Registration No.: | | | | | | | | | | |

Total Number of Pages: 02

Course: B.Tech/IDD
Sub_Code: 23ES1002

1st Semester Regular/Back Examination: 2024-25
SUBJECT: BASIC ELECTRONICS
BRANCH(S): CE, CHEM, BIOTECH, BIOMED, AE, CSIT, AERO, AEIE, AME, AUTO, CSE, CIVIL, CSE, CSEAI, CSEAIML, CSEDS, CST, ECE, ETC, EE, EEE, ELECTRICAL & C.E, ELECTRICAL, IT, ME, MECH, METTA, MINING, MINERAL, MME, EEVDT, CSEIOT
Time: 3 Hours
Max Marks: 100
Q.Code: R583
Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) What is a p-n junction diode? How does a barrier field appear across a p-n junction?
b) Explain the necessity of a parallel resistor in clamper circuit.
c) Compare between a FET and a BJT.
d) Why the field - effect transistor is called a unipolar transistor?
e) Mention advantages and limitations of integrated circuits.
f) State the characteristic an ideal Op-Amp.
g) Discuss the concept of "Virtual ground" in Op-Amp.
h) Determine the binary equivalent of 26.25.
i) State and prove De Morgan's theorem.
j) Perform the binary addition
100101 + 101 + 1101 + 100

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) The reverse saturation current of a Si p-n junction is 5 nA at 27°C. What are the static and dynamic resistances of the junction for an applied forward bias of 0.6 V?
b) Discuss the concept of Zener and avalanche breakdown.
c) Draw the common base circuit of a junction transistor. Sketch its output characteristics. Explain the active, saturation, and cutoff regions.
d) Explain the term transistor biasing. What are the factors determining the choice of the Q-point? Draw the circuit diagrams of fixed-bias and voltage divider bias arrangement of an n-p-n transistor in CE configuration. Mention the limitations and advantages of both arrangements.
e) When the channel of a JFET is said to be pinched off? Define the pinch-off voltage. What is the pinch off current? By applying Shockley's current expression, draw the transfer characteristic curve of an n-channel JFET.

f) Draw the circuit diagram of a common emitter n-p-n transistor with the following parameters: V_{BB} = 5V, R_B = 100 KΩ, R_C = 1 KΩ, V_{CC} = 10V, V_{BE} = 0.7 V, I_{CO} = 0, β = 100. Find I_B and I_C. Is the transistor operating in the saturation region? Justify.

g) Explain the principle of operation of a digital inverter.

h) Draw a non-inverting configuration using Op-Amp. Calculate the output voltage of the circuit for υ_i = 150 mV rms, R_f = 75 KΩ and R_i = 36 KΩ.

i) Calculate the output voltage for the circuit shown in figure-1 with inputs of V_1 = 40 mV rms and V_2 = 20 mV rms.

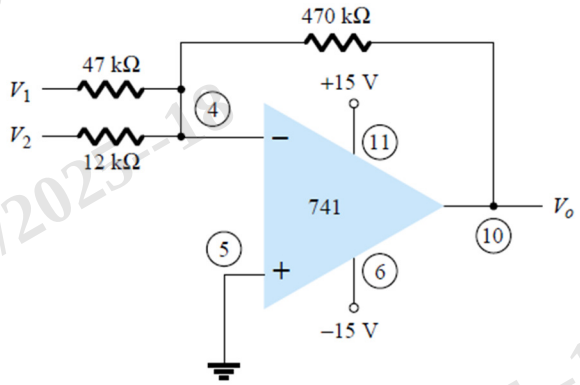


Figure-1

j) What is the difference between signed and unsigned numbers? Discuss the three different methods used for representing signed numbers in binary. Support each method by a suitable example.

k) Simplify the Boolean expressions to a minimum number of variables

I. $xy + x(wz + w\bar{z})$

II. $(x + \bar{y} + \bar{z})(\bar{x} + \bar{z})$

III. $\bar{A}B + \bar{A}\bar{C} + BC + A\bar{B}C$

l)

I. Show that an EX-OR gate can be built with NOR gates.

II. How can the NAND gates be combined to perform the NOR operation?

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 Draw the circuit diagram of (i) a half-wave rectifier and (ii) a full-wave rectifier. Explain the principle of operation of each circuit by applying a sinusoidal wave at the input of the rectifier. **(16)**

Q4 What are different types of MOSFETs? Explain with a neat sketch, the structure and the working of an n-channel enhancement type MOSFET. Draw its drain and transfer characteristic curve. **(16)**

Q5 Describe the use of operational amplifier as an integrator and differentiator. **(16)**

Q6 $f_1 = AB + A\bar{C} + C + A\bar{B}C + ABC$ **(10 + 3 + 3)**

$f_2 = \bar{B} + ABC$

(i) Simplify the above functions. Draw the original and simplified circuit.

(ii) Express f_1 *and* f_2 in standard SOP form.

(iii) Express f_1 *and* f_2 in standard POS form.

Registration No.: | | | | | | | | | | |

Total Number of Pages: 02 **Course: B.Tech/IDD**
Sub_Code: 23HS1002

1st Semester Regular/Back Examination: 2024-25
SUBJECT: English for Technical Writing
BRANCH(S): CIVIL, CHEM, BIOMED, BIOTECH, AE, AERO, AEIE, AUTO, CSE, CSEAI, CSEAIML, CSEDS, ECE, CST, ELECTRONICS & C.E, ETC, EE, ECE, EEE, ELECTRICAL & C.E, ELECTRICAL, MECH, MINERAL, METTA, MANUTECH, IT, EEVDT, CSEIOT, PLASTIC, MME, MINING
Time: 3 Hours
Max Marks: 100
Q.Code: R447
Answer Question No.1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right-hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) What is grapevine communication?
b) Draw the process of communication.
c) Write the phonemic transcription of the following: “quotient”, “pizza”, “barn’, “law”.
d) Define Stress.
e) What is bias-free communication?
f) What do you understand by “FAQs”?
g) What is a Memo?
h) Which two English consonant sounds are often confused by Indian speakers?
i) How does noise act as a communication barrier?
j) Give an example of a biased statement and its bias-free version.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) How do differences in non-verbal communication impact cross-cultural interactions?
b) How can one overcome cultural barriers in communication?
c) How do formal and informal communication channels differ?
d) What role does feedback play in the communication process? Explain.
e) Define upward communication in an organizational context.
f) How does written communication differ from oral communication?
g) How does encoding influence the effectiveness of a message?
h) Define primary and secondary stress with examples.

i) Fill in the blanks with appropriate forms of the tense mentioned in brackets:

I. The train _____ (arrive) at 8:00 PM. (Present Simple)
II. By the time you reach, I _____ (finish) my assignment. (Future Perfect)
III. She _____ (work) on the project for three hours now. (Present Perfect Continuous)
IV. They _____ (develop) the new software last month. (Past Simple)
V. When I called him, he _____ (write) the report. (Past Continuous)
VI. When I arrived, they ___ (already start) the meeting. (Past Perfect)

j) What challenges do Indian speakers face with the /w/ and /v/ sounds?

k) How does mother tongue influence the pronunciation of English vowels and consonants for Indian speakers?

l) Why is it important to avoid stereotypes in professional communication?

