, 0, 1 + j0.414, 0, 1 + j2.414}. **(08 Marks)**

PART – B

5 a. Compare Digital filter with analog filter. Also explain advantages and disadvantages of digital filter. **(08 Marks)**

b. For the given specifications $\alpha_p = 3dB$, $\alpha_s = 16dB$, $f_p = 1KHz$, $f_s = 2KHz$. Determine the order of the filter using Chebyshev type – I approximation. Find H(s). **(08 Marks)**

c. For the given specification $\alpha_p = 1dB$, $\alpha_s = 30dB$, $\Omega_p = 200$ rad/sec, $\Omega_s = 600$ rad/sec. Determine the order of low pass butterworth filter. **(04 Marks)**

6 a. Explain the transforming of an analog normalized low pass filter into analog high pass, band pass and band reject filter using frequency transformation methods. **(08 Marks)**

b. Using Bilinear transformation design a high pass filter, monotonic in passband with cutoff frequency of 1000Hz at $\alpha_p = 3dB$ and down to 10dB at 350Hz. The sampling frequency is 5000Hz. **(12 Marks)**

7 a. Explain the design of FIR filters using windows. **(10 Marks)**

b. Design a filter with

$H_d(e^{jw}) = e^{-j3w}$; $-\pi/4 \le w \le \pi/4$.

$= 0$; $\pi/4 < |w| \le \pi$.

Using Hamming window with N = 7. **(10 Marks)**

8 a. Obtain Direct form – I , Direct form – II , Cascade and Parallel form realization for the system $y(n) = -0.1y(n-1) + 0.2y(n-2) + 3x(n) + 3.6x(n-1) + 0.6x(n-2)$. **(14 Marks)**

b. Realize the system in Parallel form :

$y(n) = -0.1y(n-1) + 0.72y(n-2) + 0.7x(n) - 0.252x(n-2)$. **(06 Marks)**

*****

USN | | | | | | | | | | |

10EE661

Sixth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Operation Research

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Define operation research. Briefly explain the characteristics of operation research. **(05 Marks)**

b. A company manufactures two products A and B. Each unit of 'B' takes twice as long to produce as one unit of A. and if the company were to produce only A it would have time to produce 2000 units per day. The availability of raw – materials is sufficient to produce 1500 units per day of both A and B combined. Product B requiring a special ingredient only 600units can be made per day. If A fetches a profit of Rs. 2 per unit and B a profit of Rs.4 per unit. Find the optimum product mix by formulating LPP. **(07 Marks)**

c. Solve the following LPP by graphical method :

Max $z = 100x_1 + 40x_2$

Subject to $5x_1 + 2x_2 \le 1000$

$3x_1 + 2x_2 \le 900$

$x_1 + 2x_2 \le 500$

and $x_1, x_2 \ge 0$. **(08 Marks)**

2 a. Solve the following LPP by Big – M method :

Maximize $z = -2x_1 - x_2$

Subject to $3x_1 + x_2 = 3$

$4x_1 + 3x_2 \ge 6$

$x_1 + 2x_2 \le 4$

$x_1, x_2 \ge 0$. **(10 Marks)**

b. Find the dual of the following LPP and solve it.

maximize $z = 5x_1 - 2x_2 + 3x_3$

subject to $2x_1 + 2x_2 - x_3 \ge 2$

$3x_1 - 4x_2 \le 3$

$x_2 + 3x_3 \le 5$

$x_1, x_2 x_3 \ge 0$. **(10 Marks)**

3 a. Use dual simplex method to solve the LPP :

Maximize $z = -2x_1 - x_3$

Subject to $x_1 + x_2 - x_3 \ge 5$

$x_1 - 2x_2 + 4x_3 \ge 8$

$x_1 x_2 x_3 \ge 0$. **(10 Marks)**

b. Use revised simplex method to solve the following LPP :

maximize $z = x_1 + x_2$

subject to $2x_1 + 5x_2 \le 6$

$x_1 + x_2 \ge 2$

$x_1, x_2 \ge 0$. **(10 Marks)**

4 a. Five men are available to do five different jobs. Form past records, the time (in hours) that each man takes to do each job is known and given in the following table. **(10 Marks)**

Man	I	II	III	IV	V
A	2	9	2	7	1
B	6	8	7	6	1
C	4	6	5	3	1
D	4	2	7	3	1
E	5	3	9	5	1

b. Solve the travelling – salesman problem given by the following data :
$C_{12} = 20$ $C_{13} = 4$ $C_{14} = 10$ $C_{23} = 5$ $C_{34} = 6$ $C_{25} = 10$ $C_{35} = 6$ $C_{45} = 20$
Where $C_{ij} = C_{ji}$ and there is no route between cities i and j if the value for C_{ij} is not shown. **(10 Marks)**

PART – B

5 a. Explain stepping stone method in problems. **(05 Marks)**

b. Find the basic feasible solution of the following transportation problem by NWCR. Also find the optimal transportation plan.

