2015-2016
B. F. Y SEMESTER EXAMINATION
(ELECTRICAL)
NUMERICAL TECHNIQUES
[EAM – 351]
Credits – 04

Max Marks: 60
Duration: Three Hours

Note: Answer all questions.
Programmable calculator is not allowed.
Write answer up to four decimals.

1. (a) Solve the system of equations:
\[
\begin{bmatrix}
2 & 1 & 1 & -2 \\
4 & 0 & 2 & 1 \\
3 & 2 & 2 & 0 \\
1 & 3 & 2 & -1
\end{bmatrix}
\begin{bmatrix}
x_1 \\
x_2 \\
x_3 \\
x_4
\end{bmatrix}
= \begin{bmatrix}-10 \\
8 \\
7 \\
-5
\end{bmatrix}
\]

Using the Gauss elimination method with partial pivoting.

OR

(a') Use Crout's method, to solve the following system of equations:
\[x + y - z = 2; \quad 2x + 3y + 5z = -3; \quad 3x + 2y - 3z = 6.\]

(b) Compute SVD of the matrix:
\[
A = \begin{bmatrix}
1 \\
2 \\
1 \\
3
\end{bmatrix}
\]

(c) Find all the eigen values and eigen vectors of the matrix
\[
\begin{bmatrix}
2 & \sqrt{2} & 4 \\
\sqrt{2} & 6 & \sqrt{2} \\
4 & \sqrt{2} & 2
\end{bmatrix}
\]
by using Jacobi method.

2. (a) (i) Find the value of the uniform mesh size \( h \) that can be used to tabulate the function \( f(x) = x^2e^x \) on \([0,1]\) using quadratic interpolation such that \(|\text{error}| \leq 10^{-5}\).

(ii) Use Lagrange's interpolation formula to find a polynomial which satisfies the data:
f(0) = 1, f(1) = 3 and f(3) = 55.

(b) (i) Find whether the function defined by
\[
f(x) = \begin{cases}
-x^2 - 2x^3; & -1 \leq x \leq 0 \\
x^2 + 2x^3; & 0 \leq x \leq 1
\end{cases}
\]
is a cubic spline on \([0,1]\) or not.

(ii) If \( f(x) = \frac{1}{x} \), find the divided difference \( f(x_1, x_2, x_3, x_4) \).

Contd......2
(3991)

(b') Define quadratic splines.
(ii) Obtain a piecewise quadratic interpolating polynomial for the function

\[
\begin{array}{c|cccc}
 x & -3 & -2 & -1 & 1 \\
 f(x) & 369 & 222 & 171 & 165 & 207 \\
\end{array}
\]

(c) Obtain a rational approximation of the form

\[ R_{2,2}(x) = \frac{a_0 + a_1 x + a_2 x^2}{1 + b_1 x + b_2 x^2} \]

to \( e^x \).

3. (a) For the function \( f(x) = 1 + \sin 2x \) on the interval \([0, \pi]\), determine \( L_1, L_2 \) and \( L_\infty \) norms w.r.t. weight function \( w(x) = x \).

(b) Use the method of least squares to fit the curve \( y = \frac{c_0}{x} + c_1 \sqrt{x} \) to the table of values.

<table>
<thead>
<tr>
<th>x</th>
<th>0.1</th>
<th>0.2</th>
<th>0.4</th>
<th>0.5</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>21</td>
<td>11</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

OR

(b') A person runs the same track for five consecutive days and is timed as follows:

<table>
<thead>
<tr>
<th>Days(x)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time (y)</td>
<td>15.30</td>
<td>15.10</td>
<td>15.00</td>
<td>14.50</td>
<td>14.00</td>
</tr>
</tbody>
</table>

Make a least square fit to the above data using the function \( a + \frac{b}{x} + \frac{c}{x^2} \).

(c) Obtain the chebyshev linear polynomial approximation of the type \( y = ax + b \) to \( f(x) = \frac{1}{x^2} \) on the interval \([1,2]\).

