Maximum Marks: 60
Answer all questions.

2012–2013
B.TECH. (V-SEMESTER) EXAMINATION
(ELECTRICAL ENGINEERING)
ELECTRICAL MACHINE – II (EE – 312N)

1 (a) Explain what do you understand by the term ‘Armature Reaction’ of a synchronous machine. Discuss its effects at unity, lagging and leading power factors.
(b) Derive the expression for power developed by a three phase salient pole alternator neglecting armature resistance. Draw the power/load angle characteristics and explain the terms excitation power and reluctance power.

OR

1' (a) Explain how the values of Xd and Xq of a synchronous machine are measured experimentally by “Slip test”. Discuss the precautions used.
(b) The following data refers to 6 poles, 440 volts, 50Hz, three phase star connected alternator. The effective armature resistance is 0.15 ohm/phase.

<table>
<thead>
<tr>
<th>Field current (amp)</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>10</th>
<th>12</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>O.C. terminal voltage (volt.)</td>
<td>156</td>
<td>288</td>
<td>396</td>
<td>440</td>
<td>474</td>
<td>530</td>
<td>568</td>
<td>592</td>
</tr>
<tr>
<td>Short circuit current (Amp.)</td>
<td>11</td>
<td>22</td>
<td>34</td>
<td>40</td>
<td>46</td>
<td>57</td>
<td>69</td>
<td>80</td>
</tr>
</tbody>
</table>

Calculate the voltage regulation by M.M.F. method for full load output of 40 Amp at rated voltage and 0.8 p.f. lagging.

2 (a) What are the conditions which should be satisfied in order that an incoming alternator may be connected in parallel with infinite bus bar. Describe One Dark Two Bright Lamp method of synchronizing a three phase alternator with bus bar.
(b) Explain effect of change of excitation of a synchronous motor at constant load and hence explain the V-curves.

OR

2' (a) Explain the effect of governor characteristics on load sharing between alternators operating in parallel. Also derive an expression of power shared between two alternators in terms of their no load and full load frequencies of governor characteristics.
(b) A three phase alternator has rated voltage of 6.6 kV and a synchronous reactance of 5 ohm/phase and supplies 300 Amp at 0.8 p.f. lagging to infinite bus bar. Calculate the current and its power factor supplied by alternator if the excitation is increased by 25% keeping steam input unchanged.
3 (a) Draw and explain the equivalent circuits of a synchronous machine in d-axis and q-axis. Hence, explain the subs-transient reactance $s$ of the machine.

(b) Why a three phase synchronous motor is not self starting? Explain how it can be started as a squirrel cage induction motor using damper windings.

4 (a) Explain 'commutation' in d. c. machines. Also discuss the function of interpole windings.

(b) Define and explain 'armature reaction' in d.c. machine. Derive the expression for 'demagnetizing' and 'cross magnetizing' ampere turns.

OR

(b') A shunt generator delivers 50kW at 250V and 400 rpm. The armature and field resistance are 0.02 ohms and 50 ohms respectively. Calculate the speed of the same machine running as a shunt motor and taking 50kW input at 250 V. Allow 1 volt per brush for contact drop.

5 (a) Why a d. c. motor draws a large current at starting. Explain the function of a d. c. shunt motor starter with 'No-volt' and 'over-load' coils with the help of a neat diagram of the starter.

(b) Write short notes on any one:
   (i) Universal motor
   (ii) Hysteresis motor
1. (a) Discuss the turn on mechanism of SCR using the two transistor model. (6 + 6)
(b) What structural changes are made in the GTO to achieve turn off capability? Show that a negative gate current is necessary to turn off a GTO.

OR

(b') For the circuit configuration shown in Fig. 1, input voltage is $V_s = 200$ V with load resistance $R = 5$ Ω. The load and stray inductances are negligible and the thyristor is operated at a frequency of $f_s = 2$ kHz. If the required $dV/dt$ is 100 V/μs and the discharge current is to be limited to 100 A. Determine:

(i) the values of snubber circuit components $R_s$, $C_s$,
(ii) snubber loss, and
(iii) the power rating of snubber resistor.

