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10EE61

Sixth Semester B.E. Degree Examination, Dec.2015/Jan.2016

Power System Analysis and Stability

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 advantages of per unit system? **(04 Marks)**

b. Draw the per phase basis modeling of synchronous machine, transformer, transmission Line and Load. **(04 Marks)**

c. A 300MVA, 20KV three – phase generator has a subtransient reactance of 20%. The generator supplies a number of synchronous motors over a 64km transmission line having transformers of Fig. Q1 (c). The motors, all rated 13.2KV, are represented by just two equivalent motors. The neutral of one motor M_1 is grounded through reactance. The neutral of second motor M_2 is not connected to ground. Rated inputs to the motors are 200MVa and 100MVA for M_1 and M_2 respectively. For both motors $X'' = 20\%$ the three – phase transformer T_1 is rated 350MVA, 230/20KV with leakage reactance of 10%. Transformer T_2 is composed of three single phase transformers each rated 127/13.2KV, 100MVA with leakage reactance of 10%. Series reactance of transmission line is 0.5 Ω/km. Draw the reactance diagram with all reactance's marked in per unit. Select the generator rating as base in the generator circuit. **(12 Marks)**

Fig. Q1 (c)

2 a. With the help of waveform at the time of three phase symmetrical fault on 3 – ϕ synchronous generator, define synchronous reactances. (steady state, transient and sub – transient condition). **(06 Marks)**

b. A synchronous generator and synchronous motor each rated 25MVA, 11KV having 15% subtransient reactance are connected through transformers and line as shown in Fig Q2 (a) . The transformers are rated 25MVA, 11/66KV and 66/11KV with leakage reactance of 10% each. The line has a reactance of 10% on base of 25MVA, 66KV. The motor is drawing 15MW at 0.8 power factor leading and terminal voltage of 106 KV when a symmetrical three phase fault occurs at the motor terminals. Find subtransient current in the generator motor and fault.

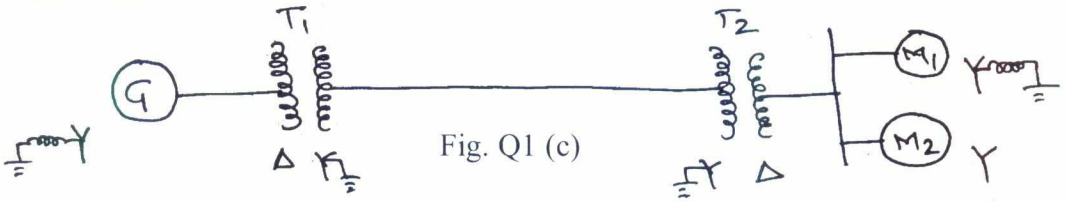


Fig. Q1 (c)

Choose base of 25MVA, 11KV in the generator circuit. **(14 Marks)**

3 a. Derive phase currents of unbalanced system in terms of sequence currents. **(05 Marks)**

b. Develop an expression for three phase power in terms of symmetrical components. **(05 Marks)**

c. A delta connected balanced resistive load is connected across an unbalance three phase supply as shown in Fig Q3 (c). With currents in lines A and B specified, find the symmetrical components of line currents. **(10 Marks)**

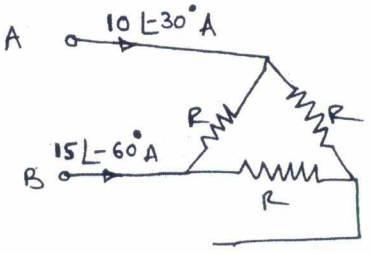
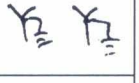
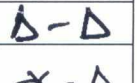


Fig. Q3 (c)

4 a. Draw zero sequence equivalent circuits of three phase transformer banks, together with diagram of connections and the symbols for one line diagram for following configuration. **(06 Marks)**

i)	
ii)	
iii)	Δ-Y
iv)	Δ-Δ
v)	

b. A 25MVA, 11KV, three phase generator has a subtransient reactance of 20%. The generator supplies two motors over a transmission line with transformers at both ends as shown in the one – line diagram of Fig Q4 (b). the motors have rated inputs of 15 and 7.5MVA, both 10KV with 25% subtransient reactance. The three phase transformers are both rated 30MVA, 10.8/121KV, connection Δ - Y with leakage reactance of 10% each. The series reactance of the line is 100ohms. Assume zero sequence reactances for the generator and motors of 0.06 pu – current limiting reactors of 2.5 ohms each are connected in the neutral of the generator and motor No.2. The zero sequence reactance of the transmission line is 300 ohms. Choose base of 25MVA and 11KV in generator circuit. Assume that negative sequence reactance of each machine is equal to its subtransient reactance. Draw the Positive, Negative and zero sequence networks of the system with reactances marked in per unit.