4. (a) A firm manufactures two products A and B on which profits earned per unit are Rs. 300 and Rs. 400 respectively. Each product is processed on two machines \( M_1 \) and \( M_2 \). Product A requires one minute of processing time on \( M_1 \) and two minutes on \( M_2 \) while product B requires one minute on each of the machines \( M_1 \) and \( M_2 \). Machine \( M_1 \) is available for not more than 7½ hours while \( M_2 \) not more than 10 hours a day. Find the number of units of products A and B to be manufactured to get maximum profit.

(a') Solve the following LPP, graphically

Minimize \[ P = 2x + 3y \]

Subject to

\[
\begin{align*}
 x + y \geq 1; & \quad 7x + 9y \geq 63; \\
 x \leq 6; & \quad y \leq 5; \quad x + 3y \geq 6; \\
 x, y \geq 0. & \quad
\end{align*}
\]

(b) Solve the following LPP by simplex method.

Maximize \[ P = 2x_1 + 3x_2 + x_3 \]

Subject to

\[
\begin{align*}
 x_1 + 3x_2 + 2x_3 & \leq 11 \\
 x_1 - 2x_2 + 5x_3 & \leq 19 \\
 3x_1 + x_2 + 4x_3 & \leq 25 \\
 x_1, x_2, x_3 & \geq 0.
\end{align*}
\]

****
Q.No. Question M.M.
1(a) Draw the structure, symbol and i-v characteristics of a TRIAC. What are the different modes of triggering of TRIAC? Show, how the function of TRIAC can be realised using SCR. [06]
1(b) Classify different types of Power diodes. Also mention their ratings and applications. [06]

OR

1(b') Draw the i-v characteristics of an SCR and explain the following terms: [06]
   i) Latching current
   ii) Holding current
   iii) Forward break-over voltage
   Also, explain the effect of gate current on forward break-over voltage.

2(a) A UJT based triggering circuit (figure 1) has the following specifications: [06]
   \[ \eta = 0.72, \quad I_p = 0.6 \text{ mA}, \quad V_p = 18 \text{ V}, \quad V_r = 1.0 \text{ V}, \quad I_r = 2.5 \text{ mA}, \quad R_{BH} = 5 \text{ k}\Omega, \quad C = 0.04 \mu\text{F}, \quad f = 2 \text{ kHz} \]
   (i) The values of \( R \) and \( R_2 \)
   (ii) If the triggering frequency of SCR is changed by varying \( R \), obtain the maximum and minimum values of \( R \) and corresponding frequencies.

![Figure 1: Connection diagram of UJT oscillator](image-url)
2(b) With the help of neat sketch and relevant waveforms, explain the working of an RC triggering circuit for an SCR. What is the main advantage of this circuit over resistance triggering circuit?

3. Draw the waveform of output voltage and source current of a two-pulse full-converter for highly inductive load. Show that the nth harmonic component of the source current is given by

\[ I_{st} = \frac{4I_s}{n\pi} \sin(n\alpha t - n\alpha) \]

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

Also find the Current Distortion Factor for this converter.

OR

3'(a) Draw the circuit of a single-phase, mid-point converter supplying a resistive load.

Draw the waveforms of load voltage and anode to cathode voltages across the thyristors for \( \alpha = 90^\circ \). Find the expression of the output voltage.

3'(b) A two-pulse, single phase, full converter is connected to a RL load, with \( R = 0.4 \Omega \) and \( L = 2 \text{ mH} \). The value of average output current \( (I_o) \) for continuous conduction was found to be 10A. If the input voltage is given to be 230V, 50 Hz, calculate:

a) \( \alpha \) for \( E = 120V \)  
b) \( \alpha \) for \( E = -120V \)

4. Draw the circuit of a three-phase, bridge type fully controlled converter. If the converter is supplying a purely resistive load, draw the waveforms of the 3-phase input voltage, output voltage, voltage across any one thyristor and current through any one phase of the input source for \( \alpha = 90^\circ \). 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. With the help of neat sketch and relevant waveforms, explain the cosine firing scheme used for triggering SCRs of a single-phase, full wave converter. Show that the output voltage of the converter is directly proportional to the control voltage of the firing circuit.

