Swami Keshvanand Institute of Technology,
Management & Gramothan

Approved by AICTE, Ministry of HRD, Government of India
Recognized by UGC under Section 2(f) of the UGC Act, 1956
Affiliated to Rajasthan Technical University, Kota

Tutorial Sheets Sample

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B.Tech I/II Semester
Engineering Chemistry
1FY2-03 / 2FY2-03

Tutorial Sheet-IV UNIT-4

EASY

Q1 What is safety glass?

Q2 Define Cloud and Pour Point.

Q3 Define Flash and Fire Point.

Q4 In which conditions Grease is preferred in machineries.

Q5 Give examples of solid lubricants and give their uses.

Q6 Define Glass.

MODERATE

Q7 Why is annealing important in manufacturing of glass?

Q8 What are cullets? Why are they added during manufacturing of glass?

Q9 What is the difference between soft glass and hard glass/?

Q10 What is the difference between tank furnace and pot furnace?

Q11 What is regenerative system of heat economy?

Q12 Discuss Borosilicate and Aluminosilicate glass.

Q13 Describe vitrification in Glass

Q14 Describe Extreme pressure lubrication

Q15 What are synthetic oils? Explain in brief

Q16 Discuss semisolid lubricants.

Q17 Discuss any five silicate glasses. Give their uses

Q18 Describe classification of lubricants

Swami Keshvanand Inst. of Tech., Mgmt. & Gramothan (SKIT) Ramnagaria, Jagtpura Jaipur-302017 0141-5160400

Submitted by

Dr. Poonam Ojha

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असतो मा सद्गमय

B.Tech I/II Semester
Engineering Chemistry
1FY2-03 / 2FY2-03

Tutorial Sheet-V UNIT-5

EASY

Q1 What is homolytic and heterolytic fission?

Q2 What are free radicals? Which is the most stable free radical and why?

Q3 What is carbocation? Why tertiary carbocation is most stable?

Q4 What is carbanion? Which is the most reactive carbanion and why?

MODERATE

Q5 What is peroxide effect? Why is it applicable only in case of addition of HBr and not in case of HCl and HI?

Q6 Alkynes undergo both electrophilic and nuclephilic addition reactions. Why?

Q7 What are electron withdrawing groups? Why are they meta-directing?

Q8 Give mechanism of chlorination of Nitrobenzene.

Q9 Give mechanism of Friedal-craft acylation reaction.

Q10 Arrange benzene, n-hexane and ethyne in decreasing order of acidic behaviour.

Q11 Explain the reactivity of alkyl halides towards SN1 reactions.

Q12 Why alcohols act both as nucleophiles as well as electrophiles while phenols usually act as nucleophiles only? Show the reaction for both.

Q13 Phenols are stronger acid than alcohols. Explain.

Q14 Discuss preparation and uses of drug 'Paracetamol'.

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Department of Physics

B. Tech. I & II Sem (2019-20)
Subject: Engineering Physics (1FY2-02/2FY2-02)

Tutorial sheet-3 (Quantum Mechanics)

Easy:

Q.1: Wave function is $\psi(x)=Ne^{ikx}$. Determine the normalization constant over the range $-a \leq x \leq a$.
[Ans.: $(2a)^{-1/2}$]

Q.2: Prove that $\psi_1 = A_1 cos(\frac{n\pi x}{a})$ and $\psi_2 = A_2 sin(\frac{n\pi x}{a})$ are orthogonal wave functions.

Q.3: Prove that the Eigen functions of a particle moving in 1-D box are orthogonal.

Q.4: Find the lowest energy of an electron confined to move in 1D potential box of width 1Å. **[Ans.: 37.5eV]**

Q.5: Determine the lowest energy [zero point energy] that a proton confined within an impenetrable one dimensional box of width 1Å. **[Ans.: 205eV]**

Q.6: Calculate the energy of first and fifth state for an electron confined in 1D box of width 1.5 Å
[Ans.: E_1=16.71eV, E_5=417.75eV]

Q.7: Calculate the energy difference between ground state and first excited state for an electron confined in a rigid 1D box of width 10^{-8}cm. **[Ans.: 112.5eV]**

Q.8: In a long chain molecule of length 5Å electrons may be treated as free to move along the length. Calculate the zero point energy, energy gap between the first two energy states of the electron and also the wavelength of absorption line arising from this transition. **[Ans.: E_0=1.5eV, ΔE=4.5eV, λ=2760Å]**

Q.9: Find the lowest energy of a neutron confined to a nucleus of size 10^{-14} meter. [Given $m_n = 1.675 \times 10^{-27}$ kg].
[Ans.: 6.13MeV]

Moderate:

Q.10: Calculate the lowest energy of an electron confined in a cubical box of side 1Å each. Also find the temperature at which the average energy of gas molecules would be equal to the lowest energy of an electron [Given: $k = 1.38 \times 10^{-23}$J/K]. **[Ans.: E= 112.8eV, T= 8.72×10^5K]**

Q.11: An electron is trapped in a cubical potential well of width 1Å. What is its first excitation energy?
[Ans.: 112.9eV]

Q.12: An electron is confined in a cubical box of each side 10Å. Find the energy of the electron in third excited state. **[Ans.: 4.14eV]**

Q.13: Determine the expectation value of position of a particle in 1-D box. **[Ans.: a/2]**

Q.14: Determine the expectation value of momentum of a particle in 1-D box. **[Ans.: 0]**

Q.15: Find the probability that a particle in a box of width 'a' can be found between x=0 and x=a/n when it is in the n^{th} state. **[Ans.: 1/n]**

Difficult:

Q.16: A particle is in cubical box of length 'a' in its ground state. Find the probability that a particle will be found in a volume defined by **$0 \le x \le a/2$, $0 \le y \le a/2$, $0 \le z \le a/2$.** **[Ans.: 12.5%]**

Q.17: Find the probability that a particle in a box can be found between 0.45a and 0.55a, when the particle is the first excited state, where 'a' is the width of the box. **[Ans.: 0.65%]**

Q.18: The wave function of a particle in the ground state in 1-D box of length L is given by $\psi_1 = \sqrt{\frac{2}{a}} Sin(\frac{\pi x}{L})$. Calculate probability of finding the particle with an interval of 1Å at the centre of the box of length 10Å. **[Ans.: 19.8%]**

Q.19: An electron is trapped in an infinitely deep well of width 'a'. if the electron in its ground stste find the probability that a particle is found in the central third of the well. **[Ans.: 61%]**

Q.20: Answer the following question with respect to a free particle trapped in a cubical box of side 'a'.

(i) Is $n_x = n_y = n_z = 1$ state degenerate?

(ii) What is the order of degeneracy for $n_x + n_y + n_z = 4$?

(iii) What shall happen to the degeneracies for $n_x + n_y + n_z = 4$ if the box is not cubical but rectangular parallelepiped with sides a, b and c such that $a = b \neq c$?

Tutorial Sheet
IV SEM ECE 2019-20
Analog and Digital Communication (4EC4-07)

Q1. An analog signal is expressed by the equation $x(t) = 3\cos(50\pi t) + 10\sin(300\pi t) - \cos(100\pi t)$. Calculate the Nyquist rate for this signal.

Q2. Find the Nyquist rate and the Nyquist interval for the signal

$$x(t) = 1/2\pi \cos(5000\pi t)\cos(3000\pi t)$$

Q3. A television signal having bandwidth of 4.2 MHz is transmitted using binary PCM system. Given that the number of quantization levels is 512.Determine

(i) Code word length (ii) Transmission bandwidth

(iii) Final bit rate (iv) Output signal to quantization noise ratio

Q4. The bandwidth of the video signal is 4 MHz. This signal is to be transmitted using the PCM with the number of quantization level 512. The sampling rate should be 20 % higher than the minimum sampling rate. Calculate the system bit rate.

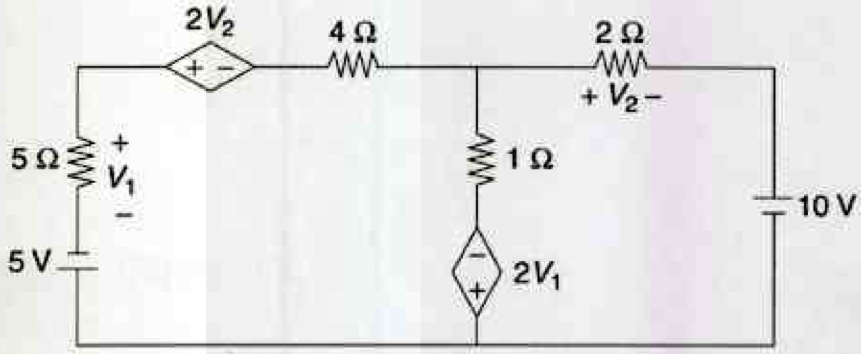
Q5. Derive the expression of the bandwidth requirement for the PCM and PAM Signal

Network Theory (3EC4-06)

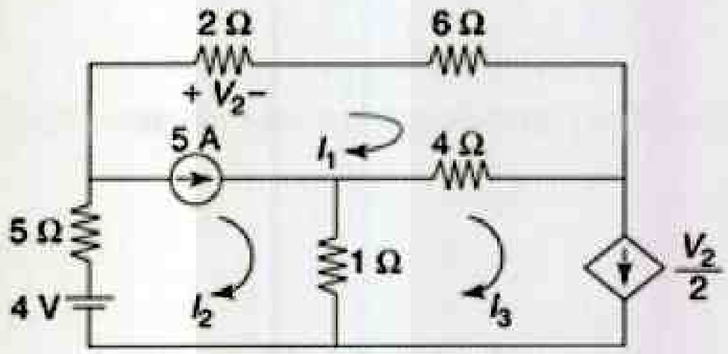
SEM:III

Tutorial Sheet

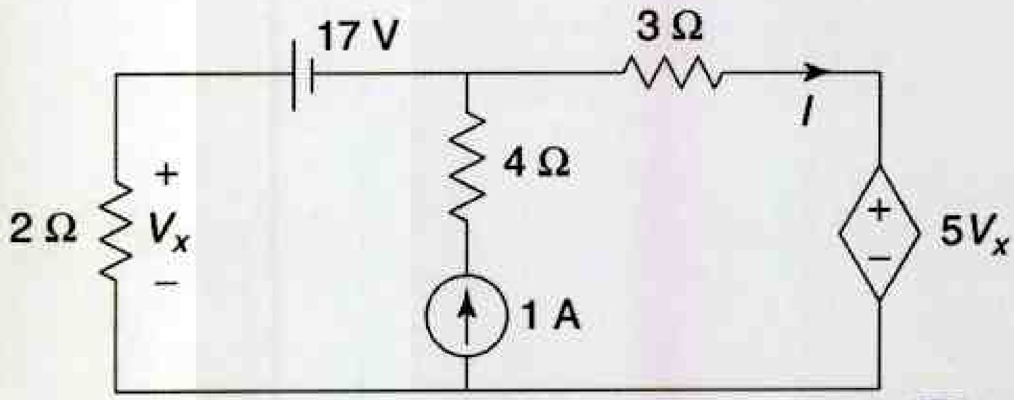
1. Find the mesh current in the circuit.



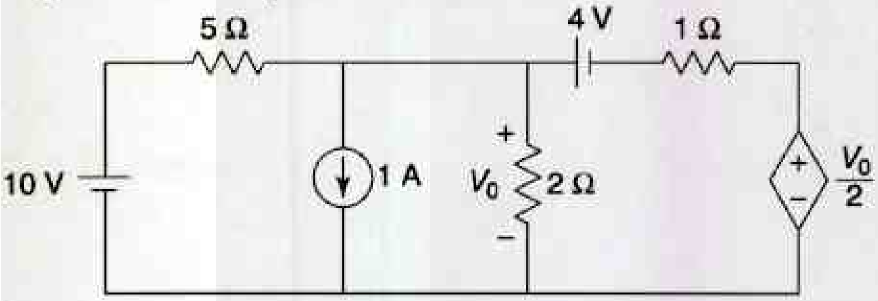
2. In the given network, Find the power delivered by the 4 V source and voltage across the 2 ohm resistor.



