MADE EASY

India's Best Institute for IES, GATE & PSUs

ESE - 2016

Detailed Solutions of

ELECTRONICS ENGG.

PAPER-I

Corporate office: 44-A/1, Kalu Sarai, New Delhi-110016 | **Ph:** 011-45124612, 9958995830

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Director's Message

UPSC has introduced the sectional cutoffs of each paper and screening cut off in three objective papers (out of 600 marks). The conventional answer sheets of only those students will be evaluated who will qualify the screening cut offs.

In my opinion the General Ability Paper was easier than last year but Civil Engineering objective Paper-I and objective Paper-II both are little tougher/ lengthier. Hence the cut off may be less than last year. The objective papers of ME and EE branches are average but E&T papers are easier than last year.

Expected Minimum Qualifying Marks in Each OBJECTIVE Paper (out of 200 Marks)					
Category	GEN	OBC	SC	ST	PH
Percentage	15%	15%	15%	15%	10%
Marks	30	30	30	30	20

Expected Minimum Qualifying Marks in Each CONVENTIONAL Paper (out of 200 Marks)					
Category	GEN	OBC	SC	ST	PH
Percentage	15%	15%	15%	15%	10%
Marks	30	30	30	30	20

Expected Screening cut off out of 600 Marks (ESE 2016)				
Branch	GEN	OBC	SC	ST
CE	225	210	160	150
ME	280	260	220	200
EE	310	290	260	230
E&T	335	320	290	260

Note: These are expected screening cut offs for ESE 2016. MADE EASY does not take guarantee if any variation is found in actual cutoffs.

B. Singh (Ex. IES)
CMD , MADE EASY Group

MADE EASY team has tried to provide the best possible/closest answers, however if you find any discrepancy then contest your answer at **www.madeeasy.in** or write your query/doubts to MADE EASY at: ***info@madeeasy.in***

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Roadmap for ESE 2017 Prelims

Paper-I
General Studies & Engineering Aptitude

"MADE EASY offers well planned Classroom and Postal Study Course which is designed by senior and expert faculty members. MADE EASY announces exclusive batches for General Studies and Engineering Aptitude to cover the syllabus of Paper-I of Preliminary exam. The classes will be conducted by experienced faculties of MADE EASY focusing on new pattern of Engineering Services Examination, 2017. Latest and updated study material with effective presentation will be provided to score well in Paper-I."

Paper-I : General Studies & Engineering Aptitude

Course content

1. **Current Affairs:** Current National and International issues, bilateral issues, current economic affairs, Defence, Science and Technology, Current Government Schemes, Persons in news, Awards & honours, current environment & wildlife, current sports, books & authors etc. Watch Video
2. **Reasoning and Aptitude :** Algebra and Geometry, Reasoning and Data Interpretation, Arithmetic, coding and decoding, Venn diagram, number system, ratio & proportion, percentage, profit & loss, simple interest & compound interest, time & work, time & distance, blood relationship, direction sense test, permutation & combinations etc. Watch Video
3. **Engineering Mathematics :** Differential equations, complex functions, calculus, linear algebra, numerical methods, Laplace transforms, Fourier series, Linear partial differential equations, probability and statistics etc. Watch Video

4. **General Principles of Design, Drawing, Importance of Safety :** Engineering Drawing, Drawing instruments, drawing standard, geometric construction and curves, orthographic projections, methods of projection, profile planes side views, projection of points, projection of straight lines, positions of a straight line with respect to HP and VP, determining true length and true inclinations of a straight line, rotation methods, trace of a line, projection of planes, importance of safety etc. Watch Video

5. **Standards and quality practices in production, construction, maintenance and services:** ISO Standards, ISO-9000 Quality Management, ISO-14000 other, BIS Codes, ECBC, IS, TQM ME, TPM, PDCA, PDSA, Six Sigma, 5S System, 7 Quality Control Tools , ISHIKAWAS -7QC Tools, Kaizer Tools-3m, TQM : Most Importance, Deming's: 14 Principles, Lean Manufacturing ME, Quality Circles, Quality Control, Sampling. Watch Video

6. **Basics of Energy and Environment:** Renewable and non renewable energy resources, energy conservation, ecology, biodiversity, environmental degradation, environmental pollution, climate change, conventions on climate change, evidences of climate change, global warming, greenhouse gases, environmental laws for controlling pollution, ozone depletion, acid rain, biomagnification, carbon credit, benefits of EIA etc. Watch Video

7. **Basics of Project Management:** Project characteristics and types, Project appraisal and project cost estimations, project organization, project evaluation and post project evaluation, risk analysis, project financing and financial appraisal, project cost control etc. Watch Video

8. **Basics of Material Science and Engineering:** Introduction of material science, classification of materials, Chemical bonding, electronic materials, insulators, polar molecules, semi conductor materials, photo conductors, classification of magnetic materials, ceramics, polymers, ferrous and non ferrous metals, crystallography, cubic crystal structures, miller indices, crystal imperfections, hexagonal closed packing, dielectrics, hall effect, thermistors, plastics, thermoplastic materials, thermosetting materials, compounding materials, fracture, cast iron, wrought iron, steel, special alloys steels, aluminum, copper, titanium, tungsten etc. Watch Video

9. **Information and Communication Technologies :** Introduction to ICT, Components of ICT, Concept of System Software, Application of computer, origin and development of ICT, virtual classroom, digital libraries, multimedia systems, e-learning, e-governance, network topologies, ICT in networking, history and development of internet, electronic mail, GPS navigation system, smart classes, meaning of cloud computing, cloud computing architecture, need of ICT in education, national mission on education through ICT, EDUSAT (Education satellite), network configuration of EDUSAT, uses of EDUSAT, wireless transmission, fibre optic cable etc. Watch Video

10. **Ethics and values in engineering profession:** ethics for engineers, Ethical dilemma, elements of ethical dilemmas, indian ethics, ethics and sustainability, ethical theories, environmental ethics, human values, safety, risks, accidents, human progress, professional codes, responsibilities of engineers etc. Watch Video

Scroll down
For Answer Key of ESE-2016

Classroom Course : Paper -1

Course Details : General Studies and Engineering Aptitude Batches

Course Duration : Regular batches : 2 months | Weekend batches : 3 months

Teaching Hours : 250-300 hours

Timings : Regular batches : 6-7 days a week and 4 hours a day. | Weekend batches : 8 hours everyday on Sat & Sun.

Study material : Well designed comprehensive study material including theory & Practice questions prepared by experienced faculty members will be provided

Batch Commencement

	Batch	Commencement Date	Venue	Timing
Classroom Course	Regular Batch	23rd June, 2016	Saket / Lado Sarai (Delhi)	7:30 a.m. to 11:30 a.m.
	Weekend Batch	2nd July, 2016	Saket / Lado Sarai (Delhi)	8:00 a.m. to 6:00 p.m.
	Regular Batch	1st July, 2016	MADE EASY Hyderabad	Evening Batch

Note : General Studies and Engineering Aptitude Batches will be commenced at all MADE EASY centres.
For latest updates and information keep visit: www.madeeasy.in

Postal Course

Postal Study Course for GS & Engineering Aptitude Paper-I will be available after 15th-July-2016
Buy online at : www.madeeasy.in

Fee Structure

Non-MADE EASY Students	Ex. MADE EASY Students	
	Those students who were enrolled in Postal Study Course, Rank Improvement, Conventional, G.S., Post GATE batches	Those students who were enrolled in long term classroom programs
Rs. 18,500/-	Rs. 15,500/-	Rs.12,500/-

Newly added technical subjects for ESE-2017

Interested students may join subjectwise classes for newly added technical subjects for ESE-2017

CE	ME	EE	E&T
—	1. Mechatronics & Robotics 2. Renewable Source of Energy	1. Signals & Systems 2. Computer Fundamentals	1. Advanced Electronics 2. Basics of Electrical Engineering 3. Advanced Communication

Fee Structure

Non-MADE EASY Students	Ex. MADE EASY Students
Rs. 6,500/- per subject	Rs.4,500/- per subject

Scroll down
For Answer Key of ESE-2016

Paper-I (Electronics Engineering)

1. Which one of the following helps experimental confirmation of the Crystalline state of matter?

(a) Shock compression
(b) Photo emission
(c) Conductivity measurements
(d) X-ray diffraction

Ans. (d)

X-ray diffraction:

It is a rapid technique for analyzing wide range of materials. It can provide information about material phase or state and unit cell dimensions.

End of Solution

2. The electrical conductivity of pure semiconductor is

(a) Proportional to temperature
(b) Increases exponentially with temperature
(c) Decreases exponentially with temperature
(d) Not altered with temperature

Ans. (a)

End of Solution

3. Consider the following statements pertaining to the resistance of a conductor:

1. Resistance can be simply defined as the ratio of voltage across the conductor to the current through the conductor. This is, in fact, George Ohm's law.
2. Resistance is a function of voltage and current
3. Resistance is a function of conductor geometry and its conductivity.

Which of the above statements are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans. (c)

Resistance of conductor

→ can be defined by using Ohm's law according to which it is a ratio of voltage across conductor to the current through the conductor.

→ $R = \rho\frac{L}{A}$

where, R = Resistance
ρ = Resistivity of material
L = Length of conductor
A = Cross-sectional area of conductor

End of Solution

4. The ratio of ionic radii of Cations i.e. r_c and that of Anions i.e. r_A for stable and unstable ceramic crystal structure, is

(a) Less than unity
(b) Greater than unity
(c) Unity
(d) Either lesser or greater than unity

Ans. **(a)**

- Ceramics are generally inorganic materials that consist of metallic and non-metallic elements.
- Cations are usually metals which are positively charged and smaller in size.
- Anions are usually non-metals with negative charge and bigger size.
- $\frac{r_c}{r_a} = \frac{\text{Cation-radius}}{\text{Anion-radius}} < 1$ (most of the cases).

End of Solution

5. Which one of the following statements is correct?

(a) For insulators the band-gap is narrow as compared to semiconductors it is narrow
(b) For insulators the band-gap is relatively wide whereas for semiconductors it is narrow
(c) The band-gap is narrow in width for both the insulators and conductors
(d) The band-gap is equally wide for both conductors and semiconductors

Ans. **(b)**

$(\text{Band-gap})_{\text{insulator}} > (\text{Band gap})_{\text{semiconductor}} > (\text{Bandgap})_{\text{conductor}}$.

End of Solution

6. In an extrinsic semiconductor the conductivity significantly depends upon

(a) Majority charge carriers generated due to impurity doping
(b) Minority charge carriers generated due to thermal agitation
(c) Majority charge carriers generated due to thermal agitation
(d) Minority charge carriers generated due to impurity doping

Ans. **(a)**

σ = Majority carrier concentration × Magnitude of charge × Mobility

$\therefore$ Majority carrier concentration $\propto$ Doping concentration.

End of Solution

7. Necessary condition for photoelectric emission is

(a) $hv \geq e\phi$
(b) $hv \geq mc$
(c) $hv \geq e\phi^2$
(d) $hv \geq \frac{1}{2}mc$

Ans. **(a)**

End of Solution

8. In some substances when an electric field is applied the substance becomes polarized. The electrons and nucleii assume new geometrical positions and the mechanical dimensions are altered. This phenomenon is called
(a) Electrostriction (b) Hall-Effect
(c) Polarization (d) Magnetization

Ans. (a)
Electrostriction: Change in the dimension or production of strain in material with application of electric field is known as electrostriction.