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 You are a recent graduate with no prior work experience but have participated in internships, volunteer work, and extracurricular activities. Prepare a CV highlighting your educational qualifications, skills, and achievements suitable for applying for an entry-level position in an IT Company. Invent necessary details. **(16)**

Q4 As the Personnel Manager, you are required to write a report on the declining employee morale at Windsor Software Solutions. Include the causes, observations, and recommendations for improvement. Draft the report in letter format to be submitted to the General Manager of the company. **(16)**

Q5 As the Chairperson of a departmental meeting at your company, you need to prepare an agenda for an upcoming meeting. The meeting will cover topics such as quarterly performance review, project updates, and employee grievances. Draft the agenda, including timings and sequence. **(16)**

Q6 As the Manager of RK Corporation, you need to address a formal letter to a client apologizing for a delay in the delivery of their order. You need to express regret, and propose a solution to maintain a positive relationship with the client. Write the letter. **(16)**

Registration No.: | | | | | | | | | | |

Total Number of Pages: 02 **Course: B.Tech/IDD**
Sub_Code: 23HS1001

1st Semester Regular/Back Examination: 2024-25
SUBJECT: Universal Human Values
BRANCH(S): MINING, METTA, MECH, ME, ELECTRICAL, ELECTRICAL & C.E, EEE, ETC, ELECTRONICS & C.E, CST, ECE, CSEDS, CSEAIML, CSEAI, CSE, CIVIL, CSE, AUTO, AERO, CSIT, AEIE, AE, CE
Time: 3 Hours
Max Marks: 100
Q.Code: R446

Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) How can we understand the value of a pen? Is it in terms of price of it? Or is it in terms of its usability (participation)? Explain as per the definition of value.

b) What are the four levels of living as proposed in the content? Is it desirable to understand the harmony in living at all these levels? Justify your answer.

c) Define self-exploration as a process for value education with a suitable sketch.

d) Differentiate the needs of human beings (self and body) in terms of time and quantity.

e) What is considered as the foundational value in relationships? Define it.

f) What do you mean by respect as per the proposal? What is the minimum content of respect?

g) State all the nine feelings as discussed in the proposal and differentiate between
- Guidance
- Care

h) What are the four orders of nature, and how are they interconnected?

i) What do you mean by co-existence in existence?

j) What do you understand by the terms 'holistic development' and 'universal human order'?

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) What are the basic aspirations of human beings, and to what extent are they being fulfilled by our current education systems?
Is happiness our innate nature or it's an external influence like eating tasty food, wearing an attractive dress or getting attention from others? Explain with suitable examples.

b) Explain animal consciousness and human consciousness considering the priority of right understanding, relationships, and physical facilities in our day-to-day living.

c) What do you mean by happiness and prosperity as per the proposal? Explain the difference between 'happiness' and 'excitement', and similarly 'wealth' and 'prosperity' in context to Universal Human Values with suitable examples.

d) Define self-regulation and health. How are the two related? Explain with an example of each when you try to explain "I am the seer, doer, and enjoyer. The body is an instrument".

e) Explain how the assumption "Human Being = Body", leads to the feeling of deprivation with suitable sketch and examples.

f) What do you perceive when a glass falls from your hand and it falls from someone's hand? Elaborate and explain the above statement as the proposal of trust. How do you feel doubt on intention is the major cause of the problem in the relationship? How do you see the solution regarding this?

g) What are the different types of evaluation discussed in the context of respect? What are their possible outcomes? What is desirable? Explain with suitable examples.

h) What is excellence? Is working for competition the same as working for excellence? Explain with the help of examples. Distinguish between respect, glory and reverence.

i) State and explain "Society", "Crowd", and "Battlefield" as discussed in the proposal. What is Desirable and Where are we today? Elaborate and explain.

j) State and explain the human participation in ensuring mutual fulfilment between the four orders with a suitable chart.

k) Reason out why it is essential to study about space. What are units and space? What is meant by the submergence of units in space? What are the three defining aspects? Draw a chart showing all the different categories of units of nature in space.

l) What do you understand by the terms 'profession' and 'professional ethics'?

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 What is meant by holistic development? Share your perspective on current trends in development compared to holistic development. Do these trends help individuals achieve their full human potential, or do they contribute to a state of being focused on physical facilities only? What should be the focus for human development? Support your answer with relevant examples and propose possible approaches to achieve the desired outcomes. **(16)**

Q4 Why is it important to study the Self? What are the activities of self and body? Describe the harmony in the Self with a few examples. How is behaviour and work decided by the self? Is it decided by the Body or by the Self? Which activity of the Self is connecting to behaviour and work? How can self-exploration help to ensure harmony in the Self? Explain with necessary and suitable examples. **(16)**

Q5 What is the building block for harmony in the society? Describe the human goal. Explain with examples. Explain how this is conducive to sustainable happiness and prosperity for all. Critically examine the goals of present-day society with respect to human goals. What is the outcome? List the dimensions (systems) that comprise a human order. Explain how each dimension contributes to the fulfilment of the human goal. How is the family order related to the universal human order? **(16)**

Q6 As per the prevailing world-view what are usually the expectations from a good professional career? Evaluate these in the context of the right understanding. What, according to you, can be a fool-proof measure to ensure professional ethics? Give justification. In spite of the increasing number and stringency of measures to curb corruption, this malaise is ever growing. Explain the reason for this situation. **(16)**

Registration No.: | | | | | | | | | | |

Total Number of Pages: 02 **Course: B.Tech/IDD**
Sub_Code: 23ES1005

1st Semester Regular/Back Examination: 2024-25
SUBJECT: Basic Civil Engineering
BRANCH(S): MINING, METTA, ME, MECH, ELECTRICAL, ELECTRICAL & C.E, EEE, EE, ETC, ELECTRONICS & C.E, CST, ECE, CSEDS, CSEAIML, CSEAI, CSE, CSE, CIVIL, AUTO, AERO, CSIT, AE, AEIE,
Time: 3 Hours
Max Marks: 100
Q.Code: R540

Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) Differentiate between coarse and fine aggregates.
b) Name the phases of composite.
c) Write two purposes of dam construction.
d) Define per capita demand.
e) Name two chemicals used for disinfection of drinking water.
f) Provide two examples of adhesives.
g) Write two applications of timber.
h) Distinguish between rigid and flexible pavement.
i) Name two non-ferrous metals used in construction work.
j) Define bearing capacity of soil.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Provide a detailed lay out of canal irrigation system.
b) State in detail about the importance of civil engineering in infrastructure development of country.
c) Classify bricks as per Indian standards.
d) Write the various uses of stones in civil engineering works.
e) State the basic components of road with neat ketch.
f) Illustrate about different types of dams.
g) Differentiate between sedimentation and sedimentation aided with coagulation.
h) Provide a detail classification of paints used in construction.
i) State about different sources of drinking water.
j) Write about different modes of transportation.

k) Classify steel on the basis of its carbon content.

l) State about different types of glass used in construction work.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3	Provide a detailed classification of rural and urban roads.	**(16)**
Q4	Summarize in detail about various types of foundations used in construction work.	**(16)**
Q5	Illustrate the water treatment process with neat schematic diagram.	**(16)**
Q6	Enumerate in detail about the types of cement used in construction sector.	**(16)**

Registration No.: | | | | | | | | | | |

Total Number of Pages: 03 **Course: B.Tech/IDD**
Sub_Code: 23ES1001

1st Semester Regular/Back Examination: 2024-25
SUBJECT: BASIC ELECTRICAL ENGINEERING
BRANCH(S): AEIE, AUTO, BIOTECH, CHEM, CIVIL, CE, CST, CSEAI, CSEDS, CSE, CSEAIME, EEE, ELECTRICAL, ECE, ETC, MANUTECH, MECH, MME, METTA, MINERAL, PLASTIC
Time: 3 Hours
Max Marks: 100
Q.Code: R582
Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) The nodal analysis and mesh analysis of an electrical circuit is based on which laws?
b) Explain how current source with a source resistance can be converted into an equivalent voltage source with simple example.
c) State Super-position theorem.
d) If two incandescent lamp of rating 100W, a fan rated 80W and a heater rated at 1000W are operated for 5 hr/day, calculate the total energy consumption in 7 days.
e) A 250 V, 50 Hz supply is connected to a pure inductor. The resulting current is 1.5 A. Calculate the value of the inductance.
f) The Magneto Motive Force of magnetic circuit is analogous to which quantity of electrical circuit? What is the reciprocal of permeability?
g) What is the function of commutator in DC machines?
h) What is the purpose of using core in a transformer and what are its features?
i) What will happen if the slip of induction motor becomes zero?
j) What are the different sources of electrical power?