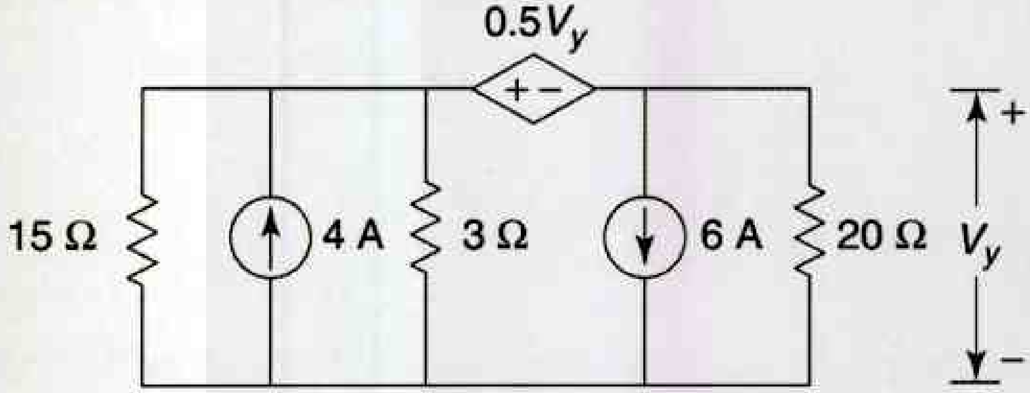
3. Find current I in the given network.



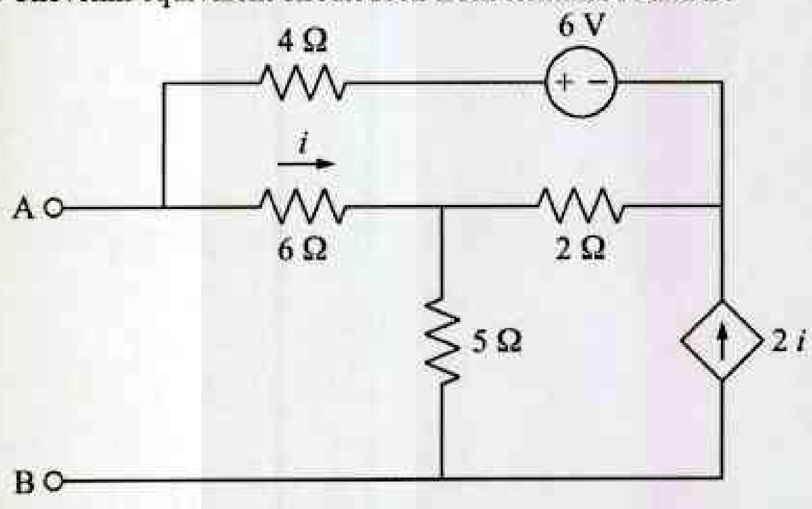
4. Find the voltage V0 in the network and also find the power delivered by the independent source and power absorbed by each of the resistors.



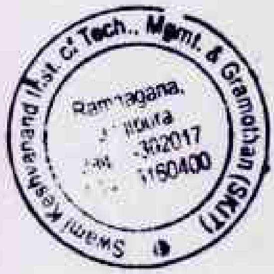
5. Find the voltage Vy in the given network and also find the power delivered by the independent source and power absorbed by each of the resistors.

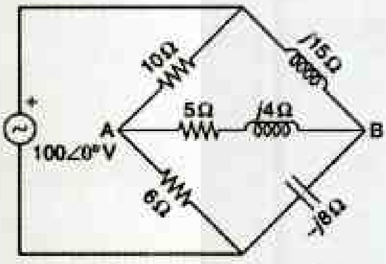


6. . Find the Thevenin equivalent circuit seen from terminal A and B.

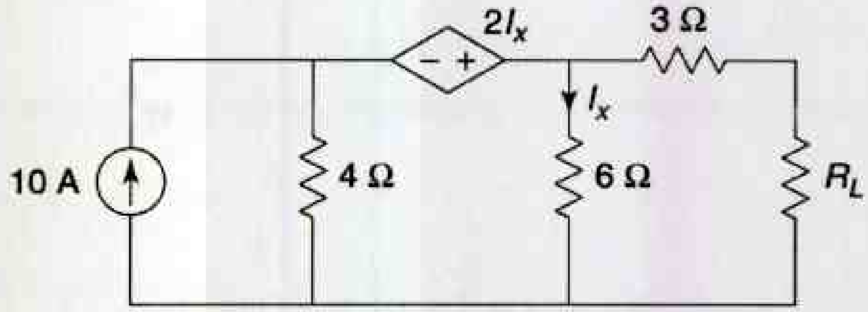


7. Find the current through (5+j4) Ω impedance using Thevenin's theorem.

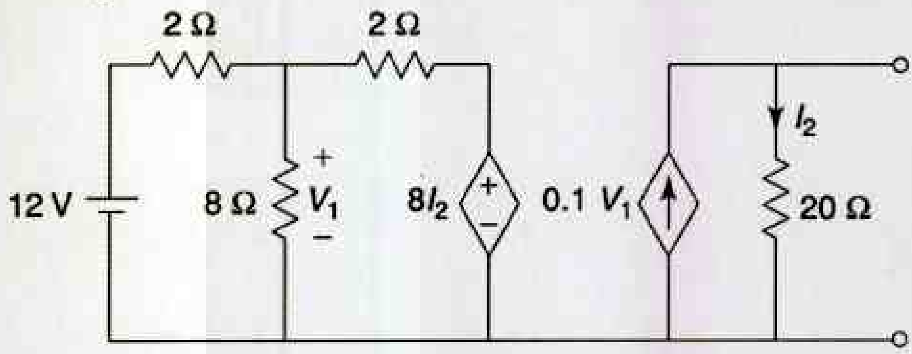




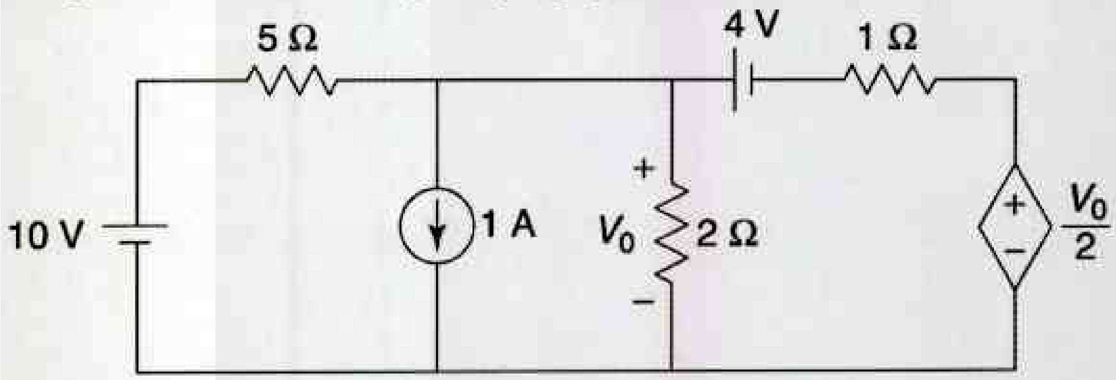
8. For the network shown in Fig., calculate the maximum power that may be dissipated in the load resistor RL



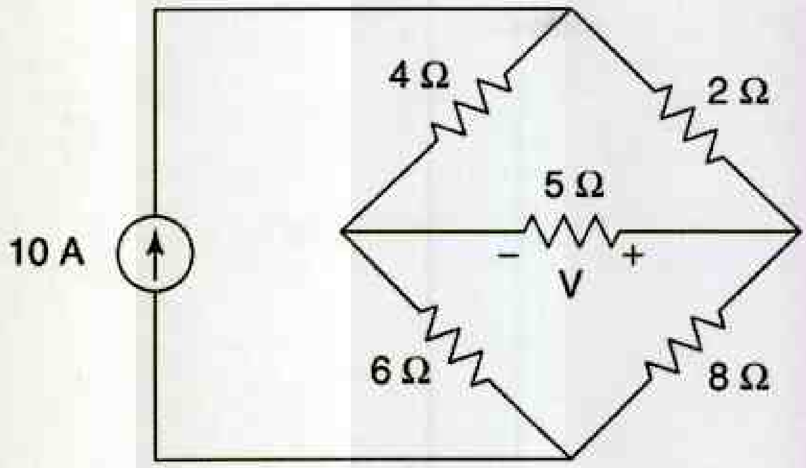
9. Find Norton's equivalent network and hence find the current in the 10 Ω resistor in Fig.



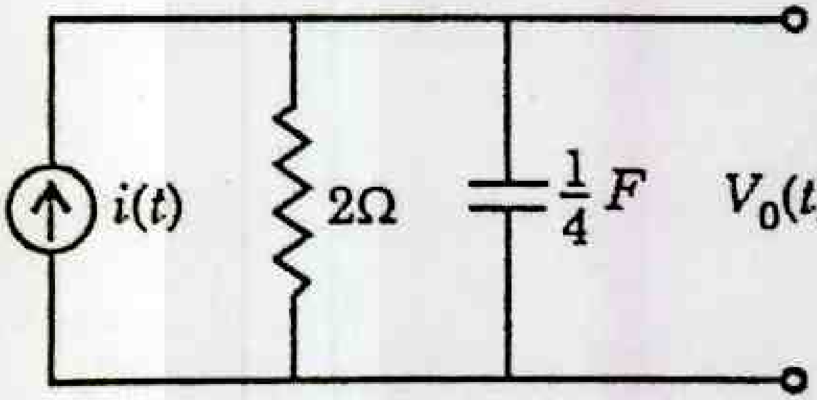
10. Find the voltage V0 in the network of Fig. using Superposition theorem



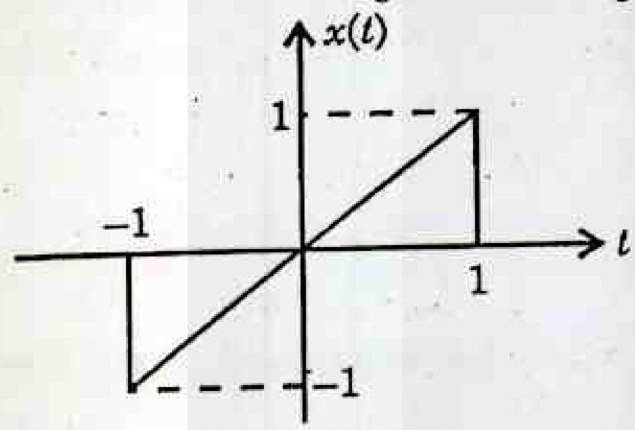
11. Find the voltage V and verify reciprocity theorem for the network shown in Fig.