End of Solution

9. In ferromagnetic materials, the net magnetic moment created due to magnetization by an applied field is :
(a) Normal to the applied field (b) Adds to the applied field
(c) In line with magneto motive force (d) Substracts from the applied field

Ans. (b)
In ferromagnetic material, the total magnetic flux density is summation of
- flux density due to applied field
- flux density due to magnetization

i.e. $B = \mu_0 H + \mu_0 M$

End of Solution

10. At what temperatures domains lose their ferromagnetic properties?
(a) Above ferromagnetic Curie temperature (b) Below paramagnetic Curie temperature
(c) Above 4° K (d) At room temperature

Ans. (a)
Above ferromagnetic curie temperature, ferromagnetism disappear and material enters into its paramagnetic state.

End of Solution

11. Which of the following materials does not have paramagnetic properties?
1. Rare earth elements (with incomplete shell)
2. Transition elements
3. Magnesium oxide

Select the correct answer from the codes given below:
(a) 1 only (b) 2 only
(c) 3 only (d) 1 and 2

Ans. (c)
Magnesium oxide is a non-magnetic material where as rare earth elements and transition elements are magnetic material.

End of Solution

Rank Improvement Batches

MADE EASY
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"MADE EASY offers rank improvement batches for ESE 2017 & GATE 2017. These batches are designed for repeater students who have already taken regular classroom coaching or prepared themselves and already attempted GATE/ESE Exams , but want to give next attempt for better result. The content of Rank Improvement Batch is designed to give exposure for solving different types of questions within fixed time frame. The selection of questions will be such that the Ex. MADE EASY students are best benefitted by new set of questions."

Features :

- Comprehensive problem solving sessions
- Smart techniques to solve problems
- Techniques to improve accuracy & speed
- Systematic & cyclic revision of all subjects
- Doubt clearing sessions
- Weekly class tests
- Interview Guidance

Syllabus Covered : Technical Syllabus of GATE-2017 & ESE-2017

Eligibility :

- Old students who have undergone classroom course from any centre of MADE EASY or any other Institute
- Top 6000 rank in GATE Exam
- Qualified in ESE written exam
- Qualified in any PSU written exam
- M. Tech from IIT/NIT/DTU with minimum 7.0 CGPA

Course Duration : Approximately 25 weeks (400 teaching hours)

Streams	Batch Type	Timing	Date	Venue
CE, ME	Weekend	Sat & Sun : 8:00 a.m to 5:00 p.m	2nd July, 2016	Saket (Delhi)
EC, EE	Weekend	Sat & Sun : 8:00 a.m to 5:00 p.m	2nd July, 2016	Lado Sarai (Delhi)
ME	Regular	8:00 a.m to 11:30 a.m (Mon-Fri)	4th July, 2016	Saket (Delhi)

Fee Structure

Batch	Non-MADE EASY Students	Ex. MADE EASY Students	
		Those students who were enrolled in Postal Study Course, Rank Improvement, Conventional, G.S, Post GATE batches	Those students who were enrolled in long term classroom programs only
Rank Improvement Batch	Rs. 26,500/-	Rs. 24,500/-	Rs. 22,500/-
Rank Improvement Batch + General Studies & Engineering Aptitude Batch	Rs. 41,500/-	Rs. 36,500/-	Rs. 31,500/-
Fee is inclusive of classes, study material and taxes			

Note:

1. These batches will be focusing on solving problems and doubt clearing sessions. Therefore if a student is weak in basic concepts & fundamentals then he/she is recommended to join regular classroom course.
2. Looking at the importance and requirements of repeater students, it is decided that the technical subjects which are newly added in ESE 2017 syllabus over ESE 2016 syllabus will be taught from basics and comprehensively .
3. The course fee is designed without Study Material/Books, General Studies and Online Test Series (OTS) . However those subjects of technical syllabus which are added in ESE-2017 will be supplemented by study material. Study Material/ Books will be provided only for the technical syllabus which are newly added in ESE-2017.

Rank Improvement Batches will be conducted at Delhi Centre only.

ADMISSIONS OPEN

Documents required : M.Tech marksheet, PSUs/IES Interview call letter, GATE score card, MADE EASY I-card • 2 photos + ID proof

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12. In a superconducting magnet, wires of superconducting material are embedded in the thick copper matrix, because while the material is in the superconducting state :
(a) The leakage current passes through copper part
(b) Copper part helps in conducting heat away from the superconductor
(c) Copper part helps in overcoming the mechanical stress
(d) Copper acts as an insulating cover for superconductor

Ans. (c)
Copper matrix helps in overcoming the mechanical stress when wire material is in superconducting state. When wire material enters to the normal state due to some accidental quarch than copper matrix takes over the job of wire material.

End of Solution

13. The crystal structure of some Ceramic materials may be thought of being composed of electrically charged Cations and Anions, instead of Atoms, and as such:
(a) The Cations are negatively charged, because they have given up their valence electrons to Anions which are positively charged.
(b) The Cations are positively charged, because they have given up their valence electrons to Anions which are negatively charged.
(c) The Cations are positively charged, because they have added one electron to their valence electrons borrowing from Anions which are negatively charged.
(d) The Cations are negatively charged, as they are non-metallic whereas Anions are positively charged being metallic.

Ans. (b)
Ceramics are generally in organic compounds that consists of cations and anions.
- Cations are usually, metals with positive charge.
- Anions are usually non-metals with negative charge.

End of Solution

14. Manganin alloy used for making resistors for laboratory instruments contains :
(a) Copper, Aluminium and Manganese
(b) Copper, Nickel and Manganese
(c) Aluminium, Nickel and Manganese
(d) Chromium, Nickel and Manganese

Ans. (b)
Manganin is an alloy of copper, Nickel and manganese.

End of Solution

15. A rolled-paper capacitor of value 0.02 μF is to be constructed using two strips of aluminium of width 6 cm, and, wax impregnated paper of thickness 0.06 mm whose relative permittivity is 3. The length of foil strips should be
(a) 0.3765 m (b) 0.4765 m
(c) 0.5765 m (d) 0.7765 m

Ans. (d)

$C = 0.02\ \mu F$
$w = 6\ cm$
$d = 0.06\ mm$
$\epsilon_r = 3$

$$C = \frac{\epsilon A}{d}$$

$$\Rightarrow \quad A = \frac{Cd}{\epsilon} = \frac{0.02\times10^{-6}\times0.06\times10^{-3}}{3\times8.854\times10^{-12}}$$

but $$A = L \times w = \frac{0.02\times10^{-6}\times0.06\times10^{-3}}{3\times8.854\times10^{-12}}$$

$$\Rightarrow \quad L \times 6 \times 10^{-2} = \frac{0.02\times10^{-6}\times0.06\times10^{-3}}{3\times8.854\times10^{-12}}$$

$$\Rightarrow \quad L = 0.7765\ m$$

End of Solution

16. A Ge sample at room temperature has intrinsic carrier concentration $n_i = 1.5 \times 10^{13}\ cm^{-3}$ and is uniformly doped with acceptor of $3\times10^{16}\ cm^{-3}$ and donor of $2.5\times10^{15}\ cm^{-3}$. Then, the minority charge carrier concentration is

(a) $0.918 \times 10^{10}\ cm^{-3}$ (b) $0.818 \times 10^{10}\ cm^{-3}$
(c) $0.918 \times 10^{12}\ cm^{-3}$ (d) $0.818 \times 10^{12}\ cm^{-3}$

Ans. (b)

P type compensated semiconductor

$$\text{Minority carrier concentration} = \frac{n_i^2}{N_A - N_D} = \frac{(1.5\times10^{13})^2}{(3\times10^{16} - 2.5\times10^{15})}$$

$$= \frac{(1.5\times10^{13})^2}{2.75\times10^{16}} = 0.81818\times10^{10}/cm^3$$

End of Solution

17. Assume that the values of mobility of holes and that of electrons in an intrinsic semiconductor are equal and the values of conductivity and intrinsic electron density are $2.32/\Omega m$ and $2.5 \times 10^{19}/m^3$ respectively. Then, the mobility of electron/hole is approximately

(a) $0.3\ m^2/Vs$ (b) $0.5\ m^2/Vs$
(c) $0.7\ m^2/Vs$ (d) $0.9\ m^2/Vs$

Ans. (a)

Since, $\mu_n = \mu_p \rightarrow \mu$

$\sigma_i = n_i q\,[2\mu]$

$$\mu = \frac{\sigma_i}{2qn_i} = \frac{2.32}{2(1.6\times10^{-19})(2.5\times10^{19})}$$

$\mu = 0.29\ m^2/V\ sec$

$\mu = \mu_n$ or μ_p

End of Solution

18. A silicon sample A is doped with 10^{18} atom/cm^3 of Boron and another silicon sample *B* of identical dimensions is doped with 10^{18} atom/cm^3 of Phosphorous. If the ratio of electron to hole mobility is 3, then the ratio of conductivity of the sample A to that of *B* is

(a) $\frac{3}{2}$ (b) $\frac{2}{3}$

(c) $\frac{1}{3}$ (d) $\frac{1}{2}$

Ans. (c)

$$\frac{\sigma_A}{\sigma_B} = \frac{\mu_p}{\mu_n} = \frac{1}{3}$$

End of Solution

19. The Hall-coefficient of a specimen of doped semiconductor is $3.06 \times 10^{-4}\ m^{-3}\ C^{-1}$ and the resistivity of the specimen is $6.93 \times 10^{-3}\ \Omega m$. The majority carrier mobility will be

(a) $0.014\ m^2\ V^{-1}s^{-1}$ (b) $0.024\ m^2\ V^{-1}s^{-1}$

(c) $0.034\ m^2\ V^{-1}s^{-1}$ (d) $0.044\ m^2\ V^{-1}s^{-1}$

Ans. (d)

$$\mu = \sigma R_H$$

$$\approx \frac{R_H}{\text{Resistivity}} = \frac{3.06\times10^{-4}}{6.93\times10^{-3}}$$

$\approx 0.044\ m^2/Vsec$

End of Solution

20. Doped silicon has Hall-coefficient of $3.68 \times 10^{-4}\ m^3C^{-1}$ and then its carrier concentration value is

(a) $2.0 \times 10^{22}\ m^{-3}$ (b) $2.0 \times 10^{-22}\ m^{-3}$

(c) $0.2 \times 10^{22}\ m^{-3}$ (d) $0.2 \times 10^{-22}\ m^{-3}$

Regular and Weekend Classroom Courses

for

ESE, GATE & PSUs 2017

(On revised syllabus of ESE-2017 & GATE-2017)

MADE EASY

India's Best Institute for IES, GATE & PSUs

Classroom Course is designed for comprehensive preparation of ESE, GATE & PSUs. The main feature of the course is that all the subjects are taught from basic level to advance level. There is due emphasis on solving objective and numerical questions in the class. High quality study material is provided during the classroom course with sufficient theory and practice test papers for objective and conventional questions alongwith regular assignments for practice. Classes are taken by highly experienced professors and ESE qualified toppers. MADE EASY team has developed very effective methodology of teaching and advance techniques and shortcuts to solve objective questions in limited time.

Course Features : • Timely coverage of technical & non-technical syllabus • Books & Reading References • Regular classroom tests followed by discussion • Doubt clearing sessions • GATE counseling session • Interview Guidance Program • All India ESE Classroom Test Series

Syllabus Covered : • All Technical Subjects alongwith 10 subjects of paper-I (as per revised syllabus of ESE 2017) • Engineering Mathematics • Reasoning & Aptitude

Books & Reading References : • Technical Subjects (Theory Book + Work Book) • Engineering Mathematics • Reasoning & Aptitude • Previous Years GATE Solved Papers • General English • Previous Years IES Solved Papers (Objective & Conventional)

Difference between Regular and Weekend Course :

In **Regular Course**, classes are conducted for 4 to 6 hours per day in a week for 8 to 9 months where as in **Weekend Courses** take 10 to 11 months for completion of syllabus as classes run nearly 8 to 9 hrs/day on every weekends and public holidays.