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) What are the types of DC machine based on their excitation? Explain with circuit diagram.
b) A 220 V shunt motor having armature resistance of 0.4 ohms takes an armature current of 30 A on a certain load. By how much must the main flux be reduced to raise the speed by 30% if the developed torque is constant? Neglect saturation and armature reaction.
c) Explain the principle of operation of a single-phase transformer.
d) Draw the vector diagram of a single-phase transformer for resistive, inductive, and capacitive loads considering winding resistances and magnetic leakage.
e) Explain about layout of distribution system with neat sketch.

f) Calculate the supply voltage V in the circuit shown in Figure 1.

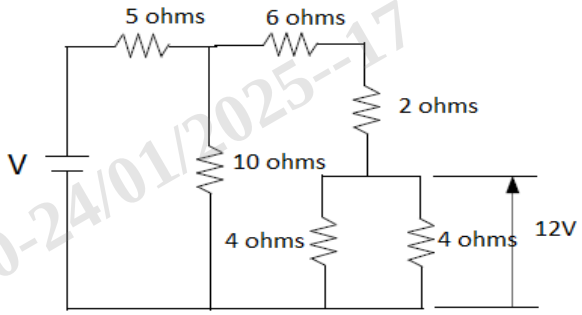


Fig. 1

g) Determine the voltage v in the circuit shown in Figure 2. Use nodal analysis method.

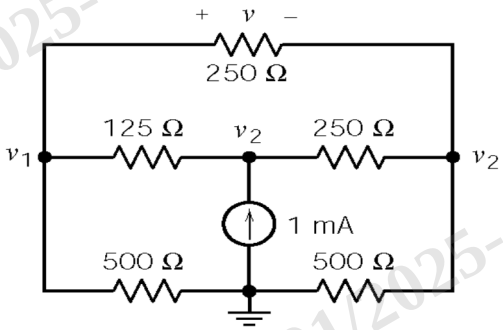


Fig. 2

h) Draw Thevenin's equivalent circuit of the circuit shown in Figure 3.

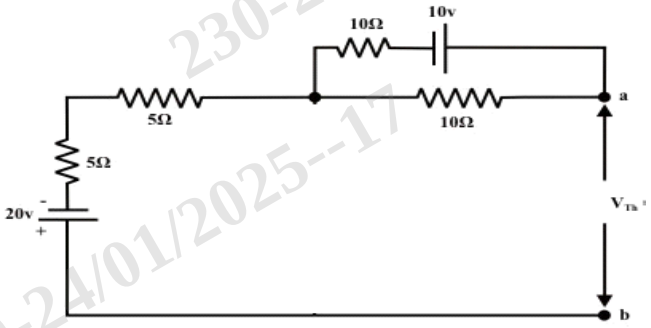


Fig. 3

i) A total current of 1 A is drawn by the circuit shown in Figure 4 fed from an ac voltage, V of 50 Hz. Find the input voltage.

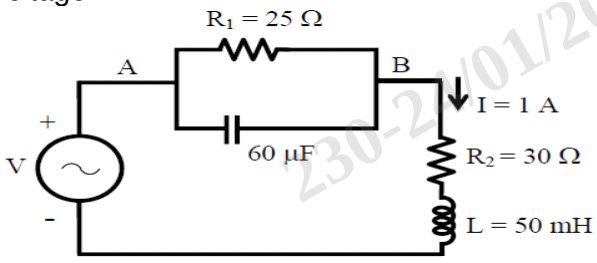


Fig. 4

j) Explain the concept of resonance in series RLC circuit and derive the expression for resonance frequency. Also, plot the related curves.

k) Three identical impedances connected in star fashion draw a line current of $(5\angle -30^0)$ A, when connected across a 400V, 50 Hz, three phase AC supply. Find the resistance, reactance, and impedance per phase.

l) Explain the term "coefficient of coupling". Two coils having self-inductances of 250 µH and 150 µH are magnetically coupled and connected in series opposition. Determine the effective inductance if the coefficient of coupling is 0.1.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 Derive the formula for conversion of star connected resistances to delta connected resistances and vice-versa. Also, find the equivalent resistance R_{ab} in the circuit shown in Figure 5. **(16)**

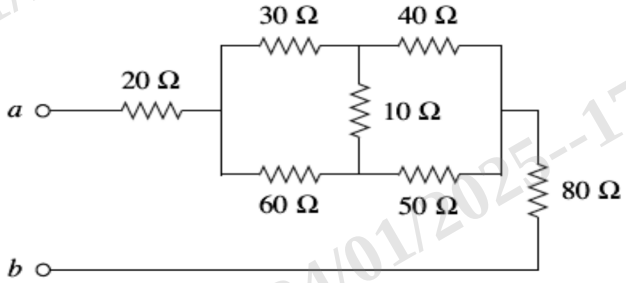


Fig. 5

Q4 Define average value, RMS value, form factor and peak factor. Find the average value, RMS value, form factor and peak factor of the waveform shown in Figure 6. **(16)**

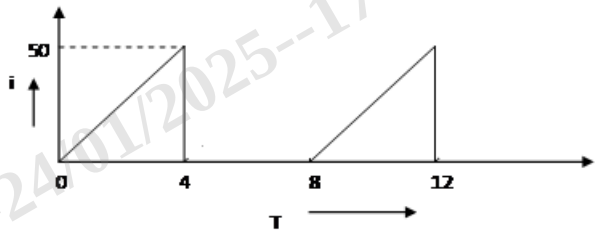


Fig. 6

Q5 **a)** Explain the operating principle of a three phase induction motor and draw its torque-slip characteristic. **(8x2)**

b) A 3-phase, 400 V, 50 Hz, 6 pole induction motor while rotating has frequency of rotor EMF 2 Hz. Calculate the slip, the rotor speed, and speed of stator field with respect to rotor.

Q6 Draw the layout of electric power supply system. With neat diagram explain the layout of hydro-electric power plant. **(16)**

Registration No.: | | | | | | | | | | |

Total Number of Pages: 03

Course: B.Tech/IDD
Sub_Code: 23BS1003

1st Semester Regular/Back Examination: 2024-25
SUBJECT: Chemistry
BRANCH(S): CHEM, CIVIL, BIOTECH, BIOMED, AE, CSIT, AEIE, AERO, AUTO, AME, CSE, CSEAI, CSEAIML, CSEDS, CST, ECE, ECE, ETC, ELECTRONICS & C.E, EEE, EE, ELECTRICAL, ELECTRICAL & C.E, IT, MECH, METTA, MINERAL, MME, MINING, CSEIOT, EEVDT
Time: 3 Hours
Max Marks: 100
Q.Code: R467
Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) If the inter-nuclear distance between two chlorine atoms in a Cl_2 molecule is 198 pm, what is the covalent radius of chlorine?

b) Write the trend in the percentage of ionic character for HF, HBr, HCl, and HI? Justify your answer.

c) Calculate the entropy change when 1 mole of an ideal gas is heated from 20 °C to 40 °C at a constant pressure. The molar heat at constant gas pressure over this temperature range is 6.189 cal deg^{-1}.

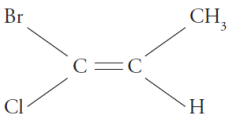
d) If dE = TdS–PdV, prove that

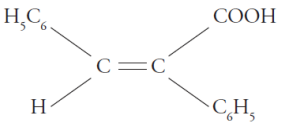
$$\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial S}\right)_V$$

e) Arrange the following in increasing order of energy and wavelength:
X-ray, Visible, Gamma ray, Infrared, Microwave, Radiowave, Ultraviolet

f) What is the main criterion for a molecule to Microwave active? Which of the following molecules will show a microwave rotational spectrum:
HCl, CH_4, CH_2Cl_2, CO_2,

g) Assign E & Z to the following compounds





h) Find the number of enantiomers and meso form in the compound: Tartaric acid [CH(OH)COOH • CH(OH)COOH]

i) Define staggered and eclipsed conformation with example.

j) How does s-character affect the stability of carbanions?

