Sapthagiri College of Engineering, Bengaluru-57

Department of Mechanical Engineering

Subject: Mechanics of Materials (18ME32) Semester: III

Question bank for slow learners

Faculty: Dr R.G.Deshpande , Mr.Chethan.B.P

COURSE OUTCOMES

At the end of this course the students will be able to,

CO1: Determine the stress, strain and elastic constants and strain energy in structural members.
CO2: Determine stress, strain under combined loading and apply theories of failure
CO3: Analyze structural members subjected bending and shear loads.
CO4: Determine the structural parameters of shafts and columns

Module 1: Stresses & Strains

1. a) List and define the Mechanical properties of materials, stating example for each.
   b) Explain the concepts and types of stress and strain, and state the law which relates them.

2. a) Draw the stress-strain diagram for Mild steel and highlight the significant points on the diagram.
   b) A 200mm long steel bar has circular cross section of 25mm diameter. Determine the Stress, deformation and axial strain induced in the bar, when it is subjected to a compressive force of 40 KN.

3. a) Derive an expression for shortening / extension of bar under the application of axial load.
   b) The following data refer to test results on Mild Steel specimen.
   Diameter of specimen: 2.5mm
   Gauge length of specimen: 200mm
   Extension under a load of 20 KN: 0.04mm
   Load at yield point: 150KN
   Maximum load: 225 KN
   Length of specimen after failure: 275mm
   Neck diameter: 18.25mm.
   Determine 1. Young's modulus 2. Yield stress 3. Ultimate stress 4. Percentage of elongation 5. Percentage reduction in area 6. Safe stress adopting a factor of safety of 2.5.

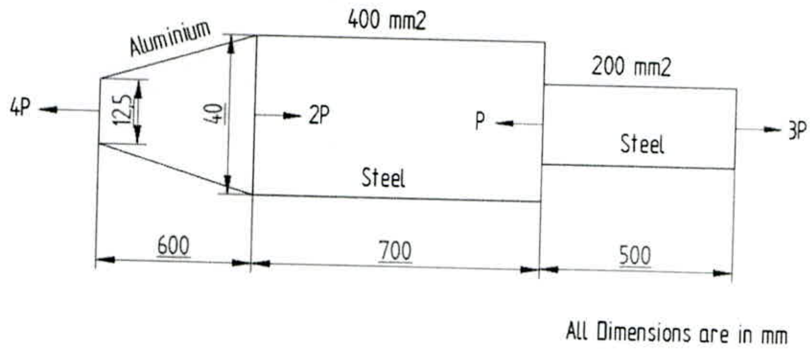
4. A bar when tested on UTM under a load of 40KN shows an extension of 0.285mm. Determine the Young's modulus of material. The bar has three sections, with diameter

and lengths of each being 25mm &160mm, 20mm & 240mm and 25mm & 160mm respectively.

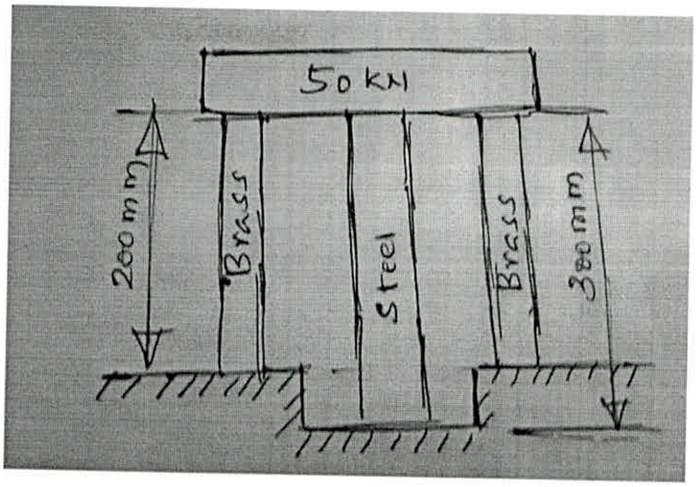
5. A bar of thickness 't' tapers in width from b_1 at one end to b_2 at another end over length L. Derive an expression for change in length of the bar when subjected to an axial force 'P'.

6. A round compound bar is made of uniform bar of 30mm diameter attached with a 200mm long tapering bar with big end and small end diameters being 30mm and 20mm respectively. The compound bar is subjected to an axial tensile force of 40KN and deformation measured was 0.2mm. Determine the length L1 of the uniform bar. Take E= $2X10^5$ N/mm^2.

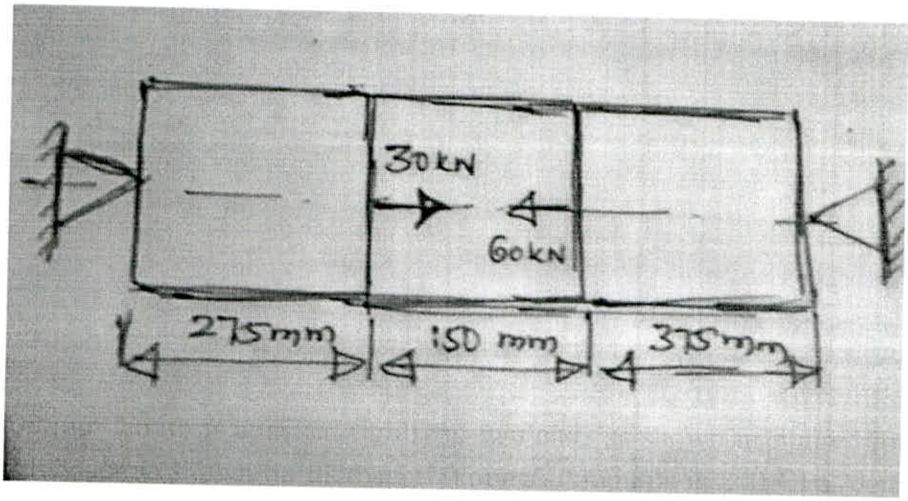
7. a) Explain Principle of Super Position, taking an example.
   b) A round bar with stepped portion is subjected to the forces as shown in figure below. Determine the magnitude of force P such that the net deformation in the bar should not exceed 1mm. Young's modulus for steel and Aluminium are 200 GPa and 70 GPa respectively. Big end and small end diameters of the tapering bar are 40mm and 12.5 mm respectively.



8. A steel rod of cross-sectional area 1600 mm^2 and two brass rods of cross section area 1000 mm^2 together support a load of 50K N as shown in figure. Find the stresses in the rods if Young's modulus of Steel and Brass are $2x\ 10^5$ N/mm^2 and $1x10^5$ N/mm^2.



9. A bar of 800 mm length is attached rigidly at two ends as shown in figure. Forces of 30 KN and 60 KN act as shown on the bar. If Young's modulus is 200 GPa, determine the reactions at the two ends. If the bar diameter is 25mm find the stresses and change in length of each portion.



10. a) Explain how the thermal stresses are induced in a structure.

    b) At room temperature the gap between bar A and bar B shown in figure is 0.25mm. Find the stresses induced in the bars if the temperature rise is 35 ^{0}C. Areas of bar A & B are 1000mm2 and 800mm2 respectively. Young's modulus for Aluminum and Brass are, 2 x 105 and 1x 105 respectively. Co-efficient of thermal expansions for Aluminium and Brass are 12 x 10^{-6} / ^{0}C and 23 x 10^{-6} / ^{0}C.

Module 2: Analysis of Stress & Strains and Cylinders

1. a) Derive expressions for Longitudinal and Circumferential stresses.

   b) A thin cylindrical shell 1m in diameter and 3m long has a metal thickness of 15 mm. It is subjected to an external fluid pressure of 5MPa. Determine, i) Circumferential &

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Longitudinal stress ii) Circumferential & Longitudinal strain, iii) Volumetric strain iv) Change in length, diameter and volume. Take Poisson's ratio = 0.29 and E=280 GPa.

