Note: Answer all questions. Each question carries equal marks.

Q.1 (a) Obtain the polar form of Cauchy Riemann equation and use it to show that \( \log z \) is analytic.

OR

(b) If \( f(z) = u + iv \) is an analytic function of \( z \), and

\[
\begin{align*}
\frac{\partial u}{\partial x} &= \frac{\cos x + \sin x - e^y}{2\cos x - e^x - e^{-x}} \\
\frac{\partial v}{\partial y} &= \frac{\cos x + \sin x - e^{-y}}{2\cos x - e^x - e^{-x}}
\end{align*}
\]

subject to the condition \( f'(i) = 0 \).

Q.2 (a) State Laurent's series and use it to expand the function \( f(z) = \frac{e^z}{(z-1)^3} \) about \( z = 1 \).

(b) Use residue theorem to evaluate

\[
\int \frac{(z-i)}{(z+1)(z-2)} \, dz
\]

where \( C \) is the circle \( |z| = 2 \).

(c) Evaluate by contour integration:

\[
\int_{\gamma} \frac{\cos 2\theta \, d\theta}{(1 - 2a \cos \theta + a^2)}, \quad -1 < a < 1
\]

(c') Evaluate by contour integration:

\[
\int_{\gamma} \frac{\cos x \, dx}{(x^2 + x^2)(x^2 + b^2)}, \quad a > b > 0
\]

Q.3 (a) Establish an intuitive formula for the reciprocal of any natural numbers...
N, and hence find the value of \( \frac{1}{19} \) correct to four decimal places.

OR

(a) Use general iteration method to find the real root of the equation
\[ 2x - \cos x + 3, \] Correct to four decimal places.

(b) Solve the following system of equations by Gauss-Seidel method
\[
\begin{align*}
27x + 6y - z &= 85, \\
6x + 15y + 2z &= 72 \\
x + y + 5z &= 7
\end{align*}
\]
Apply three iterations.

(c)(i) Find the cubic polynomial which takes the following values: \( y(0) = 1, \) \( y(1) = 0, \) \( y(2) = 1 \) and \( y(3) = 10. \) Hence or otherwise, obtain \( y(4). \)

(ii) Prove the following identities:
\[
\Delta V = V_1 - V_2 = \Delta^2, \quad hD = \log (1 + \Delta)
\]
Where the symbols have their usual meaning.

Q.4

(a) Using Taylor series method, solve the following differential equation
\[
\frac{dy}{dx} = x - y^2, \quad y(0) = 1
\]
(upto four non-zero terms) and find \( y(0.1). \)

(b) Using modified Euler's method, find the value of \( y \) at \( x = 0.02 \) and \( x = 0.04 \) of the differential equation
\[
\frac{dy}{dx} = x^2 + y, \quad y(0) = 1
\]

OR

(b') Use Runge-Kutta fourth to find \( y \) when \( x = 0.2 \) given that
\[
\begin{align*}
\frac{dy}{dx} &= y - x, \\
\frac{dy}{dx} &= x + y.
\end{align*}
\]
\( y(0) = 1 \) take \( h = 0.2 \)

(c) Solve the boundary value problem by finite difference method.
\[ y'' + y + 1 = 0 \]
with boundary condition
\[ y(0) = 0, \quad y(1) = -1 \]
with \( h = \frac{1}{4} \)

************
2015-2016
B. TECH. (ELECTRICAL) III SEMESTER EXAMINATION
Electrical Machines – I
EE-211 N

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) A 15 kVA, 2300/230 V, 50 Hz single phase transformer is to be tested to determine its excitation branch components and its series impedances. The following test data have been taken from the primary side of the transformer.
Open Circuit Test: 2300 V; 0.21 A; 50 W
Short Circuit Test: 47 V; 6.0 A; 160 W
Find the equivalent circuit of the transformer referred to high voltage side. [06]

1(b) Define efficiency of transformers. On what factors does it depend? What is the condition for maximum efficiency? [06]

1(b)' What do you understand by the term 'Voltage Regulation' of transformers? Draw the phasor diagram of the transformer for no load condition and explain various phasors. [06]

OR

2(a) A 10 kVA, 2300/230 V, 50 Hz single phase transformer is reconnected as an auto transformer getting supply from 2530 V supply and load is supplied at 2300 V. 230 V winding is having sufficient insulation against failure. Calculate kVA rating of the system and the kVA transferred inductively as well as conductively to load. [06]

2(b) When and how the two transformers are operated in parallel? Discuss the conditions necessary for parallel operation. [06]

2(b)' Giving necessary diagrams discuss a systematic procedure of converting a three phase balanced AC supply to two phase balanced system. Draw the phasor diagram. [06]

Contd.....2.
3(a) A 6 pole, 3 phase, 50Hz induction motor runs on full load with a slip of 4 percent. Given the rotor standstill impedance per phase as (0.01 + j0.05) ohm, calculate the available maximum torque in terms of full load torque. Also determine the speed at which the maximum torque occurs.