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) State Fajan's rule. How do the charge and size of the cation affect polarization and covalent character? What are the limitations of Fajan's rules in predicting covalent character?

b) What is the inert pair effect? Discuss the factors contributing to this effect taking the example of elements of Boron family.

c) (I) Derive Claypeyron–Clausius Equation.
(II) The latent heat of vaporisation of benzene at its boiling point (80 °C) is 7413 cal mol^{-1}. What is the vapor pressure of benzene at 27 °C.

d) (I) Derive the expression for the free energy change of an ideal gas as a function of pressure.
(II) ΔG for a reaction at 300 K is –16 kcal; ΔH for the reaction is –10 kcal. What is the entropy of the reaction? What will be ΔG at 330 K?

e) State Beer's Law. Derive the expression for absorbance of a homogeneous absorbing solution.

f) Discuss the basic principle of UV-Visible spectroscopy giving a detailed description of different types of transition.

g) A 2.0 x 10^{-3} M solution of a compound transmits 20% of the incident radiation of wavelength 400 nm in a cuvette of 1 cm width. Calculate the absorbance and the molar extinction coefficient.

h) Define and give examples of linear, symmetric tops, spherical tops, and asymmetric tops. Mention whether molecules will be microwave-active or not.

i) Define conformational isomerism with an example. Discuss the conformational isomerism of Cyclohexane with the stability.

j) Describe electrophilic addition reactions, including Markovnikov's rule and anti-Markovnikov additions.

k) Discuss the stereochemistry involved in nucleophilic substitution reactions (SN_1 & SN_2).

l) Describe the Friedel-Crafts alkylation mechanism in aromatic compounds.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 **a)** Define electronegativity by taking a suitable example. How does the electronegativity of elements change across a period and down the group? **(4+8+4)**

b) Discuss the different scales to express the electronegativity of an element.

c) Name the applications of electronegativity and describe any two applications in detail.

Q4 **a)** Define the concept of Entropy and its physical significance. **(4+4+8)**

b) Prove thermodynamically that in an isothermal spontaneous expansion process, the entropy is always increasing.

c) Derive an expression for the entropy change during the mixing of ideal gases. 2 moles of H_2 and 7 moles of N_2 are mixed at 298 K and 1 atmosphere. Assuming the ideal Behavior of the gas, calculate the entropy of mixing per mole of the mixture formed.

Q5 **a)** Write the basic principle of IR spectroscopy and write the expression for vibrational frequency. Mention the factors affecting the vibrational frequency. Also, describe the different types of vibration. **(8+8)**

b) Write the principle of Microwave spectroscopy. Derive the expression for the radius of a diatomic molecule using the application of microwave spectroscopy. Calculate the reduced mass and moment of inertia of $^{1}H^{35}Cl$ if the bond length is 1.27 Å.

Q6 **a)** Define a free radical with examples. How are free radicals generated in organic reactions (2 methods)? **(4)**

b) Discuss the geometry of free radicals and their structural characteristics. **(4)**

c) Arrange the following as per the decreasing stability and explain the trend using factors including ease of formation, hyperconjugation, and resonance. **(8)**

(i) $CH_2 = CH–C•H_2$, $C_6H_5C • H_2$, $(C_6H_5)_3 C•$, $(C_6H_5)_2C•H$

(ii) $C • H_3$, $(CH_3)_2 C• H$, $(CH_3)_3 C•$, $CH_3 C • H_2$

Registration No.: | | | | | | | | | | |

Total Number of Pages: 03 **Course: B.Tech/IDD**

Sub_Code: 23ES1004

1st Semester Regular/Back Examination: 2024-25

SUBJECT: Engineering Mechanics

BRANCH(S): CIVIL, CHEM, BIOTECH, CSIT, AE, AERO, AEIE, AUTO, CSE, CSE, CSEAI, CSEAIML, CSEDS, CST, ECE, ECE, ETC, EEE, EE, ELECTRICAL, ELECTRICAL & C.E, IT, MECH, MINERAL, MINING, MME, CSEIOT, EEVDT

Time: 3 Hours

Max Marks: 100

Q.Code: R512

Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.

The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) What is a free body diagram (FBD)?

b) State the Varignon's principle of moments.

c) What is a couple? What is the arm of a couple and its moment?

d) State the laws of friction.

e) Define coefficient of friction and angle of repose.

f) Differentiate between center of gravity and centroid.

g) State Pappus's theorem with an example.

h) State D'Alembert's principle with an example.

i) Define Coefficient of Restitution.

j) Write an expression showing that path of projectile is a parabola.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) The magnitude of two forces is such that when acting at right angles produce a resultant force of $\sqrt{20}$ N and when acting at 60^0 produce a resultant of $\sqrt{28}$ N. Calculate the magnitude of the two forces.

b) Two locomotives on opposite banks of a canal pull, a vessel moving parallel to the banks by means of two horizontal ropes. The tensions in these ropes have been measured to be 20 kN and 24 kN while the angle between them is 60^0. Find the resultant pull on the vessel and the angle between each of the ropes and the sides of the canal.

c) A ladder 5 meters long rests on a horizontal ground and leans against a smooth vertical wall at an angle 65° with the horizontal. The weight of the ladder is 800 N and acts at its middle. The ladder is at the point of sliding, when a man weighing 650 N stands on a rung 1.5 metre from the bottom of the ladder. Calculate the coefficient of friction between the ladder and the floor.

d) State and prove Lami's Theorem.

e) A block weighing 1000 N, overlying a 10° wedge on a horizontal floor and leaning against a vertical wall, is to be raised by applying a horizontal force to the wedge. Assuming the coefficient of friction between all the surface in contact to be 0.3, determine the minimum horizontal force required to raise the block.

f) A semicircular area is removed from a trapezium as shown in Fig. 1 (dimensions in mm). Determine the centroid of the remaining area.

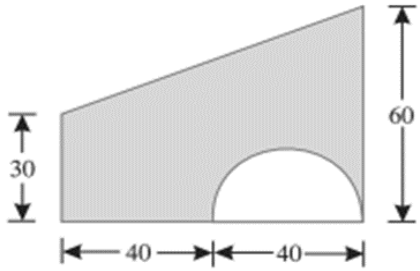


Figure 1

g) Find the moment of inertia of a triangle about its centroid.

h) At a certain instant, a body of mass 10 kg, falling freely under the force of gravity, was found to be falling at the rate of 20 m/s. What force will stop the body in (i) 2 seconds and (ii) 2 meters?

i) Two bodies A and B of mass 80 kg and 20 kg are connected by a thread and move along a rough horizontal plane under the action of a force 500 N applied to the first body of mass 80 kg as shown in Fig. 2. The coefficient of friction between the sliding surfaces of the bodies and the plane is 0.25. Determine the acceleration of the two bodies and the tension in the thread, using D' Alembert's principle.

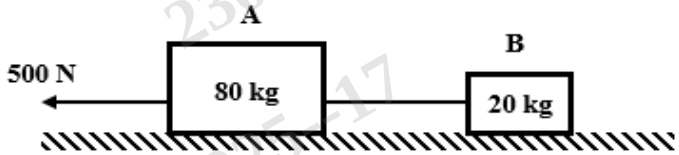


Figure 2

j) A ball overtakes another ball of twice its own mass and moving with 1/7 of its own velocity. If coefficient of restitution between the two balls is 0.75, show that the first ball will come to rest after impact.

k) Derive expression for (i) Horizontal Range and (ii) Maximum Height, when a particle is being projected from ground with velocity '*u*' at an angle '*θ*'.

l) Two bodies weighing 200 N and 450 N are hung to the ends of a rope passing over an ideal pulley as shown in Fig. 3. With what acceleration the heavier body comes down and what is the tension in the string?