Streams Offered : CE, ME, EE, EC, CS, IN, PI

New Batches Commencing at Delhi Centres	
Regular Batches Schedule	**Weekend Batches Schedule**
CE : 30th May & 7th June, 2016	CE from 28th May'16
EE : 30th May & 5th June, 2016	ME from 28th May'16
EC : 30th May & 9th June, 2016	EC from 29th May'16
ME : 5th June, 2016	EE from 29th May'16
CS : 30th May, 2016	CS from 29th May'16
IN : 16th June, 2016	

Online Admissions Available

Visit : www.madeeasy.in

ADMISSIONS OPEN

at all MADE EASY centres,

To know more about upcoming batches, Fee Structure, timing & other details, visit : www.madeeasy.in

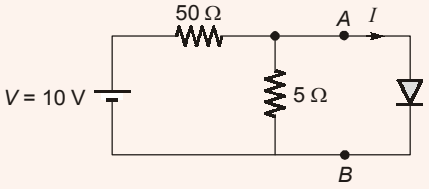
MADE EASY Centres	Delhi	Hyderabad	Noida	Jaipur	Bhopal	Lucknow	Indore	Bhubaneswar	Pune	Kolkata	Patna
	011-45124612 09958995830	040-24652324 09160002324	0120-6524612 08860378009	0141-4024612 09166811228	0755-4004612 08120035652	09919111168 08400029422	0731-4029612 07566669612	0674-6999888 09040999888	020-26058612 09168884343	033-68888880 08282888880	0612-2356615 0612-2356616

Ans. (a)

$$\text{Carrier concentration} = \frac{1}{q R_H} = \frac{1}{1.6\times10^{-19}\times3.6\times10^{-4}}$$
$$= 0.173611 \times 10^{23}/\text{m}^3 = 2 \times 10^{22}/\text{m}^3$$

End of Solution

21. What is the value of current I through the ideal diode in the circuit?



(a) 100 mA (b) 150 mA
(c) 200 mA (d) 250 mA

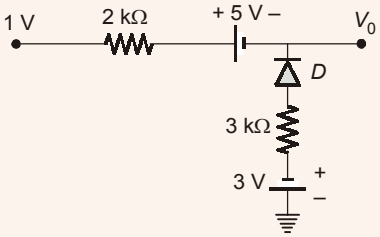
Ans. (c)

∵ Diode is in forward bias (short circuit)

$$I = \frac{10}{50} = 0.2\ \text{A} = 200\ \text{mA}$$

End of Solution

22. What is the output voltage V_0 for the circuit shown below assuming an ideal diode?



(a) $-\frac{18}{5}$ V (b) $\frac{18}{5}$ V

(c) $-\frac{13}{5}$ V (d) $\frac{13}{5}$ V

Ans. (a)

∵ Diode is forward bias (short circuit)

So by applying KVL

$3 + 3\text{k}\Omega I - 5 + 2\text{k}\Omega\, I + 1 = 0$

$$I = \frac{1}{5\,\text{k}\Omega} = \frac{1}{5}\ \text{mA}$$

$$\therefore \quad V_o = -3 - 3\times\frac{1}{5} = -\frac{18}{5}\ \text{V}$$

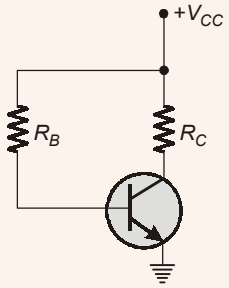
End of Solution

23. In a semiconductor diode, cut-in voltage is the voltage
(a) upto which the current is zero
(b) upto which the current is very small
(c) at which the current is 10% of the maximum rated current
(d) at which depletion layer is formed

Ans. **(b)**
It is a definition of cut-in voltage.

End of Solution

24. A transistor circuit is shown in the figure. Assume $\beta = 100$, $R_B = 200\ k\Omega$, $R_C = 1\ k\Omega$, $V_{CC} = 15\ V$, $V_{BE\ act} = 0.7\ V$, $V_{BE\ sat} = 0.8\ V$ and $V_{CE\ sat} = 0.2\ V$.



The transistor is operating in
(a) Saturation
(b) Cut-off
(c) Normal active
(d) Reverse active

Ans. **(c)**

$$I_{C\ sat} = \frac{V_{CC} - V_{CE\ sat}}{R_C} = \frac{14.8}{1k\Omega} = 14.8\ mA$$

$$I_B = \frac{V_{CC} - V_{BE\ sat}}{R_B} = \frac{14.2}{200\ k\Omega} = 0.071 mA$$

$$I_{B\ min} = \frac{I_{C\ sat}}{B} = \frac{14.8}{100} = 0.148\ mA$$

Since $I_B < I_{B\,min}$, BJT is operating is normal active mode.

End of Solution

25. The position of the intrinsic Fermi level of an undoped semiconductor (E_{Fi}) is given by

(a) $\frac{E_C - E_V}{2} + \frac{kT}{2} ln \frac{N_V}{N_C}$
(b) $\frac{E_C + E_V}{2} - \frac{kT}{2} ln \frac{N_V}{N_C}$
(c) $\frac{E_C + E_V}{2} + \frac{kT}{2} ln \frac{N_V}{N_C}$
(d) $\frac{E_C - E_V}{2} - \frac{kT}{2} ln \frac{N_V}{N_C}$

Ans. (c)

$$E_{FI} = \frac{E_C + E_V}{2} - \frac{kT}{2} In \frac{N_C}{NV} \quad \text{or} \quad = \frac{E_C + E_V}{2} + \frac{kT}{2} In \frac{N_V}{N_C}$$

End of Solution

26. The stability factor S in a bipolar junction transistor is

(a) $\frac{1+\beta}{1-\beta\left(\frac{dI_B}{dI_C}\right)}$

(b) $\left(\frac{1+\beta}{1-\beta}\right)\left[1-\left(\frac{dI_B}{dI_C}\right)\right]$

(c) $(1+\beta)\left[1-\beta\left(\frac{dI_B}{dI_C}\right)\right]$

(d) $\frac{\beta-1}{\left[1-\beta\left(\frac{dI_B}{dI_C}\right)\right]}$

Ans. (a)

$$S = \frac{1+\beta}{1-\beta\frac{\partial I_B}{\partial I_C}}$$

End of Solution

27. The leakage current in an NPN transistor is due to the flow of

(a) Holes from base to emitter
(b) Electrons from collector to base
(c) Holes from collector to base
(d) Minority carriers from emitter to collector

Ans. (c)

End of Solution

28. In Early effect

(a) Increase in magnitude of Collector voltage increases space charge width at the input junction of a BJT
(b) Increase in magnitude of Emitter-Base voltage increases space charge width of output junction of a BJT
(c) Increase in magnitude of Collector voltage increases space charge width of output junction of a BJT
(d) Decrease in magnitude of Emitter-Base voltage increases space charge width of output junction of a BJT

Ans. (c)

Output junction is *C-B* junction which is always *RB* and by increasing the magnitude of *RB* voltage depletion layer width at collector junction increases.

End of Solution

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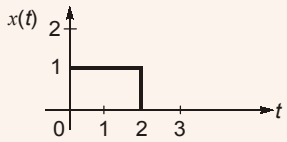
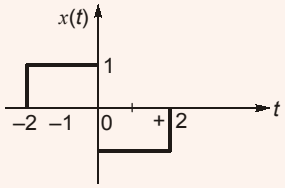
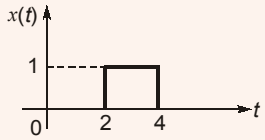
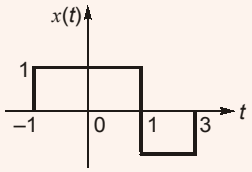
29. The signal $x(t) = u(t + 2) - 2u(t) + u(t - 2)$ is represented by

(a) 

(b) 

(c) 

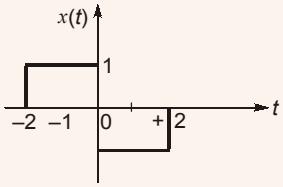
(d) 

Ans. (b)

Shifts represents instants where change in step will occur and coefficients represent the amount of step change at the shifts given to $u(t)$.

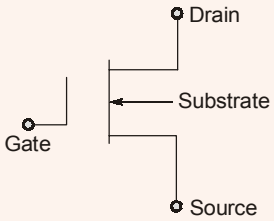
i.e. $u(t - (-2)) - 2u(t - 0) + u(t - 2)$

hence,



End of Solution

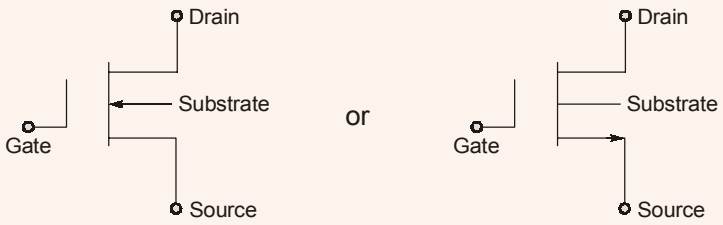
30. The figure shown represents



(a) n-channel MOSFET
(b) Enhanced-mode E-MOSFET
(c) p-Channel MOSFET
(d) J-FET

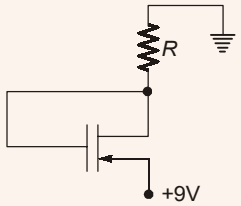
Ans. (a)

n-channel MOSFET



End of Solution

31. The PMOSFET circuit shown in the figure has $V_{TP} = -1.4$ V, $K_p' = 25\ \mu A/V^2$, $L = 2\ \mu m$, $\lambda = 0$. If $I_{DS} = -0.1$ mA and $V_{DS} = -2.4$ V then the width of channel W and R are respectively



(a) 16 μm and 66 kΩ
(b) 18 μm and 33 kΩ
(c) 16 μm and 33 kΩ
(d) 18 μm and 66 kΩ

Ans. (a)

Since G and D are short, MOSFET is in saturation.

Since $\gamma = 0$,

$$I_D = \frac{1}{2} K_N' \frac{\omega}{L} (V_{GS} - V_T)^2 \text{ and } V_{GS} = V_{DS} = -2.4 \text{ V}$$

$$-0.1 \times 10^{-3} = \frac{1}{2}(25 \times 10^{-6}) \frac{W}{2 \times 10^{-6}} [-2.4 - (-1.4)]^2$$

$$-0.1 \times 10^{-3} = \frac{25W}{4}(-1)^2 \qquad \text{Neglecting negative sign}$$

$$W = \frac{0.4 \times 10^{-3}}{25} = 16\ \mu m$$

Applying KVL to the circuit

$$0 = I_D R + V_{GS} + 9$$
$$0 = -0.1 \times 10^{-3} (R) - 2.4 + 9$$
$$R = 66\ k\Omega$$

End of Solution

32. Maximum energy of electrons liberated photoelectrically is
(a) Proportional to light intensity and independent of frequency of the light
(b) Independent of light intensity and , varies linearly with frequency of the light
(c) Proportional to both, light intensity and frequency of the light
(d) Independent of light intensity and inversely proportional to frequency of the light

Ans. (c)

End of Solution

33. The response of a Gaussian random process applied to a stable linear system is
1. A Gaussian random process
2. Not a Gaussian random process
3. Completely specified by its mean and auto-covariance functions

Which of the above statements is/are correct?
(a) 1 only
(b) 2 only
(c) 2 and 3
(d) 1 and 3

Ans. (d)

End of Solution

34. Consider a system, which computes the 'MEDIAN' of signal values in a window of size '*N*'. Such a discrete time system is

(a) Linear (b) Non-linear
(c) Sometimes linear (d) Sometimes non-linear

Ans. **(b)**

If F is function, then it is said to be linear if

$$F(A + B) = F(A) + F(B)$$

So now say there are two sets of numbers.

$$A = [2\ 5\ 9\ 6\ 3]$$
$$B = [1\ 0\ 4\ 7\ 4]$$
$$\text{mean}(A) = 5$$
$$\text{mean}(B) = 3.2$$
$$\text{mean}(A + B) = 8.2 = \text{mean}(A) + \text{mean}(B)$$

So you can see that mean is a linear operation and median is not. Now think in terms of signals or images and the same rule applies. In real life you will care about this in image processing only in some particularly.

