2015-2016  
II SEMESTER M. TECH. EXAMINATION  
(ELECTRICAL ENGINEERING)  
ADV. ELECTRIC DRIVES - II  
(EE-612)  

Maximum Marks: 60  
Credits: 04  
Duration: Three Hours.

**Note:**  
(i) Answer any Five questions.  
(ii) Symbols have their usual meaning.  
(iii) Assume suitable value for missing data.

<table>
<thead>
<tr>
<th>Question</th>
<th>Description</th>
<th>Marks</th>
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</thead>
<tbody>
<tr>
<td>1(a)</td>
<td>Derive the condition for maximum torque developed in an induction motor when it is operated from a variable frequency supply. Using above result find the expression for maximum torque developed. Discuss the operation at subsynchronous speed as well as super-synchronous speed.</td>
<td>07</td>
</tr>
</tbody>
</table>
| 1(b) | A 37.3 kW, 460 V, 60 Hz, 6 pole, 1180 rpm, Y-connected squirrel cage IM has following parameters per phase referred to stator:  \[ R_s = 0.19 \Omega, X_s = 0.75 \Omega, X_m = 20 \Omega, R_r = 0.07 \Omega, X_r' = 0.38 \Omega \]  The motor is used for regenerative braking. Calculate:  
(a) the range of active torque it can hold and corresponding speed range  
(b) maximum power it can generate and maximum mechanical power it can produce as motor.  
(c) Speed at developed braking torque of 300 Nm.  
Use exact equivalent circuit. | 05 |
| 2. | A 400 V, 50 Hz, 4 pole, 1370 rpm, Y-connected induction motor fed by a variable frequency source has the following parameters per phase referred to stator:  \[ R_s = 1.9 \Omega, R_r' = 2 \Omega, X_s = X_r' = 3 \Omega, X_m \text{ is very large and can be ignored} \]  The motor is fed by a non-sinusoidal supply. Calculate the motor torque, current and efficiency at the rated speed, if the fundamental, fifth and seventh harmonics per phase are 254 V, 100 V, and 40 V respectively. Also calculate the derating of the machine due to non-sinusoidal supply. Neglect higher harmonics, friction, windage, core losses and skin effect. | 12 |
| 3.(a) | Compare the relative merits and demerits of VSI and CSI controlled induction motor drives. | 04 |

Contd....2.
(b) A 440 V, 50 Hz, 6 pole Y-connected IM has the following parameters per phase referred to stator:

\[ R_s = 0.6 \ \Omega, \ \text{R}_r' = 0.3 \ \Omega, \ \text{X}_s = \text{X}_r' = 1 \ \Omega \]

\( X_m \) is very large and can be ignored. The normal full-load slip is 0.05.

The motor is controlled by variable frequency control with a constant (V/f) ratio. For an operating frequency of 10 Hz, calculate:
(a) Breakdown torque as a ratio of its value at rated frequency both for motoring and braking.
(b) The starting torque and current as ratio of their values at rated frequency.

4.(a) Draw a labelled block diagram for closed-loop operation of a CSI fed variable frequency induction motor drive with current control.

(b) Explain the operation of an induction motor when its speed is controlled by injecting a voltage at the terminals of its rotor. Derive the expression for the developed torque in terms of injected voltage. Also discuss the condition and the operations of the motor in sub-synchronous and super-synchronous speed ranges for its motoring and braking modes of operations.

5. Draw a neat labelled diagram of a static rotor resistance controlled drive. Derive its equivalent circuit. Establish the mathematical expression for the developed torque and draw the speed-torque characteristics. What are the salient features of this drive?

6. A 460 V, 60 Hz, 4 pole, 1760 rpm, Y-connected wound-rotor induction motor has following parameters per phase referred to stator:

\[ R_s = 0.14 \ \Omega, \ \text{X}_s = 0.4 \ \Omega, \ \text{R}_r' = 0.1 \ \Omega, \ \text{X}_r' = 0.7 \ \Omega, \ \text{X}_m = 8 \ \Omega \]

The motor is controlled by a static Scherbius scheme. The drive is designed for speed range of 30 percent below the synchronous speed. The resistance of the filter inductor is negligible. The maximum value of firing angle is 165°. Using the exact equivalent circuit
(a) calculate the torque and power factor for \( \alpha = 105° \) and 960 rpm.
(b) Now the transformer is removed and the inverter is connected directly to the ac mains. The firing angle is adjusted to get the same torque and speed as in (a). Calculate the power factor and compare it with that obtained in (a).