![Circuit Diagram](image)

Fig. 1

2. (a) Describe the various types of SCR triggering signals. Also mention the basic requirements of triggering signals. (6 + 6)
(b) With the help of suitable circuit and waveforms describe the working of R-triggering
scheme. Explain why the firing angle that can be obtained by this scheme is limited to 90°.

OR

(b') A UJT based triggering circuit has the following specifications:

\[ \eta = 0.65, \ I_p = 0.8 \ mA, \ V_p = 20 \ V, \ V_v = 0.7 \ V, \ V_D = 0.5 \ V, \ R_{\beta \beta} = 5 \ k\Omega, \]

\[ C = 0.05 \mu F, \ f = 2 \ kHz. \]

If the minimum gate voltage to trigger the SCR is 0.4 V, determine:

(i) The values of \( R_1, R_2 \) and \( R \)
(ii) Check whether \( R \) is within permissible limits
(iii) Values of \( R_{\beta 1} \) & \( R_{\beta 2} \)
(iv) Range of oscillator frequency
(v) Draw the oscillator circuit & incorporating the values of circuit parameters
(vi) Draw the output triggering pulse waveform.

3. (a) Draw the circuit of a single-phase full-bridge converter supplying a resistive load. (6 + 6)

Draw the waveform of (i) source voltage (ii) output voltage (iii) source current and (iv) anode to cathode voltage across any one thyristor for \( \alpha = 90^\circ \). Determine the average value of the output voltage if the supply voltage is given to be 100 volts.

(b) Define the following performance parameters of a converter:

(i) Ripple factor (ii) Form factor (iii) Displacement factor (iv) Total harmonic distortion.

What are the ideal values of these parameters?

OR

3'. Draw the waveform of output voltage and source current of a two-pulse semi-converter and show that the fundamental component of the source current is given by

\[ i_s = \frac{4I_a}{\pi} \cos(\alpha/2) \sin(\omega t - \alpha/2) \]

Where \( I_a \) is the magnitude of the ripple-free output current.

4. Draw the circuit of a three-phase semi-converter. If the converter is supplying a highly inductive load, draw the waveforms of the 3-phase input line voltage, output voltage, and voltage across any one thyristor and current through any one phase of the input source for \( \alpha = 60 \) degrees. Clearly indicate the conduction interval of each device. Determine the average value of the output voltage if the line-to-line input voltage is given to be 400 volts.

5. Write short technical notes on any TWO of the following: (6 x 2)

(i) Cosine wave crossing Control Scheme
(ii) Ramp Control Scheme
(iii) Digital firing angle control scheme
(iv) Dual Converters

---End of question paper---
2012-2013  
B.TECH (AUTUMN SEMESTER) EXAMINATION  
(ELECTRICAL ENGINEERING)  
POWER ELECTRONICS II  
(EE-322 N)  

Maximum Marks: 60  
Credits : 4  
Duration: Three Hours  

Note:  
(i) Answer all questions.  
(ii) Symbols have their usual meanings.  
(iii) Assume suitable values for missing data  