End of Solution

35. Consider a discrete time system which satisfies the additivity property, i.e., if the output for $u_1[n]$ is $y_1[n]$ and that for $u_2[n]$ is $y_2[n]$, then output for $u_1[n] + u_2[n]$ is $y_1[n] + y_2[n]$. Such a system is

(a) Linear (b) Sometimes linear
(c) Non-linear (d) Sometimes non-linear

Ans. **(b, d)**

- Linearity is combination of homogeneity principle and additivity principle.
- When system verifies additivity principle it still need not necessarily verify homogeneity.
- Hence, system can be somtimes linear [when homogeneity principle is also verified] and sometimes non linear [when homogeneity principle is not verified].

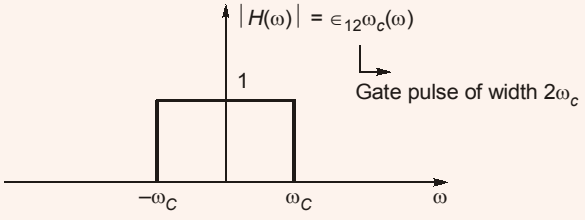
End of Solution

36. Consider an ideal low pass filter. Such a discrete-time system is

(a) always realizable physically (b) never realizable physically
(c) a non linear system (d) a linear, causal system

Ans. **(b)**

Ideal LPF magnitude response



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EE — 10 in Top 10

1 AIR — Anupam Samantaray

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2 AIR — Kumar Chitransh

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EC — 6 in Top 10

1 AIR — Agam Kumar Garg

AIR-2	AIR-3	AIR-5	AIR-6	AIR-10
				
K K Sri Nivas	Jayanta Kumar Deka	Amit Rawat	Pillai Muthuraj	Saurabh Chakraberty

IN — 9 in Top 10

1 AIR — Harshvardhan Sinha

AIR-2	AIR-3	AIR-4	AIR-7	AIR-8	AIR-8	AIR-10	AIR-10
							
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CS — 6 in Top 10

1 AIR — Ankita Jain

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PI — 5 in Top 10

1 AIR — Gaurav Sharma

AIR-4	AIR-7	AIR-8	AIR-8
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ME		CE		EE		EC		CS & PI		IN	
Top 20	Top 100	Top 20	Top 100	Top 20	Top 100	Top 20	Top 100	Top 20	Top 100	Top 20	Top 100
17 Selections	68 Selections	16 Selections	65 Selections	19 Selections	76 Selections	10 Selections	45 Selections	17 Selections	53 Selections	17 Selections	61 Selections

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$$H(\omega) = |H(\omega)|\, e^{j\angle H(\omega)}$$

$$\tau \cdot Sa\left(t \cdot \frac{T}{2}\right) \longleftrightarrow 2\pi \in_T(\omega)$$

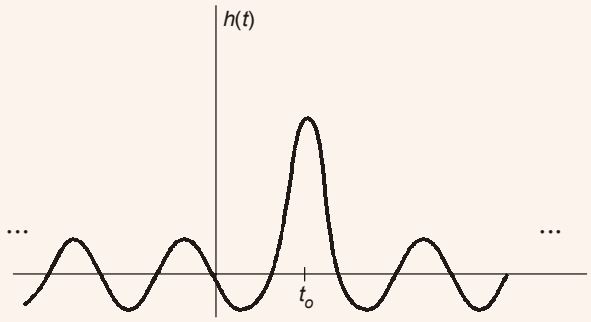
$[\angle H(\omega) \rightarrow (\text{linear}) = -\omega t_o$ for distortionless transmission$]$

$$\therefore \quad \frac{\omega_c}{\pi} S_a(\omega_c t) \longleftrightarrow G_2\omega_c(\omega)$$

$$H(\omega) = G_{2\omega_c}(\omega) e^{-j\omega t_o}$$

$$h(t) = \frac{\omega_c}{\pi} S_a(\omega_c(t - t_o))$$

And as $h(t) \neq 0$; $t < 0$, system is non-causal meaning never physically realizable.



End of Solution

37. The result of $h(2t) * \delta(t_o - 10)$ ("$*$" denotes convolution and "$\delta(\cdot)$" denotes the Dirac delta function) is

(a) $h(2t - 2t_0)$ (b) $h(2t_0 - 2t)$

(c) $h(-2t - 2t_0)$ (d) $h(2t + 2t_0)$

Ans. (a)

According to the convolution property

$$x(t) * \delta(t - t_o) = x(t - t_o)$$

Hence, $h(2t) * \delta(t - t_o) = h(2(t - t_o)) = h(2t - 2t_o)$

End of Solution

38. A ray of light incident on a glass slab (of refractive index 1.5) with an angle $\frac{\pi}{4}$, then the value of sine of angle of refraction is

(a) $\frac{1}{\sqrt{2}}$ (b) $\frac{3}{\sqrt{2}}$

(c) $\frac{\sqrt{2}}{3}$ (d) $\sqrt{2}$

Ans. (c)

$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$
$$\sin 45^\circ = 1.5 \sin\theta_2$$
$$\frac{1}{\sqrt{2}} = 1.5 \times \sin\theta_2$$
$$\sin\theta_2 = \frac{\sqrt{2}}{3}$$

End of Solution

39. The complex exponential power form of Fourier series of $x(t)$ is

$$x(t) = \sum_{K=-\infty}^{\infty} a_k \cdot e^{j\frac{2\pi}{T_0} \cdot kt}$$

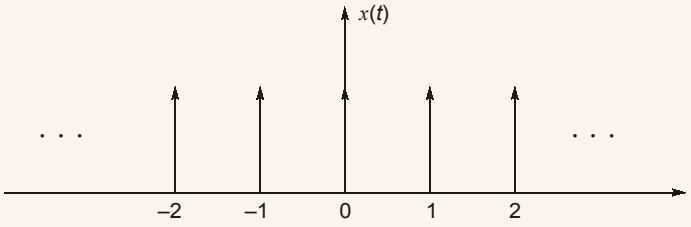
if $x(t) = \sum_{b=-\infty}^{\infty} \delta(t-b)$, then the value of a_k is

(a) $1 - (-1)^k$ (b) $1 + (-1)^k$
(c) 1 (d) –1

Ans. (c)

$$x(t) = \sum_{b=-\infty}^{\infty} \delta(t-b)$$

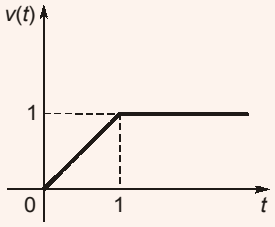
$$\cdots + \delta(t+2) + \delta(t+1) + \delta(t) + \delta(t-1) + \delta(t-2) + \cdots$$



$$a_k = \frac{1}{T_o} \int_{-T_o/2}^{T_o/2} x(t)\, e^{-\frac{j2\pi}{T_o} kt}\, dt \qquad [\because T_o = 1]$$
$$= \frac{1}{1} \int_{-1/2}^{1/2} \delta(t)\, e^{-\frac{j2\pi}{1} kt}\, dt$$
$$= 1$$

End of Solution

40. Laplace transform of the function $v(t)$ shown in the figure is



(a) $s^2[1 - e^s]$ (b) $s^2[1 - e^{-s}]$

(c) $\frac{1}{s^2}[1-e^s]$ (d) $\frac{1}{s^2}[1-e^{-s}]$

Ans. (d)

From the figure, $v(t) = r(t) - r(t-1)$

Apply LT, $V(s) = \frac{1}{s^2} - \frac{1}{s^2}e^{-s}$ $\left[\because r(t) \longleftrightarrow \frac{1}{s^2}\right]$

$= \frac{1}{s^2}[1-e^{-s}]$

$\because$ Time shifting property $\delta(t - t_o) \longleftrightarrow X(s)\, e^{-st_o}$

End of Solution

41. In a discrete-time complex exponential sequence of frequency $\omega_0 = 1$, the sequence is

1. Periodic with period $\frac{2\pi}{\omega_0}$
2. Non periodic
3. Periodic for some value of period N

Which of the above statements is/are correct?

(a) 1 only (b) 2 only

(c) 3 only (d) 1 and 3

Ans. (b)

Given that, $\omega_0 = 1$

For discrete time exponential to be periodic $C = \frac{2\pi}{\omega_o}$ (should be rational)

In the present case $= \frac{2\pi}{1} \Rightarrow$ Non-periodic.

End of Solution

42. Consider the following transforms :

1. Fourier transform 2. Laplace transform

Which of the above transforms is/are used in signal processing?

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

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ME — 10 Selections in Top 10

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AIR 2	AIR 3	AIR 4	AIR 5	AIR 7	AIR 8	AIR 9	AIR 10
							
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38 in Top 10

73 in Top 20

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CE	Selections in Top 10 **10**	Selections in Top 20 **20**	MADE EASY Selections **120** Out of **151** Vacancies	MADE EASY Percentage **79%**
ME	Selections in Top 10 **10**	Selections in Top 20 **18**	MADE EASY Selections **83** Out of **99** Vacancies	MADE EASY Percentage **83%**
EE	Selections in Top 10 **9**	Selections in Top 20 **16**	MADE EASY Selections **67** Out of **86** Vacancies	MADE EASY Percentage **78%**
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Ans. (a)

- Laplace transform used for stability verifications, transient analysis and system synthesis.
- In signal processing (which basically means filtering) Fourier transform are used, as filtering requires information purely interms of frequency.

End of Solution

43. The varactor diode has a voltage-dependent:
1. Resistance 2. Capacitance 3. Inductance
Which of the above is/are correct?
(a) 1 only (b) 2 only
(c) 3 only (d) 1 and 3

Ans. (b)
Varactor diode is also called variable capacitance diode by varying the the *RB* voltage, we can alternate the junction capacitance C_T.

End of Solution

44. The impulse response for the discrete-time system
$y[n] = 0.24\,(x[n] + x[n-1] + x[n-2] + x[n-3])$ is given by
(a) 0 for $0 \le n \le 3$ and 0.24 otherwise
(b) 0.24 for $0 \le n \le 3$ and 0 otherwise
(c) 0.24 for $n = 0$ to $n = \infty$
(d) 0 for $n = 0$ to $n = \infty$

Ans. (b)
When input $x[n] = \delta[n]$, response
$y[n] = h[n] \rightarrow$ unit impulse response
$$h[n] = 0.24\left[\delta[n] + \delta[n-1] + \delta[n-2] + \delta[n-3]\right]$$
i.e. $h[n] = 0.24 \quad 0 \le n \le 3$
$= 0 \quad$ otherwise

End of Solution

45. The product of emitter efficiency (γ) and transport factor (β^*) for a BJT is equal to
(a) Small signal current gain (b) High frequency current gain
(c) Power loss in the BJT (d) Large-signal current gain

Ans. (d)
For a BJT, $\alpha = \beta^* \gamma$
where α is is large signal current gain

End of Solution

46. Consider a two-sided discrete-time signal (neither left sided, nor right sided). The region of convergence (ROC) of the *z*-transform of the sequence is

1. All region of *z*-plane outside a unit circle (in *z*-plane)
2. All region of *z*-plane inside a unit circle (in *z*-plane)
3. Ring in z-plane

Which of the above is/are correct?