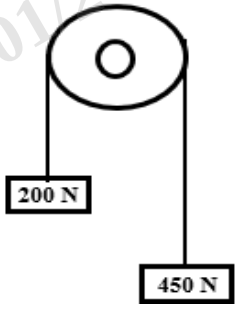


Figure 3

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 Two cylinders P and Q rest in a channel as shown in Fig. 4. The cylinder P has diameter of 100 mm and weighs 100 N, whereas the cylinder Q has diameter of 180 mm and weighs 300 N. If the bottom width of the box is 180 mm, with one side vertical and the other inclined at 60°, determine the forces at all the four points of contact. **(16)**

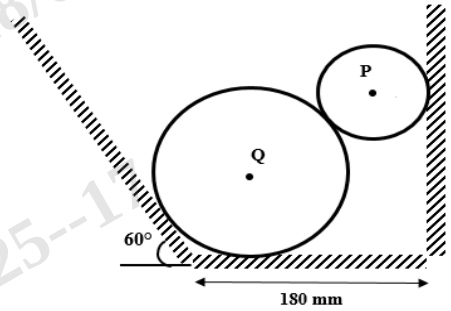


Figure 4

Q4 Determine the reactions and the forces in each member of an equilateral triangular truss supporting two loads as shown in Fig. 5. **(16)**

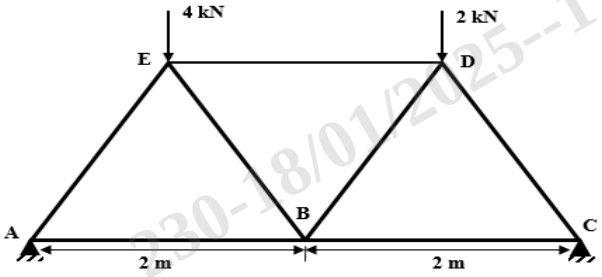


Figure 5

Q5 An I-section is made up of three rectangles as shown in Fig. 6. Find the moment of inertia of the section about the horizontal axis passing through the center of gravity of the section. **(16)**

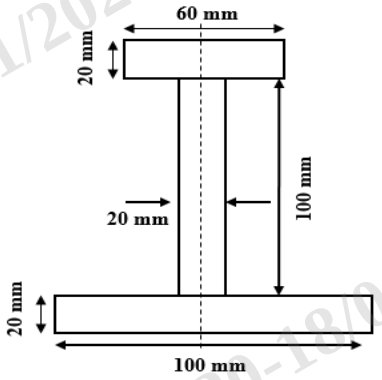


Figure 6

Q6 **a)** The motion of a particle is defined by the relations: $x = t^2 + 3t$ and $y = t^3 - 8t^2 + 3$, where x and y are in meters and t is in seconds. (i) Write the equations defining the motion of the particle in vectorial form and (ii) Calculate the velocity and acceleration of the particle at t = 3 seconds with vector diagram. **(10)**

b) A wheel increases its speed from 45 rpm to 90 rpm in 30 seconds. Find (i) angular acceleration of the wheel, and (ii) no. of revolutions made by the wheel in these 30 seconds. **(6)**

Registration No.: | | | | | | | | | | |

Total Number of Pages: 02 **Course: B.Tech/IDD**

Sub_Code: 23BS1001

1st Semester Regular/Back Examination: 2024-25

SUBJECT: Mathematics-I

BRANCH(S): BIOMED, BIOTECH, CE, CE, CHEM, CIVIL, CSIT, AE, AEIE, AERO, AUTO, CSE, CSE, CSEAI, CSEAIML, CSEDS, CST, ECE, ECE, ETC, ELECTRONICS & C.E, EE, EEE, ELECTRICAL, ELECTRICAL & C.E, MANUTECH, IT, ME, MECH, METTA, MINERAL, MINING, CSEIOT, EEVDT, PLASTIC, MME

Time: 3 Hours

Max Marks: 100

Q.Code: R422

Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.

The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) Find the length of the curve $y = \ln(\cos x); x = 0 \; to \; x = \frac{\pi}{3}$.

b) Determine the value of $\Gamma\left(\frac{11}{2}\right)$.

c) In the Taylor's series expansion of e^x about $x = 2$, find the coefficient of $(x-2)^4$.

d) A function $f(x) = 1 - x^2 + x^3$ is defined in the closed interval [–1, 1]. Find the value of x in the open interval (–1, 1) for which the mean value theorem is satisfied.

e) Find the first order partial derivatives of $f(x, y) = \log(x^2 + y^2)$.

f) Define sufficient condition for relative maxima for a function of two variables.

g) Check whether the set $S = \{(1,1,0),(0,1,0),(0,0,1)\}$ is LI or LD?

h) Are the vectors $\alpha_1 = (1,0,-1)$, $\alpha_2 = (1,2,1)$, $\alpha_3 = (0,-3,2)$ forms a basis for R^3?

i) Let A and B be two square matrices of the same order and A is symmetric. Show that BAB^T is also symmetric.

j) State Caley-Hamilton theorem.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Find the entire length of the curve $x = a(t + \sin t), y = a(1 + \cos t)$.

b) Define improper integral. Test the convergency of $\int_{-\infty}^{\infty} \frac{dx}{x^2+a^2}$.

c) Find the volume of a sphere of radius r.

d) Discuss the applicability of Rolle's theorem to the function $f(x) = |x|$ in the interval (–1, 1).

e) Show that $\frac{x}{1+x} < \log(1+x) - \frac{x}{1+x}$ using mean value theorem.

f) Expand $\tan^{-1} x$ in powers of x by Maclaurin's theorem.

g) If $u = \sin^{-1}\frac{x}{y} + \tan^{-1}\frac{y}{x}$, prove that $xu_x + yu_y = 0$.

h) Define maxima, minima, and saddle point. Find the maxima and minima of the function $f(x, y) = x^3 + 3xy^2 - 15x^2 - 15y^2 + 72x.$

i) Write the method of Lagrange's multipliers method. Find the extreme values of the function $f(x, y) = xy$ subject to $2x + 2y = 5$.

j) If $V = \{(x, y, z) : x = y\}$, then show that V is a vector space and find its basis and dimension.

k) Show that every square matrix is uniquely expressible as the sum of a symmetric matrix and a skew-symmetric matrix.

l) Find the eigenvalues and eigenvectors of the matrix $\begin{bmatrix} 3 & 1 \\ 6 & 2 \end{bmatrix}$.

Part-III
Only Type Long Answer Questions (Answer Any Two out of Four)

Q3 **a)** Find the surface of the solid generated by the revolution of the asteroid $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$ about the x-axis. **(8x2)**

b) Find the Maclaurin's series for $f(x) = e^x$. Also find the Maclaurin's series of $g(x) = \cosh x$.

Q4 **a)** If $u = f(r)$, where $r^2 = x^2 + y^2$, prove that $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = f''(r) + \frac{1}{r} f'(r)$. **(8x2)**

b) If $x = r\sin\theta\cos\phi, y = r\sin\theta\sin\phi, z = r\cos\theta$, show that $\frac{\partial(x, y, z)}{\partial(r, \theta, \phi)} = r^2 \sin\theta$.

Q5 **a)** Solve the system of linear equation by Gaussian elimination method: **(8x2)**
$2x_1 + x_2 = 0, x_1 + 2x_2 + x_3 = 0, x_2 + 2x_3 + x_4 = 0, x_3 + 2x_4 = 5.$

b) Let $U = \{(x_1, x_2, x_3, x_4): x_2 - 2x_3 + x_4 = 0\}$ and $W = \{(x_1, x_2, x_3, x_4): x_1 = x_4, x_2 = 2x_3\}$ be subspaces of $\mathbb{R}^4$. Then find basis and dimension of $U \cap W$.

Q6 **a)** Find inverse of the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 1 & 0 & 4 \\ 0 & 1 & 1 \end{bmatrix}$ using Gauss Jordan elimination. **(8x2)**

b) Define orthogonal matrix. Discuss about the eigenvalue of it.