2. a) Derive Lame's equations to find Circumferential stress and Radial Pressure in case of thick cylinders

   b) A thick cylinder outside diameter 350mm and inside diameter 250 mm is subjected to internal fluid pressure of 18 MPa. Determine maximum Hoop stress developed. Also sketch the variation of Hoop stress and Radial pressure across the thickness of the cylinder.

3. Define Principal stress, strain and derive an expression for a member subjected to direct normal stresses in two mutually perpendicular planes.
4. Derive an expression for member subjected to general two dimensional stress system.
5. A piece of material is subjected to tensile stress of $70N/mm^2$ in one direction and a compressive stress of $50N/mm^2$ in a direction at right angles to the first stress. Determine the normal, tangential and resultant stresses on a plane inclined at 400 with $70N/mm^2$ stress.
6. At a point in a strained material the principal tensile stresses across two perpendicular planes are 80MPa and 40MPa.Determine normal stress and the resultant stress on a plane inclined at 200 with the major principal plane. Determine the obliquity.

Module 3: Shear Force & Bending Moment and Stress in Beams

1. State the assumption made in pure bending and derive an expression for Bending stresses.
2. A simply supported beam having cross section of 20mm x 20mm fails when a central point load of 400N is applied. Span of beam is 2m. What UDL will break a Cantilever beam of same material 40mm wide, 60mm deep and 3m long?
3. A Rolled steel joint of I Section used as a simply supported beam has the following dimensions. Flange – (250 x 25) mm. Web - 15mm thick, overall depth 50mm. If the beam carries a UDL of 50KN/m on a span of 4m, Calculate the maximum stress produced due to bending.
4. A cantilever beam of T section has a length of 2.5m is subjected a load of W at the end. The top flange is 100 x 20 mm and web is 12 X 200 mm.
5. Draw SFD and BMD for the cantilever beam as shown in fig. below.

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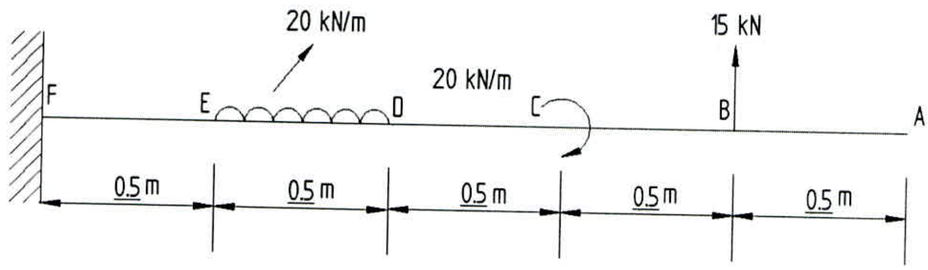
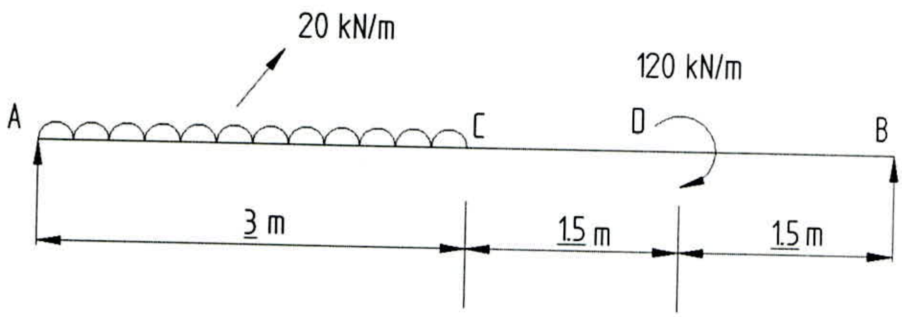
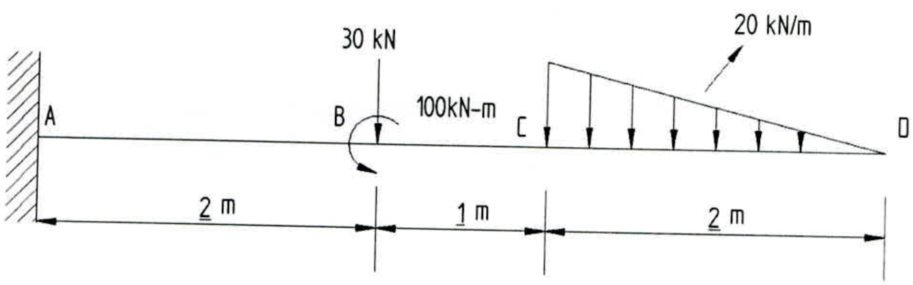


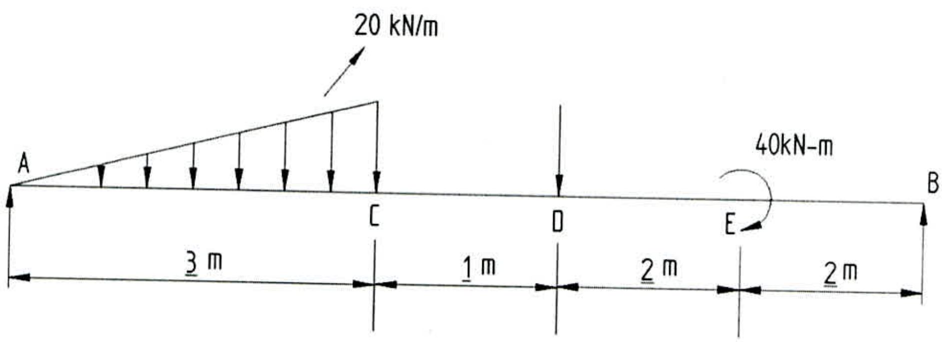
6. Draw SFD and BMD for the simply supported beam as shown in fig. below.



7. Draw SFD and BMD for the simply supported beam as shown in fig. below.



8. Draw SFD and BMD for the simply supported beam as shown in fig. below.



Module 4: Theories of Failure and Torsion

1. State the assumptions made in pure Torsion and with usual notations derive Torsion equation.

2. A solid shaft rotating at 1500 rpm transmits 70 kw of power. Maximum torque is 25% more than mean torque. Allowable shear stress is 70 MPa and modulus of rigidity is 90 GPa. Angle of twist in the shaft should not exceed 1.5^0 in one meter length. Determine the diameter of the shaft.

3. a) Prove that hollow shaft is stronger and stiffer than the solid shaft of the same material, length and weight

4. A solid circular shaft has to transmit a power of 1500 kW at 160 rpm. Find the diameter of the shaft if the shear stress is 90 N/mm^2. The maximum torque is 1.5 times the mean. What percentage of saving in material would be obtained if the shaft is replaced by hollow shaft whose internal diameter is 0.5 times the external diameter? The length and maximum shear stress is same.

5. State the Maximum Principal Stress theory Maximum shear stress theory.
A bolt is under an axial load of 25KN together with a transverse force of 20KN. Find the Diameter according to, Maximum principal stress theory and maximum shear stress theory. Take factor of safety 3, yield strength of material of bolt 300 N/mm^2 and Poisson's ratio = 0.3.

6. A solid shaft is to transmit 192 *kW* at 450 *rpm*. Taxing allowable stress for the shaft material as 70 *MPa*, find the diameter of the solid. What percentage of saving in weight would be obtained if the shaft is to replace by hollow shaft, where internal diameter is 0.8 times its external diameter? The length of the shaft, power transmission and shear stresses are equal in both the cases

7. Determine the ratio of power transmitted by hollow shaft and a solid shaft when both have same weight, length, material and speed. The diameter of solid shaft is 150*mm* and external diameter of hollow shaft is 250*mm*.

8. A ductile material has a yield strength of 360MPa. Using the following stress state : σ_1 = 120 MPa, σ_2 =0, σ_3 = -90 MPa. Determine the factor of safety using Maximum shear stress theory and Maximum principal stress theory.