Neglect friction, windage and core losses.

7. What are the salient features of vector control of induction motor? Explain the principle of vector control of induction motor. Give an example for the implementation of the algorithm.
1(a) Derive the expression for undamped natural frequency of power system oscillations and damping ratio for a single machine infinite bus system.

1(b) A power deficient area receives 50 MW over a tie line from another area. The maximum steady state capacity of the tie line is 100 MW. Find the allowable sudden load that can be switched on without loss of stability.

2(a) What is Small Signal Stability and what are the various modes of oscillations? Explain.

2(b) A system representing a generator 588 MVA, 500 MW, 21 KVAR, 50 Hz feeding large system through a step up transformer and a double circuit transmission line with data as given below.

\[ X_d = 0.235 \quad T_{do} = 6.0 \text{ s} \quad H = 3.07 \text{ MW-s/MVA} \]

Step up transformer leakage reactance = j0.15.

Transmission line reactance per circuit=j1.0,

All reactance are in per unit on 588 MVA base. Following a loss of one circuit of line analyse small signal stability characteristic about steady state operating condition.

Post fault system condition: Generator active power, \( P = 0.85 \) p.u, \( Q = 0.52 \) p.u (lagging)

Terminal voltage of generator \( V_r = 1.0 \angle 0^\circ \) p.u. All resistance are negligible.

Find (a) synchronising coefficient (b) Linearised state equation of the system using classical model. (c) Eigen values, damped frequency of oscillation in Hz, damping ratio and damped natural frequency for damping coefficient (in pu torque/pu speed) \( D = 10 \).
3(a) What is Power System Stabilizer (PSS)? What are possible input signals to it? Draw the functional block diagram of PSS and discuss the function of each block.

3(b) Explain various methods of improving transient stability of a modern power system.

4 State Liapunov's stability theorem. Explain the Liapunov's direct method for Power System Stability Analysis. Discuss for single machine infinite bus, how the system stability can be assessed by computing the transient energy at critical clearing angle by this method.

5(a) Define Sub Synchronous Resonance. Explain the difference between Sub Synchronous Resonance and Sub Synchronous Oscillation. Discuss the basic theory behind Sub Synchronous Resonance in a series capacitor compensated line.

5(b) Explain the terms 'Induction Generator Effect', 'Torsional Interaction' and 'Shaft Torque Amplification' with reference a generating unit connected to a series capacitor compensated line.

6(a) Deduce the relationship between normalised power and normalised voltage at receiving end to get family of P-V Curve at various power factors.

6(b) A simple 2 bus transmission system with transfer reactance $X$ has $E$ and $V$ as sending and receiving end voltages. Find the maximum power, the critical voltage (i.e. voltage when power is maximum) and load angle at maximum power if the load power factor is (i) Unity (ii) Zero. Also find the expression for Voltage collapse Proximity Indicator (VCPI=$\frac{dQ}{dV}$) when the load power factor is zero.

7(a) Discuss the $dQ/dV$ criterion for assessing voltage stability.

7(b) Explain how to determine the voltage stability by Q-V modal analysis. Draw a flow chart to compute V-Q sensitivity and bus participation factors of a power supply using modal analysis.
M.TECH.(ELECTRICAL) WINTER (II SEMESTER) EXAMINATION
(Power System and Drives):
FACTS Devices (EE-638N)

Maximum Marks-60 Credit-04 Time- 3 Hours

NOTE:  
(i) Answer any five questions.
(ii) Notations used have their usual meaning.
(iii) Assume suitable data, wherever necessary.

1. (a) Discuss the need of FACTS Controllers in Power System. Explain, in brief, the various types of FACTS Controllers.  
(b) Discuss the merits and demerits of VSC based FACTS controllers over variable impedance type FACTS controllers.  

2. (a) What do you mean by transmission line compensation? What are active and passive compensators? Explain the meaning of controlled series compensation?  
(b) Discuss how shunt compensation leads to improvement of stability.

3. (a) Give the schematic diagram of UPFC? Why is it superior to other conventional FACTS devices? Discuss its operating principle.  
(b) Write a note on TCPPAR.

4. Explain the working, characteristics and operating modes of variable reactance model of thyristor controlled series capacitor (TCSC). Discuss its applications.  

5. (a) Discuss the operating principle of an SSSC. How is it different from a TCSC?  
(b) Discuss, in brief, the role of IPFC in compensation of transmission line.

