# DEPARTMENT OF ELECTRICAL ENGINEERING IIT DELHI

## EEL101 FUNDAMENTALS OF ELECTRICAL ENGINEERING

**Max. Marks 35** **Major Test II (19/11/2011)** **Time 120 min.**

**(a) Attempt ALL questions. (b) Open Class notes Test.**

**Q1.** Find node voltages for the circuit shown in Fig.1. Given Vs=20 V. (4)

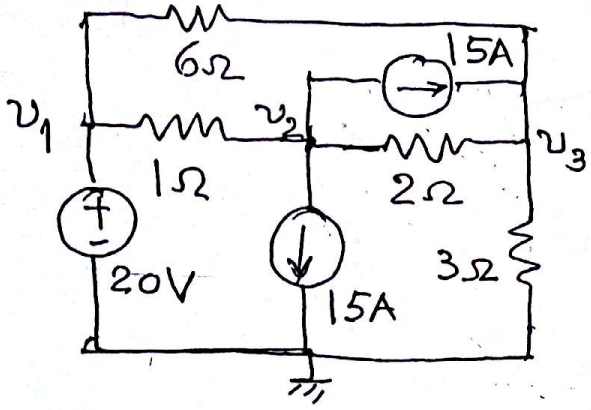



Fig. 1

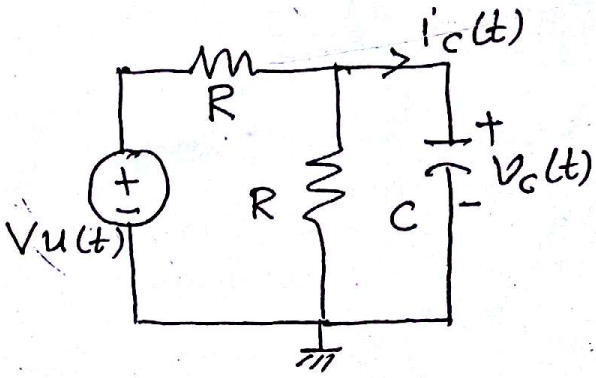



Fig 2

**Q2.** For the circuit in Fig. 2 find the step responses for capacitor current $i_{c(}(t)$ and voltage $v_c(t)$. Sketch $i_{c(}(t)$ and $v_c(t)$. (4)

**Q3.** Calculate resonance frequency of the admittance circuit shown in Fig.3. When a voltage source $v_s(t)$= Cos3t is applied to the admittance circuit, find: (a) Energy stored in the inductor $W_L(t)$, (b) Energy stored in the capacitor $W_C(t)$ and (c) Maximum total energy stored $W_{max}$, (5)