Module 5: Columns & Strain Energy

1. Derive an expression for strain energy due to normal stress?

2. A simply supported beam of span 'L' carries a point load 'W' at mid-span. Find the strain energy stored by the beam and also find the deflection.
3. A simply supported beam of span 'L' carries a UDL of 'W' per unit run over the whole span. Find the strain energy stored by the beam.
4. A simply supported beam of span 'L' carries a point load 'W' at mid-span. Find the deflection at its mid-span using castgliano's theorem.
5. Define, a) Buckling load b) Radius of Gyration c) Slenderness ratio
6. State the assumption made in Euler's theory for long columns.
7. Derive Euler's expression for following conditions, a) Both ends of column are hinged b) Both ends are fixed. C) One end fixed and other end free. d) One end fixed and other end hinged.
8. A column 6m long has its both ends fixed and has a rectangular section of 150 mm X 200mm. If Young's modulus for the material is 17.5 X 10^3 N/mm^2. Determine the crippling load on column.
9. Using Rankine's formula determine the crippling load for a mild steel strut 500mm long, with a rectangular section 50 mm X 12.5 mm having a) hinged ends b) fixed ends. Take α= 1/6500 in Rankine's formula and σ = 330 N/mm^2.
10. A 1.5m long column has acircular cross-section of 50mm diameter.One end of the column is fixed and other end is free. Taking the factor of safety as 3, calculate the safe load using,

a. Rankine formula using yield stress 560 N/mm^2 and α= 1/600

b. Euler's formula, taking young's modulus for C.I E= 1.2 x 10^5 N/mm^2.

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SAPTHAGIRI COLLEGE OF ENGINEERING

INFORMATION SCIENCE AND ENGINEERING

Academic Year 2016-17

Question Bank

Sem: VI **Subject:** Computer Networks II **Sub Code:** 10CS64

Unit-1 Packet switching Networks

1. What are datagram and virtual circuits? Distinguish between them.
2. Explain and derive delays in datagram packet switching
3. Why is packet switching more suitable than message switching for interactive applications? Compare the delays in datagram packet switching and message switching.
4. Explain the Bellman ford algorithm.
5. Explain the concept of Flooding.
6. What are the types of switched networks? Explain each of them.
7. Explain connection-oriented and connection less services.
8. Explain the working mechanism of following devices used to connect LANs.
   a. Bridge b. Router
9. Explain the working of a LAN bridge. Clearly explain how a transparent bridges sets-up 'its' table entries.
10. Explain the "store and forward" packet switching used to send a packet from the source to the destination.

Unit-2 Packet switching Networks

11. Explain the Dijkstra's algorithm.
12. With a neat diagram explain leaky bucket algorithm
13. What is ATM? Explain the concept of ATM Switching.
14. Explain the FIFO and priority queue scheduling for managing traffic at packet level
15. Explain any four properties desirable in a routing algorithm
16. Explain how folding can be used as a routing algorithm. What are the problems associated with it? How can they be prevented?

17. Write short notes on.
    a. Need for ATM
    b. End-to-end delay
    c. Jitter
    d. Buffers
    e. Queue schedulling
18. Explain the leaky bucket technique for policing, with an appropriate diagram.
19. What is Traffic Management? Explain the concepts of traffic management at packet, flow and flow aggregate levels briefly.
20. What is Random Early Deduction.

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44. What are SNMP, SMI and MIB?
45. Describe briefly DES algorithm used for encryption
46. Write short notes on: 1) fire walls. 2) SSL
47. Explain Diffie Hillman key exchange algorithm with example.
48. Describe authentication using Kerberos
49. Justify how PGP is efficient in achieving E-mail security.
50. What are the components of network management and list their functions.
51. What are the desirable properties to secure communication? Explain briefly.
52. Write a note on DES
53. Define the terms and explain the following:
    a. Authentication
    b. Digital Signature
    c. RSA algorithm
    d. Fire wall
54. Explain security and administration of SNMPV3.
55. Write short notes on:
    a. IMAP
    b. RTP
56. What is DES? How does it work? Explain.
57. Briefly describe the encryption model for a symmetric key cipher.
58. Write short notes on:
    a. SNMP protocol
    b. Management information base.
    c. H.323 architecture for internet telephony
    d. Firewalls.
59. Define the following terms:
    a. Confidentiality
    b. Authenticity
    c. Integrity
    d. Non repudiations
    e. Cryptanalysis and
    f. Intruder
60. Name and explain the different steps of a public key cryptographic system that can be used to encrypt and decrypt symmetric keys?
61. Consider a group of ten people where every person in the group needs to communicate with every person in the group needs to communicate with every other person in another group of ten people.
    a. How many secret keys are needed considering?
        i. Symmetric key cryptography?
        ii. Asymmetric key cryptography?
    b. What are the values for the above cases, if every person in a group of ten people needs to communicate with every other person in the group?
62. Explain with an appropriate example, an asymmetric key cryptographic system that can provide one time session key to the end users and discuss about its demerits?

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88. Design a Huffman encoder for a source generating {a0,a1,a2,a3,a4,a5,a6} corresponding probabilities {0.55, 0.10, 0.05, 0.14, 0.06, 0.08, 0.02}
89. What is RTSP? How is it used in multimedia network applications?
90. Explain the three broad classes of multimedia applications
91. What are the hurdles for multimedia?
92. Explain the types of redundancy in video compression
93. What are the differences between H.261 and H.263
94. Explain the three limitations of the best effort service
95. With suitable example explain RTSP messages exchanged between media player and server
96. Explain multimedia file format
97. Explain the JPEG technique for compressing continuous tone still pictures.

Unit-8 Ad-hoc Networks

99. Explain the following
    a. CGSR of Ad-hoc networks
    b. Types of attack in Ad-hoc networks.
100. Briefly explain direct and multi hop routing of intracluster routing protocol with the help of relevant diagram.
101. Write a short note on Zigbee technology.
102. With an example, explain the dynamic source routing protocol.
103. List the security issues in ad-hoc networks. Explain types of attacks.
104. What are Ad-hoc networks? Mention their application types and unique features
105. Explain the structure of a typical sensor node.
105. What are the advantages of the DEEP clustering protocol?

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Assignment 1: Linear Integrated Circuits (17EC45)

1. Explain the practical op-amp circuit with a neat diagram. Also explain the concept of inverting and non-inverting input with a suitable example.

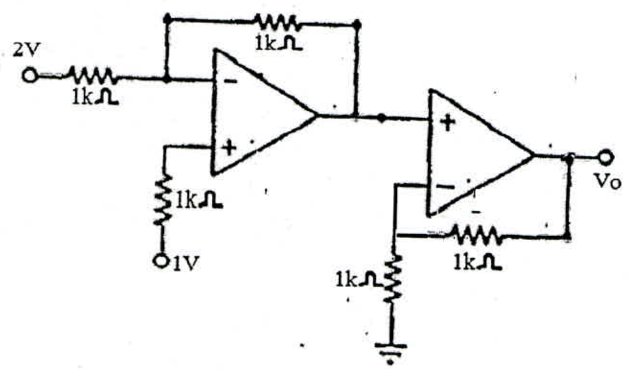
2. Define the following op-amp parameters and write their practical value for 741 op-amp.

(a) CMRR (b) Slew rate (c) Offset voltages (d) PSRR (e) Input bias current

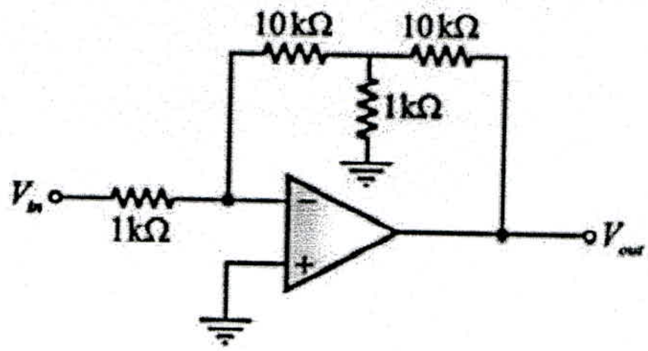
3. For a differential amplifier, show that $V_{O(cm)} = \frac{V_{i(cm)}}{CMRR} \times A_V$ where A_V is the gain of the amplifier.

