CHAPTER - 19
Differential Equations

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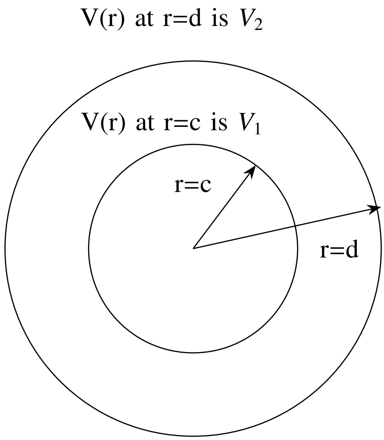
1) As shown in the figure below,two concentric conducting spherical shells, centered at $r = 0$ and having radii $r = c$ and $r = d$ are maintained at potentials such that the potentials V(r) at $r = c$ is V_1 and V(r) at $r = d$ is V_2.Assume that V(r) depends only on r, where r is the radial distance.The expression for V(r) in the region between $r = c$ and $r = d$ is



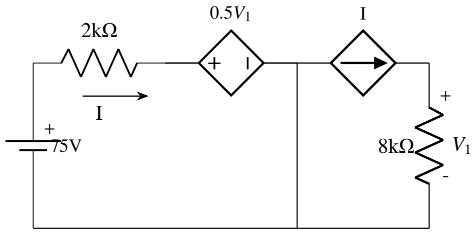
   a) $V(r) = \frac{cd(V_2-V_1)}{(d-c)r} - \frac{V_1c+V_2d-2V_1d}{d-c}$
   b) $V(r) = \frac{cd(V_1-V_2)}{(d-c)r} + \frac{V_2d-V_1c}{d-c}$
   c) $V(r) = \frac{cd(V_1-V_2)}{(d-c)r} - \frac{V_1c-V_2c}{d-c}$
   d) $V(r) = \frac{cd(V_2-V_1)}{(d-c)r} - \frac{V_2c-V_1c}{d-c}$

2) Let the probability density function of a random variable x be given as

$$f(x) = ae^{-2|x|} \tag{1}$$

   The value of $'a'$ is _____.

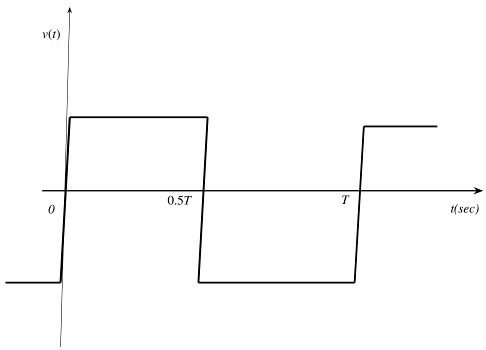
3) In the circuit shown below, the magnitude of the voltage V_1 in volts,across the $8k\Omega$ resistor is ______.(round off to nearest integer)



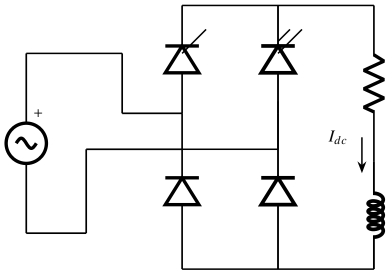
4) Two generating units rated for 250 MW and 400 MW have governer speed regulations of 6% and 6.4% respectively, from no load to full load.Both the generating units are operating in parallel to share a load of $500MW$.Assuming free governor action, the load shared in MW, by the $250MW$ generating unit is ____________.(round off to nearet integer)

5) A 20 MVA, $11.2kV$, 4-pole,50 Hz alternator has an inertia constant of 15 MJ/MVA. If the input and output powers of the alternator arc 15 MW and 10MW, respectively, the angular acceleration in mechanical $degree/s^2$ is ____________. (round off to the nearest integer)

6) Consider an ideal full-bridge single-phase DC-AC inverter with a DC bus voltage magnitude of 1000V.The inverter output voltage $V(t)$ shown below, is obtained when diagonal switches of the inverter are switched with 50 % duty cycle.The inverter feeds a load with a sinusoidal current given by,i$(t) = 10\sin\left(\omega t - \frac{\pi}{3}\right)A$, where $\omega = \frac{2\pi}{T}$. The active power,in watts,delivered to the load is ____________. (round off to nearest integer)

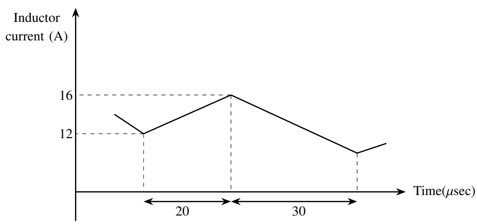


7) For the ideal AC-DC rectifier circuit shown in the figure below, the load current magnitude is $I_{dc} = 15$A and is ripple free. The thyristors are fired with a delay angle of 45°. The amplitude of the fundamental component of the source current, in amperes,is____________. (round off to two decimal places)



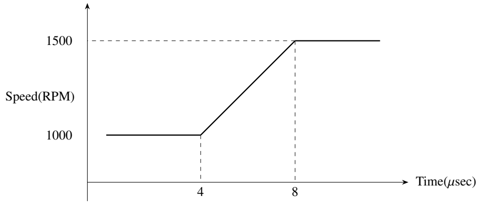
8) A 3-phase grid-connected voltage source converter with DC link voltage of 1000V is switched using sinusoidal Pulse Width Modulation (PWM)technique. If the grid phase current is 10 A and the 3-phase complex power supplied by the converter is given by$(-4000 - j3000)$ VA,then the modulation index used in sinusoidal PWM is____________. (round off to two decimal places)

9) The steady state current flowing through the inductor of a DC-DC buck boost converter is given in the figure below. If the peak-to-peak ripple in the output voltage of the converter is 1 V, then the value of the output capacitor, in μF,is ____________. (round off to nearest integer)



10) A 280 V,separately excited DC motor with armature resistance of 1Ω and constant field excitation drives a load. The load torque is proportional to the speed. The motor draws a current of 30A when running at a speed of 1000rpm. Neglect frictional losses in the motor. The speed,in rpm,at which the motor will run, if an additional resistance of value 10Ω is connected in series with the armature,is ____________. (round off to nearest integer)

11) A 4-pole induction motor with inertia of $0.1kg - m^2$ drives a constant load torque of 2Nm. The speed of the motor is increased linearly from 1000rpm to 1500rpm in 4seconds as shown in the figure below. Neglect losses in the motor. The energy,in joules,consumed by the motor during the speed change is ___________. (round off to nearest integer)



12) A star-connected 3-phase,400V,50kVA,50HZ synchronous reactance of 1Ωper phase with negligible armature resistance. The shaft load on the motor is 10kW while the power factor is 0.8 leading. The loss in the motor is 2kW. The magnitude of the per phase excitation emf of the motor, in volts,is ___________. (round off to nearest integer)

13) A 3-phase,415V,4-pole,50Hz induction motor draws 5 times the rated current at rated voltage at stating. It is required to bring down the starting current from the supply to 2times of the rated current using a 3-phase autotransformer. If the magnetizing impedance of the induction motor and on load current of the autotransformer is neglected,then the transformation ratio of the autotransformer is given by ___________. (round off to two decimal places)