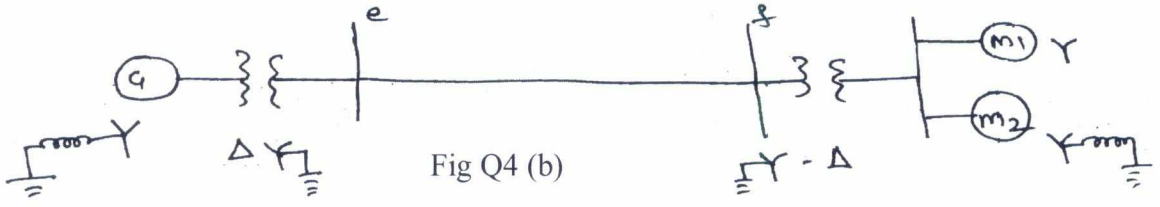


Fig Q4 (b)

(14 Marks)

PART – B

5 a. Derive the equation for the fault current when single – line – to – ground fault occurs on an unloaded generator. **(08 Marks)**

b. A salient – pole generator without dampers is rated 20MVA, 13.8KV and has direct axis subtransient reactance of 0.25 pu. The negatively, 0.35 and 0.10 per unit. The neutral of the generator is solidly grounded. Determine the subtransient current in the generator for subtransient conditions when a double link – to – ground fault occurs at the terminals of the generator. Assume that the generator is unloaded and operating at rated voltage when fault occurs Neglect resistance. **(12 Marks)**

6 a. Write a note on open conductor faults in power system. **(08 Marks)**

b. A two bus system is shown below the generators G_1 and G_2 are identical Neglecting pre – fault current and losses, calculate the fault current for L-G fault at bus – 1. All pu reactances are based on common base values.

Reactances of components (on common box)

Equipment	+ve sequence reactance (pu)	-ve sequence reactance (pu)	Zero sequence reactance (pu)
a_1	0.17	0.14	0.05
a_2	0.17	0.14	0.05
T_1	0.11	0.11	0.11
T_2	0.11	0.11	0.11
Line	0.22	0.22	0.60

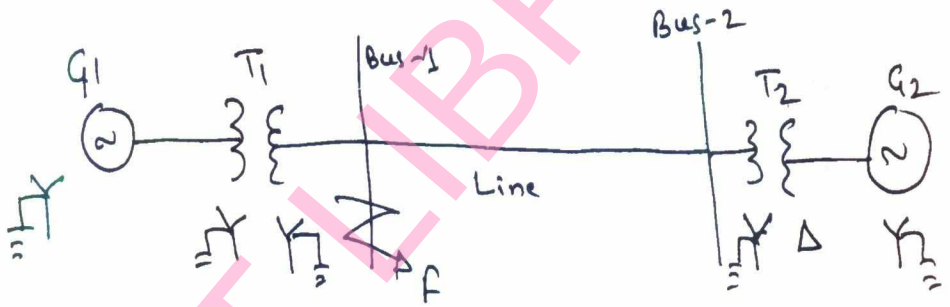


Fig Q6 (b)

(12 Marks)

7 a. Derive the swing equation

$$m\frac{d^2\delta}{d+2} =) P_a = P_s - P_e$$ **(06 Marks)**

b. Derive expression for critical clearing angle. **(08 Marks)**

c. A 50Hz, four pole turbo – generator rated 100MVA, 11KV has an inertia Constance of 2 MJ/MVA.

i) Find the stored energy in the rotor at synchronous speed.

ii) If mechanical input is suddenly raised to 80mw for an electrical load of 50mw, find rotor acceleration, neglecting mechanical and electrical losses. **(06 Marks)**

