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10EE61

Sixth Semester B.E. Degree Examination, June/July 2019

Power System Analysis and Stability

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, may be suitably assumed.***

PART – A

1 a. For the given one line diagram shown in Fig.Q1(a), draw impedance diagram and reactance diagram.

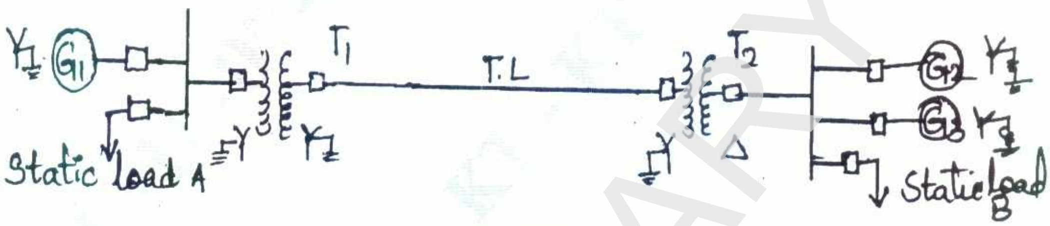

Fig.Q1(a) **(05 Marks)**

b. List any five advantages of PU system. **(05 Marks)**

c. The one line diagram of an unloaded power system is shown in Fig.Q1(c). Reactances of the 2 sections of the transmission line are shown on the diagram. The generator and transformer are rated as follows:

Gen 1 : 20 MVA, 13.8 KV, $X'' = 0.2$ pu
Gen 2 : 30 MVA, 18 KV, $X'' = 0.2$ pu
Gen 3 : 30 MVA, 20 KV, $X'' = 0.2$ pu
Tr : T_1 : 25 MVA, 220 KV/13.8, $X'' = 0.1$ pu
Tr : T_2 : 1-ϕ units each rated 10 MVA, 127/18 KV, X = 10%
Tr : T_3 : 35 MVA, 220 Y/22Y KV, X = 10%.

Draw the impedance diagram with all reactances marked in pu. Choose a base of 50 MVA, 13.8 KV.

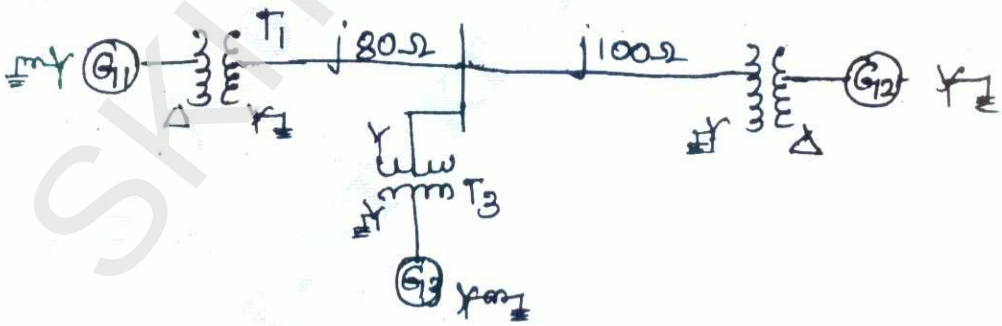

Fig.Q1(c) **(10 Marks)**

2 a. Draw the oscillogram of the short circuit current of a synchronous machine and obtain the expressions for X_d, X'_d, X''_d with the help of suitable equivalent circuits and hence show that $X''_d < X'_d < X_d$. **(10 Marks)**

b. Two generators are connected in parallel to the L.V. side of 3-ϕ Δ-Y transformer as shown in Fig.Q2(b). Ratings of Gen.1 is 50,000 KVA, 13.8 KV and that of Gen 2 is 25000 KVA, 13.8 KV and each generator has subtransiential reactance of 25%. The transformer is rated 75000 KVA, 13.8 Δ-69YKv, with a reactance of 10%. Before the fault occurs, the voltage on the H.T. tr: is 66 KV. The tr: is unloaded and there is no circulating current between the generator. Find the subtransiential current in each gen in pu, when a 3-ϕ S.C occurs on the H.T. side of tr:. Select a base in H.T. circuit.