4. Mention the ideal characteristics of an ideal op-amp.

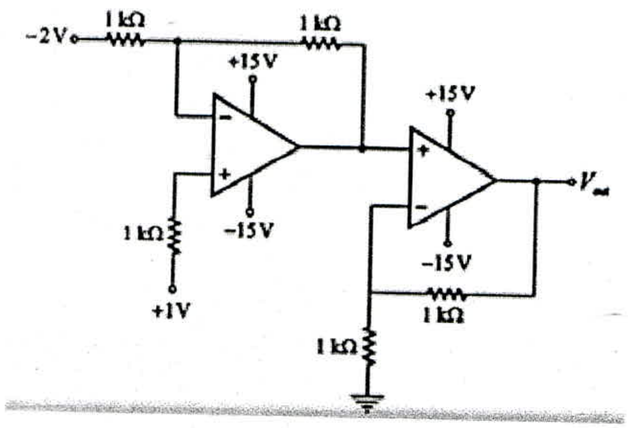
5. What is the output voltage of the op-amp circuit?



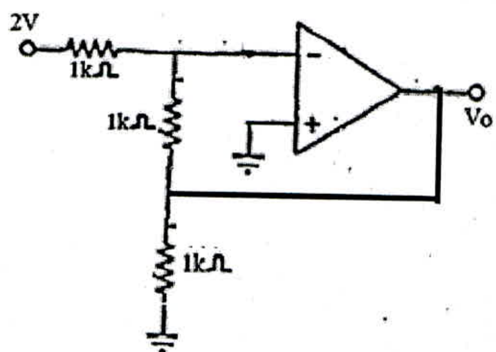
6. What is the gain of the op-amp configuration?



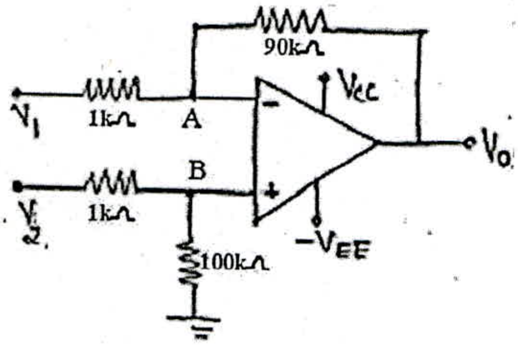
7. Determine the output voltage of the op-amp circuit



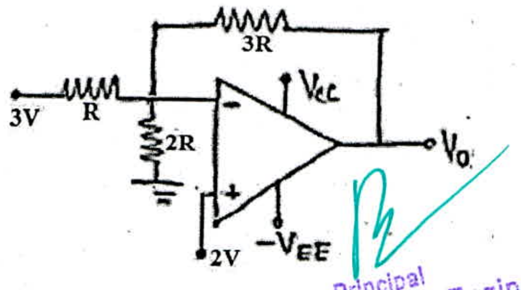
8. What is the gain of the circuit shown below.



9. Calculate the CMRR of the differential amplifier shown below.



10. Calculate the output voltage of the circuit shown below.



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Electronics & Communication Engineering Department

Linear Integrated Circuits (17EC45) = IV Semester ECE

Assignment Questions

1. List and briefly explain the characteristics of three terminal regulators.
2. Explain the important performance parameters for IC regulators
3. Draw the internal schematic for 723 IC low voltage regulator and explain its working and mention the advantages of IC regulators.
4. Explain the working of a series voltage regulator, with current limit protection.
5. Draw the block diagram representation explain the operating principle of PLL. Also define (i) Lock-in range (ii) Pull in time (iii) Capture range
6. Explain with a neat diagrams and waveforms 566 Voltage Controlled Oscillator.
7. With a neat sketch, explain the working of R-2R ladder DAC
8. With the help of a neat diagram explain the working of Successive Approximation type ADC.
9. Draw and explain the functional diagram of 555 timer.
10. Explain with a neat diagrams and waveforms the 555 timer as Monostable multivibrator.
11. Explain with a neat diagrams and waveforms the 555 timer as Astable multivibrator.

Submit on or before - 25/04/2019

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LIC (17EC45) - Assignment Questions

1. With a neat circuit diagram, explain the working of instrumentation amplifier. Also list the requirements of a good instrumentation amplifier.

2. Explain the working precision full wave rectifier using half wave rectifier and summing circuit.

3. With a neat circuit diagram explain the precision clamping circuit using op-amp with necessary waveforms.

4. Explain the working of (i) Precision rectifier type peak detector (ii) Voltage follower peak detector

5. Draw an op-amp sample and hold circuit. Sketch the signal, control and output voltage waveforms and explain the operation of the circuit.

6. Draw the circuit diagram of a RC phase shift oscillator using an op-amp. Sketch the output and feedback voltage waveforms and explain the circuit operation

7. Explain the working of Wien bridge oscillator with the help of circuit diagram, waveforms and equations.

8. With a neat circuit diagram, explain how op-amp can be used as differentiator. Discus its performance.

9. With a neat circuit diagram, explain how op-amp can be used as Integrator. Derive the necessary equations.

10. What is a ZCD? Explain the working of capacitor coupled ZCD with necessary equations.

11. With a neat circuit diagram, explain the operation of inverting Schmitt trigger circuit, draw the output waveforms and discuss the design procedure.

12. Explain how op-amp can be used as (i) logarithmic amplifier (ii) anti-log amplifier.

Date of submission: On or before 20/05/2019

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Question Bank

Module 1

1. Explain the working of practical op-amp circuit

2. Mention the important characteristics of an ideal op-amp

3. Define the following terms as applied to an operational amplifier and mention their typical values for IC 741(a) CMRR (b) PSRR (c) Slew rate (d) Output Impedance (e) Input offset voltage (f) Offset currents

4. Explain common mode voltage, common mode voltage gain and common mode rejection ratio for an op-amp. Show that $V_{o(cm)} = \frac{V_{i(cm)}}{CMRR} \times A_v$

5. With a neat circuit diagram, explain the operation of a direct coupled inverting amplifier with necessary design steps.

6. Sketch the circuit of a two input inverting summing amplifier. Explain the operation of the circuit and derive the equation for the output voltage.

7, With a neat circuit diagram explain direct coupled non inv amplifier with necessary design steps.

8. Sketch an op-amp difference amplifier circuit. Discuss the working and common mode nulling capability with necessary circuit modifications and equations.

Module 2

9. Explain the operation of a high input impedance capacitor coupled voltage follower, with a neat circuit diagram. Obtain the expression for input impedance of the circuit

10. Explain the operation of a high input impedance Capacitor coupled non inverting amplifier with a neat circuit diagram.

11. Sketch the circuit of three op-amp Instrumentation amplifier and show that $V_0 = \left|\frac{R_2}{R_1}\right|\left|1 + \frac{2R_f}{R_G}\right|[V_2 - V_1]$. Also list the requirements of a good instrumentation amplifier.

12. Explain the working precision full wave rectifier using half wave rectifier and summing circuit.

Module 3

13. With a neat circuit diagram explain the working of inverting Schmitt trigger.

14. Working / design of RC phase shift or Wien bridge oscillator

15. Circuit diagram and working of Sample and hold circuit.

16. Working of voltage follower peak detector

17. Theory and working of ZCD or problem on ZCD

18 Explain the working of Logarithmic amplifier using op-amp

Module 4

19 Working of either lowpass of highpass first order Active filter using op-amp

20. Design / problem on II order LPF or HPF

21. Working of single stage I order bandpass filter using op-amp

22. Performance parameters or characteristics of IC regulators

23. Functional diagram 723 IC regulator

24. Current Limiting circuit for IC regulators

Module 5

25. Functional block diagram of PLL and definitions of lock in range, capture range

26. Working successive approximation ADC with diagram

27.. Working of 3 bit DAC with necessary equations

28. Functional block diagram of 555 timer.

29. Working of Astable / monostable multivibrator with necessary circuit diagram and relevant equations

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Department of Electronics and Communication

Assignment –I

Subject: Engineering Electromagnetics (17EC36)

Semester/Section: III / A &B **Max Marks: 10** **Submission date: 18/09/2018**

1a) State and explain Coulomb's law in vector form. Also obtain an expression for total force on a point charge due to several charges

1b) Point charges of 50nC each are located at A(1, 0, 0), B(-1, 0, 0), C(0, 1, 0), and D(0, -1, 0) in free space. Find the total force on the charge at A

2a) Define the following (i) Electric field intensity (ii) Electric flux density

2b) Obtain the expression for electric field intensity at any point due to an infinite line charge ρ_L C/m.