6. (a) Discuss the operation of a STATCOM. Compare the control characteristics of STATCOM with SVC. How is it useful in improving the stability of the system?  
(b) Enumerate the custom power devices that can be used in distribution systems. Discuss, briefly, the role of DVR in distribution system.  

7. (a) Explain, briefly, how load compensation is carried out using DSTATCOM.  
(b) What role does UPQC play in improving the Power Quality of the distribution system.
Maximum Marks: 60  
Credits: 04  
Duration: Three Hours

Answer any five questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No.  

1. Distinguish the following:
   i) Parametric and Non-parametric Identification
   ii) Grey Box and Black Box Identification
   iii) Least Squares Estimate and Maximum Likelihood Estimate
   iv) Kalman Filter and Extended Kalman Filter

2(a) Show that for a fixed signal containing white Gaussian noise, the sample mean is the minimum variance unbiased estimate.

2(b) Discuss the common sources of error in identification.

3(a) What is the role of white noise in modelling of systems? Also discuss its properties.

3(b) Explain the operation of a discrete Kalman filter as a predictor-corrector algorithm.

4. Define and explain:
   i. Estimator Bias
   ii. Estimator Covariance
   iii. Asymptotic Unbiased Estimator
   iv. Consistent Estimator
   v. Efficient Estimator
   vi. Asymptotic Efficient Estimator

5. Draw the generalized model structure for linear time invariant system and show what modifications are required to obtain different models from it.

6. Derive the expressions for a linear least square estimation.

7. Explain different types of error used to judge a model and derive an expression for generalized error. Also explain the role of pre-whitening filters.
2015-16
M.TECH. (WINTER SEMESTER) EXAMINATION
ELECTRICAL ENGINEERING
DIGITAL INSTRUMENTATION
EE-653

Maximum Marks: 60
Credits: 04
Duration: Three Hours

Attempt any five questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No. Question M.M.
1 What is an electronic counter. classify it and explain any one of them. [12]
2 Define sensitivity of a multimeter. Draw the block diagram of a digital multimeter and explain its operation. [12]
3 How are digital voltmeters classified? Explain with the help of a neat diagram, the working of a successive approximation type digital voltmeter. [12]
4 What is the difference between wave analyzer and harmonic distortion analyzer? Explain with the help of block diagram, the working of a harmonic distortion analyzer. [12]
5 Describe the method for the measurement of capacitance at high frequency using substitution method. Discuss the problem associated with the measurement of capacitance at high frequencies. [12]
6 Describe the digital method used for the measurement of velocity. Describe their advantages and disadvantages. [12]
7 Write explanatory notes on any two of the following:
   1. Digital Recorder.
   2. Digital LCR meter.
   3. Frequency Selection wave analyzer. [12]
Answer any FIVE of the following questions. Assume suitable data if missing. Notations used have their usual meaning.

Q.No. | Question                                                                 | M.M. |
------|-------------------------------------------------------------------------|------|
1(a)  | Explain the basic principle and working of Magnetic Resonance Imaging (MRI) machine. Also explain the following terms:  
      | a. Larmor Equation.                                                      | 07   |
      | b. T1 and T2 Relaxation.                                                |      |
      | c. Gradient Coil.                                                       |      |
1(b)  | Explain the process of generation of continuous and characteristic X-Rays. | 05   |
2(a)  | Explain Pressure controlled, Volume controlled and Time controlled breathing in ventilators. Also show the changes in Pressure and Flow waveforms when the compliance of lungs varies during these modes. | 06   |
2(b)  | i) Explain the working of positive pressure ventilators.                | 06   |
      | ii) Discuss in brief the limit, trigger and cycling variables in a ventilator operation with a suitable example of each. |      |
3(a)  | What is a motor Unit? How are the EMG signals from different motor units received at the surface electrodes? Explain with the help of a suitable diagram. | 06   |
3(b)  | What are various EMG artifacts? Explain the procedure of obtaining the EMG signal from a single muscle cell. | 06   |
4(a)  | i) With the help of a suitable diagram, explain the electrical conduction system of the heart and describe the ECG waveform generated by it at the body surface. | 07   |
      | ii) Is this waveform different from Electrogram (EGM)? How?             |      |
4(b)  | Explain various ECG lead configurations. Using Einthoven's triangle, explain why | 05   |

Contd....2.
augmented unipolar lead configuration is preferred over unipolar lead configuration.