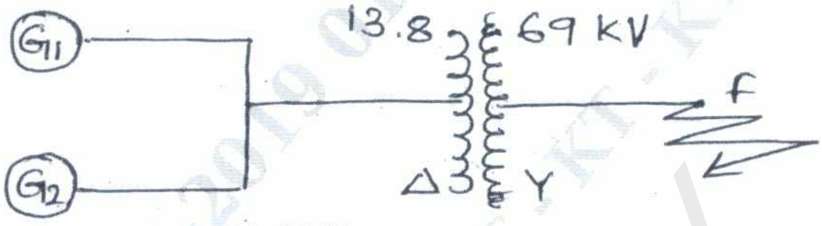

Fig.Q2(b) **(10 Marks)**

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

b. One conductor of a 3-ϕ line is open. The current flowing to the Δ-connected load through line 'a' is 10A. With the current in line 'a' as reference and assuming that line 's' is open, find the symmetrical components of the line currents. **(07 Marks)**

c. Obtain the relation between sequence components of phase and line currents in delta connected systems. **(07 Marks)**

4 a. For the following configurations of a 3-ϕ transformer, draw the winding connection and zero sequence network. **(08 Marks)**

i) Y - Δ ii) Δ - Δ iii) Y - $Y_{\perp}$ iv) $\perp$Y - Δ

b. In a 3-ϕ, 4 wire system, the sequence voltages and currents are,

$V_{a_1} = 0.9\angle 10^\circ$ pu; $V_{a_2} = 0.25\angle 110^\circ$ pu; $V_{a_0} = 0.12\angle 300^\circ$ pu

$I_{a_1} = 0.75\angle 25^\circ$ pu; $I_{a_2} = 0.15\angle 170^\circ$ pu; $I_{a_0} = 0.1\angle 330^\circ$ pu

Find the complex power in pu. If the neutral gets disconnected, find the new power. **(08 Marks)**

c. Draw a zero sequence network for the given one line diagram shown in Fig.Q4(c).

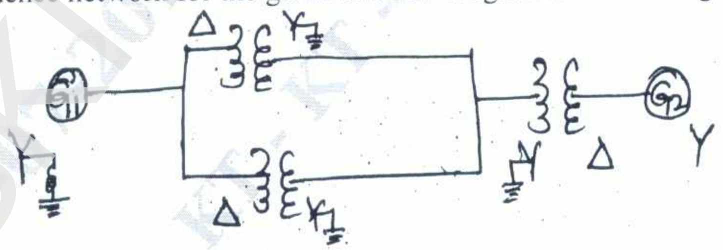

Fig.Q4(c) **(04 Marks)**

PART – B

5 a. Show that, the fault current in an unloaded generator is zero, if the neutral is not grounded in the case of LLG fault, with suitable circuit diagram and sequence networks, after deriving the expression for fault current. **(10 Marks)**

b. A 3-ϕ generator with line to line voltages of 400 V is subjected to an LLG fault. If $Z_1 = j2\Omega$, $Z_2 = j0.5\Omega$ and $Z_0 = j0.25\Omega$, determine the fault current and terminal voltages. **(10 Marks)**

6 a. Derive an expression for fault currents in case of series type of faults. (06 Marks)

b. The following data may be assumed for the network shown in Fig.Q6(b).
Generator : 50 MVA, 11 KV, $X_1 = 80\%$, $X_2 = 50\%$, $X_0 = 20\%$
Transformer : 40 MVA, 11-110 KV, $X_1 = X_2 = X_0 = 6\%$
If a L-L-G fault occurs at 'f', find the current flowing in the conductor at 'f'.

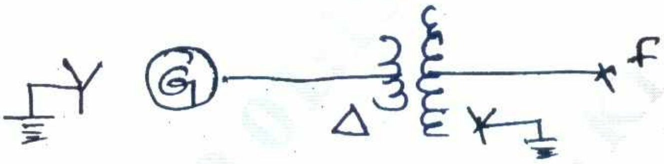

Fig.Q6(b) (10 Marks)

c. Identify the type of fault:
i) Positive, negative and zero sequence components currents are equal
ii) The fault current is not affected by neutral grounding.
iii) In the absence of neutral grounding, the fault current is zero.
iv) The positive sequence component of voltage at the point of fault is zero. (04 Marks)