<table>
<thead>
<tr>
<th>Q.1</th>
<th>(a) Compare the main features of a power BJTs and power MOSFETs.</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(b) Draw the internal structure of a p-channel MCT and explain its operation with the help of its equivalent circuit.</td>
<td>(6)</td>
</tr>
<tr>
<td></td>
<td><strong>OR</strong></td>
<td></td>
</tr>
<tr>
<td>Q.1'</td>
<td>(a) Draw the schematic symbol and internal structure of various p-n layers of SIT. Explain its operation with the help of output characteristics.</td>
<td>(6)</td>
</tr>
<tr>
<td></td>
<td>(b) Plot the dynamic characteristics of a MCT and mark various time durations. Indicate their approximate numerical values.</td>
<td>(4)</td>
</tr>
<tr>
<td></td>
<td>(c) What are the main functions of driving and isolation circuits?</td>
<td>(2)</td>
</tr>
<tr>
<td>Q.2</td>
<td>Draw a labeled diagram of a dc-dc Cuk converter. What are its main features? Explain its operation with the help of switching diagrams and waveforms. Establish the relationship between input and output voltages. Find the expressions for minimum inductance required to ensure continuous current conduction in both inductors. Also obtain the expression for peak to peak voltage ripple across capacitor $C_t$.</td>
<td>(12)</td>
</tr>
<tr>
<td>Q.2'</td>
<td>For a boost converter, establish the relationship for average inductor current and average output current at the boundary of continuous / discontinuous conduction. Plot these characteristics as a function of duty cycle. Also establish the expression for minimum inductance required for continuous conduction. (12)</td>
<td></td>
</tr>
<tr>
<td>Q.3 (a)</td>
<td>Explain the principle of series compensation of transmission line using the power electronic controller. Establish the relationship for active power flowing through the transmission line and reactive power supplied by the series source. (6)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A capacitor is connected across TCR to control the fine capacitive VAR. The ac source is 220 V, 50 Hz. The capacitive and inductive reactances are 10 Ω and 12 Ω respectively. Calculate for α = 120° (a) THD of inductive current alone, (b) the fundamental component of the input line current and (c) net lagging reactive power that can be compensated by this. (6)</td>
<td></td>
</tr>
<tr>
<td>Q.3'</td>
<td>Draw the circuit diagram of a single phase ac voltage controller with RL load and explain its operation with phase control. Sketch the relevant waveforms. Establish the relationship for instantaneous load current, rms output voltage, rms output current, rms and average thyristor current. (12)</td>
<td></td>
</tr>
<tr>
<td>Q.4</td>
<td>Draw a neat labelled diagram of a McMurray half bridge inverter. Explain its detailed operation with the help of waveforms and switching diagrams. (12)</td>
<td></td>
</tr>
<tr>
<td>Q.5</td>
<td>For a sinusoidal PWM control of 1-ph bridge inverter, how the gate pulses for various transistors are generated. Show relevant waveforms for four output pulses per half cycle. Obtain the expression for total rms output voltage as well as rms value of the nth component of the output voltage. What is the order of the most predominant lowermost harmonics for which filter has to be designed? (12)</td>
<td></td>
</tr>
</tbody>
</table>
Maximum Marks: 60

Answer ALL questions.
Assume suitable of any missing data.
Symbols and abbreviations have their usual meaning.

Q.No.  Question                                                                 M.M.
1(a)   Explain in detail the nature and causes of faults. Describe the consequences of faults on a power system.  [05]
1(b)   Describe the construction, principle of operation and application of an a.c. directional relay  [07]

OR

1'(a)   Describe the essential features of protective relay with respect to reliability discrimination.  [05]
1'(b)   “Percentage differential relay is an improvement over plain differential relay”. derivate equations and discuss the given statement.  [07]
2(a)   Describe with neat sketch construction and working of Bucholz relay.  [06]
2(b)   Describe the protection of a 3 phase, 11 kV, 50Hz alternator against unbalanced loading.  [06]

OR

2’ What is meant by 3 – zone protection, explain? With contact circuit diagram and relay characteristics, explain the protection of a long transmission line.  [12]

3(a)   Discuss the energy balance theory of arc interruption in a circuit breaker.  [04]
3(b)   Define the terms restriking voltage and recovery voltage. Obtain an expression for restriking voltage in terms of circuit parameters.  [08]
4(a)   What different tests are carried out to prove the ability of a CB, explain.  [05]
4(b)   Describe a Puffer type SF₆ circuit breaker. Enumerate its distinct advantages over other type of CB.  [07]

