

B.E. POWER ENGINEERING
 First Year, First Semester
 SUPPLEMENTARY EXAM 2023
Basic Electrical Engineering

Time: 3 hrs

Full Marks: 100

Answer any TEN questions

1. (a) Derive an expression for current division through two parallel resistances R_1 and R_2 .
 (b) Using the expression, find out the current flowing through the resistance of 8Ω in Fig. 1. 5+5

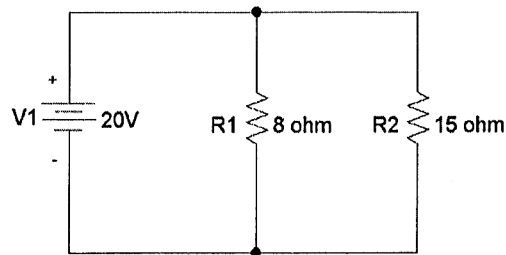


Fig. 1.

2. (a) State and explain Maximum power transfer theorem.
 (b) Calculate the value of load resistance R_L which will consume maximum power for the circuit shown in Fig. 2. 5+5

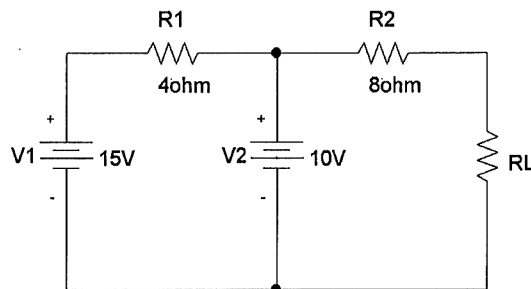


Fig. 2.

3. (a) Draw the circuit diagram and phasor diagrams of (i) purely resistive circuit. (ii) purely inductive circuit. (iii) purely capacitive circuit, supplied by sinusoidal AC voltage.
 (b) The equation of an alternating current is $i = 62.35 \sin(323 t)$ A. Determine its
 i) Maximum value
 ii) Frequency
 iii) R.M.S. value
 iv) Average value 5+5
4. (a) What is resonance? Deduce the expression of frequency in a series RLC circuit at resonance
 (b) A circuit consisting of series combination of elements as resistance of 6Ω , inductance of 0.4H and a variable capacitor is connected across a 100V , 50Hz supply. Calculate (i) value of capacitance at resonance, (ii) voltage drop across capacitor at resonance and (iii) Q-factor of coil. 5+5
5. (a) Derive an expression for energy stored in a magnetic field.
 (b) An iron ring has cross section area of 100 mm^2 and mean diameter of 10 cm . Calculate the MMF required to produce a flux of $200 \mu\text{Wb}$. Assume relative permeability of iron as 800 . 5+5

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6. (a) Define electric capacitance and derive an expression for the capacitance of a parallel plate capacitor.
 (b) Calculate the capacitance between two parallel plates of the area 0.4m^2 separated by a di-electric of 0.1 mm thick & of relative permittivity 5. If the voltage across the capacitor is 50 V , find the energy stored in the capacitor & the voltage gradient in the dielectric.

5+5

7. (a) What are the advantages of a poly-phase system over the single-phase system?
 (b) Three equal impedances of $(8+j6)\ \Omega$ are connected in star across 400V , 3 phase and 50 Hz supply. Calculate (i) Line current (ii) Power factor (iii) Active and reactive power drawn by the total load.

5+5

8. (a) Explain how the power factor of a balanced three phase load can be determined with the help of two wattmeters.

(b) A 3-phase, 500 V load has a power factor of 0.4 . Two wattmeters connected to measure the power show the total input to be 30 kW . Find the reading on each wattmeter.

5+5

9. (a) Explain with reasons as to why transformer core is made up of silicon-steel laminations.

(b) A 20 kVA Transformer has 400 turns on the primary and 40 turns on the secondary winding. The primary is connected to 2kV , 50 Hz supply. Find the full load primary and secondary currents, secondary emf and the maximum flux in the core. Neglect leakage drop and no-load primary current.

5+5

- 10.(a) Define 'slip' of a three-phase induction motor. Write down the equation for speed of an induction motor in terms of its slip, supply frequency etc.

(b) A 3-phase 6 pole 50 Hz induction motor has a slip of 1% at no load and 3% at full load. Calculate
 i) Synchronous speed (ii) no load speed (iii) full load speed iv) frequency of rotor current at standstill
 (v) frequency rotor current at full load.

5+5

11. A single-phase voltage source 'e' is given by

$$e = 50 + 50 \sin 5000t + 30 \sin 1000t$$

The corresponding current in the load circuit is given by

$$i = 11.2 \sin(5000t + 63.4^\circ) + 10.6 \sin(1000t + 45^\circ)$$

Find the active, reactive and apparent power supplied by the source.

10

- 12.(a) What are harmonics in power supply system? How are harmonics generated in a power system? What are the effects of harmonics?

(b) Find Fourier series expansion for the following signal in Fig. 3.

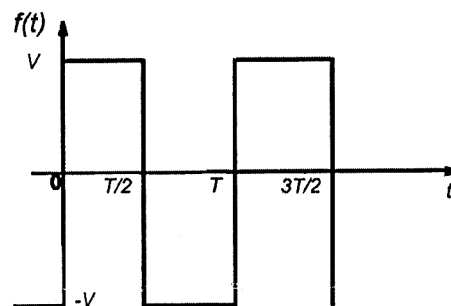


Fig. 3

13. Write short notes on **any two**:

5×2

- Eddy current loss in magnetic circuits
- Superposition theorem w.r.t. DC networks
- Use of polyphase circuits for high power AC transmission
- Faraday's laws of Electromagnetic Induction.