5(a) Discuss in brief various normal EEG waveforms? Discuss various artifacts and sources of error during an EEG Measurement.

5(b) Discuss the Unipolar and Bipolar configurations of EEG measurement. Where the following EEG Electrode would be placed?
   i) F4    ii) O3    iii) P6

6(a) Draw and discuss the basic circuit of a pacemaker. With the help of suitable diagram explain how the strength and duration of electrical pulse delivered by a pacemaker is decided.

6(b) i) What is lead maturation process in pacemakers? What is the advantage of steroid-eluting electrodes over the other metal electrodes?
   ii) If a VDD mode of pacemaker is used:
       a) Which of the heart’s chamber is paced?
       b) Which of the heart’s chamber is sensed?

7(a) Discuss the ultrasonic method of blood flow measurement.

7(b) Discuss the basic principle and working of a CT scanner. Once the intensity of X-Rays is detected by the crystal detectors, what are the subsequent stages in a CT scanner before the results can be displayed on a computer screen?
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<tr>
<td>1(a)</td>
<td>What are miller indices? How does it describe the crystallographic plane? How a crystallographic plane can be identified for a given silicon wafer?</td>
<td>[05]</td>
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<tr>
<td>1(b)</td>
<td>Describe MEMS fabrication cycle.</td>
<td>[07]</td>
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<tr>
<td>2(a)</td>
<td>Differentiate between Bulk Micromachining and Surface micro machining.</td>
<td>[05]</td>
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<tr>
<td>2(b)</td>
<td>Explain the different oxidation method for the native growth of SiO₂.</td>
<td>[07]</td>
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<tr>
<td>3</td>
<td>Compare the following evaporation method for thin film deposition.</td>
<td>[12]</td>
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<tr>
<td></td>
<td>(i) Resistive heating evaporation,</td>
<td></td>
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<td></td>
<td>(ii) Inductive heating evaporation,</td>
<td></td>
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<tr>
<td></td>
<td>(iii) Electron Beam Evaporation.</td>
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<td>4(a)</td>
<td>Describe the TMAH etching?</td>
<td>[06]</td>
</tr>
<tr>
<td>4(b)</td>
<td>What are the various problem associated with surface micromachining and its remedies.</td>
<td>[06]</td>
</tr>
<tr>
<td>5</td>
<td>Describe the principle of operation of tunnelling current accelerometer and describe its design and fabrication procedure.</td>
<td>[12]</td>
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<tr>
<td>6</td>
<td>Explain the principle of operation of MEMS double cantilever capacitive accelerometer. Describe its design and fabrication procedure.</td>
<td>[12]</td>
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<tr>
<td>7(a)</td>
<td>Describe the silicon fusion bonding mechanism.</td>
<td>[06]</td>
</tr>
<tr>
<td>7(b)</td>
<td>What are various problems associated with high temperature annealing and its remedies?</td>
<td>[06]</td>
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2015-16
M.TECH. II\textsuperscript{nd} SEMESTER EXAMINATION
M.Tech (Electrical)
Power System & Drives/High Voltage & Insulation Engineering
High Voltage Testing Techniques
EE-663
Credits: 04
Duration: Three Hours

Maximum Marks: 60

Answer any \textbf{FIVE} questions.
Notations used have their usual meaning.

1(a) Explain different methods for producing switching impulses. [06]

1(b) What is a trigatron gap? Explain its function and operation. [06]

2(a) How are rectangular current pulses generated for testing purposes? How is their time duration controlled? [06]

2(b) What is a Tesla coil? How is damped high frequency oscillations obtained from a Tesla coil? [06]

3(a) Explain one method of controlled tripping of impulse generators. Why is controlled tripping necessary? [06]

3(b) Explain with suitable circuit diagram Marx circuit arrangement for generation of impulse waves. [06]

4(a) What are the various components of a multistage impulse generator? [06]

4(b) Discuss the high current impulse test and long duration impulse current test as applicable to lightning arresters. [06]

5(a) Discuss the impulse voltage test on insulators and bushings. [06]

5(b) Explain the method of impulse testing of high voltage transformers. What is the procedure adopted for locating the failure? [06]

6(a) What is a delay cable? Explain its utility in impulse measurement. [06]

6(b) Using suitable expression show that impulse wave is composed of two exponential wave. [06]

7(a) Discuss the switching impulse tests of transformers. [06]

7(b) What are the requirements of an oscillograph for impulse and high frequency measurements in high voltage test circuits? [06]
1. Explain how the performance of a power apparatus would be affected, if lumpy circuit parameters are considered. Giving simplifying assumptions, derive the expressions for travelling voltage and current waves on over-head transmission lines. What would happen, if two voltage waves of equal magnitude travels with the same velocity but in opposite direction?