OR

(b')   Justify the use of composite material for the contact of vacuum circuit breaker.  [07]

5(a)   What are the various types of neutral grounding, explain briefly.  [06]
5(b)   (b) Explain clearly the need of insulation coordination in a power system  [06]
2012 – 2013
B. TECH. AUTUMN (V SEMESTER) EXAMINATION
ELECTRICAL ENGINEERING
(Power System Protection)
COURSE NO.: EE – 333N

Maximum Marks: 60 Credits: 04 Duration: Three Hours

Answer ALL questions.
Assume suitable value of any missing data.
Symbols and abbreviations have their usual meanings

1. (a) Discuss briefly the essential features of protective relay with respect to reliability and selectivity. 

(b) Explain clearly the terms PSM and TSM as applied to I.D.M.T. relay. 

OR 

1' (a) What is universal torque equation? Using this equation obtain an expression for MHO relay. Also draw its characteristics. 

(b) Describe how an amplitude comparator can be converted to phase comparator. 

2 Explain the effect of magnetizing inrush current on protective system of a transformer. Why desensitizing of relay will not provide satisfactory result? Describe harmonic current restraint scheme. 

OR 

2'(a) What are various abnormal conditions in a large alternator against which protection is necessary? Explain. 

(b) With contact circuit diagram and relay characteristics, explain the three zone protection of a long transmission line. 

3 (a) Describe Sleipian Theory of arc interruption in circuit breaker. 

(b) Define the terms restriking voltage and recovery voltage. Obtain an expression for restriking voltage in terms of circuit parameters. 

4 (a) Compare the merits and demerits of SF₆ gas as an arc quenching medium with air. 

(b) With the help of a neat sketch, discuss the construction and working of vacuum circuit breaker. Also mention its limitations. 

5 (a) What are the various types of neutral grounding schemes? Describe briefly. 

(b) Describe the construction, working and characteristics of a gapless arrestor.  

OR

(b') Enumerate the causes of different types of Overvoltages which may occur in a power system. Discuss how overhead ground wire provides protection to transmission lines against lightning Overvoltages?
2012-2013
B.Tech. AUTUMN (V SEMESTER) EXAMINATION
(ELECTRICAL ENGINEERING)
DYNAMIC SYSTEM ANALYSIS (EE-341N)

Maximum Marks: 60
Duration: Three Hours

Note:
- Answer all the questions
- Symbols used have their usual meanings.
- Suitable Value may be assumed for missing data, if any.
- Root locus is to be drawn on graph paper and Bode's plot on semi-log graph paper.

1. a) Match the items given in list 1 and those in list 2.

<table>
<thead>
<tr>
<th>List 1 (Component)</th>
<th>List 2 (Construction/Requirement)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potentiometer</td>
<td>Concentric Winding</td>
</tr>
<tr>
<td>Synchro Transmitter</td>
<td>Cylindrical Rotor</td>
</tr>
<tr>
<td>Control Transformer</td>
<td>High Inertia</td>
</tr>
<tr>
<td>Servomotor</td>
<td>High Resolution</td>
</tr>
<tr>
<td></td>
<td>Negative Torque Speed Characteristics</td>
</tr>
</tbody>
</table>

b) Why negative feedback is preferred in control systems? Explain.
c) Discuss the constructional features of synchros. Also explain how a synchro pair can be used for error detection.

OR

1'. a) Define:
   i) System
   ii) Physical Model
   iii) System Sensitivity
   iv) LTI System

c) Explain the principle of operation, constructional features and applications of an ac servomotor.