(a) 1 only (b) 2 only
(c) 3 only (d) 1 and 3

Ans. **(c)**

From the properties of ROC of *z*-transform, for a two sided sequences the ROC of its *z*-transform is in the form of circular strip or annular strip i.e., in the form of ring.

End of Solution

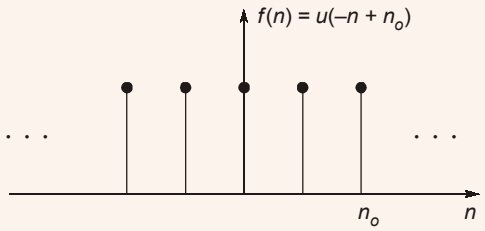
47. When is a function $f(n)$ said to be leftsided?

(a) $f(n) = 0$ for $n < 0$ (b) $f(n) < 0$ for $n > 0$
(c) $f(n) = 0$ for $n > n_0$ (d) $f(n) = \infty$ for $n < n_0$
($n_0 \rightarrow$ Positive or negative integer)

Ans. **(c)**

A signal having a non-zero value towards left of a finite value of time till $t = -\infty$ are called left sided signal.

i.e., for example



Hence, $f(n) = 0$, for $n > n_o$

End of Solution

48. Z-transform deals with discrete time systems for their

1. Transient behaviour 2. Steady-state behavior

Which of the above behaviours is/are correct?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

Ans. **(c)**

Using the unilateral transforms [both Laplace and *z*-transform] the analysis of continuous time and discrete time systems can be analysed both for transient [using time differentiation property (Laplace transform), using time shifting property (*z*-transform)] and steady state responses [using final value theorem].

End of Solution

49. The response of a linear, time-invariant, discrete-time system to a unit step input $u[n]$ is $\delta[n]$. The system response to a ramp input $n\,u[n]$ would be

(a) $\delta[n-1]$ (b) $u[n-1]$

(c) $n\,\delta[n-1]$ (d) $n\,u[n-1]$

Ans. **(b)**

From LTI system, response, for $u[n] \rightarrow \delta[n]$, for ramp input $nu[n] = r[n]$

i.e., $u[n-1] + u[n-2] + \cdots = \delta[n-1] + \delta[n-2] + \cdots$

Hence, $u[n-1]$.

End of Solution

50. Consider a discrete-random variable z assuming finitely many values. The cumulative distribution function, $F_z(z)$ has the following properties:

1. $\int_{-\infty}^{+\infty} F_z(z)\,dz = 1$
2. $F_z(z)$ is non-decreasing with finitely many jump-discontinuities
3. $F_z(z)$ is negative and non-decreasing

Which of the above properties is/are correct?

(a) 1 only (b) 2 only

(c) 3 only (d) 2 and 3

Ans. **(b)**

End of Solution

51. Consider a random process given by: $x(t) = A\cos(2\pi f_c t + \theta)$, where A is a Rayleigh distributed random variable and θ is distributed in $[0, 2\pi]$. A and θ are independent. For any time t, the probability density function (PDF) of $x(t)$ is

(a) Gaussian (b) Rayleigh

(c) Rician (d) Uniform in $[-A, A]$

Ans. **(a)**

End of Solution

52. Poisson's equation is derived with the following assumption about the medium. The medium is

(a) Non-homogeneous and isotropic (b) Non-homogeneous and non-isotropic

(c) Homogeneous and non-isotropic (d) Homogeneous and isotropic

Ans. **(d)**

End of Solution

53. The state space representation of a linear time invariant system is

$$X(t) = A\,X(t) + Bu(t) \quad ; \quad Y(t) = CX(t)$$

What is the, transfer function H(s) of the system?

(a) $C(sI - A)^{-1}\,B$ (b) $B(sI - A)^{-1}\,C$

(c) $C(sI - A)\,B$ (d) $B(sI - A)\,C$

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Ans. **(a)**

$$Y(s) = CX(s)$$
$$sX(s) = AX(s) + BU(s) \Rightarrow X(s)[s - A] = BU(s)$$
$$X(s) = (sI - A)^{-1} BU(s)$$
$$\frac{Y(s)}{U(s)} = C(sI - A)^{-1} B$$

End of Solution

54. $x(t) = \frac{1}{T_o} + \sum_{k=1}^{N} \frac{2}{T_o} \cos k\omega_o t$, is the combined trigonometric form of Fourier series for

(a) Half rectified wave
(b) Saw-tooth wave
(c) Rectangular wave
(d) Impulse train

Ans. **(d)**

Given that, $x(t) = \frac{1}{T_o} + \sum_{K=1}^{N} \frac{2}{T_o} \cos K\omega_o t$

$$a_0 = \frac{1}{T_o}, \; a_k = \frac{2}{T_o}$$

As the Fourier series coefficient a_n is independent of 'K' signal cannot be sawtooth, half rectified (or) rectangular. Hence, impulse train.

(or)

The otherway is evaluating Fourier series coefficients are verifying.

End of Solution

55. A signal xn is given by $x_0 = 3$, $x_1 = 2$, $x_2 = 5$, $x_3 = 1$, $x_4 = 0$, $x_5 = 1$, $x_6 = 2$, $x_7 = 2$, $x_8 = 4$, where the subscript 'n' denotes time. The peak value of the auto correlation of x_{2n-11}, is

(a) 0
(b) 10
(c) 54
(d) 64

Ans. **(b)**

End of Solution

56. A system has impulse response $h[n] = \cos(n)u[n]$. The system is

(a) Causal and stable
(b) Non causal and stable
(c) Non causal and not stable
(d) Causal and not stable

Ans. **(d)**

$$h[n] = \cos(n)\, u[n]$$

- Multiplication by $u[n]$ ensures,

$$h[n] = 0, \; n < 0 \text{ Hence, causal}$$

- $h[n]$ must be absolutely summable

$\left(\text{if } \sum_{n=-\infty}^{\infty} |h[n]| < \infty\right)$ which is not verified by above $h[n]$.

So it is not stable.

End of Solution

57. If the three resistors in a delta network are all equal in values i.e. R_{DELTA}, then the value of the resultant resistors in each branch of the equivalent star network i.e. R_{STAR} will be equal to

(a) $\frac{R_{DELTA}}{3}$ (b) $\frac{R_{DELTA}}{2}$

(c) $2\,R_{DELTA}$ (d) R_{DELTA}

Ans. **(a)**

Delta to star $\Rightarrow$ Resistance decreases by 3 times.

End of Solution

58. Loop-voltage equations of a passive circuit are given by

$$\begin{bmatrix} Z_{11} & Z_{12} & Z_{13} \\ Z_{21} & Z_{22} & Z_{23} \\ Z_{31} & Z_{32} & Z_{33} \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix}$$

1. $Z_{ij} = Z_{ji}$, $i, j = 1, 2, 3$
2. $Z_{ii} > 0$, $i = 1, 2, 3$
3. $\Delta Z \leq 0$

Which of the above relations are correct?

(a) 1 and 2 only (b) 1 and 3 only

(c) 2 and 3 only (d) 1, 2 and 3

Ans. **(a)**

End of Solution

59. A function $c(t)$ satisfies the differential equation $\dot{c}(t) + c(t) = \delta(t)$. For zero initial condition $c(t)$ can be represented by

(a) ϵ^{-t} (b) ϵ^{t}

(c) $\epsilon^{t}\,u(t)$ (d) $\epsilon^{-t}\,u(t)$

where $u(t)$ is a unit step function

Ans. **(d)**

$$\frac{dc}{dt} + c(t) = \delta(t)$$

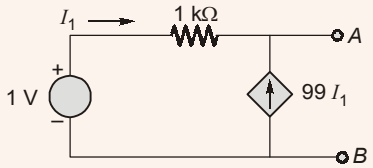
$$sC(s) + C(s) = 1$$

$$C(s) = \frac{1}{s+1}$$

$$c(t) = \epsilon^{-t}\,u(t)$$

End of Solution

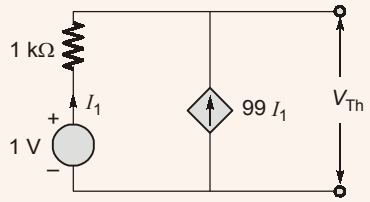
60. For the network shown, Thevenin's equivalent voltage source and resistance are, respectively



(a) 1 mV and 10 Ω
(b) 1 V and 1 kΩ
(c) 1 mV and 1 kΩ
(d) 1 V and 10 Ω

Ans. (d)

Case-I (V_{Th}):



$$I_1 + 99I_1 = 0 \quad \text{...(i)}$$

$$I_1 = \frac{1 - V_{Th}}{1 \times 10^3} \quad \text{...(ii)}$$

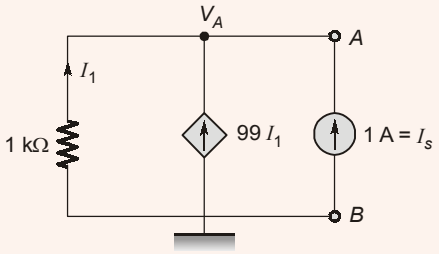
From equation (i), $100\, I_1 = 0$

$$100\left(\frac{1 - V_{Th}}{10^3}\right) = 0$$

$$100 - 100\, V_{Th} = 0$$

$$V_{Th} = 1$$

Case-2 (R_{Th}):



$$I_1 + 99I_1 + 1 = 0 \quad \text{...(iii)}$$

$$I_1 = \frac{-V_A}{1 \times 10^3} \quad \text{...(iv)}$$

From equation (iii), $100\, I_1 + 1 = 0$

$$\left(-\frac{V_A}{1000}\right) + 1 = 0$$

$$-V_A + 10 = 0$$

$$V_A = 10$$

$$R_{Th} = \frac{V_A}{I_s} = \frac{10}{1} = 10\ \Omega$$

End of Solution

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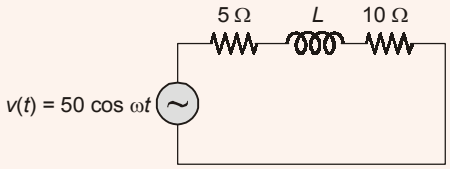
61. In the circuit shown, if the power consumed by the 5 Ω resistor is 10 W, then the power factor of the circuit is



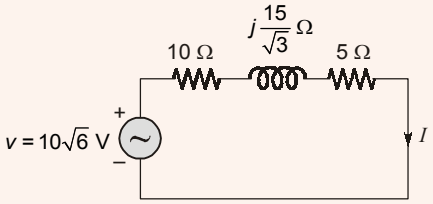
(a) 0.8 (b) 0.6
(c) 0.4 (d) 0.2

Ans. **(b)**

$$P_5 = i^2 R_5$$
$$10 = i^2 \times 5$$
$$i = \sqrt{2}$$
$$z = \frac{V}{i} = \frac{50/\sqrt{2}}{\sqrt{2}} = 25$$
$$\text{PF} = \cos\theta = \frac{R_{eq}}{z} = \frac{5+10}{25}$$
$$\cos\theta = 0.6$$

End of Solution

62. For the circuit shown, if the power consumed by 5 Ω resistor is 10 W, then



1. $|I| = \sqrt{2}$ A
2. Total impedance = 5 Ω
3. Power factor 0.866

Which of the above are correct?