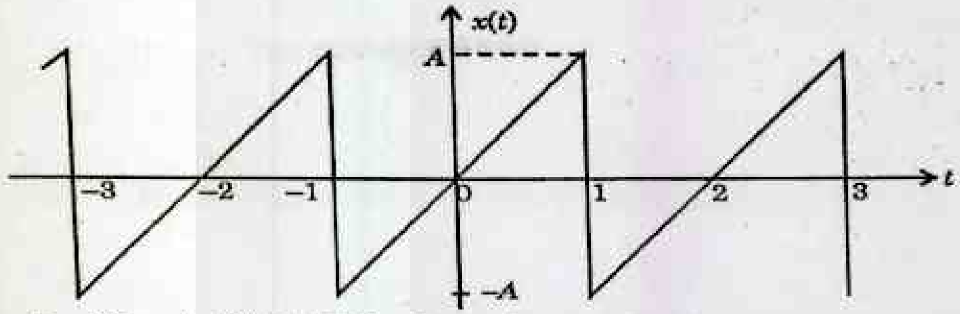
12. For the circuit shown in figure, Determine the voltage response $v_o(t)$ to a current source excitation i(t)=$2e^{-t}u(t)$, *using Fourier transform.*



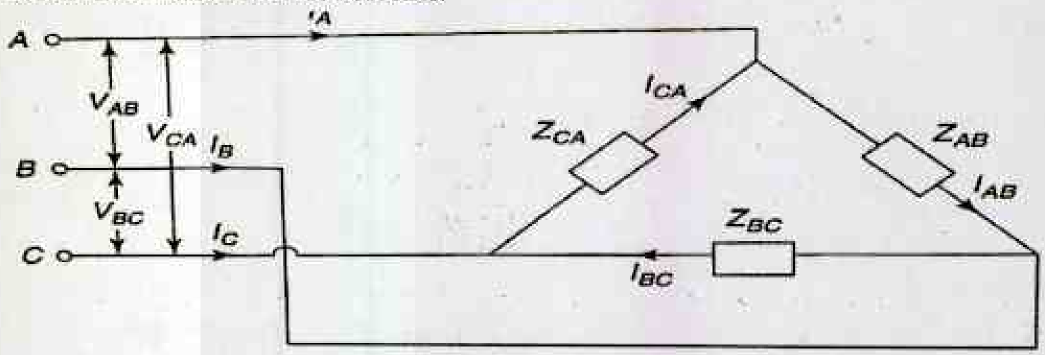
13. Find the Fourier transform of the time signal as shown in figure



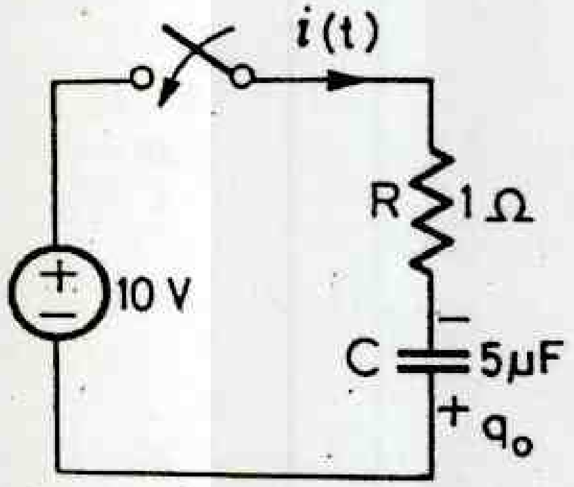
14. Find the Fourier series coefficients for the given sawtooth wave(in exponential form) as shown in figure:



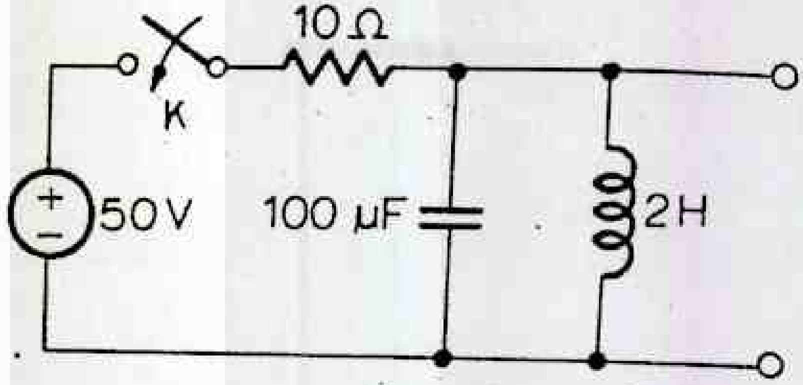
15. In the Circuit of fig., A 400 V, 50 Hz, three phase supply of phase sequence ABC is supplied to a delta connected load consisting of a 100 ohm resistor between lines A and B, a 378 mH inductor between lines B and C, and a 37.8 micro farad capacitor between lines C and A. Determine Phase and line currents.



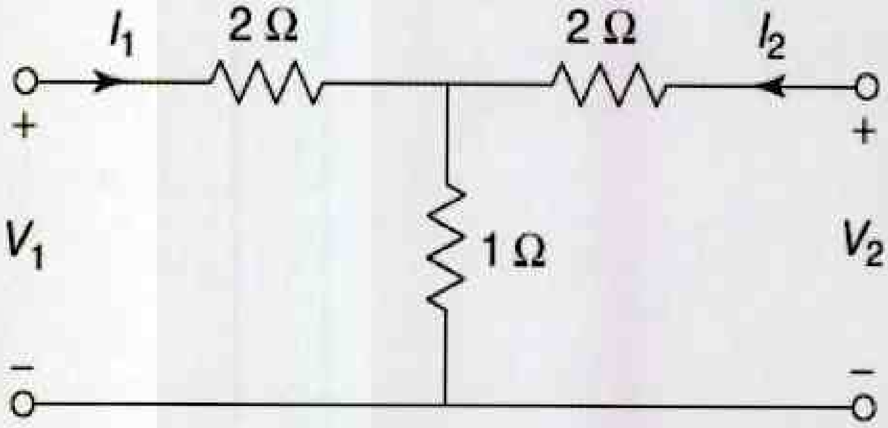
16. Find i(t) in the given figure, following switching at t=0.Assume initial charge on capacitor 250 μ coulombs as shown in figure.



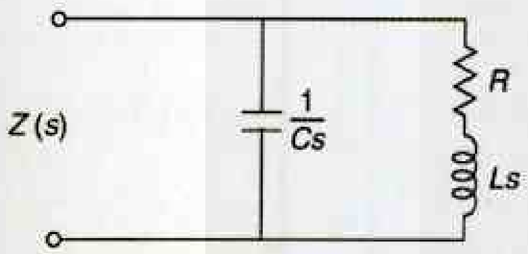
17. In the initial condition, K is closed and a steady state is reached in the network of given figure. At t=0, the switch is opened. What is the current through the inductor?

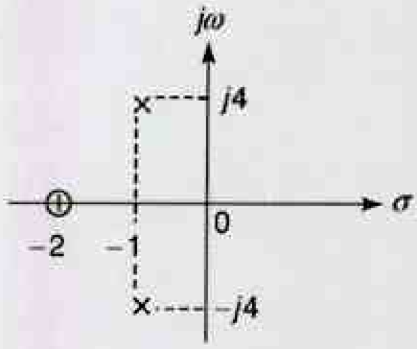


18. Two Identical sections of the network shown in figure are connected in series. Obtain the z parameter of the overall connection.

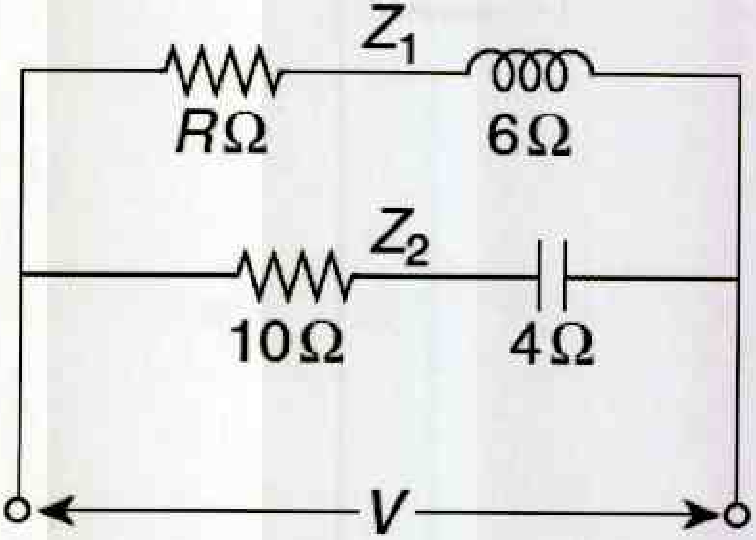


19. The Pole zero diagram of the driving point impedance function of the network of figure is shown below. At dc, the input impedance is resistive and equal to 2 ohm. Determine the values of R,L, and C.





20. A parallel circuit is shown in Calculate the value of *R* in the circuit for which the circuit will resonate.


Z_1
$R\Omega$
6Ω
Z_2
10Ω
4Ω
V

Tutorial Sheet

IV SEM ECE

Microcontroller (4EC4-05)

1. Explain what operation is performed when the following instructions are executed.
   (a) CNZ (b) XHTL (c) RAR (d) PCHL
2. Draw the timing diagram for the execution of the instruction SBBM. . If the clock frequency is 4 MHz, how much time is required to execute this instruction?
3. Write a program to find the smallest number in a given array of 10 elements. The array is stored in the memory location from 9200H onwards. Store the result at the memory location 9300 H. The length of the array is stored as the first element of an array and then the data array starts.
4. Find the content of the accumulator after the execution of the program.

```
3000  MVI A, 45H
3002  MOV B, A
3003  STC
3004  CMC
3005  RAR
3006  XRA R
3007  HLT
```

5. Explain the control word of 8255 programmable peripheral interface. Determine control word for the following configuration of the ports of the ports of 8255.

   Ports A –output
   Mode of Port A –Mode 1
   Port B-Output
   Mode of Port B-Mode 0
   Port C_{lower}(Pins PC_0-PC_2)-Output
   Remaining pins of Ports Cupper i.e. PC_4 and PC_5 –output

6. In given fig.1, identify the memory address range of ROM1, ROM2 and R/WM1.

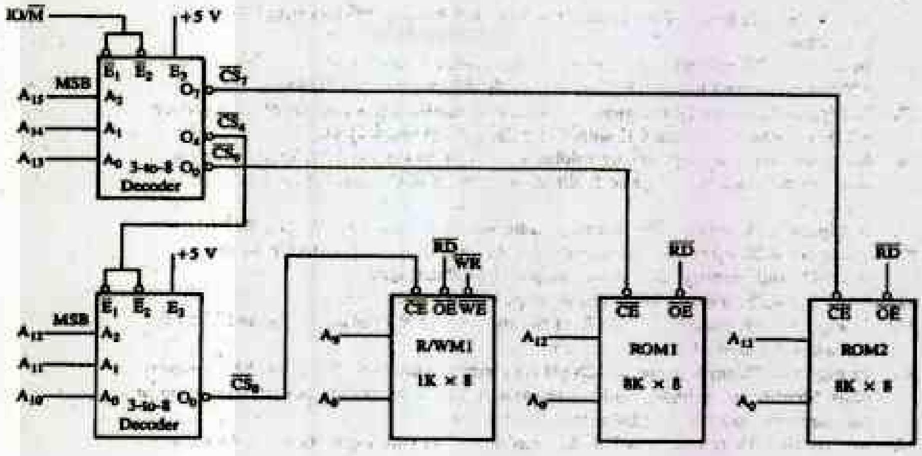


Fig. 1

7. Write a program to perform the following:

   (a) Keep monitoring pin P0.1 until it becomes high.

   (b) When P0.1 becomes high, read in the data from port 1.

   Send a low to high pulse on P0.2 to indicate that the data has been read.

8. Take 10 bytes of data RAM locations 45H to 54 H, add 02 to each of them, and save the result in data RAM locations 79 H down to 70H.

9. Assume that 5 BCD data items are stored in RAM locations starting at 40H, as shown below. Write a program to find the sum of all the numbers. The result must be in BCD.

10. Write a program to find y where $y=x^2+2x+5$, and x is between 0 to 9.

11. A switch is connected to port pin P0.1. Write a program to check the status of the switch and perform the following:

    If switch =1, send a high to low pulse to activate a siren connected to pin P1.7. Continue monitoring the pin status. Use the carry flag to check the switch status.

12. Take 10 bytes of data from data RAM locations 45H to 54H, add 02 to each of them, and save the result in data RAM locations 79H down to 70H.

13. Analyze the Jump and Call instructions of 8051 Assembly level language with suitable examples.

14. Design a counter for counting the pulses of an input signal in 1 second. The pulses to be counted are fed to pin P3.4.Assume crystal frequency is 22 MHz

15. Generate a square wave with an ON time of 3ms and an OFF time of 10ms on all pins of port 0. Assume a crystal frequency of 22MHz.

16. Draw the pattern of the TCON register. Explain each of the bits of the TCON register.

17. A square wave is being generated at pin P1.2, This square wave is to be sent to a receiver connected in serial form to this 8051.Write a program for this.

18. Two switches are connected to pins P3.2 and P3.3. When a switch is pressed, the corresponding line goes low. Write a program to

    (a)Light all LEDs connected to port 0, if the first switch is pressed.

    (b) Light all LEDs connected to port 2, if the second switch is pressed.

19. Assume we have a 256 K RAM and a 32K direct mapped cache with block sizes of 1024 words.

    (a) How many address bits are in the RAM address?

    (b) How many blocks are in the cache?

    (c) How many index bits are in the address?

    (d)How many block bits are in the address?

    (e) How many tag bits are in the address?