2. a) For a Signal Flow Graph define the following:
   i) Source node
   ii) Forward path
   iii) Non touching loops

b) Obtain the transfer function of the control system whose block diagram is shown in fig. 1

3. a) Explain the time domain performance specifications of a second order system.

b) Draw the complete root locus for the system with open loop transfer function

\[ G(s) \cdot H(s) = \frac{K}{s(s^2 + 8s + 32)} \]

OR

3'. a) Discuss the effect of adding a pole to the second order system. Also explain the concept of dominant poles.

b) A unity feedback system is characterized by the open loop transfer function

\[ G(s) = \frac{50}{s(s + 10)} \]

Determine the steady state errors for the input \( r(t) \) where \( r(t) = 1 + 2t + t^2 \)
4. a) Define and explain:
   i) BIBO Stability  
   ii) Asymptotic Stability  
   iii) Gain Margin  
   iv) Phase Margin

   b) Draw the polar plot for the following system

   \[ G(s) = \frac{1}{(1 + s)(1 + 2s)} \]

   Determine whether the plot crosses the real axis. If so determine the frequency at which the plot crosses the real axis and the corresponding magnitude of \( G(j\omega) \).

   OR

4'. a) The characteristic equation of a feedback control system is given by

   \[ s^4 + 22s^3 + 10s^2 + s + k = 0 \]

   i) Determine the range of values of \( k \) for the system to be stable.

   ii) Can the system be marginally stable? If so, find the required value of \( K \) and the frequency of sustained oscillations.

   b) Define the frequency-domain performance specifications. Also explain the advantages and limitations of frequency response analysis.

5. a) Why compensation is required? Discuss the criterion for selecting a compensator.

   b) Design a lead compensator for the system with an open-loop transfer function

   \[ G(s) = \frac{K}{s(s + 1)} \]

   for the specifications of \( K_o=12 \text{ sec}^{-1} \) and \( \Phi_m=40^\circ \).
B. TECH. AUTUMN (Vth SEMESTER) EXAMINATION
ELECTRICAL ENGINEERING
ELECTRICAL AND ELECTRONICS INSTRUMENTATION
COURSE NO.: EE – 352N

Maximum Marks: 60
Credits: 04
Duration: Three Hours

Answer All Questions
Symbols used have their usual meaning
Assume suitable value for any missing data

Q1(a) With neat sketch, explain true RMS reading voltmeter. 4
Q1(b) What is quality factor: Explain the method of series connection for Q factor measurement. 4
Q1(c) The symmetrical square wave with time period of ‘T’ sec and maximum value ‘Em’ is applied to an average responding ac voltmeter with the scale calibrated in terms of RMS value of the sine wave. Calculate the form factor and error in meter indication. 4

OR

Q1’(a) With neat sketch, explain the working of Ratio meter and Electrical resonance type frequency meters. 6
Q1’(b) Draw the functional block diagram of heterodyne wave analyzer and explain its operation. 6

Q2(a) Explain the operating principle of Ramp type digital voltmeter. 6
Q2(b) With neat sketch, explain the operation of weighted resistor and R-2R Digital to Analog converters. Compare their performance. 6

OR

Q2’(a) With the help of neat sketch, explain the working of Digital frequency meter. 6
Q2’(b) Discuss type of errors that affect the accuracy of Digital to Analog and Analog to Digital converters. 6
Q3(a) Draw a neat sketch of cathode ray tube and explain its operation.

Q3(b) Explain the current telemetry system with proper diagram.

Q3(c) Write technical note on display devices.

Q4(a) What is the advantage of using differential output rather than a single output for measuring displacement? Explain the operating principle of an LVDT.

Q4(b) What is strain gauge; explain its types and the properties of material required for construction. Derive an expression for the unbalance voltage in voltage sensitive deflecting bridge.

OR

Q4'(b) Discuss the methods used for the measurement of:
(i) Pressure    (ii) Temperature
Also discuss their relative merits and demerits.

Q5(a) Describe the use of sphere gap for the measurements of peak voltage also mention its advantages and limitations.

Q5(b) What is the significance of determining the B-H curve and Hysteresis loop of a magnetic specimen? Discuss step by step method for determining these plots.