(a) 1 and 3 only (b) 1 and 2 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. **(a)**

$$P_5 = I^2 R_5$$
$$10 = I^2 \times 5$$
$$I = \sqrt{2}$$
$$Z = \sqrt{R^2 + X_L^2} = \sqrt{15^2 + \left(\frac{15}{\sqrt{3}}\right)^2} = \sqrt{300}$$
$$\cos\theta = \frac{R_{eq}}{z} = \frac{5+10}{\sqrt{300}} = 0.866$$

End of Solution

63. For a given fixed tree of a network, the following form an independent set :

1. Branch currents
2. Link voltages

Which of the above is/are correct?

(a) 1 only (b) 2 only

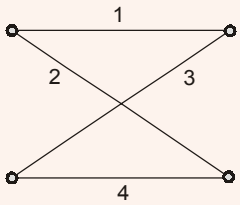
(c) Both 1 and 2 (d) Neither 1 nor 2

Ans. (d)

1. In Tie-set, link current form independent set.
2. In cut-set, branch voltage form independent set.

End of Solution

64. For the network graph, the number of trees (P) and the number of cut-sets (Q) are respectively:

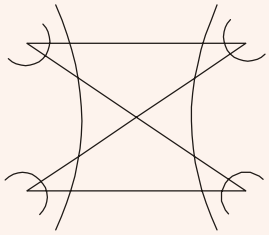


(a) 4 and 2 (b) 6 and 2

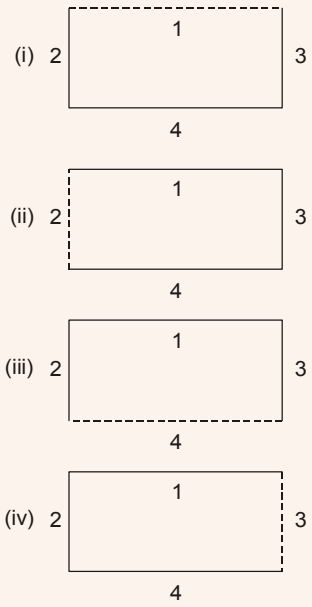
(c) 4 and 6 (d) 2 and 6

Ans. (c)

Cut-sets : 6



Tree : 4



End of Solution

65. For which one of the following measurements a thermistor can be used?
(a) Velocity (b) Humidity
(c) Displacement (d) Percent of CO_2 in air

Ans. (a)

End of Solution

66. According to network graphs, the network with
1. Only two odd vertices is traversable
2. No odd vertices is traversable
3. Two or more than two odd vertices are traversable

Which of the above statements is/are correct?
(a) 1 only (b) 2 only
(c) 3 only (d) 1 and 2

Ans. (d)
A network graph is traversable only if the number of vertices with odd degree in network graph is exactly 2 (or) 0.

End of Solution

67. For any lumped network, for any cut sets and at any instant of time the algebraic sum of all branch currents traversing the cut-set branches is always :
(a) One (b) Zero
(c) Infinity (d) Greater than zero, but less than one

Ans. (b)

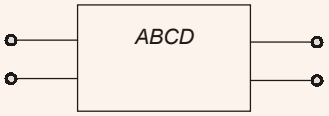
End of Solution

68. Which one of the following statements concerning Tellegen's theorem is correct?
(a) It is useful in determining the effects in all parts of a linear four-terminal network
(b) It is applicable for any lumped network having elements which are linear or nonlinear, active or passive, time varying or time-invariant, and may contain independent or dependent sources
(c) It can be applied to a branch, which is not coupled to other branches in a network
(d) It states that the sum of powers taken by all elements of a circuit within constraints imposed by KCL and KVL is non-zero

Ans. (b)

End of Solution

69. The open circuit input impedance of a 2-port network is



(a) $\frac{A}{C}\Omega$ (b) $\frac{B}{D}\Omega$
(c) $\frac{D}{C}\Omega$ (d) $\frac{A}{B}\Omega$

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Ans. (a)

$$Z_{11} = \left.\frac{V_1}{I_1}\right|_{I_2=0} = \left.\frac{AV_2 - BI_2}{CV_2 - DI_2}\right|_{I_2=0} = \frac{A}{C}$$

End of Solution

70. Consider the following statements

1. Two identical 2nd order Butterworth LP filters when connected in cascade will make a 4th order Butterworth *LP* filter.
2. A high pass 2nd order filter will exhibit a peak if *Q* exceeds certain value.
3. A band pass filter cannot be of order one.
4. A network consists of an amplifier of real gain *A* and a β network in cascade with each other. The network will generate sinusoidal oscillations if the p network is a first order *LP* filter.

Which of the above statements are correct?

(a) 1 and 2 (b) 2 and 3
(c) 3 and 4 (d) 1 and 4

Ans. (b)

End of Solution

71. The lowest and the highest critical frequencies of RC driving point admittance are, respectively :

(a) a zero and a pole (b) a pole and a zero
(c) a zero and a zero (d) a pole and a pole

Ans. (a)

End of Solution

72. The poles and zeros of a voltage function $v(t)$ are : zero at the origin and simple poles at –1, –3 and the scale factor is 5. The contribution of the pole at –3 to $v(t)$ is

(a) $2.5\,\epsilon^{-3t}$ (b) $7.5\,\epsilon^{+3t}$
(c) $2.5\,\epsilon^{+3t}$ (d) $7.5\,\epsilon^{+3t}$

Ans. (b)

$$V(s) = \frac{5s}{(s+1)(s+3)} = \frac{A}{s+1} + \frac{B}{s+3}$$

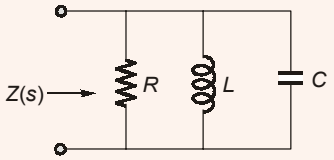
$$V(s) = \frac{-5/2}{s+1} + \frac{15/2}{s+3}$$

$$\Downarrow$$

$$7.5\epsilon^{-3t}$$

End of Solution

73. The driving point impedance of the circuit shown is given by $Z(s)=\dfrac{0.2s}{s^2+0.1s+2}$.



The component values R, L and C are respectively

(a) 0.5 Ω, 1 H and 0.1 F
(b) 2 Ω, 5 H and 5 F
(c) 0.5 Ω, 0.1 H and 0.1 F
(d) 2 Ω, 0.1 H and 5 F

Ans. (d)

$$Z(s)=\frac{0.2s}{s^2+0.1s+2}$$

$$Y(s)=\frac{s^2+0.1s+2}{0.2s}$$

$$Y(s)=\frac{s}{0.2}+\frac{1}{2}+\frac{2}{0.2s}$$

$$Y(s)=\underset{\downarrow}{5s}+\underset{\downarrow}{\frac{1}{2}}+\underset{\downarrow}{\frac{10}{s}}$$

$$B_c=sC \quad G=0.5 \quad B_L=\frac{1}{Ls}$$

$$C=5 \quad R=2 \quad L=\frac{1}{10}=0.1$$

End of Solution

74. Consider the following driving point impedances which are to be realized using passive elements:

1. $\dfrac{s+2}{s^2(s+5)}$
2. $\dfrac{s^2+3}{s^2(s^2+5)}$

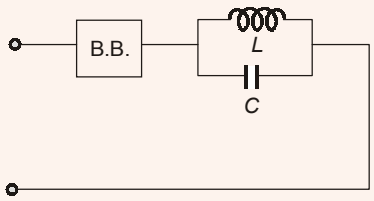
Which of the above is/are realizable?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

Ans. (d)

End of Solution

75. A reactance function in the first Foster form has poles at $\omega = 0$ and $\omega = \infty$. The black-box (B.B.) in the network contains:

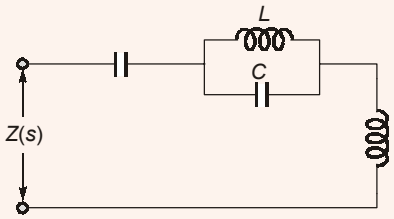


(a) An inductor
(b) A capacitor
(c) A parallel L-C circuit
(d) A series L-C circuit

Ans. (d)

Foster-I form general equation

$$Z(s) = \frac{K_o}{s} + \frac{2Ks}{s^2 + \omega^2} + HS$$



End of Solution

76. Consider the following statements:
1. The magnetic field at the centre of a circular coil of a wire carrying current is inversely proportional to the radius of the coil.
2. Lifting power of a magnet is proportional to square of magnetic flux density.
3. A static electric field is conservative (irrotational).
4. If the divergence of a vector '*A*' is zero, then vector '*A*' can be expressed as Curl of a vector *F*.

Which of the above statements are correct?
(a) 1, 2 and 3 only
(b) 3 and 4 only
(c) 1,2 and 4 only
(d) 1, 2, 3 and 4

Ans. (d)

End of Solution

77. Consider the following:
1. Electric current flowing in a conducting wire
2. A moving charged belt
3. An electron beam in a cathode ray tube
4. Electron movement in a vacuum tube

Which of the above are examples of convection current?
(a) 2, 3 and 4 only
(b) 1,2 and 4 only
(c) 1 and 3 only
(d) 1, 2, 3 and 4

Ans. (a)

End of Solution

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78. Consider the following sources :
1. A permanent magnet
2. A charged disc rotating at uniform speed
3. An accelerated charge
4. An electric field which changes linearly with time

Which of the above are the sources of steady magnetic field?
(a) 1, 2 and 3 only (b) 3 and 4 only
(c) 1, 2 and 4 only (d) 1, 2, 3 and 4

Ans. (c)

End of Solution

79. A charge Q is enclosed by a Gaussian spherical surface of radius *R*. If *R* is doubled then the outward flux is
(a) Doubled (b) Increased four times
(c) Reduced to a quarter (d) Remains unaltered

Ans. (d)

End of Solution

80. Divergence of a vector div *D* in the cylindrical coordinate system is

(a) $\frac{1}{\rho}\frac{\partial}{\partial \rho}(D_\rho)+\frac{I}{\rho}\frac{\partial D_\phi}{\partial \phi}+\frac{\partial D_z}{\partial z}$ (b) $\frac{1}{\rho}\frac{\partial}{\partial \rho}(\rho D_\rho)+\frac{I}{\rho}\frac{\partial(\phi D_\phi)}{\partial \phi}+\frac{I}{z}\frac{\partial(ZD_z)}{\partial z}$

(c) $\frac{1}{\rho}\frac{\partial}{\partial \rho}(\rho D_\rho)+\frac{I}{\rho}\frac{\partial D_\phi}{\partial \phi}+\frac{\partial D_z}{\partial z}$ (d) $\frac{\partial D_\rho}{\partial \rho}+\frac{\partial D_\phi}{\partial \phi}+\frac{\partial D_z}{\partial z}$

Ans. (c)

End of Solution

81. What is the value of work required to move *a* + 8 nC charge from infinity to a point *P* which is at 2 *m* distance from a point charge *Q* = + 5 μC?
(a) 180 μJ (b) 180 μJ
(c) 18 μJ (d) 18 nJ

Ans. (a)

$$\text{Work done} = \omega = -Q\int_{\text{initial}}^{\text{final}} \vec{E}\cdot\vec{dl} = Q\left[-\int_{\infty}^{\text{final}} \vec{E}\,\vec{dl}\right] = QV$$

Potential at 2 m distance from a point change *Q* at the origin is

$$V = \frac{Q'}{4\pi t_o r} = \frac{5\times10^{-6}}{2}9\times10^{9}$$

$$W = QV = 8\times10^{-9}\,\frac{5\times10^{-6}}{2}(9\times10^{9}) = 4\times5\times9\times10^{-6}$$

$$= 180\ \mu J$$

End of Solution

82. An electrostatic force between two point charges increases when they are
(a) More apart and dielectric constant of the medium between them decreases
(b) Less apart and dielectric constant of the medium between them decreases
(c) More apart and dielectric constant of the medium between them increases
(d) Less apart and dielectric constant of the medium between them increases

Ans. **(b)**

Force between two point charges Q_1 and Q_2 is

$$F = \frac{Q_1 Q_2}{4\pi \epsilon d^2}$$

If d, ϵ both decreases than F increases.

