Bachelor of Power Engineering 1ˢᵗ Year 2ⁿᵈ Semester Examination 2017

Principles of Electrical Engineering   REF:EX/PE/T/124/2017

FM: 100

Time: 3hr

Answer **any five** of the following:

(5×20= 100)

Q1(a). Derive the expression for force of attraction between two oppositely charged plates. 10

Q1(b). Calculate the dielectric flux in micro-coulombs between two parallel plates each 45cm square with an air gap of 2mm between them, the potential difference being 3500V. A sheet of insulating material 1.5mm thick is inserted between the plates, the permittivity of the insulating material being 5. Find out the potential gradient in the insulating material and also in air if the voltage across the plates is raised to 7000V.   10

Q2(a). What is reluctance and ampere turns? How do you find required ampere turns for a composite magnetic circuit?   10

Q2(b). A ring has a diameter of 28cm and a cross sectional area of 12cm². The ring is made up of semicircular sections of cast iron and cast steel, with each joint having reluctance equal to an air gap of 0.25mm. Find the ampere-turns required to produce a flux of 6×10^{-4} Wb. The relative permeabilities of cast steel and cast iron are 800 and 166 respectively. Neglect fringing and leakage effects.   10

Q3(a). Find the r.m.s value of a sawtooth time dependent wave.   10
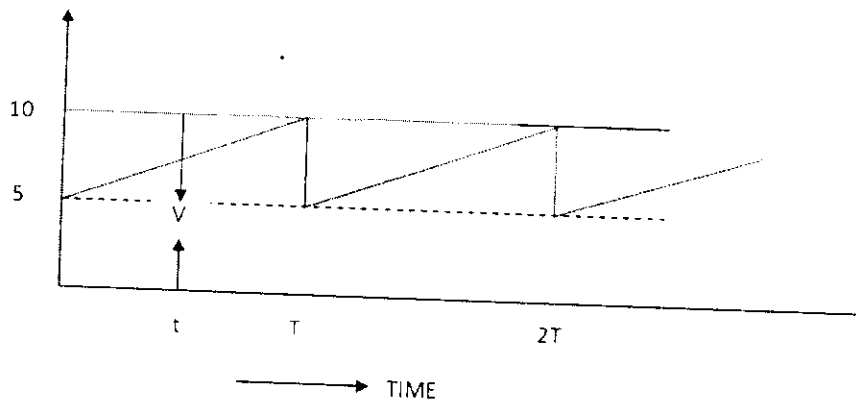
Q3(b). A total current of 15A flows through the parallel combination of three impedances: (2-j4) Ω, (6+j3) Ω and (3+j4) Ω. Calculate the current flowing through each branch. Find also the p.f of the combination. 10

Q4(a). Derive the expression for star to delta conversion in an unbalanced circuit having impedances Z_1, Z_2, Z_3. 10

Q4(b). Three impedance coils, each having a resistance of 25Ω and a reactance of 20Ω, are connected in a star to a 440V, 3-ph, 50Hz supply. Calculate (i) the line current; (ii) power supplied and (iii) the power factor. If three capacitors, each of the same capacitance, are connected in delta to the same supply so as to form parallel circuit with the above impedance coils, calculate the capacitance of each capacitor to obtain a resultant power factor of 0.9 lagging.   10

Q5(a). Deduce and show that the two wattmeters method can read power for a 3-ph system?.   10

Q5(b). The power input to a synchronous motor is measured by two wattmeters both of which indicate 60kW. If the power factor of the motor be changed to 0.9 leading, determine the readings of the two wattmeters, the total input power remaining the same. Draw the vector diagram for the second condition of the load. 10

Q6(a). State and prove Millman's theorem?   10

Q6(b). A Y-connected load is supplied from a 400V, 3-phase, 3 wire symmetrical system RYB. The branch circuit impedances are: $Z_R= 8\sqrt{3}+j\ 10$; $Z_Y = 15+j20\sqrt{3}$; $Z_B= 2-j8$. By Millman's Theorem determine the current in each branch. Phase sequence is RYB.   10

Q7(a). Deduce the expression of positive, negative and zero sequence component of an unbalanced voltage set.   10

Q7(b). Determine the values of the symmetrical components of a system of currents:
$$I_R= 10+j100\ A\ ;\qquad I_Y= 20-j80\ A;\qquad I_B= -50-j50\ A$$
Phase sequence is RYB.   10

Q8(a). Find the expression of transients in a dc RC circuit. What are the different types of transient do you know?   10

Q8(b). A 1.5H choke has a resistance of 60Ω. This choke is supplied with an a.c. voltage given by:
$$e= 120Sin\ 314t.$$
Find the expression for the transient component of the current flowing through the choke after the voltage is suddenly switched on.   10