OR

Q5'(b) An iron ring has mean diameter of 0.1 m and cross section of 33.5 mm². It is wound with magnetizing winding of 320 turns and a secondary winding of 220 turns. On reversing a current of 10 A in magnetizing winding, a ballistic galvanometer gives a throw of 272 scale divisions, while a Hbbert magnetic standard of 10 turns and a flux of $0.25 \times 10^{-3}$ Wb gives a reading of 102 scale division, other conditions remaining the same. Find relative permeability of the specimen.
1.a A company is considering the purchase of a new piece of testing equipment that is expected to produce $8000 additional income during the first year of operation, this amount will probably decrease by $500 per year for each subsequent year of ownership. The equipment costs $20000 and will have an estimated salvage value of $3000 after 8 years of use. For an interest rate of 15% compounded quarterly, determine whether the investment is economically justified or not. Use present worth method.

OR

1.a' A standby electric power generator was purchased 6 years ago for $8000. At that time it was expected that the equipment would be used for 15 years and would have a salvage value of 10 percent of the first cost. The generator is no longer needed and is to be sold for $2500. Using an interest rate of 14% compounded monthly, determine the difference between the anticipated and actual equivalent annual costs.

1.b A proposed mill in an isolated area can be furnished with power and water by a gravity feed system. A stream high above the mill will be tapped to provide flow for water needs and power requirements by connecting it to the mill with a ditch-and-tunnel system or with a wood-and-concrete flume that winds its way down from the plateau. Either alternative will meet current and future needs, and both will utilize the same power generating equipment. The ditch-and-tunnel system will cost $500000 with an annual maintenance cost of $2000. The flume has an initial cost of $200000 and a yearly maintenance cost of $12000. In addition, the wood portion of the flume will have to be replaced every 10 years at a cost of $100000. Compare the alternatives on the basis of capitalized costs with an interest rate 8% per year.
2.a. Differentiate between:

i. Defender and Challenger

ii. Demand Pull inflation and Cost Push Inflation

iii. Declining balance and double declining balance methods of depreciation

2.b. 4 projects are to be compared on the basis of benefit cost criteria. Each project has an expected life of 50 years and is to be evaluated with a tax free interest rate of 10%. Data for the project, in rupees, are as follows:

<table>
<thead>
<tr>
<th>Proposal</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Cost (Rs.)</td>
<td>150,000</td>
<td>200,000</td>
<td>310,000</td>
<td>450,000</td>
</tr>
<tr>
<td>Annual</td>
<td>8,000</td>
<td>10,000</td>
<td>5,000</td>
<td>20,000</td>
</tr>
<tr>
<td>Maintenance Cost (Rs.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated Annual Benefits (Rs.)</td>
<td>35,000</td>
<td>30,000</td>
<td>59,000</td>
<td>80,000</td>
</tr>
<tr>
<td>Salvage Value (Rs.)</td>
<td>2500</td>
<td>2000</td>
<td>4000</td>
<td>4500</td>
</tr>
</tbody>
</table>

On the basis on an incremental B/C ratio analysis select the appropriate alternative.

OR

2. b'. A machine was purchased 3 years ago for Rs. 40,000. It is proposed to replace it with a new machine which will cost Rs.34,500 and is expected to reduce the operating costs. Costs and salvage values for the two machines are as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Defender D</th>
<th>Challenger C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Operating cost (Rs.)</td>
<td>Salvage Value (Rs.)</td>
</tr>
<tr>
<td>0</td>
<td>3400</td>
<td>12500</td>
</tr>
<tr>
<td>1</td>
<td>3400</td>
<td>7000</td>
</tr>
<tr>
<td>2</td>
<td>3900</td>
<td>4000</td>
</tr>
<tr>
<td>3</td>
<td>4600</td>
<td>2500</td>
</tr>
<tr>
<td>4</td>
<td>5600</td>
<td>100</td>
</tr>
<tr>
<td>5</td>
<td>2600</td>
<td>2000</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>15000</td>
</tr>
</tbody>
</table>