End of Solution

83. A plane $Y = 2$ carries infinite sheet of charge 6 nC/m^2. If medium is free space then force on a point charge of 10 mC located at the origin is

(a) $-1080\,\pi\bar{a}_y$ N (b) $-108\,\pi\bar{a}_y$ N

(c) $-10.8\,\pi\bar{a}_y$ N (d) $-1.08\,\pi\bar{a}_y$ N

Ans. **(d)**

Electric field at origin due to $P_s = 6\frac{nC}{m^2}$ infinite sheet charge on $y = 2$ surface is

$$\vec{E} = \frac{P_s}{2\epsilon_o}\hat{a}_N = \frac{6\times10^{-9}}{2\frac{1}{36\pi}\times10^{-9}}(-\hat{a}_y) = 3\times36\pi(-\hat{a}_y)$$

Force m 10 mC charge $= \vec{F} = Q\vec{E}$

$$\vec{F} = 10\times10^{-3}\left[3\times36\pi(-\hat{a}_y)\right] = 1.08\pi(-\hat{a}_y)$$

End of Solution

84. The potential at the centroid of an equilateral triangle of side $r\sqrt{3}$ due to three equal positive point charges each of value q and placed at the vertices of the triangle would be

(a) $\frac{q}{2\pi\epsilon_0 r}$ (b) $\frac{\sqrt{3}q}{8\pi\epsilon_0 r}$

(c) $\frac{3q}{4\pi\epsilon_0 r}$ (d) zero

Ans. (c)

If a is the side of the equilateral triangle than potential at the centre due to 3 point charges each having 'q' charge at corners is

$$V = \frac{3\sqrt{3}\,q}{4\pi \epsilon_o\, a}$$

given side of equilateral triangle = $a = r\sqrt{3}$

$$V = \frac{3\sqrt{3}\,q}{4\pi \epsilon_o\, r\sqrt{3}} = \frac{3q}{4\pi \epsilon_o\, r}$$

End of Solution

85. The point form of the relation connecting vector magnetic potential A and current density J is

(a) $\nabla \times A = J + \frac{\partial D}{\partial t}$

(b) $A = \int \frac{\mu_0 J}{4\pi \epsilon R}\, dv$

(c) $\nabla^2 A = -\mu_0 J$

(d) $\frac{\partial A}{\partial} = -\frac{J}{\sigma}$

Ans. (c)

End of Solution

86. In the region $Z < 0$, $\epsilon_{r1} = 2$, $\bar{E}_1 = 3\bar{a}_x + 4\bar{a}_y - 2\bar{a}_z$ V/m. For region $Z > 0$, where $\varepsilon_{r2} = 6.5$, $\bar{E}_2$ is

(a) $-3\bar{a}_x + 4\bar{a}_y + \frac{6.5}{4}\bar{a}_z$ V/m

(b) $-3\bar{a}_x + 4\bar{a}_y + \frac{4}{6.5}\bar{a}_z$ V/m

(c) $-3\bar{a}_x + 4\bar{a}_y - \frac{6.5}{4}\bar{a}_z$ V/m

(d) $-3\bar{a}_x + 4\bar{a}_y - \frac{4}{6.5}\bar{a}_z$ V/m

Ans. (d)

For z = 0 boundary $\hat{a}_z$ component of the vector is normal.

$$\vec{E}_1 = -3\hat{a}_x + 4\hat{a}_y - 2\hat{a}_z$$

$$\vec{E}_{t_1} = -3\hat{a}_x + 4\hat{a}_y \; ; \; \vec{E}_{N1} = -2\hat{a}_z$$

First boundary condition $\Rightarrow \vec{E}_{t_1} = \vec{E}_{t_2}$

$$\vec{E}_{t_2} = -3\hat{a}_x + 4\hat{a}_y$$

Second boundary condition $\Rightarrow \vec{D}_{N1} - \vec{D}_{N2}$

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3	Amit Kumar Mishra	150	766.46
21	Nishant Kumar	144	712.45
59	Sandeep Singh Olla	144	678.23
11	Raman Kunwar	142	732.88
6	Pawan Jeph	140	745.57
23	Ishan Shrivastava	140	709.24
24	Abhishek Verma	140	705.12
65	Yogendra Singh	140	676.44

Mechanical Engineering

Rank	Name	Personality Test	Total Marks
36	Rohit Singh	148	659
56	Harmandeep Singh	148	640
29	Anuj Kumar Mishra	146	675
39	Anubhaw Mishra	142	657
7	Sudhir Jain	140	708
13	Kumar Sourav	140	699
31	Saurabh Singh Lodhi	140	665
41	Praseed Sahu	140	653
54	Vedant Darbari	140	642
74	Vinay Kumar	140	598

Electrical Engineering

Rank	Name	Personality Test	Total Marks
13	Neetesh Agrawal	150	708
12	Pankaj Fauzdar	149	712
11	Ankita Gupta	146	714
22	Umesh Prasad Gupta	146	687
2	Partha Sarathi Tripathy	141	772
20	Apurva Srivastava	140	692
1	Shaik Siddhikh Hussain	135	772
3	Nikki Bansal	134	761
31	Akhil Pratap Singh	134	673
9	Sudhakar Kumar	132	718

Electronics & Telecommunication Engg.

Rank	Name	Personality Test	Total Marks
9	Shruti Kushwaha	144	754.88
1	Ijaz M Yousuf	142	801.22
18	Hitesh	142	743.22
2	Saurabh Pratap Singh	140	791.57
13	Dhanesh Goel	140	747.22
60	Harshit Mittal	140	705.36
14	Shyam Sundar Sharma	136	745.57
43	Anshul Agarwal	136	713.21
49	Aman Chawla	136	709.98
8	Nidhi	132	754.77

$$\epsilon_1 \vec{E}_{N1} = \epsilon_2 \vec{E}_{N2}$$

$$\vec{E}_{N2} = \frac{\epsilon_1}{\epsilon_2}\vec{E}_{N1} = \frac{2\epsilon_o}{6.5\epsilon_o}(-2\vec{a_z})$$

$$\vec{E}_{N2} = -\frac{4}{6.5}\hat{a}_z$$

$$\vec{E}_2 = \vec{E}_{t2} + \vec{E}_{N2} = -3\bar{a}_x + 4\bar{a}_y - \frac{4}{6.5}\bar{a}_z \text{ V/m}$$

End of Solution

87. Consider the following statements regarding a conductor and free space boundary
1. No charge and no electric field can exist at any point within the interior of a conductor
2. Charge may appear on the surface of a conductor

Which of the above statements are correct?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

Ans. (c)

End of Solution

88. A sphere of homogeneous linear dielectric material of dielectric constant ≥ 1 is placed in a uniform electric field E_0, then the electric field E that exists inside the sphere is

(a) Uniform and $E < E_0$ (b) Uniform and $E \geq E_0$
(c) Varies but $E < E_0$ always (d) Varies but $E > E_0$ always

Ans. (c)

End of Solution

89. Which of the following Maxwell's equations represents Ampere's law with correction made by Maxwell?

(a) $\nabla \cdot E = \frac{\rho}{\epsilon_o}$ (b) $\nabla \cdot B = 0$

(c) $\nabla \times E = \frac{\partial B}{\partial t}$ (d) $\nabla \times B = \mu_0 J + \mu_0 \epsilon_0 \frac{\partial E}{\partial t}$

Ans. (d)

End of Solution

90. Precision is composed of two characteristics, one is the number of significant figures to which a measurement may be made, the other is

(a) Conformity (b) Meter error
(c) Inertia effects (d) Noise

Ans. (a)

End of Solution

91. If phasors $P_1 = 3 + j4$ and $P_2 = 6 - j8$, then $|P_1 - P_2|$ is

(a) 5 (b) $\sqrt{53}$

(c) $\sqrt{73}$ (d) $\sqrt{153}$

Ans. **(d)**

$$= \sqrt{3^2 + 12^2} = \sqrt{9 + 144} = \sqrt{153}$$

End of Solution

92. A plane wave in free space has a magnetic field intensity of 0.2 A/m in the Y-direction. The wave is propagating in the Z-direction with a frequency of 3 GHz. The wavelength and amplitude of the electric field intensity are, respectively :

(a) 0.05 m and 75 V/m (b) 0.10 m and 75 V/m

(c) 0.05 m and 150 V/m (d) 0.10 m and 150 V/m

Ans. **(b)**

$$\vec{H} = 0.2\, a_y : f = 3 \text{ GHz}$$

$$\lambda = \frac{C}{f} = \frac{3 \times 10^8}{3 \times 10^9} = 0.1\text{m}$$

$$\frac{E}{H} = 120\pi \text{ for free space}$$

$$E = 120\pi\,(H) \Rightarrow E = 120\pi\,(0.2) = 24\pi = 75 \text{ V/m}$$

End of Solution

93. For energy propagation in a lossless transmission line, the characteristic impedance of the line is expressed in ohm as below (where notations have usual meanings).

(a) $\sqrt{LC}\ \Omega$ (b) $\sqrt{\frac{L}{C}}\ \Omega$

(c) $\sqrt{\frac{C}{L}}\ \Omega$ (d) $\sqrt{\frac{R + j\omega L}{G - j\omega L}}\ \Omega$

Ans. **(b)**

End of Solution

94. A quarter wavelength transformer is used to match a load of 200 Ω to a line with input impedance of 50 Ω. The characteristic impedance of the transformer would be

(a) 40 Ω (b) 100 Ω

(c) 400 Ω (d) 1000 Ω

Ans. **(b)**

$$Z_q = \sqrt{(50)\,(200)} = 100\ \Omega$$

End of Solution

95. For a lossless transmission line L = 0.35 μH/m, C = 90 pF/m and frequency = 500 MHz. Then the magnitude of propagation constant is

(a) 14.48 (b) 17.63

(c) 19.59 (d) 21.20

Ans. (b)

For lossless line, $r = j\omega\sqrt{LC}$

$$|r| = \omega\sqrt{LC} = 2\pi f\sqrt{LC}$$

$$= 2\pi(500\times10^6)\sqrt{0.35\times10^{-6}\times90\times10^{-12}}$$

$$= 2\pi(500\times10^6)\,5.61\,(10^{-9})$$

$$= 176.32\times10^{-1} = 17.63$$

End of Solution

96. If an antenna has a main beam with both half-power beam widths equal to 20°, its directivity (D) is nearly:

(a) 90.6 (b) 102.5

(c) 205 (d) 226

Ans. (b)

$$\theta_{HP\pi\omega} = 20^\circ$$

$$D = \text{Directivity} = \frac{41253}{(\theta_{HP\pi\omega})^2} = \frac{4153}{(20)^2} = 103.13$$

Nearest option is (b).