2(c) A uniform volume charge density of 0.2 $\mu C/m^3$ is present throughout the spherical shell extending from r = 3 cm to r = 5 cm. If $\rho_v = 0$ elsewhere: Find the total charge present throughout the shell

3a) State and explain Gauss's law.

3b) Derive an expression for the Electric field intensity due to a uniformly charged infinite plane sheet using Gauss's law.

3(c) Calculate the divergence of D at point P(–2, 3,5) given $\mathbf{D} = \frac{1}{z^2}\left[10xyz\,\mathbf{a_x} + 5x^2z\,\mathbf{a_y} + (2z^3 - 5x^2y)\mathbf{a_z}\right]$

4a) State and prove Divergence theorem. What is its significance? (5 + 7)

4b) Given the vector field in cylindrical co-ordinates as $\mathbf{A}(r, \emptyset, z) = 30\,e^{-r}\,\vec{a}_r - 2z\,\vec{a}_z$ V/m; verify the Divergence theorem for the volume enclosed by r =2 and z = 5.

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Department of Electronics and Communication

Assignment –II

Subject: Engineering Electromagnetics (17EC36)

Semester/Section: III / A &B **Max Marks: 10** **Submission date: 27/10/2018**

1a) Define electric potential and derive the expression for the potential due to a point charge.

1b) Obtain the continuity equation of current and what is its significance?

1c) Determine the work done in carrying a $2\mu C$ charge from (2, 1, −1) to (8, 2, −1) in the electric field $\mathbf{E} = y\,\mathbf{a}_x + x\,\mathbf{a}_y$ along the parabola $x = 2y^2$

2a) Obtain Laplace's and Poisson's equations. Write the expression of $\nabla^2 V$ in all co-ordinates.

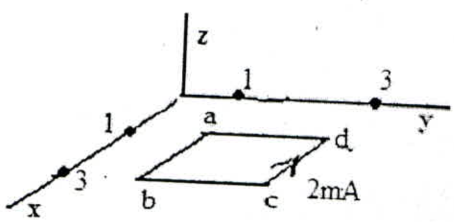
(b) State and explain Uniqueness theorem.

(c) Given the potential field $V = (Ar^4 + Br^{-4})\sin 4\phi$ (a) show that $\nabla^2 V = 0$ (b) Select A and B such that V=100V and $|E| = 500$V/m at P(r =1, $\Phi = 22.5^\circ$, z = 2)

3a) Derive the expression for the capacitance of a coaxial cable using Laplace's equation.

3b) State and explain Lorentz force equation and mention its applications.

3(c) In a certain region of space $\mathbf{B} = \frac{3}{x}\,\vec{a}_z\,\mu T$, Find the force exerted on a rectangular current loop in z = 0 plane bounded by x =1 and x = 3; y =1 and y = 3 carrying a current of 2 mA.



4a) Derive the expression for the force exerted between two differential current elements?

4b) Conducting spherical shells with radii a = 10 cm and b = 30 cm are maintained at a potential difference of 100V such that V(r=b) = 0 and V(r=a) = 100V. Determine V and E in the region between the shells. If $\varepsilon_r = 2.5$ in the region, determine the total charge induced on the shells and capacitance of the capacitor

4c) Find the force per meter length between two parallel long conductors separated by 10cm in air carrying a current of 100 A in the same direction. Comment on the nature of the force.

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Department of Electronics and Communication

Assignment –III

Subject: Engineering Electromagnetics (17EC36) **Semester/Section: III / A &B**

1(a) Obtain magnetic boundary conditions at the interface between two different magnetic materials.

1(b) Explain Lorentz force equation and mention few of its applications.

2(a) Derive an expression for Magnetic force exerted on a magnetic material.

2(b) Derive an expression for the force between two differential current elements.

3(a) Obtain Maxwell equation from Faraday's law

3(b) Write Maxwell's equations for time varying fields in both point form and integral form.

4(a) What is displacement current? Show that in a capacitor, the conduction current density and displacement current density are equal.

4(b) Derive Maxwell's equation from Ampere's law.

5(a) Find the magnetic field intensity inside the magnetic material for the following conditions (i) $\mathbf{M} = 100$ A/m, $\mu = 15\mu$H/m (ii) $\mathbf{B} = 300\mu$T, $\chi_m = 15$ (iii) There are 8.28×10^{20} atoms/m^3, each atom has a dipole moment of 5×10^{-27} A m^2 and $\mu_r = 30$.

5(b) Determine the value of K so that the following equations satisfies the Maxwell's equations in source free region (i) $\mathbf{E} = (Kx - 100t)\ \mathbf{a}_y$; $\mathbf{H} = (x + 20t)\ \mathbf{a}_z$ (ii) $\mathbf{D} = (5x\ \mathbf{a}_x - 2y\ \mathbf{a}_y + Kz\ \mathbf{a}_z)$; $\mathbf{B} = 2y\ \mathbf{a}_y$

6(a) The point charge Q = 18nC has a velocity 5×10^6 m/s in the direction $a_v = 0.6a_x + 0.75a_y + 0.3a_z$ Calculate the magnitude of the force exerted on the charge by the field when both B & E acting together. Given $\mathbf{B} = 3\mathbf{a}_x - 4\mathbf{a}_y + 6\mathbf{a}_z$ mT and $E = [-3\mathbf{a}_x + 4\mathbf{a}_y + 6\mathbf{a}_z] \times 10^3$ V/m

6(b) Wet Marshy soil is characterized by $\sigma = 10^{-1}$ S/m, $\varepsilon_r = 15$ and $\mu_r = 1$. At frequencies of 6kHz, 1MHz, 10MHz, 1GHz and 10 GHz indicate whether the soil is considered a conductor or a dielectric.

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Dear students, kindly look into the following theory questions while preparing for the exams

Module1

1. State and explain coulomb's law in vector form. Explain how force due to many charges can be calculated.
2. Define electric field intensity and derive an expression for the electric field intensity due to infinite line charge.
3. Define electric field intensity, electric flux and electric flux density. Derive the relationship between electric field intensity and electric flux density.

Module 2

1. **State and explain Gauss's law and comment on the nature of Gaussian surface.**
2. Derive an expression for the electric field intensity due to infinite surface charge using gauss's law
3. Define divergence and give examples.
4. Obtain Maxwell's first equation (State and explain Gauss's law in point form)
5. **State and explain divergence theorem**
6. Define the term potential and derive an expression for the potential due to a point charge.

8. Derive the relationship between electric field and electric potential (Show that $E = -\nabla V$)
9. Obtain continuity equation of current.

