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PES University, Bengaluru

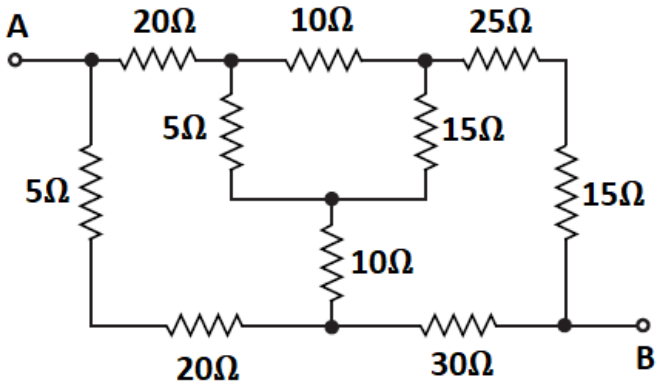
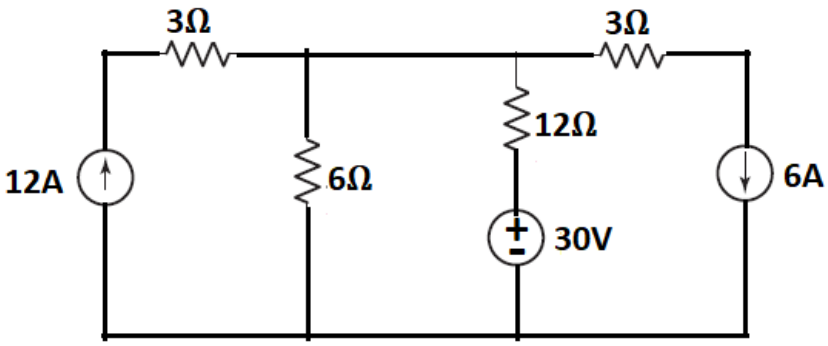
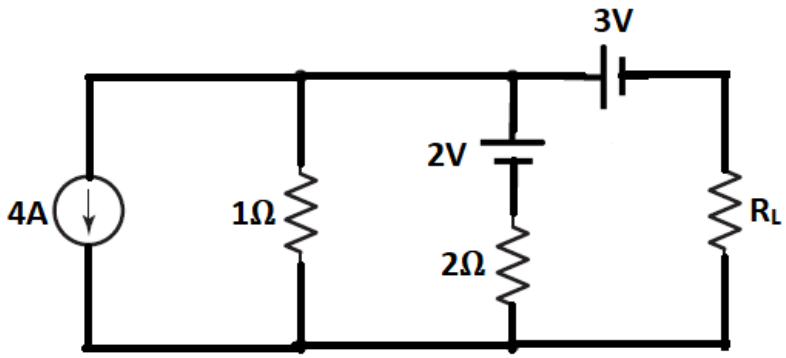
(Established under Karnataka Act No. 16 of 2013)

UE21EE141B

JULY 2022: END SEMESTER ASSESSMENT (ESA) B TECH II SEMESTER

UE21EE141B – ELEMENTS OF ELECTRICAL ENGINEERING

Time: 3 Hrs	Answer All Questions	Max Marks: 100

1	a)	Obtain the equivalent resistance between the terminals A & B in the given network: 	6M
	b)	Determine the current through 6Ω resistor in the given network using Superposition Theorem. 	6M
	c)	Using Thevenin's Theorem, determine the range of current through R_L as it varies from 10Ω to 100Ω. 	8M