20. Write the difference between RISC and CISC?

Tutorial Sheet

Semester: V semester

Course: Electromagnetic Waves (5EC4-02)

Q1. At a frequency of 5 MHz a parallel wire transmission line has the following parameters: R = 250 W, L = 20 mH, G = 0, C = 50 pF. The line is 10 meters long, terminated in a resistance of 300W. Find out:

a. Characteristics Impedance

b. Propagation Constant

Q2. A lossless transmission line with characteristic impedance 50 Ω is 30 meter long and operates at 2 MHz. The line is terminated with a load $Z_L = (60 + j40)$ ohms. Calculate-

(e) VSWR

(f) Reflection coefficient

Q3. A uniform plane wave at frequency of 300 MHz travels in vacuum along +y direction. The electric field of the wave at some instant is given as $E = 3x$◎○ɔ $+ 5\hat{z}$. Find the phase constant of the wave and also the vector magnetic field.

Q4. A uniform plane wave traveling in a medium having dielectric constant 9, has peak electric field of 10 V/m. The frequency of the wave is 1 GHz. Find the wavelength and peak magnetic field of the wave. If at some location (z=0) and some instant (t=0), the electric field is 5V/m, find the magnitudes of the electric field and magnetic field at z= 2m and t= 50 msec. Assume that wave is moving in z direction.

Q5. A conducting medium has relative permittivity 18 and loss tangent 10^{-3} at 100 MHz. Find the conductivity of the medium. Also find the distance over which the wave amplitude reduces to 1/e of its original amplitude?

Q6. A uniform plane wave traveling in a medium having dielectric constant 9, has peak electric field of 10 V/m. The frequency of the wave is 1 GHz. Find the wavelength and peak magnetic field of the wave. If at some location (z=0) and some instant (t=0), the electric field is 5V/m, find the magnitudes of the electric field and magnetic field at z= 2m and t= 50 msec. Assume that wave is moving in z direction.

Q7. At some location inside a lossy dielectric material the measured peak electric field of a wave is10V/m. The material has relative permittivity of 8 and conductivity of 100 $\Omega^{-1}m^{-1}$. Find the average power density of the wave at tht location. Also find the power density at a distance of 1 cm in the direction of the wave propagation. The frequency of the wave is 100 MHz.

Tutorial Course Name-Microwave Theory &Techniques
Course code- 5EC04-05 Topic –Waveguides and Network Analysis

Q1. A Rectangular waveguide is filled by dielectric material of $\varepsilon r=9$ and has inside dimension of 7* 3.5 cm. It operates in the dominantTE10 mode Determine

a) Cut off Frequency
b) Phase velocity in guide at frequency 2GHz.
c) Guide wavelength at same frequency

Q2. A Coaxial line has the following physical dimensions.

Diameter of inner conductor =0.49cm

Inner diameter of outer conductor =1.10cm

Polyethylene dielectric $\varepsilon_r = 2.3$

Calculate:

1) Inductance per unit length
2) Capacitance per unit length
3) Characteristic Impedance
4) Velocity of propagation

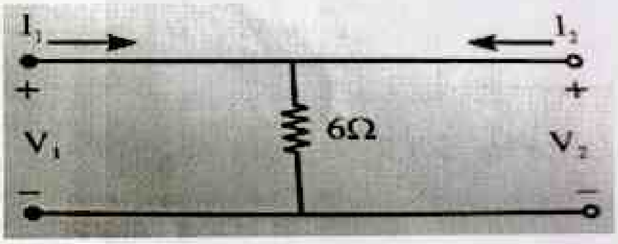
Q3. A rectangular waveguide is designed to operate in TE_{10} mode at a frequency of 10GHz.It is desired that frequency of operation to be at least 15% above cut-off frequency of the propagating and 20% below cut-off frequency of next higher mode. Determine the dimensions of the waveguide.

Q4. An air filled hollow rectangular waveguide of 150m long and is tapped at the end with a metal plate .If a short pulse of frequency 7.2GHz is introduced into the input end of the guide. How long it takes the pulse to return to the input end. Assume Cut –off Frequency f_c is 6.5GHz.

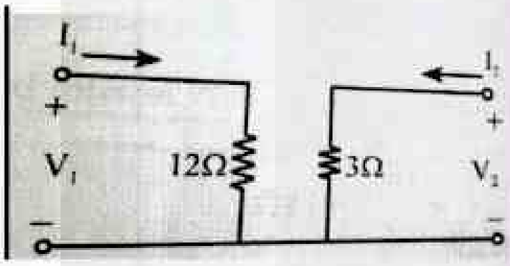
Q5. Determine the Cut-off wavelength for the dominant mode in a rectangular waveguide of breadth 10cm.For a 2.5 Ghz signal propagated in this waveguide in the dominant mode, calculate the guide wavelength, the group and the phase velocities?

Q6. An air filled circular waveguide is to be operated at a frequency of 6GHz and is to have dimensions such that fc=0.8f for TE_{11} mode .Determine the diameter of the waveguide and guide wavelength.

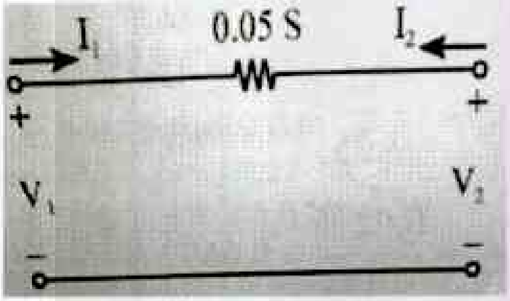
Q7. Find the impedance parameters for two port network



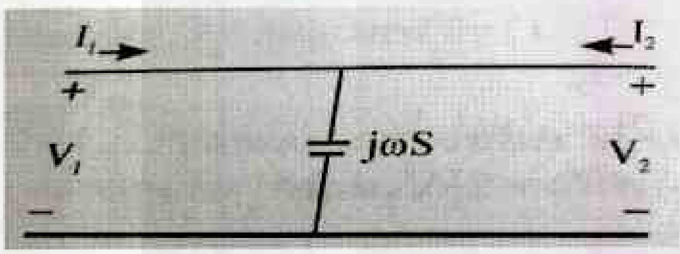
Q8. Find the impedance parameters for two port network



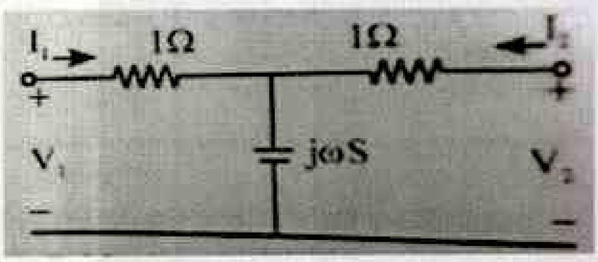
Q9. Find the admittance parameters of the circuit shown in figure



Q10. Determine the transmission parameters of the network



Q11. Determine the transmission parameters of the network?



Q12. Prove that for a reciprocal, lossless, three port network, that all ports cannot be perfectly matched

Q13. Consider two port network with individual scattering matrices [S^A] and [S^B].Show that the cascade of these two networks is given by-

$$S_{21}= \frac{S_{21^A}S_{21^B}}{1 - S_{22^A}S_{11^B}}$$

Assume a_2=0 (perfectly matched)

Q14. A two port network has the scattering matrix

$$[S] = \begin{bmatrix} 0.15\angle 0 & 0.85\angle -45 \\ 0.85\angle 45 & 0.2\angle 0 \end{bmatrix}$$

Verify that the network is reciprocal and lossless .If port(2) is terminated with matched load .What is the return loss at port (1). If port (2) is terminated with a short circuit. What is the return loss at port (1)

Q15. If the impedance matrix of a device is-

$$\begin{bmatrix} 4 & 2 \\ 2 & 4 \end{bmatrix}$$

Find out the Scattering matrix

ZERO TUTORIAL SHEET

1. Calculate the energy of a stream of water at a pressure of 200 kPa, flowing at 8m/s at an elevation of 5m above a given datum. Take the density of water as 1000 kg/m^3.
2. The pressure and temperature of combustion gases are 6atm and 560 ^{0}C, respectively, at the inlet of a gas turbine. The pressure drops to 1atm while the gases flow through the turbine. Assuming that the expansion is isentropic, determine the enthalpy drop of the gases in the turbine. c_p for gases=1.006 kJ/kg-K, γ=1.4
3. A blower delivers 1.2 kg/s of air at 20 ^{0}C with a power consumption of 12 kW. The inlet and outlet velocities of air are 120m/s and 180m/s, respectively. Assuming the adiabatic conditions, estimate the exit temperature of air. Take c_p=1.005 kJ/kg-K.

TUTORIAL SHEET-1 (UNIT-1)

Basic Concepts of Turbomachines : Defination, Classification, Basic laws and governing equations
Dimensional Analysis : Buckingham's π- theorem, Specific speed, Different coefficients, Similitude

1. What do you mean by specific speed of turbomachine? Also explain the significance of specific speed.**(RTU2018, 8marks)**
2. A turbine working under a head of 6m at a speed of 200 rpm develops 80 kW power, when the flow rate of water is 108 m^3/min. The runner diameter is 1m. If the head on the turbine is increased to 16m, Determine its new speed, discharge and power. **(RTU2018, 8marks)**
3. What is a turbomachine? Also derive the Euler's expression for a turbomachine. **(RTU2018, 8marks)**
4. A hydraulic turbine has an output of 6000 kW under a head of 30m and runs at 85 rpm. What is the type of turbine? What would be its speed and power developed when working under a head of 18m. **(RTU2018, 8marks)**
5. Newton's second law of motion results in steady state linear momentum equation. Why is the angular momentum the most descriptive parameter for turbomachines. **(RTU2017, 8marks)**
6. The drag force exerted by a flowing fluid on a solid body depends on the length of the body 'L', velocity of flow 'V', density of fluid 'ρ' and viscosity 'μ'. Find an expression for drag force using Buckingham's theorem. **(RTU 2017,15, 8marks)**
7. Derive an expression for specific speed of a hydraulic turbine. Also give the dimensionless specific speed ranges for hydraulic turbines. **(RTU 2017,2012, 8marks)**
8. Write down the expression for the dimensionless power coefficient of a turbine stage. Prove that it is proportional to the loading coefficient. **(RTU2017, 8marks)**
9. How are the following laws and governing equations applied to the turbomachines ?
   (i) Steady flow energy equation (ii)Second law of thermodynamics (iii)Newton's second law of motion (iv)Continuity equation **(RTU 2016, 2012, 8 marks)**
10. A turbine develops 7500kW under a head of 24.7m at 135 rpm. What is the specific speed? What would be its normal speed and output under a head of 19.5m? **(RTU 2016, 8marks)**
11. Explain Geometric, kinematic and dynamic similarities. State two governing parameters for each kind of similarity. **(RTU 2016, 2009, 6marks)**
12. Prove the following equation for the performance of turbo compressor.
    $\frac{P01}{P02} = (\frac{N}{\sqrt{T01}}, \frac{m\sqrt{T01}}{P01})$ **(RTU 2016, 10marks)**
13. What is Similitude? What are the different types of similarities between the model and its prototype? **(RTU 2015, 6marks)**
14. A model of a Kaplan turbine, one tenth of the actual size is tested under a head of 5m when actual head for proto turbine is 8.5m. The power to be developed by prototype is 9000kW. When running at 120rpm at an overall efficiency of 85%, determine
    (i) Speed (ii) Discharge, and (iii) Power of model **(RTU 2015, 10marks)**
15. Define Turbomachinery? Classify turbomachinery. Derive the Euler's expression for turbomachinery ? **(RTU 2015, 2012, 2009, 8marks)**
16. Explain the conditions where the complete similarity between the actual hydraulic turbomachines and the model shall exist. **(RTU 2012)**
17. Derive the general energy transfer equation for a rotating machine and state the meaning of each term. List the assumptions. **(RTU2009)**

Home Assignment

18. State Buckingham's π-theorem. Describe this theorem for dimensional analysis.
19. The efficiency of a turbomachine depends on density 'ρ', dynamic viscosity 'μ' of the fluid, angular velocity 'ω', diameter 'D' of the rotar and the discharge 'Q'. Express 'η' in terms of the dimensionless parameters.
20. Show that the discharge of a centrifugal pump is given by, $Q=ND^3 f[gH_m/N^2D^2, \mu/ND^2\rho]$
21. One-fifth scale model of a pump was tested in a laboratory at 1000 rpm. The head developed and the power input at the best efficiency point were found to be 8m and 30kW respectively. If the prototype pump has to work against a head of 25m, determine its working speed, the power required to drive it and the ratio of the flow rates handled by the two pumps.
22. A multistage(full scale) centrifugal pump runningat 500 rpm delivers 5 m^3/s, against a head of 100m. A model of this pump delivers 0.3 m^3/s and the power input is 100kW at an efficiency of 90%. Calculate (i) the speed of the model and (ii) the scale ratio.