2(a) If \( Z_{d1}, Z_{d2}, Z_{d3}, \ldots, Z_{d(n-1)} \) be the surge impedances of \((n-1)\) lines bussed at a junction, derive expressions for transmitted voltage and current waves beyond the junction. The incident wave was travelling on a line with impedance \( Z_i \).

2(b) Explain, what would happen if a square voltage wave travelling on a line is suddenly terminated into a short circuit. Draw necessary incident, reflected and refracted waves of currents and voltages.

3(a) Explain why the initial voltage distribution along the windings of a high voltage large power transformer connected to a line is of much importance. Show that the maximum potential gradient across the winding of a transformer when attacked by a lightning stroke would be \((aV/L)\), and that it would occur at the first few turns of the winding. Various terms used have their usual meanings.

3(b) Citing suitable examples, explain the difference between direct and indirect strokes.
of lightning on high voltage operating systems.

4(a) Explain, how a thunder cloud cell as referred to natural lightning phenomenon is formed.

4(b) Giving a neat sketch mentioning various time periods involved, discuss temporal development of a lightning flash to high rise buildings.

5(a) What are surge diverters? Where they are placed in a system? How do they protect transmission line or terminal equipment?

5(b) Define T.F.R. What is its role in protecting the lines? Discuss why and how its value could be reduced?

6(a) Explain, why more emphasis is given to lightning surges over switching surges as far as systems operating at or below 220 kV are concerned?

6(b) A surge voltage of 50 kV travelling in a transmission line of 500 Ohms, meets a junction point where two lines of impedances 600 and 200 Ohms are joined. Determine the voltage and the current for the surge transmitted into each of the two circuits.

7 Write notes on any THREE of the following

(a) Protector tubes
(b) Prediction of 'Back Flashover Rates'
(c) Attenuation of travelling waves
(d) Distortion of travelling waves on lines
(e) Isokeraunic charts.
2015-16
M.TECH. (WINTER SEMESTER) EXAMINATION
High Voltage & Insulation Engineering
Insulation Technology for Superconductors
EE-667
Maximum Marks: 60
Credits: 04
Duration: Three Hours

Answer any five questions.
Assume suitable data if missing.
Notations used have their usual meaning.

1 (a) What advantages are offered by applying HTSC to motors and generators? Discuss the electric power applications of superconductivity.

(b) A superconducting wire of Niobium is wound over a thick tantalum wire whose critical magnetic field at 0 K is $830 \times 10^{-4}$ Tesla. The number of turns of Nb wire is 1000. Assuming that the whole system is maintained at a temperature of 4 K, find the current that has to be passed through Nb wire to make the tantalum change to the normal (resistive) state. $T_c$ for tantalum is 4.483 K.

2 Discuss the breakdown of mechanism of liquid nitrogen viewed from area and volume effects. Also draw the neat sketch of average breakdown voltage versus (SEA) $90$ and (SLV) $90$ for coaxial electrode configuration.

3 Why loss index of solid insulation is an important parameter to be considered at cryogenic temperature? Explain the mechanisms of dipolar relaxation, interfacial polarization and ionic oscillations associated with dielectric losses in liquids or solids.

4 Discuss the factors which influence dielectric strength of electrical insulating materials and hence deduce the breakdown strength equation as suggested by Swanson. Also explain how thickness‘$t$‘ is incorporated in the breakdown strength equation.

5(a) Discuss the desired properties of electrical insulating materials at cryogenic temperature. What is the role of radiation resistance at cryogenic temperature?

(b) Discuss the pressure dependence of dielectric breakdown in liquid nitrogen.

6 Why it is essential to study dielectric breakdown characteristics of cryogenic nitrogen gas above liquid nitrogen? Also discuss the breakdown of cryogenic gas under uniform and non-uniform fields and show how they are correlated.