7 a. Define:
i) Stability as applied to power system studies
ii) Infinite bus (04 Marks)

b. Derive the power angle equation of a non-salient pole synchronous machine connected to an infinite bus. Draw the power angle curve. (10 Marks)

c. A turbo generator, 6 pole, 50 Hz of capacity 80 MW working at 0.8 p.f. has an inertia of 10 MJ/MVA.
i) Calculate the energy stored in the rotor at synchronous speed.
ii) Find rotor acceleration if the mechanical input is suddenly raised to 75 MW for an electrical load of 60 MW. (06 Marks)

8 a. Bring out the difference between power angle curve and swing curve. What information can we get from these curves? (06 Marks)

b. Write a note on equal area criterion. (06 Marks)

c. Find the expressions for power developed and torque developed when an unbalanced supply voltage is given to 3-ϕ induction motor. (08 Marks)

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10EE62

Sixth Semester B.E. Degree Examination, June/July 2019

Switch Gear and Protection

Time: 3 hrs. Max. Marks:100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. Explain with a neat sketch, the construction and working of a HRC fuse. Also explain its properties and characteristics. **(08 Marks)**

b. Discuss the Recovery Rate Theory and Energy balance theory of ARC interruption in a circuit Breaker. **(08 Marks)**

c. Explain the difference between isolating switch and load break switch. **(04 Marks)**

2 a. Derive an expression for Restriking Voltage and Rate of Rise of Restriking Voltage (RRRV). **(07 Marks)**

b. A 50 Hz generator has an emf to neutral is 7.5 KV (rms). The reactance of the generator and the connected system is 4Ω and the distributed capacitance to neutral is 0.01 μF with negligible resistance:

i) Maximum voltage across the circuit breaker contacts

ii) Frequency of oscillation

iii) RRRV average up to first peak of oscillations. **(06 Marks)**

c. Explain the phenomenon of current chopping and capacitive current in the circuit breaker. **(07 Marks)**

3 a. Explain the construction and working of minimum oil circuit breaker. **(07 Marks)**

b. Explain the working of Air Break Circuit breaker. **(06 Marks)**

c. With a neat sketch explain the construction and working of Puffer type SF_6 Breaker. **(07 Marks)**

4 a. Explain the construction, working, advantages and disadvantages of vacuum circuit breakers. **(08 Marks)**

b. Write explanatory note on:

i) Direct testing of CB

ii) Synthetic testing

iii) Rating of circuit breaker **(12 Marks)**

PART – B

5 a. What do you mean by Protective Relaying? Discuss the desirable requirements of Protective Relaying. **(08 Marks)**

b. With a neat sketch, explain the construction and working of directional over current relay. **(12 Marks)**

6 a. Derive an expression for the torque produced by an Induction type relay. **(06 Marks)**

b. Explain with neat sketch the working of Buchholz's relay. **(06 Marks)**

c. Explain with a neat sketch, the construction and operating characteristics of percentage differential relay protection. **(08 Marks)**

7 a. Draw and explain the Merz-Price Protection of Star and Delta connected Alternator Stator windings. State its advantages. **(10 Marks)**

b. Discuss the important Faults on Alternator. **(04 Marks)**

c. A 5000 KVA, 6.6 KV, Star connected alternator has $X_S = 2\ \Omega$ per phase and 0.5 Ω resistance. It is protected by Merz-Price balanced current system which operates when the out of balance current exceeds 30% of the load current. Determine what proportion of alternator winding is unprotected if the star point is earthed through a resistor of 6.5 Ω? **(06 Marks)**

8 a. Explain with block diagram of a microprocessor based over current relay. **(06 Marks)**

b. Explain with circuit, Restricted Earth-Fault protection in a transformer. **(06 Marks)**

c. What do you mean by phase fault and ground fault in 3 phase induction motor? How the motors are protected against such faults? **(08 Marks)**

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Sixth Semester B.E. Degree Examination, June/July 2019
Electrical Machine Design

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. What are the major considerations to evolve a good electrical machine design? **(06 Marks)**

b. What are the desirable properties of insulating materials? **(04 Marks)**

c. Determine the number of poles, armature diameter and core length for the preliminary design of 500 kW, 400 V, 600 rpm, D.C. shunt generator. Assuming an average flux density in the air gap of 0.7 Wb/m^2 and specific electric loading of 38400 A/m. Take core length to pole arc = 1.1. **(10 Marks)**