8 Write short notes on :

a. Operation of 3 – Q Induction motor with one line open.

b. Steady state and transient stability.

c. Line – Line fault on unloaded generator.

d. Concept of equal area criterion. **(20 Marks)**

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10EE62

Sixth Semester B.E. Degree Examination, Dec.2015/Jan.2016
Switchgear and Protection

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Explain the construction and working of a HRC fuse with a neat sketch. List the advantages and disadvantages. **(10 Marks)**

b. Write a short note on energy management of power. **(05 Marks)**

c. Explain difference between isolating switch and load breaking switch. **(05 Marks)**

2 a. What is Resistance switching? Derive an expression for critical value of resistance to be added to circuit breaker. **(08 Marks)**

b. Explain in detail, two theories of arc interruption in circuit Breakers. **(06 Marks)**

c. In a 132KV system, the reactance and capacitance up to the location of the circuit breaker is 3Ω and 0.015 respectively. Calculate the following :
i) The frequency of transient oscillation
ii) Maximum value of restriking voltage across the contacts of the circuit Breaker and
iii) Maximum value of rate of rise restriking voltage. **(06 Marks)**

3 a. Explain the working of an air blast circuit breaker with reference to
i) Axial blast ii) Cross blast **(12 Marks)**

b. Explain the properties of SF_6 gas. **(08 Marks)**

4 a. With a neat diagram explain the short circuit test on circuit breaker. **(08 Marks)**

b. With a neat diagram, explain any one type of synthetic testing of circuit Breaker. **(06 Marks)**

c. Explain the phenomenon of lightning discharge. **(06 Marks)**

PART – B

5 a. Explain the concept of primary and back up protection. **(06 Marks)**

b. What are the essential qualities of a protective relay? Explain them briefly. **(10 Marks)**

c. What is Relay? Define : i) Pickup level ii) burden iii) dropout with respect to relays. **(04 Marks)**

6 a. With a neat sketch, explain the working of induction type directional over current relay. **(10 Marks)**

b. Explain with a neat circuit, the working of voltage balance differential relay. **(05 Marks)**

c. Explain the working principle of an impedance Relay. **(05 Marks)**

7 a. Draw and explain the Merz – Price protection of alternator stator windings, state its advantage (Y and Δ connected alternators). **(10 Marks)**

b. A 6.6KV, star connected alternator has a transient reactance of 2Ω per phase and negligible winding resistance. It is protected by circulating current Merz – Price protection. The alternator neutral is earthed through the resistance of 7.5Ω. The relays are set to operate when there is out of balance current of 1 ampere in secondary of 500/5 amper current transformers. How much % of winding is protected against earth fault? **(10 Marks)**

8 a. With the basic circuit diagram, explain the harmonic restraint relay protection for a transformer. **(08 Marks)**

b. Explain single phasing in induction motors. How motor is protected from single phasing. **(08 Marks)**

c. List the various abnormal conditions against which large induction motor has to be protected. **(04 Marks)**

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10EE63

Sixth Semester B.E. Degree Examination, Dec.2015/Jan.2016
Electrical Machine Design

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. ***Draw figures wherever necessary.***
3. ***Assume suitable values for any missing data.***

PART – A

1 a. What are the desired properties of insulation materials used in electrical machines? Name some insulation materials and state where they are utilized. **(04 Marks)**

b. Derive the output equation of a D.C. machine. **(06 Marks)**

c. Calculate the diameter and length of armature core of a 70 kW, 240 V, 900 rpm, 4 pole D.C. shunt generator. The average flux density is 0.7 webers/metre^2 and AC/m is 34,000. The ratio of core length to pole pitch is 0.8. Full load armature drop is 9.6 V and field current is 3.0 Amperes. **(10 Marks)**

2 a. Discuss the factors which influence the selection of, i) number of poles ii) number of slots iii) air gap of a DC machine. **(06 Marks)**

b. Discuss why the armature core, field poles of a D.C. machine are laminated, while yoke is not normally laminated. **(04 Marks)**

c. A shunt field coil has to develop an mmf of 9000 AT. The voltage drop in the coil is 40 V and resistivity of round wire used is 0.021 ohms/meters/mm^2. Depth of winding is 35 mm approximately and length of mean turn is 1.4 m. Design a coil so that the power dissipated is 700 W/m^2 of the total coil surface (outer, inner top and bottom). Take the diameter of the insulated wire to be 0.2 mm greater than the bare copper. **(10 Marks)**