3(b) Explain the procedure of drawing the circle diagram of an induction motor. What information can be drawn from the circle diagram? OR

3(b)' Sketch the torque – slip characteristics of 3 phase induction motor indicating, therein the starting torque, maximum torque and the operating region. How do starting and maximum torque vary with the rotor resistance?

4(a) Compare 3-phase cage and wound type induction motors with reference to construction and performance.

4(b) A 500V, 6 pole, 50 Hz, 3-phase induction motor develops 20kW inclusive of mechanical losses when running at 995 rpm, the power factor being 0.87. Calculate (a) the slip, (b) the rotor \( R^2 \) loss (c) the total input if the stator loss is 1500W. OR

4(b)' A 25 h.p., 6-pole, 50 Hz, 3 phase slip ring induction motor runs at 960 revolutions per minute on full load with a rotor current per phase of 35 A. Allowing 250W for the copper loss in the short circuiting gear, and 1000W for mechanical losses, find the resistance per phase of the three phase rotor winding.

5(a) Discuss double revolving field theory of a single phase induction motor and explain why this motor is not self-starting.

5(b) Explain the working principle of split phase type single phase induction motor with the help of neat sketch. How can you reverse the direction of rotation of such motor? OR

5(b)' Discuss the procedure for determining the parameters of equivalent circuit of a single phase induction motor.
2015-2016
IIIrd SEMESTER B.TECH. EXAMINATION
(ELECTRICAL ENGINEERING)
Power System Engineering
(EE – 231N)
Credits: 04

Maximum Marks: 50
Duration: Three Hours

Note:

- Attempt any two parts from each 5 questions. Each part carries 6 marks.
- Symbols and abbreviations used have their usual meanings. Assume suitable value for missing data, if any.

1. (a) Write a short note on 'types of overhead line conductors' bringing out the reasons for using ACSR conductors.
   (b) Deduce an expression for line to neutral capacitance for a 3-phase overhead transmission line when the conductors are unsymmetrically spaced but transposed.
   (c) Calculate the inductance per phase and capacitance line to neutral for the three-phase, double-circuit transposed line whose phase conductors have a diameter of 2 cm, with the horizontal conductor configuration as shown in Fig.1.

![Fig.1]

2. (a) Find ABCD constants for nominal ac circuit of a medium transmission line.
   Write expressions of sending end voltage and current in matrix form.
   (b) A 3-phase, 60 Hz, 500 kV transmission line is 300 km long. The line inductance is 0.97 mH/ph/km and its capacitance is 0.0115 μF/ph/km. The line supplies a load of 1000 MVA, 0.8 power factor lagging at 500 kV. Assume lossless line. Only series capacitors are installed at the midpoint of the line providing 40% compensation. Find the sending end voltage and voltage regulation.
   (c) Determine the critical disruptive voltage, visual disruptive voltage and corona power loss of a 3-phase transmission line 160 km long, conductor diameter 1.036 cm, 2.44m delta spacing, air temperature 26.67 °C, altitude 2440 m corresponding to an approximate barometric pressure of 73.15 cm, operating voltage 110 kV at 50 Hz. Assume surface irregularity factor 0.85 and μ=0.72

3. (a) Explain why the voltage across the insulators of insulator string are not equal and describe the methods of improving this voltage distribution.
   (b) Each conductor of a 3-phase overhead line is suspended from a cross arm of a steel tower by a string of 4 disc insulators. The voltage across the second unit is 14.7 kV and across the third 20 kV. Find the voltage between the conductors and the string efficiency.

Contd.....2.
(c) An overhead transmission line has span of 150 m. Horizontal wind pressure is 20 kg/m² and the thickness of ice is 1.25 cm. Radius of conductor is 1.40 cm and weight is 1520 kg/km, and ultimate strength of 12500 kg. Use safety factor of 2 and 912 kg/m² for the weight of ice. Using the Parabolic method, determine the deflected and vertical sag.

4. (a) Derive a formula for the electric stress in a single core cable. Where is the maximum and minimum stress? Find the economical size of cable conductor which gives minimum value of electric stress at conductor surface.
   (b) Derive the expression for calculating the current rating of a cable.
   (c) Find the maximum working voltage of a single core cable having 2- insulating materials A and B with following data;
   Conductor radius 0.5 cm, inside sheath radius 2.5 cm, maximum working potential gradient of A, 60 kV/cm, maximum working potential gradient of B 50 kV/cm. Relative permittivity of A and B are 4 and 2.5 respectively.