Solutions :- ***<u>Zero Tutorial</u>***: 1) 281.05 J/kg **2)** 335.74 kJ/kg 3)20.99 ^{0}C
<u>Tutorial-1</u>: 2)326.59rpm, 176.36 m^3/min., 348.37kW 4)Francis Turbine(N_s=93.77rpm), 65.84rpm, 2788.54kW
10) N_s=212.33rpm, N=119.95 rpm, P=5260.99kW **14)** 920.4 rpm, 0.866 m^3/s, 36.12kW **19)** $\eta=f(\mu/D^2 \omega \rho, Q/D^3 \omega)$
21) N_p=353.5rpm, P_p=4143kW, Q_p/Q_m=44.18 **22)** Nm=839.5rpm, D_m/D_p=0.33

Name:________________________ **University Roll No.:** ________________________

TUTORIAL SHEET No. 1

TOPICS *Demand Forecasting: Moving Average, Exponential Smoothing, Linear Regression Method, Seasonal Forecast*

1. A local building products store has accumulated sales data for 2x 4 lumber (in board feet) and the number of building permits in its area for the past 10 quarters as follows:

Quarter	1	2	3	4	5	6	7	8	9	10
Building Permits(x)	8	12	7	9	15	6	5	8	10	12
Lumber Sales (in 1000 of board feet)(y)	12.6	16.3	9.3	11.5	18.1	7.6	6.2	14.2	15.0	17.8

Develop a linear regression model for these data and determine the forecast for lumber given ten building permits in next quarter.

2. Kushal Elecrtronics, Jayanti market, Jaipur has determined that the sales for double-door refrigerators in recent years as shown in table below. Forecast the demand for the year 2021 using associate method of linear regression model.

Year	Sales (No. of units)
2015	1050
2016	1080
2017	1120
2018	1160
2019	1200
2020	1300

3. Lakeside Hospital, Udaipur has used a 8-month moving-average forecasting method to predict drug and surgical dressing inventory requirements. The actual demand for one of such item is as shown below. Using the previous moving average data, convert to an exponential smoothing forecast for month 33.

Month	24	25	26	27	28	29	30	31	32
Demand	78	65	90	71	80	101	84	60	73

4. Aroma Drip Coffee Inc. produces commercial coffee machines that are sold all over the world. The company's production facility has operated at near capacity for over a year now. Wayne Conner, the plant manager, thinks that sales growth will continue. He wants you to develop long range forecasts to help plan facility requirement for the next 3 years. Sales records for the past 10 years have been compiled.

Year	Annual Sales (thousands of unit)	Year	Annual Sales (thousands of unit)
1.	1000	6.	2000
2.	1300	7.	2200
3.	1800	8.	2600
4.	2000	9.	2900
5.	2000	10.	3200

Wayne Conner is trying to plan cash, personnel and materials and supplies requirement for each quarter of next year. The quarterly sales data for the past three years seem to reflect fairly the seasonal output pattern that should be expected in the future. Estimate quarterly sales for next year.

Year	Quarterly sales (thousands of unit)				Amount
	Q_1	Q_2	Q_3	Q_4	Total
8.	520	730	820	530	2600
9.	590	810	900	600	2900
10.	650	900	1000	650	3200

5. HiTek Computer Services repairs and services personal computers at its store, and it makes local service calls. It primarily uses part-time State University students as technicians. The company has had steady growth since it started. It purchases generic computer parts in volume at a discount from a variety of sources whenever they see a good deal. Thus, they need a good forecast of demand for repairs so that they will know how many computer component parts to purchase and stock, and how many technicians to hire. The company has accumulated the demand data shown in the accompanying table for repair and service calls for the past 12 months, from which it wants to calculate exponential smoothing forecasts using smoothing constants (α) equal to 0.30 and 0.50. Also compare the forecast obtained by these two different smoothing constants using MAD.

Period	1	2	3	4	5	6	7	8	9	10	11	12
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Demand for Service & Repair Calls	37	40	41	37	45	50	43	47	56	52	55	54

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SWAMI KESHVANAND INSTITUTE OF TECHNOLOGY, MANAGEMENT AND GRAMOTHAN

DEPARTMENT OF MECHANICAL ENGINEERING

HEAT TRANSFER (5ME1A)

TUTORIAL SHEET-2 (Unit-2)

1.Calculate the amount of energy required to solder together two very long pieces of bare copper wire 1.5mm in diameter with solder that melts at 190°C. The wires are positioned vertically in air at 20°C. Assume that the heat transfer coefficient on the wire surface is 20W/m^2°C and thermal conductivity of wire alloy is 330 W/m°C. **(Ans- 2.52W)**

2. It is required to heat oil to about 300°C for frying purpose. A ladle is used in frying. The section of the handle is 5mm×18mm. The surrounding are at 30°C. The conductivity of material is 205 W/m°C. If the temperature at a distance of 380mm from the oil should not reach 40°C, determine the convective heat transfer coefficient. **(Ans- 30.17 W/m^2°C)**

3. A very long 25 mm diameter copper rod(k = 380 W/m°C) extends horizontally from a plane heated wall at 120 °C. The temperature of the surrounding air is 25°C and the convective heat transfer coefficient is 9 W/m^2°C.

i) Determine the heat loss.

ii) How long the rod be in order to be considered infinite? **(Ans- 34.48W, 1.36m)**

4. A longitudinal copper fin (k=380 W/m°C) 600 mm long and 5 mm diameter is exposed to air stream at 20 °C. The convective heat transfer coefficient is 20 W/m^2°C. If the fin base temperature is 150 °C, determine:

i) The Heat transferred, and

ii) The efficiency of fin. **(Ans- 6.29W, 25.66 %)**

5. The velocity distribution in the boundary layer is given by: $(u/U) = (y/\delta)$, when the velocity at a distance y from the plate and $u = U$ at $y = \delta$, δ being boundary layer thickness. Find:

i) The displacement thickness,

ii) The momentum thickness,

iii) The energy thickness and

iv) The value of δ^*/θ. **(Ans- δ/2, δ/6, δ/4, 3)**

6. The velocity Profile for laminar boundary in the form given below:

$$(u/U) = 2(y/\delta) - (y/\delta)^2$$

Find the thickness of boundary layer at the end of the plate 1.5 m long and 1 m wide when placed in water flowing with the velocity of 0.12 m/s. Calculate the value of coefficient of drag also. Take μ for water = 0.001 N-s/m^2. **(Ans- 0.00344)**

7. Air is flowing over a smooth flat plate with a velocity of 12 m/s. The velocity profile is in the form:

$$(u/U) = 2(y/\delta) - (y/\delta)^2$$

The length of the plate is 1.1 m and width 0.9 m. If the laminar boundary layer exists up to a value of R_e = 2×10^5 and kinematic viscosity of air is 0.15 stokes, find:

i)The maximum distance from the leading edge up to which laminar layer exists.

ii) The maximum thickness of boundary layer. **(Ans- 0.25m, 3.06mm)**

8. Ambient air at 20 °C flows at velocity of 10m/s parallel to a wall 5 m wide and 3 m high. Calculate the heat transfer rate if the walls maintained at 40°C. The critical Reynolds number is equal to 5×10^5. The properties of air at the mean film temperature may be taken as:

k= 0.0263 W/m K, $\nu = 15.89 \times 10^{-6}$ m²/s and $P_r = 0.707$.

Appropriate correlation from the following may be used

$$Nu = 0.664\ Re^{0.5}\ P_r^{1/3}$$

$$Nu = 0.0375\ Re^{0.8}\ P_r^{1/3}$$

$$Nu = 0.0375\ [Re^{0.8} - 23200]\ P_r^{1/3}$$ **(Ans- 7098W, 8322W, 17.24%)**

9. A flat plate 1 m wide and 1.5 m long is to be maintained at 90 °C in air when free temperature is 10 °C. Determine the velocity at which the air must flow over the plate so that the rate of energy dissipation from the plate is 3.75 kW.

Use $\overline{Nu} = \bar{h}L/k = 0.664(Re_L)^{1/2}\ (Pr)^{1/3}$ for laminar flow

$\overline{Nu} = \bar{h}L/k = [0.036\ (Re_L)^{0.8} - 836]\ (Pr)^{1/3}$ for turbulent flow

Take the following air properties at 50 °C:

$\rho = 1.0877$ kg/m³, k=0.02813 W/m°C, $C_P = 1007.3$ J/kg°C, $\mu = 2.209 \times 10^{-5}$ kg/ms and $P_r = 0.703$.

(Ans- 15.5m/s)

10. Water is flowing at the rate of 50 kg/min through a tube of inner diameter 2.5 cm. The inner surface of the tube is maintained at 100 °C. If the temperature of water increases from 25 °C and 55 °C, find the length of the tube required.

The following relation may be used:

$$Nu = 0.023\ (Re)^{0.8}\ (Pr)^{0.4}$$

The properties of water can be taken from the following table:

T(°C)	ρ(kg/m³)	C_P(J/kg-K)	k × 10^{-2} (W/m-k)	μ × 10^6 (kg/m-s)
40	992.2	4174	63.35	652
50	988.1	4178	64.74	550
60	983.2	4082	65.90	470
70	977.8	4187	66.72	405
80	971.8	4195	67.41	335

(Ans- 2.45m)

Swami Keshvanand Institute of Technology, Management & Gramothan Jaipur

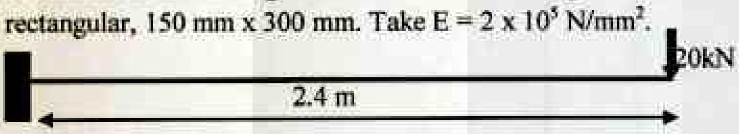
Department of Mechanical Engineering

Subject: Mechanics of Solids 3ME4-07

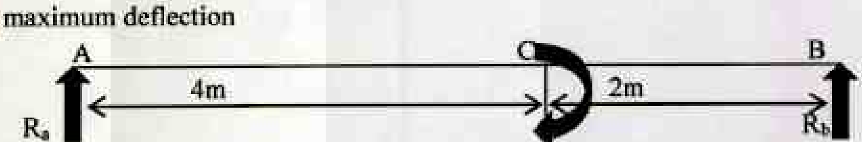
Tutorial Sheet No. 05

Topic: Deflection of Beams & Pressure Vessels

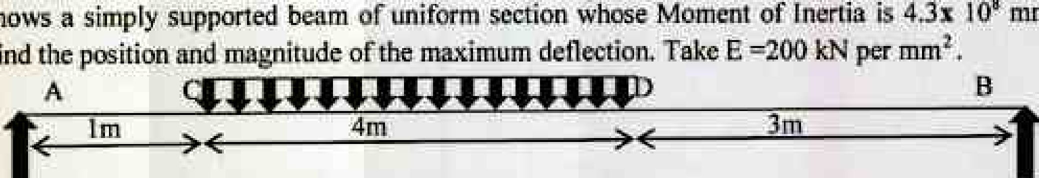
1. What is hoop and longitudinal stress? Also derive formula for wall of thin cylinders (cylinder thickness).
2. What are pressure vessels or shells? What type of stresses act upon them? Differentiate between thin and thick shells.
3. What assumptions are taken in the analysis of thin cylinders? Also determine the stresses in thin spherical vessel.
4. A thin cylindrical vessel of 500 mm diameter is subjected to an internal pressure of 2 N/mm^2, If the thickness of vessel is 20mm, find the hoop stress, longitudinal stress and maximum shear stress. [RTU 2016]
5. Derive the expression for slope and deflection for following cases of Cantilever beam of length 'L'.
   (a) Concentrated load 'W' at free end.
   (b) Concentrated load 'W' not at free end.
   (c) UDL ('w' N/m) on whole span.
   (d) UDL ('w' N/m) on a part of span from fixed end.
6. Derive expression for slope and deflection for following cases of Simply Supported beam of length 'L'.
   (a) Concentrated load 'W' at midspan.
   (b) Eccentric concentrated load using (a) Double integration method (b) Macaulays's Method.
   (c) UDL on whole span [RTU 2013]
7. Establish the governing differential equation of beams i.e. $\frac{dy}{dx} = M / EI$ .What are its limitations?
8. What is Macaulay's method of beam deflection analysis? How it is related to direct/double integration method?
9. Discuss the Area Moment Method to calculate slope and deflection for the case of simply supported beam with a uniformly distributed load over whole length. [RTU 2010]
10. A cantilever 2.4 m long is loaded as shown in figure. Calculate the slope & deflection at the free end if the section is rectangular, 150 mm x 300 mm. Take $E = 2 \times 10^5$ N/mm^2.