3 a. Show that the output of a 3 phase core type transformer is $5.23\ f.B_m H.d^2 H_W \times 10^{-3}$ KVA where 'f' is the frequency, B_m – the maximum value of flux density in webers/m^2, d is the effective diameter of the core in meters, H is the magnetic potential gradient in the limit in amperes/metre and H_W is the height of window in meteres. **(10 Marks)**

b. The ratio of flux to full load mmf in a 400 KVA 50 Hz, single phase core type power transformer is $.2.4 \times 10^{-6}$. Calculate the net cross area and the window area of the transformer maximum flux density in the core is 1.3 weber/metre^2, current density 2.7 A/mm^2 and window space factor is 0.26. Also calculate the full load mmf. **(10 Marks)**

4 a. For a constant total volume of conductors in a transformer. Show that for a minimum copper loss, current densities in the windings must be equal. **(04 Marks)**

b. A single phase, 400 V, 50 Hz transformer is built from stampings having a relative permeability of 1000. Length of flux path is 2.5 m, area of cross section of the arc is 2.5×10^{-3} metre^2 and the primary winding has 800 turns. Estimate the maximum flux and no load current of the transformer. Given loss at working flux density is 2.6 w/kg. Given weighs 7.8×10^3 kg/m^3. Stacking factor is 0.9. **(08 Marks)**

c. A 3 phase, 50 Hz oil cooled core type transformer has the following dimensions. Distance between core centres 0.2 m, height of window 0.24 m. Diameter of circumscribing circle is 0.14 m. Flux density in the core is 1.25 Wb/m^2 and the current density in the conductors is 2.5 A/mm^2. Estimate the KVA rating. Assume a window space factor of 0.2 and a core area factor of 0.56, core is 2 stepped. **(08 Marks)**

PART – B

5 a. Discuss the factors to be considered while choosing the number of slots for the rotor of an induction motor. **(04 Marks)**

b. What are the effects of increasing the air gap of an induction motor? **(04 Marks)**

c. A 30 H.P., 3 phase, 440 V, 960 rpm, 50 Hz delta connected induction motor, has a specific, electric loading of 25,000 AC/m and a specific magnetic loading of 0.46 webers/metre^2. The full load efficiency is 86%, pf is 0.87, Pole pitch core length = 1. Find following : i) Stator core dimensions ii) Number of stator slots and the number of turns in the stator winding. **(12 Marks)**

6 a. Discuss the advantages of skewing the rotor slots in an induction motor. **(04 Marks)**

b. What are the factors to be considered while designing the rotor of a slip ring induction motor? **(04 Marks)**

c. A 90 kw, 500 V, 50 Hz, 3 phase induction motor has a star connected, stator winding accommodated in 63 slots with 6 conductors/slot. If the slip ring voltage on open circuit is to be about 400 V, find a suitable rotor winding stating,
i) Number of slots ii) Number of conductors/slot iii) Coil span iv) Approximate full load current per phase in rotor. Assume efficiency of 90% and p.f. of 0.86. **(12 Marks)**

7 a. Discuss the factors which influence the selection of stator (armature) slots in an alternator. **(05 Marks)**

b. Derive the output equation of an alternator. **(05 Marks)**

c. Design suitable values of diameter and length of a 75 MVA, 11 KV, 50 Hz, 3000 rpm, 3 phase star connected alternator. Also determine the value of flux, conductors / slot, number of turns / phase and size of armature conductors.
Given :
Average gap density = 0.6 webers/meter^2
Ampere conductors/meter = 50,000
Peripheral speed = 180 metres/sec
Winding factor = 0.95
Current density = 6 A/mm^2 **(10 Marks)**