Registration No.: | | | | | | | | | | |

Total Number of Pages: 03

Course: B.Tech/IDD
Sub_Code: 23BS1002

1st Semester Regular/Back Examination: 2024-25
SUBJECT: PHYSICS
BRANCH(S): PLASTIC, MINING, METTA, MECH, ME, MANUTECH, ELECTRICAL, ELECTRICAL & C.E, EEE, ELECTRONICS & C.E, ETC, ECE, CST, CSEDS, CSEAIML, CSEAI, CSE, CSE, AUTO, AERO, AEIE, AE, CSIT, CIVIL, CHEM, CE, CE
Time: 3 Hours
Max Marks: 100
Q.Code: R466

Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III. The figures in the right hand margin indicate marks.

Part-I

Q1 Answer the following questions: **(2 x 10)**

a) A mass attached to a spring undergoes simple harmonic motion. What would happen to the period of oscillation if the mass is halved? Justify your answer.

b) In a driven RLC circuit, how does the power dissipated change as the driving frequency moves away from resonance?

c) Why do thin films exhibit interference effects when illuminated by monochromatic light? A thin film of oil has a refractive index of n = 1.5 and is illuminated with light of wavelength λ = 600 nm. What is the minimum thickness of the film required for constructive interference in the reflected light?

d) What is the role of the grating spacing d in determining the position of diffraction maxima? A diffraction grating has 6000 lines per inch. A monochromatic light of wavelength λ = 500 nm is incident on it. Calculate the angle of the first-order maximum.

e) In a transverse electromagnetic wave, if the electric field oscillates in the vertical direction, in which direction does the magnetic field oscillate? In an electromagnetic wave, the electric field has a maximum value of E_0 = 3 V/calculate the corresponding magnetic field strength at the same point, assuming the wave propagates in free space.

f) How does Ampère's law with Maxwell's correction relate to the magnetic field generated by both current and changing electric fields? If the magnetic field in a region changes with time as $B = 2t\hat{k}$ T, calculate the induced electric field (in differential form) at a distance of 1 m from the origin, using Faraday's law.

g) Why is it incorrect to think of an electron as simply a particle or a wave? An electron is moving at a speed of 2×10^6 m/s. Calculate the wavelength associated with it.

h) What does it mean to normalize a wave function in quantum mechanics? Why is normalization important for the physical interpretation of the wave function?

i) What are the key characteristics that differentiate laser light from ordinary light? How does the coherence impact the applications of laser in fields like communication and medical treatments?

j) Why does the three-level system typically require more power to achieve population inversion compared to the two-level system?

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Difference between heavy, critical, and light damping in an oscillating system. A system with mass m = 2 kg and spring constant k = 16 N/m is subjected to a damping force. If the system is critically damped, calculate the value of the damping coefficient γ.

b) Explain the working principle of a forced electrical oscillator. How does the driving frequency affect the amplitude of oscillations in a driven RLC circuit?

c) With a suitable diagram obtain the relation between thickness of air film enclosed between the Plano-convex lens and plane glass plate of Newton's ring apparatus. In a Newton's ring experiment, the radius of the 5th ring is measured to be 2.5 mm, and the radius of the 10th ring is 5.0 mm. If the radius of curvature of the lens is 1.2 m, calculate the wavelength of the light used.

d) Explain the phenomenon of Fraunhoffer diffraction due to a single slit. Obtain the condition for the formation of minima and maxima in the diffraction pattern.

e) Mention the significance of Maxwell's electromagnetic equation. Obtain Maxwell's equation which is derived from Faraday's law of electromagnetic induction.

f) Starting from Ampere's circuital law with Maxwell's correction, derive its differential form. What is the significance of the displacement current term in this equation?

g) Difference between group velocity and phase velocity. Establish the relationship between group velocity and phase velocity.

h) Derive the time-dependent Schrödinger equation for a free particle starting from the energy operator and wave function representation. Discuss the assumptions involved in the derivation.

i) Explain the concept of population inversion in a three-level and four-level laser system. Why is population inversion a necessary condition for laser action?

j) Difference between spontaneous and stimulated emission. In a laser system, what is the role of the pumping mechanism in achieving population inversion?

k) Set up one-dimensional wave equation for a vibrating string under tension. Discuss the physical assumptions made during the derivation.

l) Define the quality factor (Q) of an oscillatory system. Derive the expression for the quality factor of an LCR circuit

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 **a)** Derive the equation of motion for a forced damped harmonic oscillator and solve it to find the steady-state solution. **(7+5)**

b) A forced damped harmonic oscillator is driven by a sinusoidal force of amplitude F_0 = 10 N at a driving frequency ω = 3 rad/s. If the mass is 2 kg, damping coefficient is 1 Ns/m, and spring constant is 20 N/m, calculate: I. The amplitude of steady-state oscillation and II. The phase angle between the driving force and displacement. **(2+2)**

Q4 **a)** Derive the expression for the diameter of the nth bright ring in Newton's rings. Compare and contrast the expressions for the diameters of bright and dark rings. **(5+3)**

b) Explain the applications of Newton's rings in determining the wavelength of monochromatic light. **(5)**

c) In a Newton's rings experiment, the diameter of the 20^{th} bright ring is 0.8 cm. If the light source is changed to a wavelength λ_2 such that the diameter of the 20^{th} bright ring becomes 1.0 cm, calculate the new wavelength λ_2. **(3)**

Q5 **a)** Derive Maxwell's wave equation for a conducting medium. Incorporate the conductivity σ of the medium and discuss how it affects the propagation of electromagnetic waves. **(6+2)**

b) Show how Maxwell's wave equation in a vacuum leads to the conclusion that electromagnetic waves propagate at the speed of light. Derive the expression for the speed of light c in terms of ε_0 and μ_0. **(5)**

c) In a vacuum, an electromagnetic wave has an electric field amplitude $E_0 = 50$ V/m. Calculate the corresponding magnetic field amplitude B_0 of the wave. **(3)**

Q6 **a)** Derive the expression for the allowed energy levels of a particle confined in a one-dimensional box of width L. Discuss the quantization of energy and its physical significance. **(7)**

b) Establish the relationship between Einstein's coefficients A_{21}, B_{21}, and B_{12} for a system in thermal equilibrium. **(5)**

c) With the help of an energy level diagram, explain the lasing action in a He-Ne Laser. Why is it classified as a four-level laser system? **(4)**

Registration No.: | | | | | | | | | | |

Total Number of Pages: 02 **Course: B.Tech/IDD**
Sub_Code: 23ES1003

1st Semester Regular/Back Examination: 2024-25
SUBJECT: PROGRAMMING IN C AND DATA STRUCTURE
BRANCH(S): PLASTIC,MINING, METTA,MECH, ME,MANUTECH,ELECTRICAL, ELECTRICAL &C.E., EEE,ETC,ELECTRONICS & C.E., ECE,CST,CSEDS,CSEAIML,CSEAI,CSE,AUTO,AEIE,AERO, AE, BIOMED, BIOTECH,CHEM,CIVIL, CE
Time: 3 Hours
Max Marks: 100
Q.Code: R511
Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) What is a global variable and a local variable? Give an example.
b) Define a symbolic constant. Give an example. Why is it used?
c) What are *getchar ()* and *putchar ()* functions and why they are used?
d) List the different types of errors that occur during the execution of a C program.
e) Differentiate between postfix and prefix operators with an example.
f) Distinguish between compiler and interpreter.
g) Differentiate between *while* and *do-while* loops.
h) Distinguish between homogeneous and heterogeneous data structures.
i) Explain pointer to function with an example.
j) Difference between a binary tree and a binary search tree with an example.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Difference between Linear Search and Binary Search. Write the pseudocode to implement binary search. Search the value "14" from the following sequence of numbers:
2, 5, 10, 14, 15, 30, 38
b) What is dynamic memory allocation? Write and explain the different dynamic memory allocation functions in C.
c) Write a program to find the area of a rectangle using call-by-reference.
d) Write a program to find whether a number is PALINDROME or not.
e) Write a C function "*isprime(num)"* that accepts an integer argument and returns 1 if the argument is prime; a 0, otherwise. Write a C program that invokes this function to generate the prime numbers between a given ranges.

f) Explain what is an algorithm and what is a flow-chart? How are they used as a problem-solving tool? Give an example to justify your answer.

g) Write a C program to copy the contents from one string to another without using the string functions.

h) Write a program to read 20 unsorted numbers to an array and pass the address of this array to a function to sort the numbers in ascending order using bubble sort technique.

i) Explain array of pointers and pointer to array with an example from each.

j) Can a function return multiple values? Justify with an example.

k) Differentiate between "break" and "continue" statements with an example.

l) Construct the binary tree from the given sequence:
Pre-order: A B D E C F
In-Order: D B E A F C

Part-III
Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 **a)** Explain about array of structures and structure within a structure with an example. **(8+8)**

b) Write a C program to maintain a record of 10 players of Indian Cricket team. Print the scores of each player in 5 matches given the name of each player.