11. A cantilever of 3 m span carries a uniformly distributed load of 10 kN per meter length for 2m starting from the fixed end. Determine the slope & deflection of free end. Take E = 200 GPa & $I = 80*10^6$ mm^4.
12. Derive the expression of deflection at the free end of a cantilever of length 'L' which carries a point load 'W' at the free end by 'strain energy due to bending' method. Take EI = constant for the beam.
13. A horizontal beam is simply supported at A and B, 6m apart. The beam is subjected to a clockwise couple of 300kN at a distance of 4m from the left end as shown in figure. If $E = 2 \times 10^5$ N/mm^2 and $I = 2 \times 10^8$ mm^4. Determine :
    (a) Deflection at the point where couple is acting
    (b) The maximum deflection



14. Figure shows a simply supported beam of uniform section whose Moment of Inertia is 4.3×10^8 mm^4. For the loading shown, find the position and magnitude of the maximum deflection. Take E =200 kN per mm^2.



15. Write short notes on Mohr's I and II theorem for slope and deflection. [RTU 2013]
16. A cylinder of thickness 1.5 cm has to withstand maximum internal pressure of 1.5 N/m^2. If the ultimate tensile stress in the material of the cylinder is 300 N/mm^2, factor of safety 3.0 and joint efficiency 80%, determine the diameter of the cylinder. [RTU 2015]

GATE QUESTIONS

1. A concentrated load P acts at the middle of a simply supported beam of span 'L' and flexural rigidity 'EI'. Another simply supported beam of identical material, geometry and span is being acted upon by an equivalent distributed load (w = P/L) spread over the entire span. Is the central deflections in both the beams are identical? If not, What is the ratio of deflections? [1994]
2. A cantilever AB of length 'L' has fixed end A and free end B. It is loaded by applying a concentrated load 'W' at the midpoint C of the cantilever.
   (a) Determine the deflection and slope at points C and B.
   (b) Show deflections and slopes on the cantilever. [2002]
3. A simply supported laterally loaded beam was found to deflect more than a specified value. Which of the following measures reduce the deflection ?
   a) Increase the area moment of Inertia. c)Increase the span of the beam.
   b) Select a different material having lesser modulus of elasticity. d) Magnitude of the load to be increased.
4. A cantilever beam of length L is subjected to a moment M at the free end. The moment of inertia of the beam cross section about the neutral axis is 'I' and the Young's Modulus is E. The magnitude of the maximum deflection is:
   (a) $ML^2/2EI$ (b) ML^2/EI (c) $2ML^2/EI$ (d) $4ML^2/EI$
5. A cantilever beam with flexural rigidity of 200 N-m^2 is loaded as shown in fig 1. The deflection (in mm) at the tip of the beam is .... [2015]
6. A horizontal cantilever beam of circular cross section, length 1 m and flexure rigidity EI = 200 N-m^2 is subjected to an applied moment M_B= 1N-m at the free end as shown in fig 2. The magnitude of the vertical deflection of free end is .... [2019]
7. A cantilever beam having square section of side 'a' is subjected to an end load. If 'a' is increased by 19%, the tip deflection decreases by approximately by:
   (a) 19% (b) 29% (c) 41% (d) 50%
8. A thin cylinder of 100 mm internal diameter and 5 mm thickness is subjected to an internal pressure of 10 MPa and a torque of 2000 Nm. Calculate the magnitude of principal stresses.
9. A thin cylinder of inner radius 500 mm and thickness 10 mm is subjected to an internal pressure of 5MPa. The average circumferential (hoop) stress in MPa is:
   (a) 100 (b) 250 (c) 500 (d) 1000
10. A long thin walled cylinder shell, closed at both the ends, is subjected to an internal pressure. The ratio of the hoop stress to longitudinal stress developed in the shell is:
   (a) 804.7 (b) 1 (c) 2 (d) 4
11. A thin gas cylinder with an internal radius of 100 mm is subjected to an internal pressure of 10 MPa. The maximum permissible working stress is restricted to 100 MPa. The minimum, cylinder wall thickness (in mm) for safe design must be:
12. A gas is stored in a cylindrical tank of inner radius 7 m and wall thickness 50 mm. The gauge pressure of the gas is 2 MPa. The maximum shear stress (in MPa) in the wall is:
   (a) 35 (b) 70 (c) 140 (d) 280

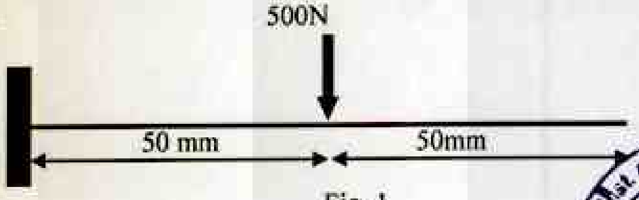


Fig. 1

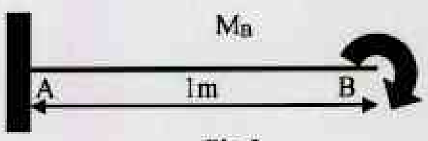


Fig.2

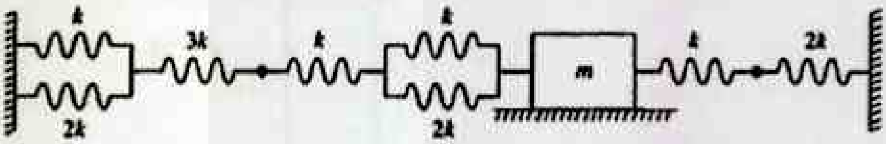
TUTORIAL SHEET #1

1. Describe the following terms in context of vibrations:
(i) Natural Frequency (ii) Resonance (iii) Simple Harmonic motion (iv) Phase angle

2. What do you understand by center of percussion? Explain its role in designing various engineering applications. [RTU 2009]

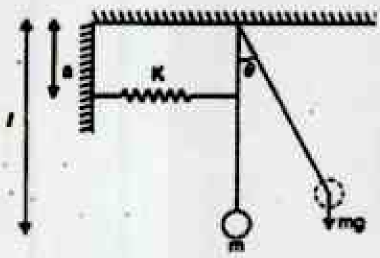
3. The displacement vector of a vibrating body is given by: $x = 5\sin(31.41t + \frac{\pi}{4})$. Determine the displacement, velocity and acceleration after 0.11 second. Also determine the frequency of vibration.

4. Find the natural frequency of the spring-mass system shown in figure below.

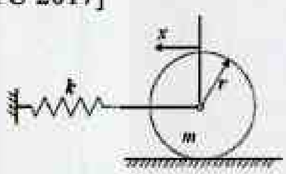


5. A spring-mass system k_1, m_1 has a natural frequency f_1. Calculate the value of k_2, another spring which when connected to k_1 in series decreases the frequency by 20%. [RTU 2017]

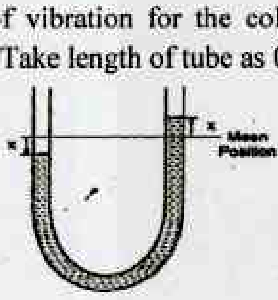
6. Determine the natural frequency of vibrations for the spring pendulum as shown in figure below. [RU 2003]



7. A circular cylinder of mass 4 kg and radius 12 cm is connected by a spring of stiffness 6000 N/m as shown in figure. If it is free to roll on horizontal rough surface without slipping. Determine the natural frequency. [RTU 2017]



8. Calculate the natural frequency of vibration for the column of liquid in a simple U-Tube manometer as shown in figure below. Take length of tube as 0.2 m. [RU 2003]



9. Derive the frequency equation for a compound pendulum. Explain the importance of center of percussion. [RTU 2015]

10. A cantilever beam of negligible mass is loaded with mass 'm' at the free end as shown in figure below. Find the natural frequency of vibration.

11. A shaft supported freely at the ends has a mass of 100 kg placed 25 cm from one end. Find the frequency of the natural transverse vibrations if the length of the shaft is 75 cm, E = 200 GN/m^2 and shaft diameter is 4 cm. [RTU 2016]

12. A torsional pendulum consists of a disc type rotor of mass 2 kg and diameter 0.2 m at the lower end supported by a rod of diameter 5 mm and length 1 m. The modulus of rigidity of the rod material may be assumed to be 83 GPa. Calculate the natural frequency of torsional vibrations.

13. Explain the salient characteristics of a coulomb damped system. How is it different from a viscous damped system? Also derive the equation governing the vibration of a coulomb damped spring-mass system. [RTU 2013]

14. What do you understand by under-damped system, over-damped system and Critically damped systems? Explain with examples. [RTU 2016]

15. The natural frequency of an undamped vibrating system is 100 rad/s. A damper with a damping factor of 0.8 is introduced into the system. Determine the frequency of vibration of the damped system in rad/s. [GATE-2000]

16. A vibrating system is defined by following parameters:
m = 3 kg, k = 100 N/m, c = 3 N sec/m.
Determine the damping factor, frequency of damped vibration and logarithmic decrement. [RTU 2010 & 2017]

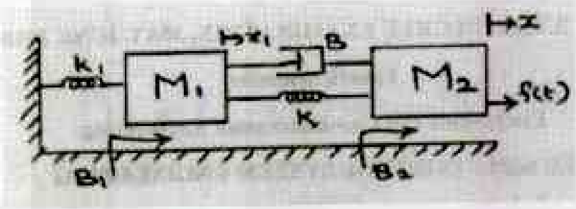
17. A torsional pendulum when immersed in oil indicates its damped natural frequency as 200 Hz. But when it was put to vibration in vacuum having no damping, its natural frequency was observed as 250 Hz. Find the value of damping factor of oil.

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

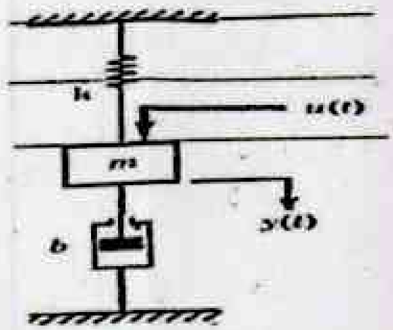
(Department of Electrical Engineering)

Tutorial –I Control System (V Sem.)