8 a. Define SCR and explain its effect on machine performance. **(08 Marks)**

b. The field coils of a salient pole alternator are wound with a single layer winding of a bare copper strip of 30 mm deep, with separating insulation of 0.15 mm thick. Determine a suitable winding length, number of turns and thickness of conductors to develop an mmf of 12000 AT with a potential difference of 5 volts per coil and with a loss of 1200 watts/metre^2 of total coil surface. The mean length of turn is 1.2 m and resistivity of copper is 0.021 Ω/m/mm^2. **(12 Marks)**

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10EE64

Sixth Semester B.E. Degree Examination, Dec.2015/Jan.2016
Digital Signal Processing

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. List and state any four properties of DFT. **(06 Marks)**

b. Find the DFT of a sequence $x(n) = \{1, 1, 0, 0\}$ and find the IDFT of $Y(K) = (2, 1+j, 0, 1-j)$ **(08 Marks)**

c. Consider the finite length sequence x(n) shown in Fig. Q1 (c). The five point DFT of x(n) is denoted by X(K). Plot the sequence whose DFT is $Y(K) = e^{\frac{-4\pi K}{5}} X(K)$. **(06 Marks)**

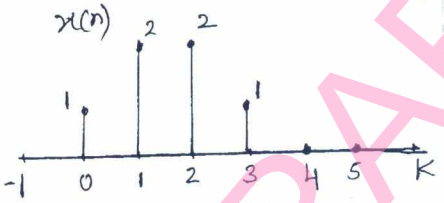

Fig. Q1 (c)

2 a. Perform the circular convolution of the following sequence $x(n) = \{1, 1, 2, 1\}$, $h(n) = \{1, 2, 3, 4\}$ using DFT and IDFT method. **(08 Marks)**

b. Find the output y(n) of a filter whose impulse response is $h(n) = \{1, 1, 1\}$ and input signal $x(n) = \{3, -1, 0, 1, 3, 2, 0, 1, 2, 1\}$ using overlap–add method. Use 5-point circular convolution in your approach. **(12 Marks)**

3 a. What is FFT? Explain Decimation-in-Time algorithm. **(08 Marks)**

b. Given the sequences $x_1(n)$ and $x_2(n)$ below. Compute the circular convolution $x_1(n) \circledast_N x_2(n)$ for N = 4. Use DIT – FFT algorithm. **(12 Marks)**

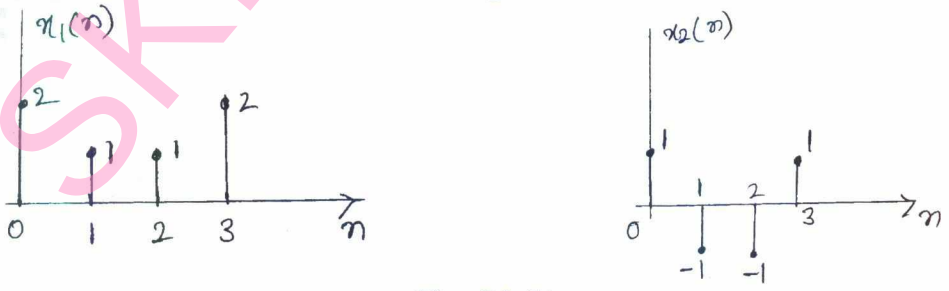

Fig. Q3 (b)

4 a. What is DIF algorithm? Draw the 4-point radix-2 DIF-FFT Butterfly structure for DFT. **(06 Marks)**

b. Find the 4-point real sequence x(n), if its 4-point DFT samples are $X(0) = 6$, $X(1) = -2 + j2$, $X(2) = -2$. Use DIF-FFT algorithm. **(08 Marks)**

c. Find the 4-point DFT of the sequence, $x(n) = \cos\left(\frac{\pi}{4}n\right)$ using DIF-FFT algorithm. **(06 Marks)**

PART – B

5 a. Distinguish between analog and digital filters. **(04 Marks)**

b. Design an analog Bandpass filter to meet the following frequency-domain specifications:
i) a -3.0103 dB upper and lower cutoff frequency of 50 Hz and 20 kHz.
ii) a stopband attenuation of atleast 20 dB at 20 Hz and 45 kHz and
iii) a monotonic frequency response. **(10 Marks)**

c. The system function of the analog filter is given by $H_a(s) = \frac{s+0.1}{(s+0.1)^2+9}$.
Obtain the system function of the IIR digital filter by using Impulse invariance method. **(06 Marks)**