	1	2	3	4	5	Available
A	4	3	1	2	6	80
B	5	2	3	4	5	60
C	3	5	6	3	2	40
D	2	4	4	5	3	20
Required	60	60	30	40	10	200 Total

(15 Marks)

6 a. Explain the characteristics of game theory. **(05 Marks)**

b. Reduce the following game by dominance property and solve it. **(07 Marks)**

		Player B			
		I	II	III	IV
Player A	I	3	2	4	0
	II	3	4	2	4
	III	4	2	4	0
	IV	0	4	0	8

c. Solve the following game by graphical method.

		B		
		I y_1	II y_2	III y_3
A	x_1 I	1	3	11
	$1-x_1$ II	8	5	2

(08 Marks)

7 a. Explain the basic steps in PERT – CPM. **(06 Marks)**

b. A project has the following schedule.

Activity	Time in weeks	Activity	Time in weeks
(1 – 2)	4	5 – 7	8
(1 – 3)	1	6 – 8	1
(2 – 4)	1	7 – 8	2
(3 – 4)	1	8 – 9	1
(3 – 5)	6	8 – 10	8
(4 – 9)	5	9 – 10	7
(5 – 6)	4	–	–

Construct PERT network and compute :

i) T_E and T_L for each event

ii) Float for each activity

iii) Critical path and its duration. **(14 Marks)**

8 a. Mention the situations for the replacement of models **(04 Marks)**

b. The probability P_n of failure just before are n is shown below. If individual replacement cost is Rs. 12.50 and group replacement costs is Rs. 3.00 per item. Find the optimal replacement policy.

n	1	2	3	4	5
P_n	0.1	0.2	0.25	0.3	0.15

(16 Marks)

* * * * *

USN | | | | | | | | | | |

10EE666

Sixth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Electrical Engineering Materials

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Define :
i) Resistivity ii) Conductivity ii) Temperature co-efficient of resistance. **(03 Marks)**

b. With usual notations prove that $R_t = R_o (1 + \alpha_o t_)$ **(05 Marks)**

c. Explain Fermi Dirac distribution. **(06 Marks)**

d. A coil is made of copper wire. At 15°C the resistance of the coil is 250 ohms. What will be the temperature of the same coil if the resistance is 300 ohms? Take $\alpha_0 = 0.0038$ ohm per degree C at 0°C. **(06 Marks)**

2 a. Define Hall effect. With necessary sketches, explain the concept of Hall effect and derive equation for Wall voltage V_H? What will be the Hall co-efficient when electrons and holes both are considered as density carries? **(10 Marks)**

b. Classify magnetic materials and explain each type with necessary sketches. **(10 Marks)**

3 a. Explain dielectric strength and mention factors influencing dielectric strength. Briefly explain each factor. **(05 Marks)**

b. Explain Electronic polarization and prove that $\in_r = 1 + 4\pi a^3 N$. **(10 Marks)**

c. Calculate the capacitance in micro-farads of a capacitor having 9 parallel plates separated by mica sheets 0.2mm thick. The area of one side of each plate is $12cm^2$ and dielectric constant of mica is 5. **(05 Marks)**

4 a. Explain the following dielectric gases with applications : i) SF_6 ii) Nitrogen. **(10 Marks)**

b. What is the function of oil which is used in transformer? **(05 Marks)**

c. Explain ageing of insulators by mentioning few adverse effects after ageing. **(05 Marks)**

PART – B

5 a. Briefly explain semi conductor materials used for solar cells? **(08 Marks)**

b. Mention different types of fuel cells and explain Alkaline fuel cells. **(08 Marks)**

c. Briefly explain solar selective coatings. **(04 Marks)**

6 a. With the help of neat sketches explain photo electron spectroscopy. **(07 Marks)**

b. Explain Magnetic Resonance Phenomena. **(06 Marks)**

c. Explain working and parts of atomic absorption spectroscopy. **(07 Marks)**

7 a. Explain different applications of Piezoelectric materials. **(08 Marks)**

b. Define Hydrogels. How hydrogels are classified on basis of route, ionic charge and physical structure. Mention few properties and applications. **(12 Marks)**

8 a. Explain the following plastics with examples: i) Thermo plastics ii) Rubber. **(12 Marks)**

b. Explain different applications of ceramics to conductors and insulators. **(08 Marks)**

* * * * *