This question paper contains 8 printed pages]

CODE : FS-17

ELECTRICAL ENGINEERING

Time : 3 *Hours* *Maximum Marks* : 200

Note :— (*i*) Question No. **3** and Question No. **6** in Part I and Part II are compulsory. The candidate has to answer *two* questions from each part including the compulsory one. In all *five* questions have to be answered. All questions carry equal marks.

(*ii*) Parts of same questions must be attempted together and not to be attempted in between the answers to other questions.

Part I

1. (*a*) An electromagnetic wave from an under water source with perpendicular polarization is incident on water-air interface at $\theta_i = 200°$. Using $\varepsilon_r = 81$ and $\mu_r = 1$ for fresh water.

P.T.O.

Find :

(*i*) critical angle θ_c

(*ii*) reflection coefficient Γ

(*iii*) transmission coefficient T

(*iv*) attenuation in dB for each wavelength in the air.

(*b*) At 300° K, the intrinsic concentration of Si is 1.5×10^{16} m^{-3}. The free electron mobility is 0.13 $m^2/V\text{-}s$ and the hole mobility is 0.05 $m^2/V\text{-}s$.

Find :

(*i*) the conductivity of the intrinsic Si

(*ii*) the increase in conductivity of the doped Si, if the dopent concentration is two parts per 10^8 atoms. 40

2. (*a*) For unity feedback system :

$$G(S) = K / S(1 + 0.4S)(1 + 0.25S)$$

Find :

(*i*) the range of values of K

(*ii*) marginal value of K and

(*iii*) the frequency of sustained oscillations.

(*b*) For a feedback control system :

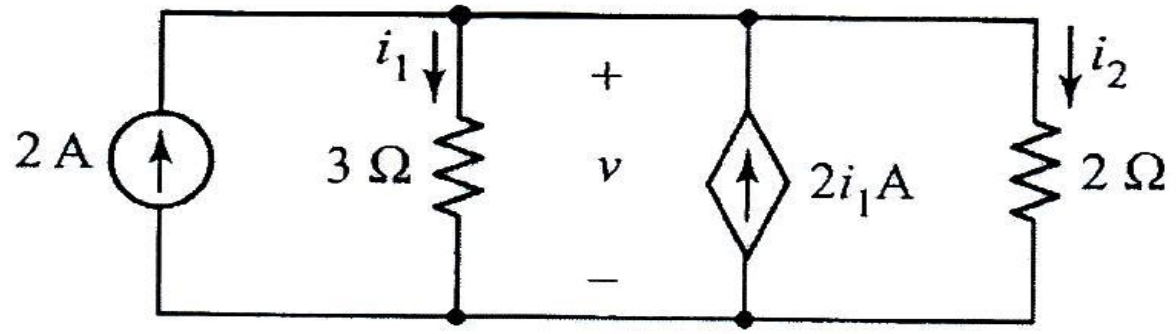
$$G(S)\,H(S) = 40 / (S + 4)(S^2 + 2S + 2)\,.$$

Find :

(*i*) the Gain Margin and

(*ii*) draw the Nyquist plot and comment on close loop stability. 40

3. (*a*) For the circuit shown below, find the currents i_1 and i_2.



(*b*) A balanced three-phase, star connected 210 V, 50 Hz, supply feeding to a delta connected load. The load absorbs a total power of 3 kW at a lagging pf of 0.85. Find :

(*i*) the per-phase impedance

(*ii*) what value capacitors should be connected in parallel with the per phase to result in unity pf. 40

4. (*a*) A single-phase transformer is rated at 1000 kVA, 5000/250 V. The full load copper losses are 2000 W and iron losses are 1200 W. Find the efficiency at :

(*i*) full load 0.8 p.f. lagging, and

(*ii*) load kVA for maximum efficiency.

(*b*) A 480 V, 6-pole, star connected, 50 Hz, cylindrical rotor synchronous generator has negligible armature resistance and 1.0 ohm per phase synchronous reactance. The full load armature current is 60 A. Total losses at full load are 4.2 kW. The field current has been so adjusted

that the terminal voltage at no load is 480 V. Find the :

(*i*) terminal voltage and regulation at full load, p.f. 0.8 lagging,

(*ii*) efficiency at full load, p.f. 0.8 lagging,

(*iii*) torque developed by the machine, at full load, p.f. 0.8 lagging. 40

5. (*a*) A moving coil voltmeter with a resistance of 20 ohm gives a full scale deflection of 120° when a potential difference of 100 mV is applied across it. The moving coil has a dimension of 30 mm × 25 mm and wound with 100 turns. The control spring constant is 0.375×10^{-6} Nm /deg, Find the flux density in the air gap.

(*b*) What are active filters ? Describe a low pass active filters and derive the expression for cutoff frequency. Draw its frequency characteristics. 40

Part II

6. (*a*) A 200 km, 3-phase, 50 Hz transmission line has the following data :

$A = D = 0.938 < 1.20$; $B = 131.2 < 72.30\ \Omega$;

$C = 0.001 < 72.30\ \Omega$

The sending end voltage is 230 kV. Find :

(*i*) receiving end voltage VR on no load

(*ii*) line charging current

(*iii*) maximum power that can be transferred at 220 kV and the corresponding reactive power.

(*b*) One conductor of a three-phase lines is open. The current flowing to the delta connected load is 20 amp. through line A. Using this as a reference and assuming line C is open. Determine the symmetrical components of the line currents. (A B C phase sequence) 40

7. (*a*) Draw a simple block diagram of a micro-processor, and explain the function of each block in brief.

(*b*) Describe the comparison between FM, PAM and PCM telemetering system. An FM signal represented by the equation :

$E = 10 \sin (8 \times 108\,t + 7 \sin 6 \times 104\,t)$ V.

Determine :

(*i*) carrier frequency

(*ii*) modulating frequency

(*iii*) modulation index

(*iv*) maximum deviation. 40

8. (*a*) Give the classification of power semiconductor devices based on the controllability. What should be the characteristics for an ideal switch ? Give the ideal i-v characteristics of Diode, SCR, & IGBT.

(*b*) For the Buck converter the following are the operating parameters Vs = 24 V,

L = 200 μH, R = 20 Ω, C = 200 μF, f = 10 kHz, D = 0.4.

Find :

(*i*) whether the mode of Operation is CCM or DCM

(*ii*) the output voltage V_0. 40