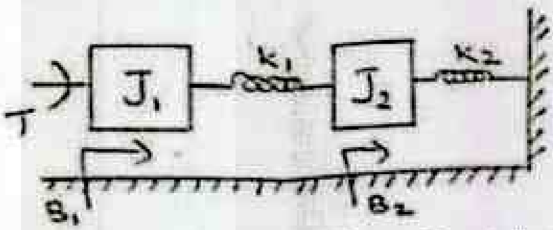
1. Write the differential equations governing the mechanical translational system as shown in figure and determine the transfer function



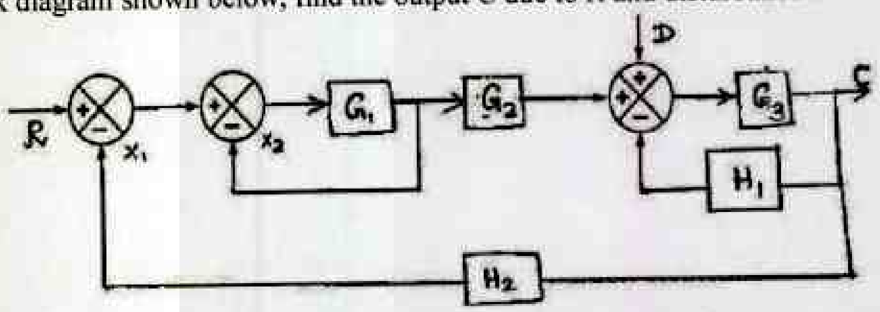
2. Draw the equivalent electrical analogous circuit for the mechanical system in Fig using force-voltage analogy



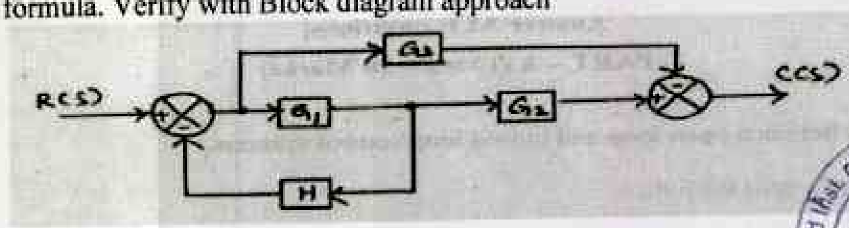
3. Write differential equations governing the mechanical rotational system shown in Fig. below. Draw the electrical equivalent analogy circuits (current and voltage)



4. For the block diagram shown below, find the output C due to R and disturbance D.



5. Convert the block diagram shown in figure to signal flow graph and find the transfer function using Mason's gain formula. Verify with Block diagram approach



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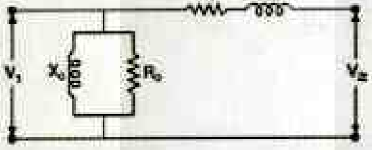
TUTORIAL SHEET: 1-phase Transformer

1. A 1-phase transformer has 400 primary and 1000 secondary turns. The net cross sectional area of the core is 60 cm^2. If the primary is connected to a 50 Hz supply at 500 V, determine (a) the peak value of the flux density in the core and (b) the voltage induced in the secondary winding. (E)
2. A single phase 50 Hz core type transformer has core of cross section area 400 sq. cms. The permissible maximum flux density is 1 Wb/m^2. Calculate the number of turns per limb on the high and low voltage sides for a 3000 / 220V ratio. (E)
3. A single phase transformer has 180 and 90 turns respectively in its secondary and primary windings. The respective resistances are 0.233 ohm and 0. 067 ohm. Calculate the equivalent resistance of (a) the primary in terms of the secondary winding (b) the secondary in terms of the primary winding and (c) the total resistance of the transformer in terms of the primary. (M)
4. A 40 KVA transformer with a ratio of 2000/250 V has a primary resistance of 1. 15 ohm and a secondary resistance of 0. 0155 ohm. Calculate (a) the total resistance in terms of the secondary winding (b) total copper loss on full load. (M)
5. A 5 KVA transformer has a nominal voltage rating of 1100/ 110 volts. With the low voltage winding short circuited, it is found that 33 volts is required to circulate rated full load current and the corresponding power input is 85 watts. Determine the per cent voltage regulation when the load takes rated current at 0. 8 p.f. lagging. (M)
6. Determine the regulation of a transformer in which ohmic loss is 1% of the output and the reactance drop 5% of the voltage when p.f. is (a) 0. 8 lag (b) unity (c) 0. 8 lead. (M)
7. Calculate the values of Ro, Xo, Rt and Xt in the diagram for the equivalent circuit of a single phase 4 kVA, 200/400 V 50 Hz transformer of which the following are the test results
   O.C. test 200V, 0.7 A, 70W on low voltage primary side
   S.C. test 15 V, 10A, 80W on HT side.



(D)

8. Fig. shows the equivalent circuit for a 1-phase transformer. Fig. gives resistance and reactance in ohms in terms of the primary side. The ratio of secondary to primary turns is 10. Determine (a) the secondary terminal voltage (b) the primary current (c) the efficiency.

(D)

9. The maximum efficiency of a 500 kVA, 3300/500 V 50 Hz single phase transformer is 97% and occurs at ¾ full load unity p.f. If the impedance is 10%. Calculate the regulation at full load, p.f. 0.8 lag. (D)
10. In a 25 KVA 2000/200 V transformer the iron and copper losses are 350 and 400 W respectively. Calculate the efficiency on unity p.f. at (a) full load and (b) half load (c) Determine the load for maximum efficiency and the iron and copper loss in this case. (D)

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Tutorial Sheet: Unit-II: Electromagnetic Force & Torque

1. A rotating transducer shown in Fig has a linear relationship between flux linkage and current. The inductance varies as ($L_{r1} + L_{r2} \cos 2\theta$).
   a) Derive a general expression for torque.
   b) Calculate the average torque when the rotor has a constant angular velocity ω rad/sec, that is $\theta=\omega t$ and the current varies as $I_m\cos(\omega t+\delta)$

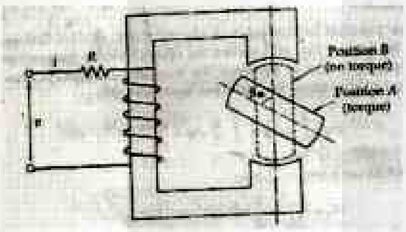


Fig. Singly Excited Magnetic System (E)

2. For the doubly-excited system shown in Fig., the inductances are approximated as follows:
   $L1=11+3\cos2\theta$ H; $L2=7+2\cos2\theta$ H; $M=11\cos\theta$ H.
   The coils are energized with direct currents $I1=0.7$A, $I2=0.8$A.
   a) Find the torque as a function of θ, and its value when $\theta=-50$.
   b) Find the energy stored in the system as a function of θ.

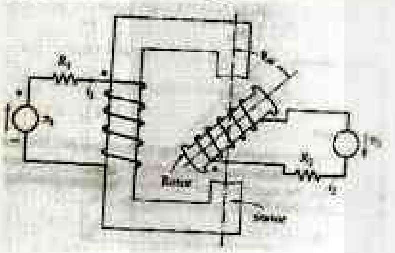
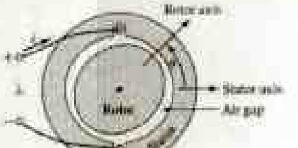


Fig. Doubly Excited Magnetic System (M)

3. The inductance of a coil on a magnetic circuit is found to vary with rotor position as $L(\theta)=L_o+L_2\cos(2\theta)+L_4\sin(4\theta)$; where, $L_o=25.4$mH, $L2=8.3$mH and $L4=1.8$mH.
   a) Find the torque as a function of θ for a winding current of 3. A.
   b) Find a rotor position θ_{max} that produces the largest negative torque.



(M)

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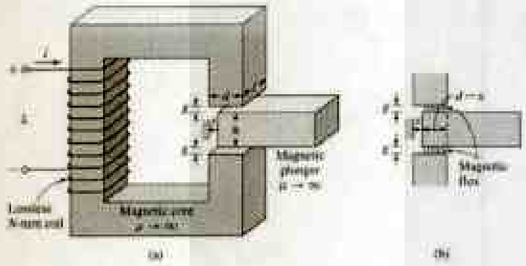
4. Consider a plunger whose inductance varies as $L(x) = Lo\ (1-(x/d)^2)$. Find the force on the plunger as a function of x when the coil is driven by a controller which produces a current as a function of x of the form $i(x) = Io\ (x/d)^2$ A (M)

5. For the relay shown, find the force on the plunger as a function of x when the coil is driven by a controller which produces a current as a function of x of the form

$i(x)=Io(x/d)A$

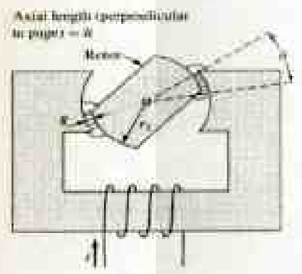


(D)

6. The magnetic circuit shown in Fig. is made of high permeability electrical steel. The rotor is free to turn about a vertical axis. The dimensions are shown in the figure.

a). Derive an expression for the torque acting on the rotor in terms of the dimensions and the magnetic field in the two air gaps. Assume the reluctance of the steel to be negligible (i.e. $\mu \to \infty$) and neglect the effects of fringing.

b) The maximum flux density in the overlapping portions of the air gaps is to be limited to approximately 1.65T to avoid excessive saturation of the steel. Compute the maximum torque for r1=2.5 cm, h=1.8cm, and g=3mm.



(D)

7. Write an expression for the inductance of the magnetic circuit of Pb6 as a function of θ. Using this expression, derive an expression for the torque acting on the rotor as a function of the winding current i and the rotor angle θ. (D)

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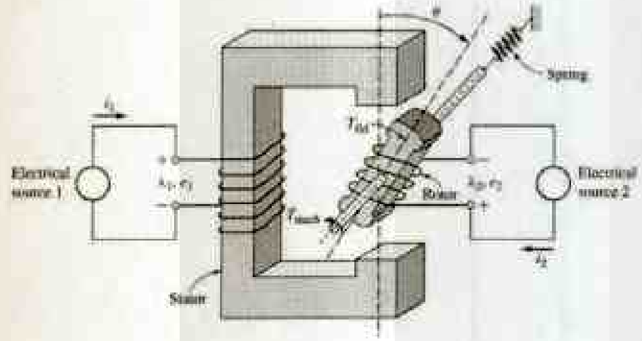
8. In the system shown, the inductances in henrys are given as L_{11}=(3+cos2θ) X 10^{-3}; L_{12}=0.3cosθ; L_{22}=30+10cos2θ. Find and plot the torque Tfld(θ) for current i_1=0.8A and i_2=0.01A.



(M)

9. Find an expression for the torque of a symmetrical two-winding system whose inductances vary as

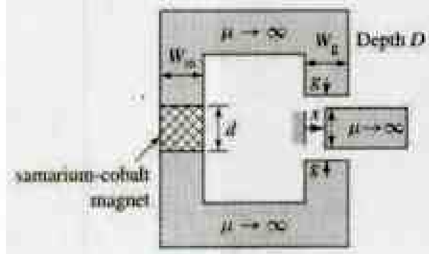
L11=L22=0.8+0.27cos4θ

L12=0.65cos2θ

for the condition that i1=-i2 =0.37A. (M)

10. (a) Derive an expression for the coenergy in the magnetic circuit of Fig. as a function of the plunger position x. (b) Derive an expression for the x-directed force on the plunger and evaluate it at x=Wg/2. Neglect any effects of fringing fluxes. The dimensions are:

Wm=2.0 cm Wg=2.cm D=3.0 cm d=1.0 cm go=0.2 cm



(D)

(EMD Analysis of Tutorial Sheet → E-Easy; M-Moderate; D-Difficult)

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Tutorial Sheet: Unit I Magnetic fields & Magnetic Circuits

1. In the magnetic circuit detailed in Figure 1 with all dimensions in mm, calculate the required current to be passed in the coil having 200 turns in order to establish a flux of 1.28 mWb in the air gap. Neglect fringing effect and leakage flux. The B-H curve of the material is given in Figure 2. Permeability of air may be taken as, $\mu 0 = 4\pi \times 10-7$ H/m. (D)

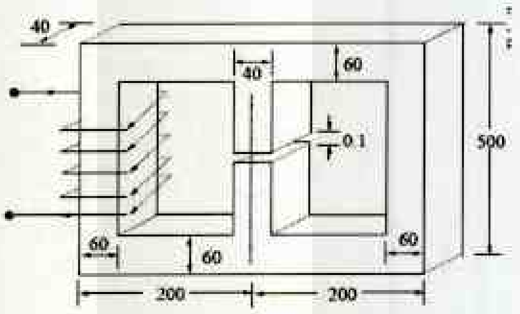


Figure 1

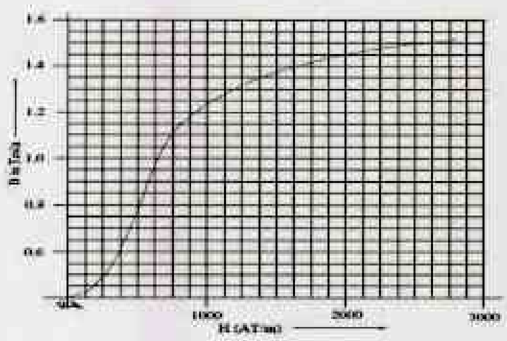
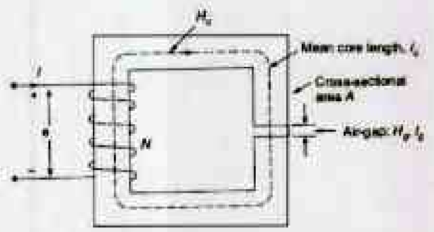