6 a. A Chebyshev – I filter of order N = 3 and unit bandwidth is known to have a pole at $s = -1$.
i) Find the two other poles of the filter and parameter ε.
ii) The analog filter is mapped to the z-domain using the bilinear transformation with T = 2.
Find the transfer function H(z) of the digital filter. **(12 Marks)**

b. Distinguish between Butterworth and Chebyshev filter. **(04 Marks)**

c. What is Bilinear transformation? Explain warping and prewarping effect. **(04 Marks)**

7 a. What is Gibb's phenomenon? **(04 Marks)**

b. Distinguish between FIR and IIR filters. **(04 Marks)**

c. A filter is to be designed with the following desired frequency response:

$$H_d(w) = \begin{cases} 0 & -\frac{\pi}{4} < w < \frac{\pi}{4} \\ e^{-j2w} & \frac{\pi}{4} < |w| < \pi \end{cases}$$

Find the frequency response of the FIR filter designed using a rectangular window defined below:

$$W_R(n) = \begin{cases} 1 & 0 < n < 4 \\ 0 & \text{Otherwise} \end{cases}$$ **(12 Marks)**

8 a. Sketch the direct form-I, direct form-II realizations for the system function given below:

$$H(z) = \frac{2z^2+z-2}{z^2-2}.$$ **(10 Marks)**

b. Obtain a Cascade realization for a system having the following system function:

$$H(z) = \frac{(z-1)(z-2)(z+1)z}{\left(z-\frac{1}{2}-j\frac{1}{2}\right)\left(z-\frac{1}{2}+j\frac{1}{2}\right)\left(z-j\frac{1}{4}\right)\left(z+j\frac{1}{4}\right)}.$$ **(10 Marks)**

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10EE666

Sixth Semester B.E. Degree Examination, Dec.2015/Jan.2016
Electrical Engineering Materials

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 different types of materials used for the manufacturing of brushes. **(10 Marks)**

b. With usual notations prove that $R_T = R_t[1+\alpha_t(T-t)]$. **(10 Marks)**

2 a. Bring out the differences between hard and soft magnetic materials. **(06 Marks)**

b. The total loss in a sample of sheet weighing 10 kg is 20watts at 50 c/s and 35 watts in 75 c/s, both being, measured at the same peak flux density. Separate the loss at 50 c/s into its hysteresis and eddy current components. **(08 Marks)**

c. An electric field of 80 v/m in applied to a sample of n-type semiconductor whose hall coefficient is –0.0125 m^3/c. Determine the current density in the sample $\mu_c = 0.36\ m^2\ v^{-1}\ s^{-1}$. **(06 Marks)**

3 a. With a neat sketch, explain the testing of transformer oil as per ISI standards. **(10 Marks)**

b. Define dielectric materials. What are the types of dielectric materials? Explain the behaviour of dielectric in alternating fields. **(10 Marks)**

4 a. What is polarization? Explain the different types of polarization. **(10 Marks)**

b. List out the properties of SF6 gas. **(05 Marks)**

c. A condenser is connected for 0.25 seconds across 220 V supply. The current being kept steady at 0.22 A. Calculate its charge and capacitance. **(05 Marks)**

PART – B

5 a. With a neat sketch, explain the working of fuel cell. **(08 Marks)**

b. Explain the working of solar photovoltaic cell with the help of neat sketch and write the equivalent circuit and VI characteristics. **(12 Marks)**

6 a. What is Electron Spin Resonance (ESR)? Explain the experimental setup of ESR with suitable graphs. **(10 Marks)**

b. Explain the concept of Nuclear Magnetic Resonance (NMR) with the help of experimental set up. **(10 Marks)**

7 a. What are the advantage, disadvantages and applications of piezoelectric devices? **(08 Marks)**

b. Write a note on smart hydro-gel. **(06 Marks)**

c. What is magnetostriction? Explain the types of magnetostriction with neat graphs. **(06 Marks)**

8 a. What is plastic? What are the properties of plastic? **(08 Marks)**

b. Bring out difference between thermoplastic and thermosetting plastic. **(08 Marks)**

c. Write a note on rubber. **(04 Marks)**

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