Q4 **a)** Explain the two-way selection (*if, if-else, nested if-else*) in C language. **(8+8)**

b) Write a C program to read a year as input and find whether it is a leap year or not

Q5 **a)** Explain what is a recursive function along with its properties. **(10+6)**

b) Write a C program to print the Fibonacci sequence of 10 numbers using recursion.

Q6 **a)** Differentiate between an array and a linked-list. **(10+6)**

b) Write an algorithm to create a single linked-list of 5 nodes. Insert the elements and display them.

Registration No.: | | | | | | | | | | |

Total Number of Pages: 02

Course: B.Tech/IDD
Sub_Code: 23ES1002

1st Semester Regular/Back Examination: 2024-25
SUBJECT: BASIC ELECTRONICS
BRANCH(S): CE, CHEM, BIOTECH, BIOMED, AE, CSIT, AERO, AEIE, AME, AUTO, CSE, CIVIL, CSE, CSEAI, CSEAIML, CSEDS, CST, ECE, ETC, EE, EEE, ELECTRICAL & C.E, ELECTRICAL, IT, ME, MECH, METTA, MINING, MINERAL, MME, EEVDT, CSEIOT
Time: 3 Hours
Max Marks: 100
Q.Code: R583

Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) What is a p-n junction diode? How does a barrier field appear across a p-n junction?
b) Explain the necessity of a rectifier.
c) Compare between a FET and a BJT.
d) Why the field - effect transistor is called a unipolar transistor?
e) Mention advantages and limitations of integrated circuits.
f) State the characteristic an ideal Op-Amp.
g) Discuss the concept of “Virtual ground” in Op-Amp.
h) Determine the binary equivalent of 26.25.
i) State and prove De Morgan’s theorem.
j) Perform the binary addition
100101 + 101 + 1101 + 100

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) The reverse saturation current of a Si p-n junction is 5 nA at 27°C. What are the static and dynamic resistances of the junction for an applied forward bias of 0.6 V?
b) Discuss the concept of Zener and avalanche breakdown.
c) Draw the common base circuit of a junction transistor. Sketch its output characteristics. Explain the active, saturation, and cutoff regions.
d) Explain the term transistor biasing. What are the factors determining the choice of the Q-point? Draw the circuit diagrams of fixed-bias and voltage divider bias arrangement of an n-p-n transistor in CE configuration. Mention the limitations and advantages of both arrangements.
e) When the channel of a JFET is said to be pinched off? Define the pinch-off voltage. What is the pinch off current? By applying Shockley’s current expression, draw the transfer characteristic curve of an n-channel JFET.

f) Draw the circuit diagram of a common emitter n-p-n transistor with the following parameters: V_{BB} = 5V, R_B = 100 KΩ, R_C = 1 KΩ, V_{CC} = 10V, V_{BE} = 0.7 V, I_{CO} = 0, β = 100. Find I_B and I_C. Is the transistor operating in the saturation region? Justify.

g) Explain the principle of operation of a digital inverter.

h) Draw a non-inverting configuration using Op-Amp. Calculate the output voltage of the circuit for υ_i = 150 mV rms, R_f = 75 KΩ and R_i = 36 KΩ.

i) Calculate the output voltage for the circuit shown in figure-1 with inputs of V_1 = 40 mV rms and V_2 = 20 mV rms.

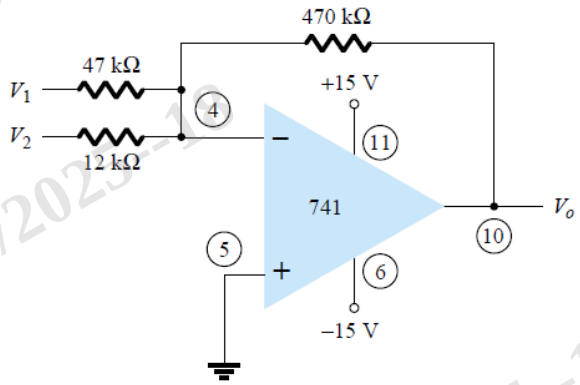


Figure-1

j) What is the difference between signed and unsigned numbers? Discuss the three different methods used for representing signed numbers in binary. Support each method by a suitable example.

k) Simplify the Boolean expressions to a minimum number of variables

I. $xy + x(wz + w\bar{z})$

II. $(x + \bar{y} + \bar{z})(\bar{x} + \bar{z})$

III. $\bar{A}B + \bar{A}C + BC + A\bar{B}C$

l)

I. Show that an EX-OR gate can be built with NOR gates.

II. How can the NAND gates be combined to perform the NOR operation?

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 Draw the circuit diagram of (i) a half-wave rectifier and (ii) a full-wave rectifier. Explain the principle of operation of each circuit by applying a sinusoidal wave at the input of the rectifier. **(16)**

Q4 What are different types of MOSFETs? Explain with a neat sketch, the structure and the working of an n-channel enhancement type MOSFET. Draw its drain and transfer characteristic curve. **(16)**

Q5 Describe the use of operational amplifier as an Adder and Subtractor. **(16)**

Q6 $f_1 = AB + A\bar{C} + C + A\bar{B}C + ABC$ **(8 + 4 + 4)**

$f_2 = \bar{B} + ABC$

(i) Simplify the above functions.

(ii) Draw the neat original circuit.

(iii) Draw the neat simplified circuit.

Registration No.: | | | | | | | | | | |

Total Number of Pages: 03 **Course: B.Tech/IDD**
Sub_Code: RBE1B001

1st Semester Back Examination: 2024-25
SUBJECT: BASIC ELECTRICAL ENGINEERING
BRANCH(S): CSE, CSEAI, ECE, CSEAIML, CSEDS, CST, CIVIL, CE, BIOTECH, CSIT, AUTO, MANUTECH, MECH, ELECTRICAL & C.E, ELECTRICAL, EEE, ETC, PLASTIC, MME
Time: 3 Hours
Max Marks: 100
Q.Code: R584

Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) Draw the *V-I* characteristics of ideal and practical voltage and current sources.

b) Determine the equivalent resistance between a-b terminals of the network shown in Figure 1 using series and parallel concepts (step by step).

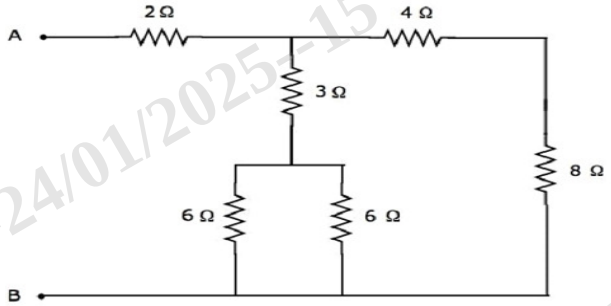


Fig.1

c) State Super position Theorem?

d) Three non-inductive resistances of 5 Ω, 20 Ω, and 25 Ω are connected in delta. Obtain its equivalent star connected system maintaining the same phase sequence.

e) What is the steady state value of voltage across inductor and current through capacitor?

f) The impedance of an electrical circuit is (30 – j50) ohms. Determine (I) the resistance, (II) the capacitance, and (III) the magnitude of the impedance, when the circuit is connected to a 240 V, 50 Hz supply.

g) Explain the term fringing and leakage flux.

h) How do hysteresis and eddy current losses depend on frequency?

i) What is slip in an induction motor?

j) Classify DC generators based on their excitation.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) State Norton's Theorem. Find current through R_L = 18 Ω of the network shown in Figure 2 using Norton's theorem.