Figure 2

2. The magnetic circuit of Fig. has dimensions: Ac = 4X4 cm^2, lg = 0.06 cm, lc = 40 cm; N = 600 turns. Assume the value of $\mu_r = 6000$ for iron. Find the exciting current for Bc = 1.2 T and the corresponding flux and flux linkages. (M)



3. A wrought iron bar 30 cm long and 2 cm in diameter is bent into a circular shape as shown in Fig. It is then wound with 600 turns of wire. Calculate the current required to produce a flux of 0.5 mWb in the magnetic circuit in the following cases:

(i) no air-gap;

(ii) with an air-gap of 1 mm; μr (iron) = 4000 (assumed constant); and

(iii) with an air-gap of 1 mm; assume the following data for the magnetization of iron:

H in AT/m	*2500*	*3000*	*3500*	*4000*
B in T	*1.55*	*1.59*	*1.6*	*1.615*

(D)

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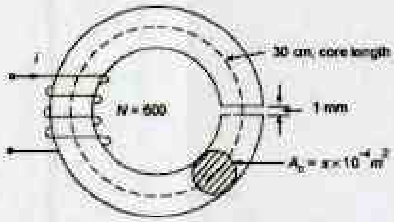
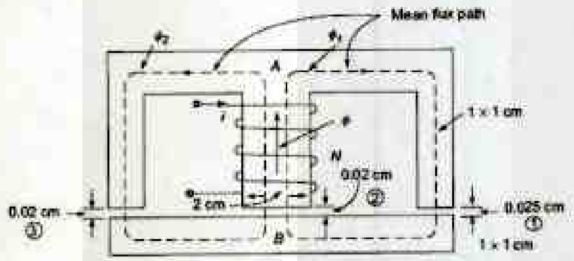


4. The magnetic circuit of Fig. has cast steel core with dimensions as shown:
Mean length from A to B through either outer limb = 0.5 m
Mean length from A to B through the central limb = 0.2 m
In the magnetic circuit shown it is required to establish a flux of 0.75 mWb in the air-gap of the central limb. Determine the mmf of the exciting coil if for the core material (a) μr = (b) μr = 5000. Neglect fringing.



(M)

5. The magnetic circuit of Fig. 1 has cast steel core. The cross-sectional area of the central limb is 800 mm^2 and that of each outer limb is 600 mm^2. Calculate the exciting current needed to set up a flux of 0.8 mWb in the air gap. Neglect magnetic leakage and fringing. The magnetization characteristic of cast steel is given in Fig. 2.

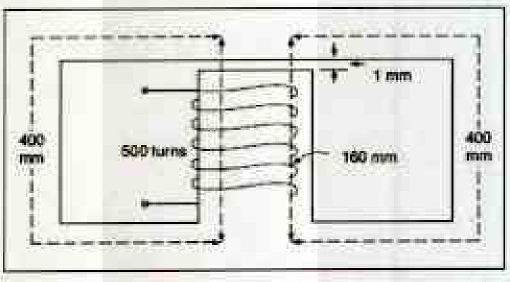


Fig. 1

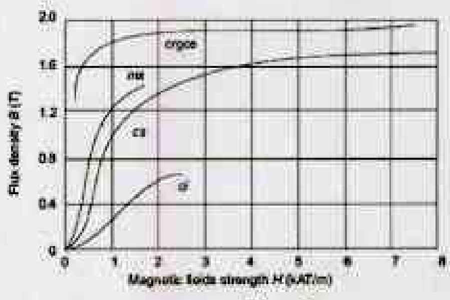


Fig. 2

(D)

6. The magnetic circuit of Fig. has a cast steel core whose dimensions are given below:
Length (ab + cd) = 50 cm Cross-sectional area = 25 cm^2
Length ad = 20 cm Cross-sectional area = 12.5 cm^2

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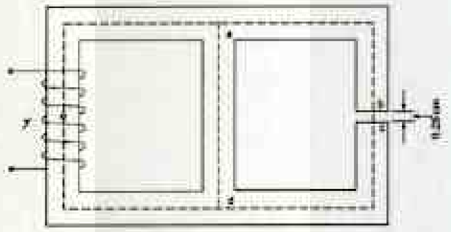
Length dea = 50 cm Cross-sectional area = 25 cm^2

Determine the exciting coil mmf required to establish an air-gap flux of 0.75 m Wb. Use the B-H curve of Fig. 2 in Problem 5.



(D)

7. A cast steel ring has a circular cross-section of 3 cm in diameter and a mean circumference of 80 cm. A 1 mm air-gap is cut out in the ring which is wound with a coil of 600 turns.

(a) Estimate the current required to establish a flux of 0.75 mWb in the air-gap. Neglect fringing and leakage.

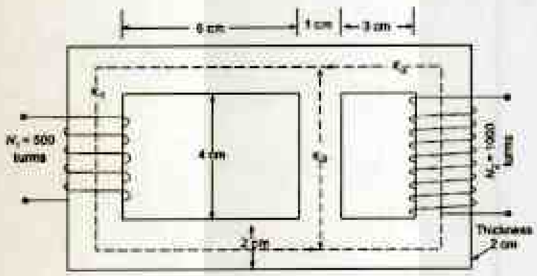
(b) What is the flux produced in the air-gap if the exciting current is 2 A? Neglect fringing and leakage.

Magnetization data:

H (AT/m)	*200*	*400*	*600*	*800*	*1000*	*1200*	*1400*	*1600*	*1800*	*2020*
B (T)	*0.10*	*0.32*	*0.60*	*0.90*	*1.08*	*1.18*	*1.27*	*1.32*	*1.36*	*1.40*

(D)

8. For the magnetic circuit of Fig, find the self and mutual inductances between the two coils. μc = 1600.



(M)

9. For the magnetic circuit of Problem 2, find the following:

(a) Induced emf e for Bc = 1.2 sin 314t T,

(b) reluctance Rc and Rg

(c) coil inductance, L and

(d) magnetic field energy at Bc = 1.2 T (E)

10. The total core loss of a specimen of silicon steel is found to be 1500 W at 50 Hz. Keeping the flux density constant the loss becomes 3000 W when the frequency is raised to 75 Hz. Calculate separately the hysteresis and eddy current loss at each of those frequencies. (E)

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur
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Tutorial –I Electrical Machine-II (IV Sem.)

1. A 4-pole, 3-phase, 50-Hz generator has an active length of $L = 0.5$ m, diameter of $D = 0.4$ m, 48 slots, 60°-phase-spread double-layer winding. Assume air-gap flux density to be sinusoidal with $Bmax =$ 0.7 Tesla. Coils have 5 turns each and are short chorded by 2 slots.
   Calculate Slot pitch (β in electrical degrees), Rated speed (in RPM), Flux per pole & Pitch-factor.
2. Consider the stator of 6-pole 3-phase induction motor being supplied from a 50-Hz supply. Find the speed (in mechanical degrees per second) of the stator-field with respect to a ground observer.
3. If in above question the rotor is rotating with 5% slip then find the speed of the rotor (in mechanical degrees per second) with respect to the ground.
4. Consider a 3-phase, 4-pole, 50-Hz induction motor. The rotor is star connected with per phase resistance = 0.5 Ω and reactance = 1.2 Ω. When the stator is excited with the rated supply, the induced EMF in the rotor is 130 V per phase at standstill condition. Find the rotor current (in A) at starting
5. Consider a 3-phase, 4-pole, 50-Hz induction motor. The rotor is star connected with per phase resistance = 0.5 Ω and reactance = 1.2 Ω. When the stator is excited with the rated supply, the induced EMF in the rotor is 130 V per phase at standstill condition. Find the rotor power factor at starting
6. Consider a 3-phase, 4-pole, 50-Hz induction motor. The rotor is star connected with per phase resistance = 0.5 Ω and reactance = 1.2 Ω. When the stator is excited with the rated supply, the induced EMF in the rotor is 130 V per phase at standstill condition. Find the torque (in Nm) at starting.
7. Consider a 12-kW, 3-phase, 4-pole, 440-V, 50-Hz star connected induction motor. The stator resistance per phase is 1 Ω. At no load it draws a line current of 10 A and an input power of 600 W. At full load it draws a line current of 20 A and an input power of 13.8 kW. Friction and windage loss is 200 W. The rotor copper loss at no load is negligible. Estimate stator core loss (in W)
8. Consider a 12-kW, 3-phase, 4-pole, 440-V, 50-Hz star connected induction motor. The stator resistance per phase is 1 Ω. At no load it draws a line current of 10 A and an input power of 600 W. At full load it draws a line current of 20 A and an input power of 13.8 kW. Friction and windage loss is 200 W. The rotor copper loss at no load is negligible. Estimate air-gap power (in W) at full load

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur
(Department of Electrical Engineering)

Tutorial –II Electrical Machine-II (IV Sem.)

Common data for question 1 to 9

Consider a 15-kW, 3-phase, 440-V, 50-Hz, 6-pole, slip-ring induction motor operating under rated conditions. The maximum torque occurs at 10% slip and it is double of the full load torque, stator impedances, core loss and mechanical losses are negligible.

Calculate

1. Slip at full load = _____ %
2. Speed at full load = _____ rpm
3. Full load torque = _____ Nm
4. Maximum torque = _____ Nm
5. Starting torque = _____ Nm
6. Rotor copper loss at full load = _____ W
7. *Starting current Full load current* = _____
8. *Current at maximum torque Full load current* = _____
9. Full load efficiency = _____ %

Common data for question 10 to 14

A 3-phase, wound rotor induction motor has following parameters Rotor resistance = 0.02 Ω per phase Rotor reactance = j 0.1 Ω per phase Stator impedances, rotational losses and no-load current are negligible

10. The maximum torque occurs at slip = _____ %
11. _____ Ω resistance per phase is to be added to the rotor to get maximum torque at starting
12. To get half of the maximum torque at starting minimum _____ milli-Ω resistance per phase is to be added to the rotor.
13. The addition of the extra resistance (as in question 3) will make starting current to be _____ % of the original (without extra resistance) starting current

Tutorial –III Electrical Machine-II (IV Sem.)

Common Data for Question 1 to 4

A round-rotor, star-connected, synchronous motor has a synchronous impedance of (0.1 + j 2) Ω. For the purpose of the power factor improvement in a plant, this motor is used as a synchronous condenser under no mechanical load. It is required to draw - 50 kVAR reactive power from a 440 V (line to line) bus. (The minus sign is used to indicate that it needs to draw capacitive reactive power at a leading power factor). It has a constant loss of 1 kW.

1. **The line current will be _____ A**
2. **The required excitation voltage per phase is _____ V**
3. **Power angle (δ) will be _____ degree (enter a positive number ignoring the sign)**
4. **This motor is a. Under excited**
   b. Over excited

Common Data for Question 5 to 7

A round-rotor, delta-connected, synchronous generator is feeding power to a 440-V (line-to-line) bus at unity power factor. Excitation voltage is 520 V (line-to-line). Synchronous reactance is j 5 Ω and armature resistance is negligible.

5. **The amount of power fed to the bus is _____ kW**
6. **Armature current (per phase) is _____ A**
7. **Power angle (δ) is _____ degree (enter a positive number ignoring the sign)**

8. **A star-connected, salient-pole synchronous motor connected to a 440 V (line-to-line) infinite bus has xd = 4Ω andxq = 2Ω and negligible armature resistance. The open circuit excitation is Ef = 220 V (line-to-line). The motor is operating under a constant load torque. The load angle δ = 30°.Calculate Gross mechanical power in kW**