2 a. Estimate the AT/pole required for the air gap of a 500 V, 6 pole, 300 rpm, lap connected DC machine. The armature core having 90 slots is 30 cm long. The pole pitch is 50 cm and pole arc is 33 cm. The air gap length may be taken as 5 mm. There are 16 conductors per slot of width 1.3 cm. Assuming 5 vertilating ducts, each of 1 cm wide. The carter's coefficient is 0.66 and 0.72 for slot / width gap of 2.6 and 2.0 respectively. **(10 Marks)**

b. The following are, particulars refer to the shunt field coil for a 440 V, 6 pole, DC generator, mmf/pole = 7000 A, Depth of winding is 50 mm, length of inner turn = 1.1 m. length of outer turn = 1.4 m, loss radiated from outer surface = 1400 W/m^2, Space factor = 0.62, resistivity = 0.02 $\Omega/m/mm^2$. Calculate the

(i) Diameter of the wire. (ii) Length of coil.
(iii) Number of turns (iv) Exciting current.

Assume voltage drop of 20% of terminal voltage across field regulator. **(10 Marks)**

3 a. Derive the output equation of 3-ϕ shell type transformer. **(08 Marks)**

b. Calculate overall dimensions for a 200 KVA, 6600/440 V, 50 Hz. Three phase core type transformer. The following data may be assumed:

Volt per turn $E_t = 10V$; $B_m = 1.3\ Wb/m^2$, $\delta = 2.5\ A/mm^2$, $K_W = 0.30$,

Overall Height = Overall width, Use a three stepped core.

(Given a = 0.90 d; b = 0.70 d; c = 0.42 d; d = diameter of circumscribing circle. Net iron Area Ai = 0.60 d^2)

Also draw the diagram showing all the overall dimensions. **(12 Marks)**

4 a. A 15000 KVA, 33/6.6 KV, Three phase Star / Delta core type transformer has the following data: Area of cross section of core limit = 0.15 m^2, Area of cross section of the yoke = 0.18 m^2, length of flux path in each limb = 2.3 m, each yoke = 1.6 m, Number of turns in HV winding = 450, AT/m in core leg is 540 A/m and the yoke is 260 A/m as obtained from magnetization curves; loss per kg in iron is 2.5 W/kg in limit and 1.4 W/kg in yoke. Density of iron is 7.8 g/CC. Estimate the no load current per phase. **(10 Marks)**

b. Design an adequate cooling arrangement for a 250 KVA, 6600/400 V, 50 Hz, 3-ϕ Delta/star core type oil immensed natural cooled transformer with the following particular:

(i) Winding temperature not to exceed 50°C
(ii) Total loss at 90°C are 5 kW.
(iii) Tank dimensions, Height × length × Width = 125 × 100 × 50 (All in cm).
(iv) Oil level = 115 cm length.

Sketch the diagram to show the arrangement of cooling tubes. **(10 Marks)**

PART – B

5 a. What are the usual values of specific loadings? With usual notations derive the output equation of a three phase induction motor. **(10 Marks)**

b. Determine the main dimensions, turns per phase and number of slots of a 250 Hp, 3-ϕ, 50 Hz, 400 V, 1410 rpm slip ring. Induction motor. Assume Bav = 0.5 Wb/m^2, (ac) = 30000 A/m; $\eta = 0.9$, p.f. = 0.9, Kw = 0.955, Ratio of core length to pole Pitch = 1.2. The machine is Delta connected. **(10 Marks)**

6 a. A 11 kW, Three phase, 6 pole, 50 Hz, 220 V, star connected induction motor has 54 stator slots each containing 9 conductors. Calculate the values of bar and end ring currents. The number of rotor bars is 64. The machine has an efficiency of 0.86 and a power factor of 0.85. The rotor mmf may be assumed to be 85% stator mmf. Also find the bar and end ring sectional areas if the current density is 5 A/mm^2. **(10 Marks)**

b. A 15 kW, 400 V, Three phase, 50 Hz, 6 pole induction motor has a diameter is 0.3 m, and core length of 0.12 m. The number of stator slots are 72, with 20 conductors per slot. Calculte the value of magnetizing current per phase if the length of air gap is 0.55 mm. The gap contaction factor is 1.2. Assume that mmf required for the iron parts is 35% in the air gap. Coil span = 11 slots. **(10 Marks)**