OR

5' What is a dual converter? Draw its circuit and explain its operation both with and without circulating current. Compare the two modes of operation.
## 1(a)
**Explain in brief:**
- a) Energy due to fission
- b) Multiplication factor
- c) Critical size

## 1(b)
Draw flue gas flow diagram of a thermal power plant and explain each of its components.

## 1(a')
What are the factors responsible for selecting a site of a thermal power plant? Explain them briefly.

## 1(b')
With the help of a neat diagram explain the working of pressurized water reactor.

## 2(a)
**Explain in brief:**
- a) Stream flow
- b) Hydrograph
- c) Biological effects on the environment.

## 2(b)
With the help of a diagram explain the working of speed regulating system of a Pelton turbine.

## 2(b')
With the help of a diagram explain the working of combined cycle gas turbine plant.

## 3(a)
What are the benefits of Cogeneration system?. Also explain any two cogeneration technologies with the help of a neat diagram.

## 3(b)
What are different types of captive power plant? Explain them briefly.

## 4(a)
Explain the speed-time curve for train movement.

## 4(a')
Drive the expression for tractive effort for propulsion of train.
<table>
<thead>
<tr>
<th>Q 4(b)</th>
<th>Explain the power supply system for the electric traction. Also explain the arrangement that should be adopted when supply for traction work is available from national grid.</th>
<th>[6]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q 5(a)</td>
<td>What are the requirements of a good light? Also explain different types of lightening schemes.</td>
<td>[6]</td>
</tr>
</tbody>
</table>

**OR**

<table>
<thead>
<tr>
<th>Q 5(a')</th>
<th>What is electroplating? Also explain different operations involved in electroplating.</th>
<th>[6]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q 5(b)</td>
<td>A football ground 120m x 60m is to be illuminated by lamp of 1000W, lamps supported on 12 towers distributed around ground to provide approximate uniform illumination. Assume 40% light reaches ground and illumination of 1000 lumens/m² is required. Calculate number of lamps on each tower. Overall efficiency of each lamp is 30 lm/watt.</td>
<td>[6]</td>
</tr>
</tbody>
</table>
2015-16
B.E. (AUTUMN SEMESTER) EXAMINATION
ELECTRICAL ENGINEERING
ELECTRICAL & ELECTRONICS INSTRUMENTATION
EEE-352N

Maximum Marks: 60 Credits: 04 Duration: Three Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No. Question M.M.

1(a) Discuss the relative advantages and disadvantages of analog and digital [04]
methods of measurement of electrical quantities.

1(b) Explain the working of an integrating type of digital voltometer with the help of [06]
a block diagram.

1(c) Find the resolution of a 4½ digit digital voltometer used for voltage [02]
measurement.

OR

1 Write notes on the following: [12]
   a) Digital Multimeter.
   b) Digital method used for the measurement of A.C. power.

2 Write notes on the following: [12]
   a) Analog and digital data acquisition systems.
   b) Digital storage Oscilloscope.

OR

2(a) What do you understand by the term 'Multiplexing'? Make a comparison of [08]
frequency division multiplexing (FDM) and time division multiplexing (TDM)
used in telemetry systems.

2(b) What is position telemetry? Illustrate your answer with an example. [04]

Contd.....2.
3(a) What is a Piezo Electric Transducer? What are the materials used in such transducers? Define its voltage and charge sensitivities.

3(b) Describe the constructional features and performance characteristics of a linear variable differential transformer. A LVDT produces an output of 2V rms for a displacement of $50 \times 10^{-6}$ cm. Calculate the sensitivity of LVDT in $\mu$V/mm.

4(a) Describe any suitable method used for measuring temperature inside the winding of a field coil of an electric generator.

4(b) Describe any two methods used for the measurement of low pressure.