5. (a) What is electric substation? Discuss the different ways of classifying the substation.
   (b) Draw the single line diagram of a 33kV/11 kV substation having the following equipment.
      (i) 2-transformers 33kV/11 kV, 5MVA, A/A, 3-phase
      (ii) 33kV double bus bar with bus coupler, 11 kV single bus with sectionalisation.
      (iii) 2- incoming lines 33kV
      (iv) 2- outgoing lines 33kV
      (v) 6-outgoing lines 11 kV distributed equally
      Show positions of CTs, PTs, isolators, lightning arrestors, CBs etc.
   (c) Enumerate various methods of neutral grounding. Explain with the help of circuit and phasor diagram the function of a Peterson coil in 3-phase system with reference to neutral grounding.
Q1a. State and explain Miller's theorem. Using this theorem find the neutral shift voltage $V_{ON}$ for the circuit shown in Fig1.

OR

a'. State and explain Tellegen's theorem. Verify this theorem for the circuit shown in Fig2.

Q1b. In the series circuit shown in Fig3 the sinusoidal source is $v = 100\sin(300t + \phi)$. Determine the resulting current if switch is closed when $\phi = 0$.

Q2a. Circuits shown in Fig 4a & 4b are cascaded. Find overall transmission parameters of the network.

OR

a'. Derive expressions for $ABCD$ parameters in terms of open circuit and short circuit impedances.

b. Find $Z$ parameters of the network shown in Fig5.

Contd.....2.
Q3 Write the following matrices for the network graph shown in Fig 6
a. Fundamental loop matrix.
b. Fundamental cut-set matrix.
c. Also find number of possible trees.
Select node 4 as reference node and edges 4, 5 & 6 as links of the graph.

OR

Q3' For the network shown in Fig 7 find loop currents using branch impedance matrix and tie-set matrix.

Q4(a) The poles and zeros of the driving point impedance of the circuit shown in Fig 8 are as under:
Zero at \( s = -2 \), poles at \( s = -1 \pm 4 \). If \( Z(0) = 1 \), find the values of R, L and C.

OR

(a') For the network shown in Fig 9 find driving point impedance and its poles and zeros.
(b) If \( F(s) = \frac{s(s+1)}{(s+4)(s^2+4s+9)} \), find \( f(t) \) using pole zero diagram of the function.

Q5(a) Enumerate advantages of \( m \)-derived filters over constant \( K \)-type filters. Design \( \pi \)-section of an \( m \)-derived high pass filter having a cut-off frequency of 3KHz, frequency of infinite attenuation at 2.7 KHz and a design impedance of 600 ohms.

OR

(a') A \( \pi \)-section filter network consists of a series arm inductance of 10 mH and two shunt arm capacitances of 0.16µF each. Calculate the cut off frequency, attenuation and phase shift at 12KHz. What is the value of nominal impedance in this band?
(b') Obtain the state transition matrix of the system described by the following state equations.

\[
\begin{bmatrix}
  x_1 \\
  x_2
\end{bmatrix} =
\begin{bmatrix}
  0 & 1 \\
  -2 & -3
\end{bmatrix}
\begin{bmatrix}
  x_1 \\
  x_2
\end{bmatrix} +
\begin{bmatrix}
  0 \\
  1
\end{bmatrix} u(t)
\]

Contd...
2015-2016
B. TECH. (ELECTRICAL) III SEMESTER EXAMINATION
Electrical Engineering Materials
EE-277

Maximum Marks: 60          Credits: 04          Duration: Three Hours

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

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a)</td>
<td>Describing free electron theory of metals and mentioning the assumptions derive the equation ( v_0 = -eE (v/m) ).</td>
<td>[6]</td>
</tr>
<tr>
<td>1(b)</td>
<td>Discuss thermoelectric phenomenon and establish a relationship for c.m.f produced between two junctions of two different metals. OR</td>
<td>[6]</td>
</tr>
<tr>
<td>1(b)'</td>
<td>Compare and explain the phenomena of ‘Thermionic Emission’ and ‘Field Emission’.</td>
<td>[6]</td>
</tr>
<tr>
<td>2(a)</td>
<td>In a parallel plate capacitor an oil of relative permittivity of 2.3 is used as dielectric and the maximum working potential gradient is not to exceed 1000 V/mm. Calculate the approximate plate area required for a capacitance of 0.0003 ( \mu F ), the maximum working voltage being 10 kV. Assume ( \varepsilon_0 = 8.8542 \times 10^{-12} \text{ F/m}. )</td>
<td>[6]</td>
</tr>
<tr>
<td>2(b)</td>
<td>Using atomic model, show that the dielectric constant of a mono atomic gas may be given as ( \varepsilon = 1 + 4 \pi a^2 N ). Explain the assumptions. OR</td>
<td>[6]</td>
</tr>
<tr>
<td>2(b)'</td>
<td>What do you understand by the term ‘loss tangent’ of a dielectric? Show that it may be given as the ratio of imaginary part to real part of complex permittivity of the dielectric.</td>
<td>[6]</td>
</tr>
</tbody>
</table>
3(a) Discuss and compare suspended particle theory and bubble theory of breakdown of liquid dielectrics.