7 a. Explain the choice of specific magnetic and electric loadings in design of synchronous machine. **(10 Marks)**

b. Determine for a 500 KVA, 6600 V, 12 pole, 500 rpm, star connected salient pole alternator suitable value for,

(i) Diameter at the air gap.
(ii) Core length.
(iii) Number of stator slots.
(iv) Number of conductors.

Assume specific electric loading as 30000 A/m, specific magnetic loading as 0.60 Wb/m^2. Core length is 0.65 times pole pitch. Winding factor = 0.955. **(10 Marks)**

8 a. What are the methods employed to eliminate harmonics from the generated voltages in design of synchronous machine? Explain. **(10 Marks)**

b. A 588 MVA, 22000 V, 50 Hz, three phase star connected direct water cooled generator has a stator bore of 1.3 m and a stator core length of 6.0 m. If the stator winding has 2 conductors / slot, and there are two circuits / phase, calculate

(i) Number of stator slots.
(ii) Average flux density in the gap,

Assume specific electric loading as 20000 A/m and winding factor of 0.92. **(10 Marks)**

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10EE64

Sixth Semester B.E. Degree Examination, June/July 2019
Digital Signal Processing

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Determine the 8 point DFT of the Signal x(n) = {1, 1, 1, 0, 0, 0, 0, 0}. Also sketch its magnitude and phase. **(10 Marks)**

b. Given the periodic sequences x(n) = {1, 3, 5, 7}, h(n) = {2, 4, 6, 8}. Find their convolution using Stockman's method. **(10 Marks)**

2 a. The 5 samples of the 8 point DFT X(K) are X(0) = 0.25, X(1) = 0.125 – j 0.3018, X(6) = 0, X(4) = 0, X(5) = 0.125 – j 0.0518. Determine the remaining samples. **(04 Marks)**

b. Compute the N point DFT of $x(n) = a^n$ where $0 \le n \le N-1$. Hence determine the value of DFT for $x(n) = 0.5^n u(n)$ $0 \le n \le 3$. **(06 Marks)**

c. Determine the output of a linear FIR filter whose impulse response is h(n) = {1, 2, 3} and input signal x(n) = {1, 2, 3, 4, 5, 6, 7, 8, 9} using overlap save method. Use 5 point circular convolution in your approach. **(10 Marks)**

3 a. Develop decimation in Time FFT algorithm with all necessary steps and neat signal flow diagram used in computing N point DFT X(K) of a N point sequence x(n). **(10 Marks)**

b. Determine the DFT of the given sequence x(n) = {2, 1, 4, 6, 5, 8, 3, 9} by FFT algorithm which gives the output in bit reversal order. **(10 Marks)**

4 a. Find the Four point circular convolution of x(n) and h(n) using Radix x-2 DITFFT algorithm $x_1(n) = \{2, 1, 1, 2\}$ h(n) = {1, –1, –1, 1}. **(10 Marks)**

b. Develop a radix – 3 DITFFT algorithm for evaluating the DFT for N = 9 which accepts bit reversal I/P. **(10 Marks)**

PART – B

5 a. Design a Digital Butterworth digital high pass filter with the following specifications.

$$|H(e^{j\omega})| \le 0.2 \qquad 0 \le \omega \le 0.2\pi \quad T = 1\text{Sec}$$

$$0.8 \le |H(e^{j\omega})| \le 1 \qquad 0.6\pi \le \omega \le \pi$$

Using Impulse Invariant method. **(10 Marks)**

b. Convert the given analog transfer function into equivalent digital transfer function using bilinear transformation technique.