5. Write notes on any two of the following:
   a) Intelligent Instrumentation.
   b) Wide area measurement system (WAMS)
   c) Micro electro mechanical system (MEMS) based sensors
   d) Global positioning system (GPS)
2015-16
B.E. (AUTUMN SEMESTER) EXAMINATION
ELECTRICAL ENGINEERING
High Voltage Engineering
EEE –361

Maximum Marks: 60  Credits: 04  Duration: Three Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No.  M.M.
1(a) Derive an expression for breakdown in electronegative gases under uniform field [06]
conditions as postulated by Townsend’s theory. Also write such expression in
normal gases.
(b) Explain electrochemical deterioration and intrinsic breakdown mechanism in solid
dielectrics. Also draw the curve showing the variation of breakdown strength with
time depicting the mechanism of breakdown in solid dielectrics.

OR

1'(a) Define Townsend’s primary and secondary ionization coefficients and hence derive
[07]
Townsend’s breakdown equation of a gas under uniform fields. Also define
attachment coefficient and explain how the breakdown equation gets modified for
electronegative gases.
(b) Enumerate various mechanisms that lead to breakdown in solid dielectrics. Explain
[05]
thermal and electromechanical breakdown in detail.

2(a) Why the lowest unit of n-stage cascade connection has the maximum power rating? [02]
(b) Develop expressions for wave-front and wave-tail time using approximate analysis
of basic Marx circuit.
(c) Discuss induction regulator for voltage control of a testing transformer with a
suitable figure stating its advantages over other methods.

OR

2'(a) Explain how high frequency high voltages are generated. What are its advantages.
and applications?

(b) With the help of a neat sketch describe the working of Cockcroft Walton voltage multiplier circuit for generation of high dc voltages. Why is it desirable to increase capacitance in lower stages in the circuit but it is not done?

3(a) Discuss the sphere gap method used for measurement of high voltages. Also discuss the effect of humidity, atmospheric conditions and nearby earthed objects on the measurements using this method.

(b) With the help of a neat sketch explain the Chubb and Fortescue method used for the measurement of high voltages. Also explain how the influence of frequency on the reading is eliminated.

OR

(b') With the help of a neat sketch explain measurement of ac voltages by Electrostatic voltmeter. What are its advantages and limitations?

4(a) What is the significance of non-destructive high voltage tests? Explain the Schering bridge used for the measurement of loss tangent.

(b) Define PDIV, Apparent charge and PDEV. Draw an analogue circuit and hence determine the expression for PDIV for discharge in voids.

5(a) Define Salinity index.

(b) Distinguish between Type and Routine test.

(c) What is Condition Monitoring? With the help of an example explain how it is implemented.

(d) Discuss Loading cycle test, Thermal stability test and Dielectric thermal resistance test performed on cables.
Q.No.                  Question                                           M.M.
1(a) What do you understand by complex dielectric constant? Derive relation for    [05]
complex dielectric constant showing real and imaginary parts.
1(b) Given that the dielectric constant of a material in an alternating field has a real and   [07]
imaginary component, deduce an expression for the current density in the material if the material forms a medium between the conductors of a condenser connected to an alternating current source. Also calculate energy loss per unit volume in the medium.

OR

1’ Explain the frequency dependence of electronic polarizability of a dielectric in an alternating electric field. [12]

2(a) Explain following processes:
   i. Photo-ionization
   ii. Ionization by collision

2(b) Explain streamer theory of breakdown in air at atmospheric pressure showing all successive stages of streamer development diagrammatically. [06]

OR

2’(a) Describe Townsend's current growth phenomenon in a gas subjected to uniform electric fields. [06]

2’(b) Discuss various mechanisms of vacuum breakdown. [06]
3(a) Explain the phenomenon of electrical conduction in pure liquids showing the conduction current-electric field characteristic. How does it differ from that in gases?

3(b) Explain any two mechanisms by which breakdown occur in commercial liquid dielectrics.

4(a) Explain electrochemical deterioration and intrinsic breakdown mechanism in solid dielectrics. Also draw the curve showing the variation of breakdown strength with time depicting the mechanism of breakdown in solid dielectrics.

4(b) Explain the internal discharge phenomenon which leads to breakdown in solid dielectrics.

OR

4'(a) What is thermal breakdown in solid dielectrics? With the help of suitable curve show thermal instability condition.