Module 3

1, Obtain Laplace's and Poisson's equations from Gauss's law (with usual notations, deduce Laplace's and Poisson's equations from Maxwell's first equation)

2. **State and explain uniqueness theorem**
3. Derive the expression for the capacitance of (i) parallel plate capacitor (ii) Coaxial cable (iii) Spherical capacitor
4. **State and explain Biot-Savart's law in vector form**

5.State and explain Ampere's law (Prove that the line integral of magnetic field intensity H around a closed path is exactly equal to the current enclosed by that path)

6 State and explain stokes theorem

7. **Compare scalar and vector magnetic potentials**

8 obtain an expression for vector magnetic potential

Module 4

1. Derive Lorentz force equation and mention its applications

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2. Derive the expression for the force on a differential current element and deduce the total force (dF = idl ×B and F = BIL sinθ)

3. Derive an expression for the force between tow differential current elements.

4. Discuss magnetic boundary conditions at the interface between tow different materials

5. Write short notes on magnetic circuit and expression for reluctance.

Module 5

1.State and explain Faraday's law in point and integral form or Show that

2. Derive Ampere's law in both forms suitable to time varying fields or Show that

3. What is loss tangent and what is its significance?

4. Show that conduction and displacement currents are equivalent in a capacitor

5. Show that conduction and displacement current are in quadrature (conduction and displacement currents are phase shifted by 90°)

6. Write Maxwell's in both point and integral form for time varying fields

7. Obtain the expression for wave equation interms of E and H

8. Obtain the solution to wave equation for a free space

9 Obtain the expression for intrinsic impedance and show that the intrinsic impedance of free space is 377 Ω

10. Write short notes on skin effect and skin depth

11. State and explain Poynting theorem.

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Engineering Electromagnetics – 17EC36

Assignment 3

1. Starting from Maxwell's equation, derive the wave equation interms of E and H for a general medium. Also deduce the Helmholtz equation for free space.

2. Obtain the solution of wave equation for a uniform plane wave in free space.

3. Derive an expression for the intrinsic impedance for a general medium and show its value for free space as 377 Ω.

4. Explain Skin effect in conductors and define skin depth.

5. State and explain Poynting theorem.

- Submission date : on or before : 03/012/2018

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SAPTHAGIRI COLLEGE OF ENGINEERING-Bangalore 560057

Department of Electronics and Communication

Assignment –III

Subject: Engineering Electromagnetics (17EC36) **Semester/Section: III / A &B**

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MICROPROCESSORS QUESTION BANK FOR MODULE 1 AND MODULE 2 (For Slow Learners)

1. Give a brief historical background on microprocessors. (Reference 1)
2. Explain the CPU architecture of 8086. (1.2 of Text)
3. Briefly discuss about register organisation of 8086. (1.1 of Text)
4. Discuss about 8086 flags (PSW – Program Status Word) register. (1.2.2 of Text)
5. Explain the importance of memory segmentation. (1.2.1 of Text)
6. What are the main advantages of the segmented memory. (1.2.1 of Text)
7. Discuss about non-overlapping segments and overlapping segments. (1.2.1 of Text)
8. What is addressing mode? Mention the types of addressing modes and briefly explain each one. (2.2 of Text)
9. Identify the addressing modes of the following instructions:
   ADC AX,[SI] MOV BL,[5000] MOV DX, 2500H[BX+SI] SBB CX,5
   MOV [BX+SI+6],BL MOV BX,[BP+50]
10. Indicate the addressing modes of the destinations operand and calculate its physical address for the following instructions:
    (i) MOV WORDPRR[BX+DI+3456H], 8ACDH
    (ii) ADC [BP + 200H],AX

    Assume DS=4567H, SS=4000H, BX=5000H, DI=CDEFH, BP = 69B0H, SP = 64A0H
11. If CS=5000H, DS=75A0H, SS=9210H, ES=A890H, BX=70A5H, BP=3575H, find the physical address of the source data for the following instructions:
    MOV DL,[BX+5000H] SUB CH,[BP+7] CMP AX,[1000H]
12. If DS = CBA0H, CS=4000H, SI=4567H and IP=2055H, what is the address of the instruction that is fetched and what is the address of the data?

    OR

    Explain the physical address formation of 8086.
13. Identify the error in the following instructions and make the corrections.
    MOV DS,1234H MOV ES,DS SUB [5000H],[9000H]
14. Explain the significance of following pins of 8086: (1.3 of Text)
    (i) ALE (ii) $\overline{\text{BHE}}$ (iii) $\overline{\text{TEST}}$ (iv) M/$\overline{\text{IO}}$ (v) RESET (vi) READY

    OR

    (i) $\overline{\text{LOCK}}$ (ii) HOLD (iii) HLDA (iv) DT/$\overline{\text{R}}$ (v) $\overline{\text{DEN}}$ (vi) INTR (vii) NMI
15. Explain various machine language instruction formats used in 8086 with examples.

    OR

    Discuss about six general formats of instructions in 8086 instructions set. (2.1 of Text)

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16. The opcode of MOV instructions is 100010. Determine the machine language code for the following instructions: i) MOV AL,[BX] ii) MOV 56[SI],CL iii) MOV AL,BL (3.2 of Text)

17. Write down the instructions formats for the following two types of cases of 8086 and form the opcode for the indicated instruction: (i) Register to Register ; ADD AX,BX (ii) Immediate to register ; ADD AX,1200H. (3.2 of Text)

18. Construct the machine code for following instructions:

i) MOV BL,CL   ii) MOV DX,AX

OR

i) MOV BX,5000H   ii) MOV [SI],DL

OR

i) MOV SI[BP],5   ii) MOV 20H[BX+SI],CX

OR

i) MOV BP[SI+500H],7293H   ii) MOV BX,[SI]

OR

i) ADD AX,BX   ii) ADD AX,5000H   (3.2 of Text)

19. Explain the following instructions (Data transfer and Arithmetic) with examples: (2.3.1 and 2.3.3 of Text)

i) PUSH   ii) POP   iii) XCHG   iv) XLAT

OR

i) IN   ii) OUT   iii) LDS/LES   iv) SAHF

OR

i) LEA   ii) LAHF   iii) PUSHF   iv) POPF

OR

i) SBB   ii) CMP   iii) DAA   iv) DAS

OR

i) AAA   ii) AAS   iii) AAM   iv) AAD ➡ (ASCII Instructions)

OR

i) MUL   ii) IMUL   iii) DIV   iv) IDIV

OR

i) CBW   ii) CWD   iii) NEG   iv) DEC

20. Explain the following instructions (Control / Branch) with examples: (2.3.6 and 2.3.7 of Text)

i) JMP   ii) CALL   ii) INT N   iv) RET   v) IRET

OR

i) LOOP   ii) INTO   iii) JNZ/JNE   iv) JNGE   v) JO

OR

i) JNLE/JE   ii) JL/JNGE   iii) LOOPNZ   iv) LOOPE   v) JS

OR

Discuss about unconditional jump instructions with examples.

OR

Discuss about conditional jump instructions with examples.

21. Develop an assembly level language program to add two 16-digit packed BCD numbers.

22. Develop an ALP to multiply two 16-bit packed BCD numbers.

23. Write a program sequence that will reverse the contents of the 4 bytes LIST through LIST+3.

24. Write an ALP to convert an ASCII coded decimal number to its binary equivalent.

25. Write 8086 program to find the smallest number out of N 16 bit unsigned numbers stored in the memory block starting with the address 2000h. Store the result at word location 3000H.

(Hint: Use an assembler directive ORG two times i.e ORG 2000H then ORG 3000H and in logicYou can use JB/JA since its an unsigned number, if its an signed number then you have to use JL/JG in the program).

27. Discuss about following instructions (Logical Instructions) with examples. (2.3.3 of Text)
AND, OR, NOTXOR, TEST, SHL/SAL, SHR, SAR, ROR, ROL, RCR, RCL.

28. Write a short note on string instructions. (2.3.4 of Text)

OR

Explain the following instructions (String Instructions) with examples: (2.3.4 of Text)
MOVSB/MOVSW, CMPSB/CMPSW, SCASB/SCASW,
LODSB/LODSW, STOSB/STOSW, REP Prefix.

29. How the following instructions are differed from each other.
i) AND & TEST ii) MOV & MOVS iii) CMP & CMPS iv) JA & JG

30. Briefly discuss about the following Flag manipulation instructions with examples:
CLC, CMC, STC, CLD, STD, CLI, STI. (2.3.8 of Text)

31. Explain the following Processor control instructions. (2.3.8 of Text)
WAIT, HLT, NOP, ESC, LOCK.

32. What are assembler directives and operators? Discuss about following assembler directives and operators with examples: DB, DW, DQ, DT, ASSUME, END, SEGMENT, ENDS, ENDP, EQU, OFFSET, PROC, PTR, SHORT, NEAR, FAR, TYPE, LENGTH, NAME, LOCAL, GROUP, PUBLIC, EXTRN, GLOBAL, '+' and '-' operators.