$H(s) = \dfrac{1}{(s+1)(s+2)}$. Take T = 1 sample/Sec. **(04 Marks)**

c. Determine the order of low pass filter if it has pass band attenuation of –3dB at 500Hz and stop band attenuation of –40dB at 1000 Hz. **(06 Marks)**

6 a. Explain Impulse Invariant transformation technique. (10 Marks)

b. Design Chebyshev high pass filter using bilinear transformation for the following specifications

$\omega_p = 0.2\pi \quad \omega_s = 0.01\pi$

$\alpha_p = -1\text{dB} \quad \alpha_s = -10\text{dB}$ (10 Marks)

7 a. Design an ideal low pass FIR filter whose desired frequency response is

$$H_d(e^{j\omega}) = \begin{cases} 1 & \frac{\pi}{3} \geq \omega \geq \frac{-\pi}{3} \\ 0 & \pi \geq |\omega| \geq \frac{\pi}{3} \end{cases}$$

Using Hamming window.

Determine the impulse response for N = 9. (10 Marks)

b. Design a high pass FIR filter whose desired frequency response is given by

$$H_d(e^{j\omega}) = \begin{cases} e^{-j\left(\frac{N-1}{2}\right)^{\omega}} & \pi \geq |\omega| \geq \frac{\pi}{2} \\ 0 & \pi > |\omega| \geq 0 \end{cases}$$

For N = 9 using Frequency Sampling technique. (10 Marks)

8 a. Obtain the direct form I, direct form II and parallel form realization for the transfer function. $H(z) = \dfrac{8z^3 - 4z^2 + 11z - 2}{\left(z - \frac{1}{4}\right)\left(z^2 - z + \frac{1}{2}\right)}$ (10 Marks)

b. Realize the ladder structure for

$H(z) = \dfrac{2z^{-2} + 3z^{-1} + 1}{z^{-2} + z^{-1} + 1}$. (05 Marks)

c. Realize the FIR filter having impulse response

$h(n) = \delta(n) - \frac{1}{4}\delta(n-1) + \frac{1}{2}\delta(n-2) + \frac{1}{2}\delta(n-3) - \frac{1}{4}\delta(n-4) + \delta(n-5)$

Use minimum number of multipliers. (05 Marks)

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10EE666

Sixth Semester B.E. Degree Examination, June/July 2019
Electrical Engineering Materials

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Briefly explain the properties and uses of following materials i) Copper ii) Aluminium. **(08 Marks)**
b. Explain Fermi dirac distribution. **(06 Marks)**
c. The resistance of wire increases from 40 Ω at 28°C to 49Ω at 80°C. Find the temperature coefficient and resistance of the material at 0°C. **(06 Marks)**

2 a. Write a short note on :
i) Intrinsic semiconductors ii) Extrinsic semiconductors. **(10 Marks)**
b. List the differences between hard and soft magnetic materials. **(06 Marks)**
c. A mild steel ring having a cross sectional area of $5cm^2$ and a mean circumference of 40cm is wound with 200 turns. For an exciting current of 6.4A, through the coil, the total flux produced was found to be 0.8mwb. Determine : i) Flux density ii) Field intensity. **(04 Marks)**

3 a. Define dielectric strength. Explain the factors affecting the dielectric strength. **(06 Marks)**
b. An air condenser of capacitance 0.005μF is connected to a DC supply of 500V. It is then disconnected from the supply and immersed in oil with a dielectric constant of 2.5. Find the energy stored in condenser before and after immersion. **(06 Marks)**
c. Write a short note on :
i) Dipolar relaxation ii) Dielectric loss. **(08 Marks)**

4 a. Explain the mechanical and thermal properties of insulating materials. **(12 Marks)**
b. Explain different types of insulating varnishes. **(08 Marks)**

PART – B

5 a. With a neat sketch, explain the working of Fuel cell. **(10 Marks)**
b. With the help of neat diagram explain the working of solar photo voltaic cell. **(10 Marks)**

6 a. Explain in detail about magnetic resonance. **(08 Marks)**
b. Explain in detail about atomic absorption spectroscopy. **(12 Marks)**

7 a. What are shape memory alloys? Explain their effects. Also explain their properties and applications. **(12 Marks)**
b. Explain the properties of Electro Archeological Fluids and mention their applications. **(08 Marks)**

8 a. What are ceramics? How these are classified? Explain the properties of each class in brief. **(12 Marks)**
b. Explain the following :
i) Rubber ii) Thermoplasts. **(08 Marks)**

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