7 Discuss the deterioration and breakdown of solid dielectrics by internal discharges at cryogenic temperature. What are the factors which reduce the discharge repetition rate at low temperatures?
2015-16
M.TECH. (WINTER SEMESTER) EXAMINATION
ELECTRICAL ENGINEERING
PARTIAL DISCHARGES IN POWER APPARATUS
EE-69

Maximum Marks: 60
Credits: 04
Duration: Three Hours

Answer any five questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No. | Question                                                                 | M.M.
------|--------------------------------------------------------------------------|------
1     | Enumerate the types of discharges that occur in high voltage insulation systems. Differentiate and distinguish between various types of partial discharges that occur in electrical systems. | [12] |
2(a)  | With suitable sketches, explain the phenomena of occurrence of partial discharges in cavities below the inception voltage and hence show that the minimum voltage at which discharges can persist can be almost one-half of the inception voltage. | [06] |
2(b)  | Explain the ABC-model of discharges occurring in a cavity within a dielectric and hence explain the phenomena of intermittent discharge in an asymmetrical cavity. How the ABC-model gets modified for surface discharges? | [06] |
3     | Explain various quantities related to the magnitude of discharges. Derive an expression for discharge magnitude and discharge energy from a single discharge due to breakdown of a void in a solid insulation and hence justify choice of 'apparent charge' as a measure for partial discharges. | [12] |
4     | Explain the recurrence of discharges when an insulating medium is subjected to an AC voltage. Explain why the repetition rate under DC voltage is several orders lower than at AC voltage? | [12] |
5     | Enumerate various non-electrical methods for partial discharge detection in high voltage equipment. Explain the principle of partial discharge detection using acoustic and optical methods in electrical systems. | [12] |
6     | With suitable sketches discuss the principle of electrical discharge detection circuit for measurement of partial discharges. Explain the need for providing a coupling capacitor in the circuit. | [12] |
7     | Explain in detail the phenomena of occurrence of partial discharges and its detection in any one of the following:
      (a) Capacitors
      (b) Cables
      (c) Bushings.
      (d) Transformers
      (e) Synchronous Generators | [12] |
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<td>1(a)</td>
<td>Discuss classification of optimization problems with their mathematical statements and examples.</td>
<td>[06]</td>
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<tr>
<td>1(b)</td>
<td>With reference to Advance Optimization Technique briefly explain: Ant colony and Genetic Algorithm optimization.</td>
<td>[06]</td>
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<tr>
<td>2(a)</td>
<td>State multivariable optimization problem with equality constraints. Discuss the necessary and sufficient conditions to solve such problems by method of Lagrange Multipliers.</td>
<td>[06]</td>
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<tr>
<td>2(b)</td>
<td>Find the dimensions of a box of largest volume that can be inscribed in a sphere of unit radius.</td>
<td>[06]</td>
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<tr>
<td>3.</td>
<td>Find the maximum of the function $f(x) = x^4 - 14x^3 + 60x^2 - 70x$ in the interval of $(0, 2)$ by golden section method. Explain the steps involved in finding the solution.</td>
<td>[12]</td>
</tr>
<tr>
<td>4.</td>
<td>Minimize the function $f(x_1, x_2) = 2x_1^2 + x_2^2$ in the interval of $(1, 2)$ by Univariate method. Write the steps involved and draw the flow chart in finding the solution.</td>
<td>[12]</td>
</tr>
<tr>
<td>5.</td>
<td>Draw the flow chart of Steepest Descent Method and the write steps involved. Using the method minimize the function $f(x, y) = 4x^2 - 4xy + 2y^2$ starting from the initial point $(x_0, y_0) = (2, 3)$.</td>
<td>[12]</td>
</tr>
<tr>
<td>6.</td>
<td>Draw the flowchart for simplex algorithm. Minimize the following function using simplex algorithm $f(x_1, x_2, x_3) = -x_1 - 2x_2 - x_3$</td>
<td>[12]</td>
</tr>
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*Contd....2.*
7. Ali plans to drive from NY to LA. He has friends in several cities. After 1 day's driving he can reach up to Columbus, Nashville, or Louisville, after 2 days of driving can reach Kansas City, Omaha, or Dallas, after 3 days of driving can reach Denver or San Antonio, after 4 days of driving can reach the final destination Los Angeles. The actual mileages between cities are given in the figure below. Where should Ali spend each night of the trip to minimize the number of miles traveled?

Subject to

\[ 2x_1 + x_2 - x_3 \leq 2 \]
\[ 2x_1 - x_2 + 5x_3 \leq 6 \]
\[ 4x_1 + x_2 + x_3 \leq 6 \]
\[ x_1, x_2, x_3 \geq 0 \]