For other ALPs refer 3.4 of Text's example programs.

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Assignment Question For Slow learners

1. Define the laws of thermodynamics

Define Gibbs free change for chemically reversible and electrochemical reaction.

2. What are galvanic cells and electrolytic cells?
3. Explain the following terms (i) Single electrode potential (ii) Std electrode potential, (iii) Reference electrode
4. What is single electrode potential? Derive the Nernst equation for single electrode potential.
5. How many minutes can a calculator works on mercury cell having a cell potential of 1.5V drawing 4×10^{-4} watt. The mass of mercuric oxide available is 3g and molecular mass of HgO is 225 g/mol.
6. Calculate the potential of the following cell $Zn/Zn^{2+}(0.013M)//Cu^{2+(}0.033M/Cu$ at 25^0C (E^0_{Zn} = -0.76V & E^0_{Cu} = 0.34V)
7. Write a note on types of single electrode with example
8. What are reference electrodes? Explain the construction & working of calomel reference electrode.
9. What are concentration cells? Explain the construction & working principle of concentration cell.
10. What are ion selective electrodes? Explain construction and working principle membrane electrode.
11. Explain the determine the pH of the solution by using glass electrode?

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Sapthagiri College of Engineering
Department of Electronics and Communication
Question Bank for Basic Electronics (18ELN14/24)

For Slow Learners.

Module – 1
Semiconductor Diodes and Applications

1. Explain the operation of PN junction diode under forward and reverse bias conditions with the help of V-I characteristics curve.
(Dec '18 – 7M, MQP '18 – 8M, Jun '18 – 8M, Dec '17 – 6M, Dec '16 – 6M, Jun '16 – 6M)

2. What is PN junction diode? With the help of circuit diagram, explain the V-I characteristics of a diode. ***(Jun '19 – 7M, Jun '17 – 6M)***

3. Draw and explain the V-I characteristics of a Si (Silicon) diode.
(Dec '18 – 5M, Dec '15 – 8M, Dec '14 – 5M)

4. Draw and explain the V-I characteristics of a Ge (Germanium) diode. ***(Jun '15 – 5M)***

5. Define following diode parameters: (i) Static resistance (ii) Dynamic resistance (iii) Knee voltage (iv) Forward voltage drop (v) Maximum forward current (vi) Reverse saturation current (vii) Reverse breakdown voltage (viii) Peak inverse voltage (PIV) (ix) Maximum power rating ***(Dec '16 – 5M, MQP '15 – 6M)***

6. What is semiconductor diode? Explain the different equivalent circuits of diode.
(Jun '19 – 6M)

7. Explain the (i) Ideal diode approximation (ii) Practical diode approximation (iii) Piecewise linear approximation of diode. ***(Jun '18 – 6M)***

8. What is a rectifier? ***(Dec '15)***

9. What is rectifier circuit? Explain the classification of the rectifier. ***(Jun '19)***

10. With a neat circuit diagram, explain the working of a half-wave rectifier along with relevant waveforms. ***(Jun '17 – 6M, Jun '15 – 7M, Dec '14 – 7M, MQP '15 – 6M)***

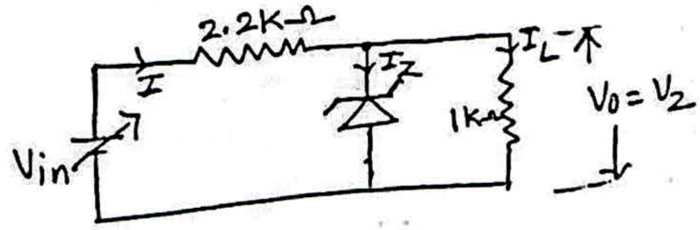
11. With a neat circuit diagram and waveforms, explain the working of half-wave rectifier and derive the expression for average load current. ***(MQP '18 – 8M)***

12. Derive the expressions for I_{dc}, V_{dc}, I_{rms}, V_{rms}, regulation, efficiency η_r, ripple factor γ and PIV of a half-wave rectifier. ***(Jun '19 – 8M)***

13. Show that the ripple factor of a half wave rectifier is 1.21 and maximum efficiency is 40.5%.
(Dec '18 – 6M, Dec '14)

14. With a neat circuit diagram, explain the working of a two diode (centre-tapped) full-wave rectifier along with relevant waveforms.
(Dec '18 – 7M, MQP '18 – 8M, Jun '18 – 5M, Dec '17, Jun '17 – 8M, Jun '16 – 6M, Dec '15 – 8M, Jun '15 – 10M, MQP '14 – 8M)

15. With a neat circuit diagram and waveforms, explain the working of centre-tapped full-wave rectifier. Show that efficiency of full-wave rectifier is 81%. ***(Dec '18 – 8M, Dec '17 – 10M)***



$V_Z = 6.1$ V, $I_{Zmin} = 2.5$ mA, $I_{Zmax} = 25$ mA, $r_Z = 0\ \Omega$. ***(Jun '16 – 4M)***

53. A Zener diode has a breakdown voltage of 10 V. It is supplied from a voltage source varying between 20 – 40 V in series with a resistance of 820 Ω. Using an ideal Zener model, obtain the minimum and maximum Zener currents. ***(MQP '18 – 6M)***

54. Design Zener voltage regulator for the following specifications:
Input Voltage = 10 V ± 20%, Output Voltage = 5 V, $I_L = 20$ mA, $I_{Zmin} = 5$ mA and $I_{Zmax} = 80$ mA. ***(MQP '14 – 5M)***

55. Design a Zener diode voltage regulator circuit to meet the following specifications:
$I_L = 20$ mA, $V_o = 5$ V, $P_Z = 500$ mW, $V_i = 12$ V ± 2 V and $I_{Zmin} = 8$ mA. ***(Jun '19 – 5M)***

56. Design the Zener regulator for the following specifications:
Output voltage = 5 V, Load current = 20 mA, Zener voltage $P_{Z(min)} = 500$ mW and Input voltage = 12 V ± 3 V. ***(Dec '18 – 5M)***

Special Diodes and 7805 Voltage Regulators

1. Write a note on photodiode and mention its applications.
2. Explain the working of photodiode. ***(Jun '19 – 5M)***
3. Write a short note on photodiode. ***(MQP '18 – 3M)***
4. Explain VI characteristics of photodiode and its operation. ***(Dec '18 – 4M)***
5. Explain the principle of operation of a light-emitting diode (LED) and mention its applications.
6. Write a short note on light-emitting diode. ***(MQP '18 – 4M)***
7. Write a short note on photocoupler. ***(MQP '18 – 4M)***
8. Explain the functional block diagram of 78XX series voltage regulator. ***(Jun '19 – 6M)***
9. Explain the operation of 7805 fixed IC voltage regulator. ***(MQP '18 – 6M)***
10. Explain the features of LM7805 fixed regulator. ***(MQP '18 – 6M)***

Module – 3

Operational Amplifiers and Applications

1. What is an op-amp? Mention the applications of op-amp.
(Jun '19, Jun '18, Dec '17, Dec '16, Dec '15, MQP '15, MQP '14)

2. Describe the characteristics of basic op-amp. List out its ideal characteristics.
(MQP '18 – 8M)

3. What is op-amp? List out the ideal and practical characteristics of op-amp.
(Dec '18 – 7M)

4. Explain the characteristics of an ideal op-amp.
(Jun '19 – 6M, Dec '18 – 5M, MQP '18 – 8M, Jun '18 – 5M, Dec '17 – 6M, Jun '17 – 4M, Dec '16 – 6M, Jun '16 – 7M, Dec '15 – 4M, Jun '15 – 6M, Dec '14 – 5M, MQP '15, MQP '14 – 6M)