4'(b) What is composite dielectric? Explain its properties.

5(a) What is the necessity of determining the limits of temperatures for the insulating materials? Give classification of insulating materials based on their temperature withstand capacity.

5(b) Discuss the application of insulating materials in circuit breakers. Classify different types of insulating materials used in construction of high voltage switchgear.
NOTE: Assume suitable data if missing.

1a. (i) Differentiate between luxuries and necessities?
(ii) What do you mean by GDP and GNP?

1b. A man owns a corner plot. He must decide which of the several alternatives to select in trying to obtain a desirable return on his investment. After much study and calculation, he decides that the two best alternatives are as given in the following table:

<table>
<thead>
<tr>
<th></th>
<th>Build Gas Station</th>
<th>Build Soft Ice-Cream stand</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Cost (Rs.)</td>
<td>20,00,000</td>
<td>36,00,000</td>
</tr>
<tr>
<td>Annual Property taxes (Rs.)</td>
<td>80,000</td>
<td>1,50,000</td>
</tr>
<tr>
<td>Annual Income (Rs.)</td>
<td>8,00,000</td>
<td>9,80,000</td>
</tr>
<tr>
<td>Life of building (years)</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Salvage value (Rs.)</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Evaluate the best alternatives if the rate of return is 12% per annum.

OR

1(b'). Compare the following proposals to maintain a canal. Use interest rate 5% per annum.

<table>
<thead>
<tr>
<th>Proposal A (Buying Dredging Machine)</th>
<th>Proposal B (Concrete Lining)</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Cost</td>
<td>$ 65,000</td>
</tr>
<tr>
<td>Annual maintenance cost</td>
<td>$ 32,000</td>
</tr>
<tr>
<td>Salvage value</td>
<td>$ 7,000</td>
</tr>
<tr>
<td>Life, years</td>
<td>10</td>
</tr>
</tbody>
</table>

Contd.....2.
2. Attempt any two questions from the following.

(a) What do you understand by defender and challenger?

A diesel engine was installed 10 years ago at a cost of Rs. 50,000. It has a present realizable market value of Rs. 15,000. If kept, it can be expected to last five years more, with operating and maintenance cost of Rs. 14,000 per year and to have a salvage value of Rs. 8,000 at the end of the fifth year. This engine can be replaced with an improved version costing Rs. 65,000 which has an expected life of 20 years. This improved version will have an estimated annual operating and maintenance cost of Rs. 9,000 and ultimate salvage value of Rs. 13,000. Using an interest rate of 15%, determine whether to keep or replace the old engine.

(b) What are the various criteria for performing a cost benefit analysis?

Two mutually exclusive projects are being considered for investment. Project A1 requires an initial outlay of Rs. 30,00,000 with net receipts estimated as Rs. 9,00,000 per year for the next 5 years. The initial outlay for the project A2 is Rs. 60,00,000, and net receipts have been estimated at Rs. 15,00,000 per year for the next seven years. There is no salvage value associated with either of the projects. Using the benefit cost ratio, which project would you select? Assume an interest rate of 10%.

(c) Differentiate between declining and double declining methods.

A company has purchased an equipment whose first cost is Rs. 1,00,000 with an estimated life of eight years. The estimated salvage value of the equipment at the end of its lifetime is Rs. 20,000. Calculate using declining and double declining methods, the depreciation for the fourth year and the book value at the end of fifth year. Compare the results.

3a. Explain the two different models of decision making. What are the similarities and differences between them? Use one suitable example from the industry to illustrate your point.

3b. What are the different informational roles a manager plays? Use one example each for every role from the industry to illustrate your point.

4. Explain the term “Job design”? Explain the job enlargement and the job enrichment approach of job design.

5. Explain Maslow’s theory of motivation. Suppose you are a manager at a power production company like NTPC. How would you ensure that the various needs (as identified by Maslow) of your subordinates are met.

5. Suppose you are an HR manager at TCS. Knowledge of a new software package is necessary for completing your project. You are tasked with designing a training program. What different steps would you take to ensure that the training program you designed would be successful? Show those steps in the form of a flow chart.