3(b) Mentioning examples, give temperature classification of insulating materials. OR

3(b)' Giving suitable example discuss Piezoelectricity phenomenon.

4(a) Why there is energy loss in a magnetic material, when subjected to an alternating magnetic field. What are the factors affecting these losses? Explain how these losses are minimized.

4(b) Giving examples, differentiate between soft and hard ferromagnetic materials. OR

4(b)' What is anti-ferromagnetism? Draw the susceptibility versus temperature curve for MnF₂.

5(a) Giving suitable examples supporting with data differentiate between use of epoxy resins and inorganic insulating materials in electrical systems.

5(b) Explain the properties of Ferrites and suggest their use in electrical systems. OR

5(b)' What properties an ideal liquid insulating material should possess for use in power transformers? Compare mineral oil with vegetable oils.
2015-16
B.TECH. (AUTUMN SEMESTER) EXAMINATION
ELECTRICAL ENGINEERING
ELECTRONIC DEVICES AND CIRCUITS
EL – 201

Maximum Marks: 60
Credits: 04
Duration: Three Hours

Q. No. Question
1(a) Derive an expression for a.e. or small-signal resistance \( r_d \) of a diode. Find \( r_d \) at bias current of 0.1 mA, 1 mA, and 10 mA. Assume \( n = 2 \).
1(b) How does a Schottky barrier diode differ from a silicon junction diode?
1(c) Differentiate between diffusion and depletion capacitances of a pn junction diode.

OR

1' With the aid of suitable energy band diagrams explain the operation of a Tunnel diode.

2(a) In the circuit of Fig.1, \( v_{ac} \) is a small sine-wave signal with zero average. The transistor \( \beta \) is 100.

(a) Find the value of \( R_2 \) to establish a dc emitter current of 0.5 mA.
(b) Find \( R_C \) to establish a dc collector voltage of +5 V.
(c) For \( R_2 = 10 \) k\( \Omega \) and the transistor \( r_o = 200 \) k\( \Omega \) draw the small-signal equivalent circuit of the amplifier and determine its overall voltage gain.

Contd...
2(b) With neat diagram explain the working characteristics of Uni-junction transistor. Give its equivalent circuit.

OR

2' In the circuit of Fig. 2, the input signal $v_{in}$ is coupled to the gate through a very large capacitor (shown as infinite). The transistor source is connected to ground at signal frequencies via a very large capacitor (shown as infinite). The output voltage signal that develops at the drain is coupled to a load resistance via a very large capacitor (shown as infinite).

(a) If the transistor has $V_t = 1 \text{ V}$, and $k_{m} \frac{W}{L} = 2 \text{ mA/V}^2$, find the dc quantities $I_D$, $V_D$ and $V_{DS}$.

(b) Find $g_m$ and $r_o$ if Early voltage ($V_A$) = 100 V.

(c) Draw a complete small-signal equivalent circuit model for the amplifier, assuming all capacitors behave as short circuits at signal frequencies. Using this model, find $R_m$, $v_{gs}/v_{in}$, $v_{gs}/v_{ds}$, and $v_o/v_{gs}$.
3(a) Calculate the output voltage (Vo) and Zener current in the regulator circuit of Fig. 3 for $R_L = 1 \, \text{k}\Omega$.

3(b) Explain the operation of Class A amplifier with the help of signal waveforms. Prove that its maximum power conversion efficiency is 25%.

OR

3' Find the midband gain and the upper 3-dB frequency of the common-emitter amplifier of Fig. 4 for the following case: $V_{cc} = V_{bb} = 10 \, \text{V}$, $I = 1 \, \text{mA}$, $R_0 = 100 \, \text{k}\Omega$, $R_C = 8 \, \text{k}\Omega$, $R_{sig} = 5 \, \text{k}\Omega$, $R_L = 5 \, \text{k}\Omega$, $\beta = 100$, $V_d = 100 \, \text{V}$, $C_f = 1 \, \text{pF}$, $f_r = 800 \, \text{MHz}$ and $r_f = 50 \, \Omega$. 
4(a) With the help of general structure of the feedback amplifier, explain the concept of negative feedback. Determine the feedback factor $\beta$ for a negative-feedback amplifier that has a closed-loop gain $A_C = 100$ and an open-loop gain $A = 10^3$.

4(b) Derive the condition of oscillation for the Hartley oscillator circuit using BJT. Also find its oscillating frequency.

5(a) Explain the following terms:
   i. Slew rate
   ii. CMRR
   iii. Offset voltage and its removal

5(b) Draw the circuit of an op-amp based instrumentation amplifier. Derive an expression for the output voltage of this circuit.