End of Solution

97. An instrument always extracts some energy from the measured medium. Thus the measured quantity is always disturbed by the act of measurement, which makes a perfect measurement theoretically impossible and it is due to :

(a) Skin-effect (b) Inductive effect

(c) Loading effect (d) Lorenz effect

Ans. (c)

End of Solution

98. The characteristic impedance η_0 of a free space is:

(a) $\frac{\mu_0}{\varepsilon_0}$ (b) $\sqrt{\frac{\mu_0}{\varepsilon_0}}$

(c) $\sqrt{\mu_0\,\varepsilon_0}$ (d) $\mu_0\,\varepsilon_0$

Ans. (b)

$$\eta_0 = \sqrt{\frac{\mu_0}{\epsilon_o}} = 120\pi$$

End of Solution

99. A $3\frac{1}{2}$ digit voltmeter has an accuracy specification of ± 0.5% of reading ± one digit.

What is the possible error in volts when the instrument displays 2.00 V on the 10 V scale?

(a) 0.03 V (b) 0.02 V

(c) 0.01 V (d) 0.005 V

Ans. **(b)**

$3\frac{1}{2}$DVM, Accuracy = ±0.5% + 1 digit

FSD = 10 V, Reading = 2 V

error (1) = ±0.5% of reading

$= \pm\frac{0.5}{100}\times 2\text{ V} = \pm 0.01$

1 digit $= \frac{V_{FSD}}{10^N} = \frac{10}{10^3} = 0.01 \Rightarrow$ error (2)

Total error = error (1) + error (2)

= 0.01 + 0.01 = 0.02 V

End of Solution

100. A megger is an instrument used for measuring:

(a) Very high voltages (b) Very low voltages

(c) Very high resistances (d) Very low resistances

Ans. **(c)**

End of Solution

101. The values of capacitance and inductance used in the series LCR Circuit are 160 pF and 160 μH with the inherent tolerance -10% in each. Then, the resonance frequency of the circuit is in the range of:

(a) 0.8 MHz to 1.2 MHz (b) 0.9 MHz to 1.0 MHz

(c) 0.8 MHz to 1.0 MHz (d) 0.9 MHz to 1.2 MHz

Ans. **(b)**

Given that $L = (160 \pm 10\%)\ \mu H = (160 \pm 16)\ \mu H$

$C = (160 \pm 10\%)\ pF = (160 \pm 16)\ pH$

by considering maximum values $\Rightarrow L = 176\ \mu H,\ C = 176\ pF$

$$f_r = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{176\times10^{-6}\times176\times10^{-12}}} = 0.9\text{ MHz}$$

by considering maximum values $\Rightarrow L = 144\ \mu H,\ C = 144\ pF$

$$f_r = \frac{1}{2\pi\sqrt{144\times10^{-6}\times144\times10^{-12}}} = 1.09\text{ MHz}$$

End of Solution

102. Dynamic characteristics of instruments leading to variations during measurement are:
1. Speed of response 2. Fidelity 3. Dynamic error
Which of the above are correct?
(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (a)

End of Solution

103. The reliability of an instrument refers to:
(a) Degree to which repeatability continues to remain within specified limits
(b) The extent to which the characteristics remain linear
(c) Accuracy of the instrument
(d) Sensitivity of the instrument

Ans. (a)

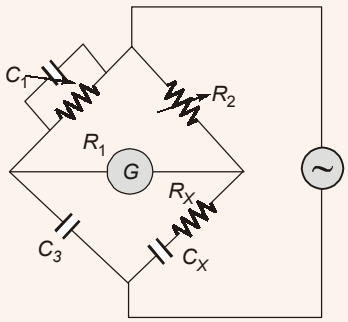
End of Solution

104. AC Voltmeters use diodes with:
(a) High forward current and low reverse current ratings
(b) Low forward current and low reverse current ratings
(c) Low forward current and high reverse current ratings
(d) High forward current and high reverse current ratings

Ans. (a)

End of Solution

105. The bridge circuit shown can be used to measure unknown lossy capacitor C_x with resistance R_x. At balance:



(a) $R_X = \frac{C_1}{C_3}R_2$ and $C_X = \frac{R_1}{R_2}C_3$ (b) $R_X = \frac{C_3}{C_1}R_1$ and $C_X = \frac{R_2}{R_1}C_3$

(c) $R_X = \frac{R_1}{C_2}R_2$ and $C_X = \frac{C_1}{R_1}R_2$ (d) $R_X = R_2$ and $C_X = C_3$

where R_1, R_2, C_1 and C_3 can be assumed ideal components.

Ans. (a)

$$R_2\frac{1}{j\omega C_3} = \frac{R_1}{1+j\omega C_1R_1}\left(R_x+\frac{1}{j\omega C_x}\right)$$

$$\frac{R_2}{j\omega C_3}(1+j\omega C_1R_1) = R_1R_x+\frac{R_1}{j\omega C_x}$$

$$\frac{R_2}{j\omega C_3}+\frac{j\omega C_1R_1R_2}{j\omega C_3} = R_1R_x+\frac{R_1}{j\omega C_x}$$

On comparing real and imaginary part

$$R_1R_x = \frac{C_1R_1R_2}{C_3}$$

$$\therefore \quad R_x = \frac{C_1R_2}{C_3}$$

$$\frac{R_2}{j\omega C_3} = \frac{R_1}{j\omega C_x}$$

$$C_x = \frac{R_1}{R_2}C_3$$

End of Solution

106. Inductance of a coil having Q value in the range of ($1 < Q < 10$), can be measured by using:

(a) Hay's bridge
(b) De Sauty's bridge
(c) Maxwell's bridge
(d) Carry Foster's bridge

Ans. (c)

End of Solution

107. The instrument servomechanism is actually an instrument system made of components, which are:

(a) Exclusively passive transducers
(b) Exclusively active transducers
(c) Combination of passive transducers and active transducers
(d) Exclusively primary sensing elements

Ans. (c)

End of Solution

108. The scale of an electrodynamometer usually reads the:

(a) Average value of the ac
(b) Mean value of the ac
(c) Effective value of the ac
(d) Squared value of the ac

Ans. (c)

End of Solution

109. The resolution of an indicating instrument can be defined as:
1. Variation in the meter reading for the same applied input
2. Detectable change in the deflection due to smallest change in the applied input
3. Detectable change in the output due to drifting of pointer
Which of the above statements are correct?
(a) 1 only (b) 2 only
(c) 3 only (d) 1 and 3

Ans. (b)

End of Solution

110. While measuring the phase difference between the signals $v_1(t) = 10 \sin \omega t$ and $v_2(t) = 10 \sin (\omega t + \phi)$, the Lissajous pattern observed on CRO is a circle. The value of ϕ is:
(a) 2π (b) π
(c) $\frac{\pi}{2}$ (d) $\frac{\pi}{4}$

Ans. (c)

End of Solution

111. The expected voltage across a resistor is 100 V. However, the voltmeter reads a value of 97 V. The relative error is:
(a) 0.97 (b) 0.03
(c) 0.07 (d) 3.00

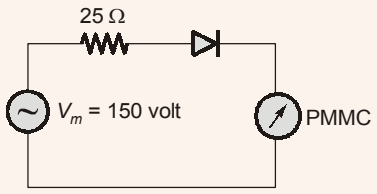
Ans. (b)

$$\text{Measured voltage} = V_m = 97 \text{ V}$$
$$\text{True voltage} = V_T = 100 \text{ V}$$
$$\text{Relative error} = \frac{V_m - V_T}{V_T} = \frac{97 - 100}{100} = -0.03$$

End of Solution

112. A sinusoidal voltage of amplitude 150 V has been applied to a circuit having a rectifying device that prevents flow of current in one direction and offers a resistance of 15 Ω. for the flow of current in the other direction. If hot wire type and PMMC type instruments are connected in this circuit to measure the electric current, their readings would respectively be:
(a) 3.18 A and 5 A (b) 5 A and 3.18 A
(c) 3.18 A and 5 mA (d) 5 A and 3.18 mA

Ans. (b)



PMMC (A) $\Rightarrow$ $I_{avg} = \dfrac{V_{avg}}{R} = \dfrac{150/\pi}{15} = 3.18$ A

$V_{avg} = \dfrac{V_{avg}}{\pi} = \dfrac{150}{\pi}$

Hot wire (A) $\Rightarrow$ $I_{RMS} = \dfrac{V_{RMS}}{R} = \dfrac{V_m/\sqrt{2}}{R}$

$I_{RMS} = \dfrac{150/\sqrt{2}}{15} = 7.07$ amp

End of Solution

113. A tachometer encoder can be used for measurement of speed :
(a) of false pulses because of electrical noise
(b) in forward and reverse directions
(c) in one direction only
(d) for single revolution in a multiple track

Ans. (d)

End of Solution

114. A rotameter works on the principle of variable:
(a) Pressure (b) Length
(c) Area (d) Resistance

Ans. (c)

End of Solution

115. An input voltage required to deflect a beam through 3 cm in a Cathode Ray Tube having an anode voltage of 1000 V and parallel deflecting plates 1 cm long and 0.5 cm apart, when screen is 30 cm from the centre of the plates is :
(a) 300 V (b) 200 V
(c) 100 V (d) 75 V

Ans. (c)

Given that
$D = 3$ cm $= 3 \times 10^{-2}$ m
$l_d = 1$ cm $= 1 \times 10^{-2}$ m
$d = 0.5$ cm $= 0.5 \times 10^{-2}$ m
$V_a = 1000$ volt

$$L = 30 \text{ cm} = 30 \times 10^{-2} \text{ m}$$

$$D = \frac{V_d \cdot L \cdot I_d}{2V_a \cdot d}$$

$$\Rightarrow \quad V_d = \frac{D \times 2V_a \cdot d}{L \cdot I_d}$$

$$V_d = \frac{3\times10^{-2} \times 2 \times 1000 \times 0.5 \times 10^{-2}}{30 \times 10^{-2} \times 1 \times 10^{-2}} = 100 \text{ volt}$$

End of Solution

116. A 6-bit ADC has a maximum precision supply voltage of 20 V. What are the voltage changes for each LSB present and voltage to be presented by (100110), respectively?

(a) 0.317 V and 12.06 V
(b) 3.17 V and 12.06 V
(c) 0.317 V and 1.206 V
(d) 3.17 V and 1.206 V

Ans. **(a)**

Given 6 bit converter that maximum voltage = 20 volt

for maximum voltage ⇒

1 1 1 1 1 1 = 20 volt
⇓ ⇓ ⇓ ⇓ ⇓ ⇓
(32 + 16 + 8 + 4 + 2 + 1) = 63 volt

$$63 = 20 \text{ volt}$$

$$\Rightarrow \quad 1 = \frac{20}{63} = 0.317 \text{ presion}$$

measured ⇒

$$100110 \Rightarrow [(1.32) + 0 + 0 + (1 \times 4) + (1 \times 2) + 0] \times 0.317$$
$$\Rightarrow 12.06 \text{ volt}$$

End of Solution

117. Which of the following transducers measures the pressure by producing emf as a function of its deformation?

(a) Photoelectric transducer
(b) Capacitive transducer
(c) Inductive transducer
(d) Piezoelectric transducer

Ans. **(d)**

End of Solution

118. Maxwell's bridge measures an unknown inductance in terms of:

(a) Known inductance
(b) Known capacitance
(c) Known resistance
(d) Q of the coil

Ans. **(b)**

End of Solution

119. Strain gauges are constructed with Germanium chips because Germanium:
(a) has a strong Hall Effect
(b) is crystalline in nature
(c) can be doped
(d) has piezoelectric property

Ans. (c)

End of Solution

120. The advantages of an LVDT is/are:
1. Linearity 2. Infinite resolution 3. Low Hysteresis
Which of the above advantages is/are correct?
(a) 1 only (b) 2 only
(c) 3 only (d) 1, 2 and 3

Ans. (d)

End of Solution

■■■■