5. Explain the internal block diagram of an operational amplifier. *(Dec '18 – 6M, Jun '16)*

6. With neat circuit diagrams, explain the different input modes of an op-amp.
(Dec '18 – 6M)

7. Explain the following terms related to op-amp: (i) Open loop voltage gain (ii) Common mode gain (iii) CMRR (iv) Maximum Output Voltage Swing (v) Input Offset Voltage (vi) Input Offset Current (vii) Input bias current (viii) Input impedance (ix) Output impedance (x) Slew rate (xi) PSRR/Supply voltage rejection ratio (xii) Virtual ground.
(Jun '19 – 8M, Dec '18 – 8M, MQP '18 – 10M, Jun '18 – 6M, Dec '17 – 5M, Jun '16 – 5M, Dec '15 – 6M)

8. Write a short note on virtual ground concept of an op-amp. *(Dec '17 – 6M)*

9. Explain the operation of an op-amp as an (i) Inverting amplifier (ii) Non inverting amplifier. Derive an expression for the output voltage and voltage gain.
(Dec '18 – 8M, Dec '17 – 4M, Jun '17 – 6M, Dec '16 – 6M, Jun '16 – 5M)

10. Draw the circuit of inverting op-amp. Derive the expression for the voltage gain.
(MQP '18 – 8M, Jun '18 – 7M, Dec '17 – 5M)

11. Explain the operation of an op-amp as a non-inverting amplifier with neat diagram and waveforms. Derive the expression for output voltage.
(Dec '18 – 6M, MQP '18 – 6M, Jun '18 – 4M)

12. With neat circuit and necessary equations, explain the voltage follower circuit using op-amp. Mention its important properties.
(Jun '19 – 4M, MQP '18 – 4M, Dec '17, Jun '17 – 6M, Dec '16 – 6M, Dec '15 – 4M, Jun '15 – 5M, MQP '15 – 6M, MQP '14)

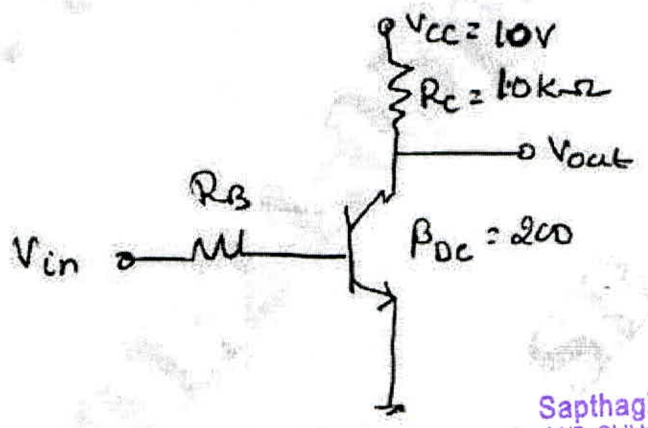
13. Explain how an op-amp can be used as (i) Inverting summer (ii) Non inverting summer.
(Dec '17, Jun '17, MQP '14)

Module – 4

BJT Applications

1. What is an amplifier? Explain the operation of transistor amplifier circuit. ***(MQP '18 –8M)***
2. With neat circuit diagram, explain how transistor is used as a voltage amplifier. Derive an equation for A_v. ***(Jun '19 – 6M, Dec '18 – 8M)***
3. Briefly explain how a transistor is used as an electronic switch. ***(MQP '18 – 6M)***
4. Explain the operation of BJT (transistor) as an amplifier and as a switch. ***(MQP '18 – 10M)***
5. With a neat circuit diagram, explain how transistor can be used to switch an LED ON/OFF and give the necessary equations. ***(Dec '18 – 8M)***
6. Determine the value of the collector resistor in an npn transistor amplifier with $\beta_{dc} = 250$, $V_{BB} = 2.5$ V, $V_{CC} = 9$ V, $V_{CE} = 4$ V and $R_B = 100$ kΩ.
7. In a transistor amplifier circuit, determine the voltage gain and the ac output voltage if $V_b = 100$ mV, $R_C = 1$ kΩ and $r'_e = 50$ Ω.
8. The transistor in common emitter configuration is shown in figure, with $R_C = 10$ kΩ and $\beta_{dc} = 200$. Determine

   (i) V_{CE} at $V_{in} = 0$ (ii) $I_{B(min)}$ to saturate the collector current (iii) $R_{B(max)}$ when $V_{in} = 5$ V. $V_{CE(sat)}$ can be neglected. ***(Dec '18 – 4M)***



Feedback Amplifiers

1. What is feedback amplifier? What are the properties of negative feedback amplifier? ***(Jun '19 – 6M)***
2. What is a feedback amplifier? Briefly explain different types of feedback amplifiers. ***(MQP '18 – 6M)***
3. Define feedback amplifier. With necessary diagram and equation explain the different types of feedback. ***(MQP '18 – 12M)***
4. List the advantages of negative feedback in an amplifier. Explain the voltage series feedback amplifier. Show that the gain bandwidth product for a feedback amplifier is constant. ***(MQP '18 – 10M)***

Module – 5

Digital Electronics Fundamentals

1. Compare analog and digital signal. ***(Dec '18 – 4M)***

2. What is Boolean algebra? State the laws of Boolean algebra.

3. State and prove DeMorgan's theorem.
(Dec '18 – 4M, Dec '17 – 5M, Jun '17 – 6M, Dec '16 – 5M, Jun '16 – 4M, Dec '15 – 6M, MQP '15 – 8M)

4. State and prove DeMorgan's theorem for 2 variables.
(Jun '18 – 4M, Dec '17 – 8M, Dec '15 – 4M)

5. State and prove DeMorgan's theorem for three variables. ***(Jun '15 – 6M, MQP '14 – 4M)***

6. State and prove DeMorgan's theorem for 4 variables. ***(Dec '18 – 8M)***

7. State DeMorgan's theorem for 4 variables and prove by the method of perfect induction.
(Dec '14 – 6M)

8. With the help of switching circuit, input/output waveforms and truth table, explain the operation of a NOT Gate. ***(MQP '14 – 5M)***

9. Write the logical symbol, truth table and Boolean expressions of all the logic gates: (AND, OR, NOT, NOR, NAND, EX-OR, EX-NOR). ***(Dec '18 – 9M)***

10. Explain the basic gates AND, OR and NOT gates with truth tables. ***(Jun '17 – 6M)***

11. Write the symbol and truth table of the following gates:
(i) AND (ii) NOR (iii) XOR (iv) NAND ***(Jun '19 – 7M)***

12. Write symbol and truth tables of AND, OR, EX-OR and NOT gates. ***(Jun '17 – 8M)***

13. With the help of a diode switching circuit and truth table, explain the operation of (i) OR gate (ii) AND gate.
(Dec '17 – 6M, Jun '16 – 8M, Dec '15 – 4M, Jun '15 – 6M, Dec '14 – 4M)

14. Explain the operation of (i) NOR gate (ii) NAND gate (iii) XOR gate (iv) XNOR gate.

15. Write the symbol, truth table and final expression for NAND and EX-OR gate (for two inputs).
(Jun '16 – 4M)

16. Design a logic circuit, symbol and truth table of exclusive – OR gate. ***(Dec '14 – 4M)***

17. Which are the universal gates? Realize basic gates using universal gates. ***(Dec '18 – 7M)***

18. What are universal gates? Realize AND and OR gates using universal gates.
(Dec '16 – 5M, Dec '15 – 2M, Jun '15 – 5M)

19. What is the speciality of NAND and NOR gates? Realize basic gates using (i) NAND gates only *(ii)* NOR gates only. ***(Jun '17 – 4M, Jun '16 – 5M, Dec '14 – 4M)***

20. Realize two input Ex-OR gate using only NAND gates.
(Dec '18 – 5M, Jun '18 – 5M, Dec '15 – 5M, MQP '14 – 5M)

21. Realize a two input exclusive NOR gate using only NAND gates, indicating the output at each