Should a replacement be made if the required rate of return is 15% and the services of the machine will be needed for only 4 more years?
3.a. How do different managers require different skills and roles in an organization? Explain using practical examples. 06
3.b. What are the environmental and ethical issues considered important in context of management? Give examples. 06
4.a. Differentiate between tactical goals and operational goals in the context of an organization. 04
4.b. What do you understand by chain of command? Explain narrow versus wide spans. 04
4.c. Leadership and management are related but they are not same. Do you agree? Giving suitable examples support your answer. 04

OR

4′.a. Explain the leadership grid in the context of behavioral approach to leadership. 04
4′.b. List the benefits and limitations of job specialization. Explain any two approaches used to counter the problem associated with job specialization. 04
4′.c. Why is motivation important in organization? State the essential elements of any motivation theory. 04

5.a. What is first order exponential smoothing method of making forecast? Demand for part number 2710 was 200 in April, 50 in May and 150 in June. The forecast for April was 100 units. With a smoothing constant of 0.2 and using first order exponential smoothing, what is the July forecast? 04
5.b. A company orders a certain automobile part periodically and delivery is instantaneous. Annual demand estimated to be 2160 units is constant. The cost of the part/unit and procurement cost per order are $8 and $9 respectively while the carrying charge per unit time is estimated to be 15% of the cost of the part. What quantity should be ordered and when? 04
5.c. What is Pareto’s analysis and how it is used in industry? Explain with an example. 04
Answer ALL the questions. Notations used have their usual meaning.

1(a) Explain the difference between orientational, electronic and ionic polarizations in brief. [05]

(b) Define static dielectric constant and obtain the relation \( P = \varepsilon_0(\varepsilon_r-1) E \). [05]

(c) What is piezoelectricity? Give two examples of piezoelectric materials. Draw hysteresis curve for ferroelectric material and discuss it briefly. [05]

OR

(c') The electronic polarizability of the Ar atom is \( 1.8\times10^{-39} \) F.m\(^2\). What is the static dielectric constant of Ar gas at 1 atmospheric pressure at room temperature (300K)? [Given: \( k_B = 1.38 \times 10^{-23} \) J/K and \( \varepsilon_0 = 8.854 \times 10^{-12} \) F/m] [05]

2(a) What is dipolar relaxation? Obtain the relation for orientational polarization in alternating fields. [07]

(b) Explain the diffusion process in semiconductors and find a relation for diffusion current per unit area for \( n \) and \( p \) type semiconductors. [05]

(c) An intrinsic Si sample is doped with donors from one side such that \( N_d = N_c \exp(-ax) \). [03]

   (i) Find an expression for \( E(x) \) at equilibrium over the range for which \( N_d >> n_i \).

   (ii) Evaluate \( E(x) \) when \( a = 4 \) (\( \mu \)m\(^{-1} \)).

3(a) How ferromagnetism is explained on the basis of exchange interaction? Give a brief account of Weiss theory of ferromagnetism. [07]

(b) The magnetic field in a diamagnetic material is \( 1000 \) Am\(^{-1} \). Calculate the magnetization and flux density of the material if its susceptibility is \(-0.4\times10^{-5}\). [04]

(c) Distinguish between hard and soft magnetic materials. Give two examples for each. [04]

**Continued......2**
4(a) Derive the London's equations and explain the term coherence length.

(b) A d.c. voltage of 1\(\mu\)V is applied across a Josephson junction. Calculate the frequency of the Josephson current generated. [Given: \(h = 6.63 \times 10^{-34}\) J.s]

(c) Discuss briefly the potential applications of superconductors.

OR

4(a') Explain d.c. Josephson effect. Show that the super current of superconducting pairs across the junction depends on the phase difference.

(b') A superconductor sample has a critical temperature of 3.722 K in zero magnetic field of 0.0305 T at 0 K. Evaluate the critical field at 2 K

(c') Discuss the thermodynamics of superconducting transition in detail.