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2	a)	A single-phase AC series circuit has supply voltage and supply current of $200\sin(100\pi t)$ V and $10\sin(100\pi t + 60°)$ A respectively. Determine i) Element values ii) Active, Reactive and Apparent Powers iii) Power factor	6M
	b)	The load connected across an AC supply consists of a heating load of 20KW, a motor load of 40KVA at a power factor of 0.8 lag and another load of 25KW at a power factor of 0.6 lag. Determine i) Total Active, Reactive and Apparent power drawn from the supply ii) Overall Power factor iii) New value of power factor, if an ideal capacitor having a reactive power rating of 20KVAR is connected across it	6M
	c)	A single-phase AC network consists of impedances Z_1 and Z_2 connected in parallel. This parallel combination is connected in series with another impedance Z_3. If this network is connected across a 200V, 50Hz AC supply & the supply current is 10A at a lagging power factor of 0.6, determine i) Impedance Z_2 if $Z_1 = (15+j20)\ \Omega$ & $Z_3 = (6+j8)\ \Omega$ ii) Branch currents in Z_1 and Z_2 iii) Reactive Powers in Z_1 and Z_2	8M
3	a)	With a neat labelled circuit diagram, derive the relationship between line current and phase current in a balanced delta connected three phase system.	6M
	b)	The power input to a three-phase load is measured by two wattmeters, one of which indicates 5KW when the load power factor is 0.5 lag. If the power factor of the load is changed to 0.8 lag, determine the new readings of the wattmeters if the total active power remains same as before.	6M
	c)	A balanced three-phase star connected load is supplied from a symmetrical three-phase 400V, 50 Hz system. The current in each phase of the load is 10A and lags by 60° behind the phase voltage. Determine i) Impedance per phase ii) Resistance and inductance per phase iii) Total Active & Reactive Powers Considering R-phase voltage as reference, draw phasor diagram representing all phase voltages & phase currents. Consider RYB phase sequence.	8M
4	a)	With proper nomenclature, derive EMF equations of a single-phase Transformer.	6M
	b)	An 8-pole alternator running at 750 rpm supplies power to a three-phase induction motor. If the induction motor is running at 1440 rpm under Full load condition, determine i) Frequency of three phase supply generated by alternator ii) Number of poles of the motor iii) % Full load slip of the motor iv) Frequency of rotor currents of the motor under full load v) No load speed of the motor if no load slip is 1%	6M

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	c)	A 5KW, 200V DC shunt motor draws 4A when running light, from a 200V DC supply. If the armature and field winding resistances are 1 Ω and 100 Ω respectively, determine i) Constant losses ii) Efficiency when running as motor drawing 5KW at rated voltage iii) Efficiency when running as generator supplying 5KW at rated voltage	8M
5	a)	Write a short note on the following: i) Necessity of Earthing ii) Advantages of Lithium-ion Battery	4M
	b)	The power consumed in the inductive load is 5 KW at 0.6 lagging power factor. The input voltage is 230 V, 50 Hz. Find the value of the capacitor C which must be placed in parallel, such that the resultant power factor of the input current improves to 0.9 lagging.	6M
	c)	The following table gives average consumption hours for various loads in a typical household:	10M

S.No.	**Name of the Appliance**	**Wattage**	**Average consumption hours per day**
1.	Geyser	2000W	1 Hour
2.	TV	50W	6 hours
3.	Four LED Bulbs	20W each bulb	6 hours each bulb
4.	Three Ceiling Fans	75W each fan	8 hours each fan
5.	Refrigerator	100W	24 hours
6.	Water Pump	1500W	20 minutes

Considering a 30-day month, determine

i) Total number of units consumed in a month
ii) Monthly bill for the above consumption units considering a domestic connection of 5KW sanctioned load with tariff details listed in a table below:

S.No.	Type of Charges	Tariff Details
1.	Fixed Charges for sanctioned load per month	Rs. 100/- for first KW Rs. 110/- for every additional KW
2.	Energy Consumption Charges	0 to 50 units ----- Rs. 4.15 per unit 51 to 100 units ----- Rs. 5.60 per unit 101 to 200 units ----- Rs. 7.15 per unit Above 200 units ----- Rs. 8.20 per unit
3.	Fuel Adjustment Charges	NIL

Consider an overall tax of 9% on energy consumption charges.