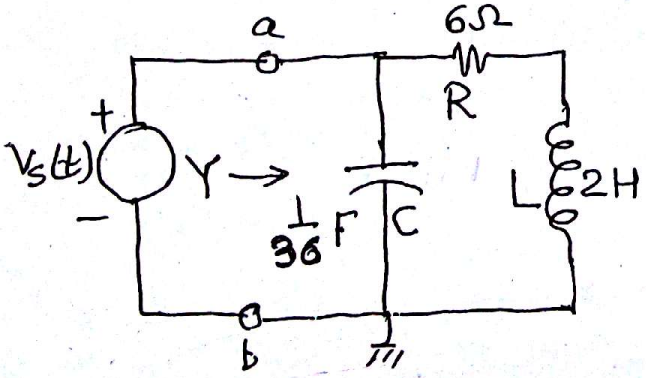



Fig. 3

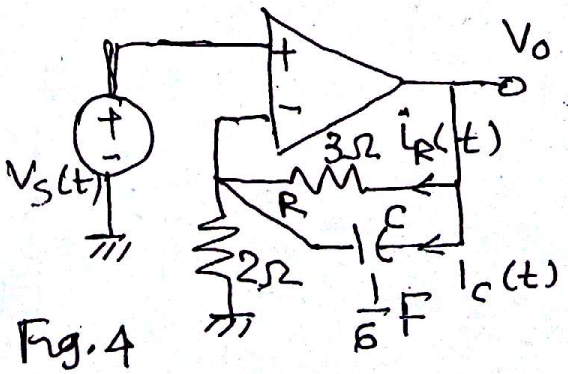
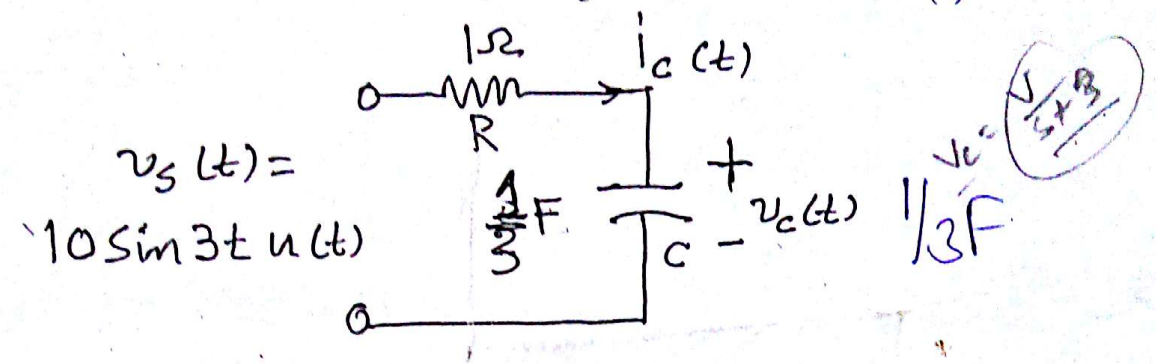



Fig. 4

**Q4.** For the op-amp circuit shown in Fig.4 find: (a) $v_o(t)$, (b) $i_R(t)$ and $i_{c(}(t)$ when $v_S(t)$= 6 Sin3tu(t). (4)

**Q5.** Applying Laplace Transform determine the response $i_c(t)$ and $v_c(t)$ to a sinusoidal excitation $v_s(t) = 10\text{Sin}3tu(t)$ for the circuit shown in Fig.5. (4)




**Q6.** For a 2400:240V, 50Hz, 48kVA 1-phase transformer open and short circuit tests conducted with low voltage winding as primary, show the following readings: $W_{OC}$=380 W, $I_{OC}$=3.8 A, $W_{SC}$=400 W and $V_{SC}$=4.5V. Calculate the transformer core loss resistance $R_C$, magnetizing reactance $X_M$, net series resistance $R_{SC}$ and leakage reactance $X_{SC}$ from low voltage end. Draw corresponding equivalent circuit. What will be the values of these parameters if the tests were conducted from the high voltage end? (4)

**Q7.** A DC shunt motor has 12 kW rated input power at 100V rated input voltage when it runs at rated speed of 1000rpm. It draws 6A current at no load. Motor armature resistance is 0.1Ω. Calculate (a) Rated input current, (b) Rated electromagnetic torque produced by the motor, (c) no load speed and (d) Speed regulation when rated load is withdrawn from the motor. Neglect friction torque. (4)

**Q8 (a).** Using graphical method, explain production of rotating field in a basic 3-phase, 2-pole, 6- slot cylindrical rotor AC synchronous generator, due to balanced 3-phase currents $i_A = I_M \text{Cos}314tA$, $i_B = I_M \text{Cos}(314t - 2\pi/3)A$ and $i_C = I_M \text{Cos}(314t - 4\pi/3)A$ flowing in its armature winding, by showing the resultant field at t=0s, 1.666 ms and 3.33ms. (3)

(b) A 3-phase Y-connected AC synchronous generator has rated phase voltage of 150V for a rated load at 0.8 power factor lagging. Find the synchronous reactance of the generator $X_S$ when the generated induced voltage $E_F$ is 219V.Also calculate the toque angle $\delta_G$. Draw corresponding phasor diagram. Neglect the armature resistance. 10KVA (3)