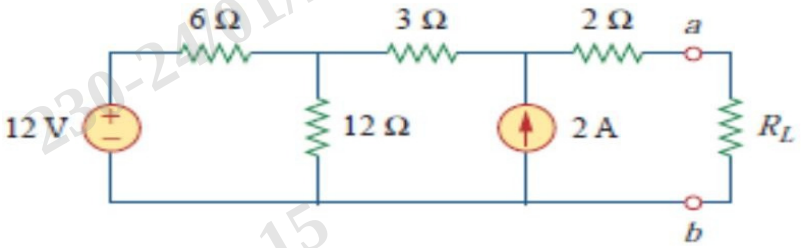


Fig.2

b) Find v_0, I_1, I_2 and I_3 using nodal analysis of the network shown in Figure 3.

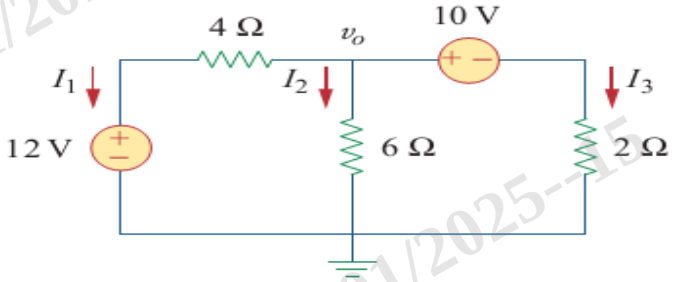


Fig.3

c) Determine the form factor of the current whose waveform is shown in Figure 4.

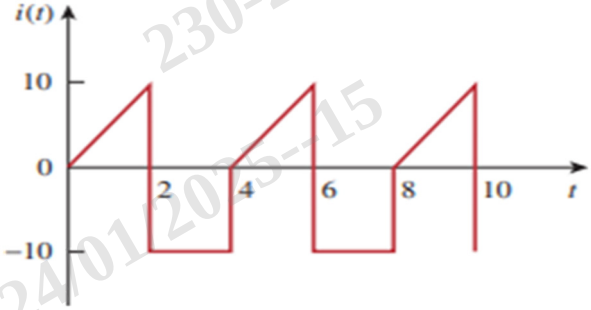


Fig.4

d) A coil having a resistance of 2 Ω and inductance of 0.01 H is connected across a 220 V, 60 Hz supply. Calculate the apparent power, active power and reactive power drawn from the source. Show the powers in power triangle diagram.

e) At t = 0, a DC voltage source of 120 V is applied to a series RL circuit having R = 20 ohm, L = 8 H. Determine the time at which voltage drop across R & L are same.

f) An iron ring of circular cross-section of 5×10^{-4} m^2 has mean circumference of 2 m. It has a saw cut of 2 mm and is wound with 800 turns. Determine the exciting current when flux in air gap is 5×10^{-3} Wb. Given μ_r of iron is 600. Neglect leakage and fringing.

g) Draw the B~H curve of a magnetic material and explain its significance.

h) A 3-phase induction motor has 6-poles and runs at 960 rpm on full load. It is supplied from an alternator having 4 poles and running at 1500 rpm. Calculate the full load slip of the motor.

i) A 6- pole lap wound DC shunt motor has 500 conductors in the armature. The resistance of the armature path is 0.05. The resistance of shunt field is 25 W. Find the speed of the motor when it takes 120 A from the dc mains of 100 V supply. Flux per pole is 0.2 mwb.

j) For the three coupled coils in Figure 5 below, calculate the total inductance.

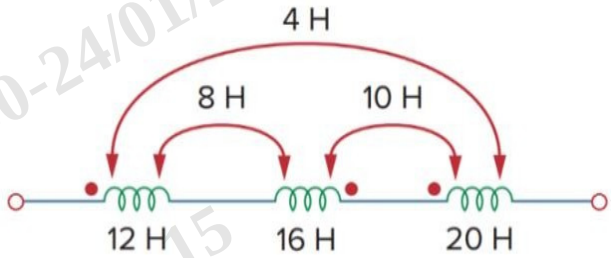


Fig. 5

k) The EMF per turn of 3300 V / 395 V, 50 Hz single- phase core type transformer is 7.5 V, if the maximum flux density is 1 tesla, then find a suitable number of primary and secondary turns and the net cross- sectional area of the core.

l) The armature of a 4-pole, DC shunt motor has a lap-connected armature winding with 740 conductors. The no load flux per pole is 30 mwb. If the armature current is 40 A, determine the torque developed.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 Determine the current flowing through in each branch shown in Figure 6 when the input voltage across A-B is $100\angle 0^0$ at 50 Hz. **(16)**

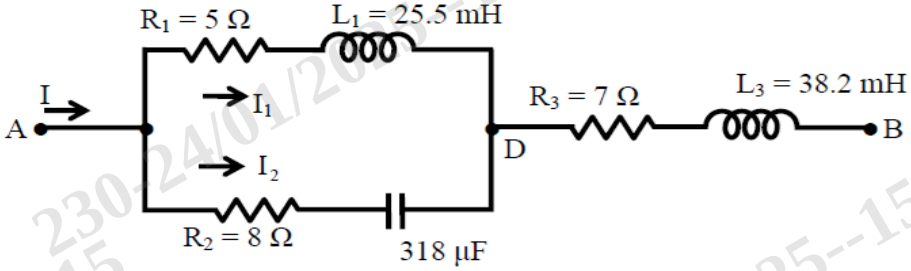


Fig.6

Q4 **a)** Derive the relationship between line and phase values of balanced star and delta connected load with balanced supply. **(8+8)**

b) A three-phase delta connected load consumes a power of 60 kW taking a lagging current of 200 A at a line voltage of 400 V, 50 Hz. Find the parameters of each phase. What would be the power consumed, if the load were connected in star?

Q5 Explain Biot-Savart's Law in detail. What are the limitations of Biot-Savart's Law? What factors determine the magnetic field at a point due to a current-carrying wire? **(16)**

Q6 Explain the principle of operation of a single phase transformer. Also, derive its EMF equations. **(16)**

Registration No.: | | | | | | | | | | |

Total Number of Pages: 02 **Course: B.Tech**
Sub_Code: RBL1B002

1st Semester Back Examination: 2024-25
SUBJECT: BASIC ELECTRONICS ENGINEERING
BRANCH(S): ETC, EEE, ELECTRICAL & C.E, ELECTRICAL, MECH, MINING, METTA, IT, AEIE, CIVIL, CST, CSEAIML, ECE, CSE
Time: 3 Hours
Max Marks: 100
Q.Code: R585
Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) Explain the depletion region in p-n diode.
b) Differentiate between clipper and clamper circuit.
c) Why the emitter region of a transistor is more heavily doped than the base region?
d) "BJT is current controlled while FET is voltage controlled". Justify.
e) Mention advantages and limitations of integrated circuits.
f) Draw the equivalent circuit of ideal Op-Amp.
g) What is CMRR in Op-Amp? Mention its value in ideal Op-Amp.
h) Determine the hexadecimal equivalent of 26.25.
i) State and prove De Morgan's theorem.
j) Discuss Absorption theorem present in Boolean algebra.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Draw the equivalent circuit of Si p-n diode. Discuss the procedure to find the equivalent circuit.
b) With neat circuit diagram, describe the operation of bridge rectifier. Calculate its PIV.
c) Show the width and doping profile of a transistor. Justify your answer. Draw the symbol of p-n-p and n-p-n transistor.
d) Discuss how a transistor can be used as a voltage amplifier.
e) For an n-channel D- and E-MOSFET
I. Draw the structure and corresponding symbol.
II. Draw Drain and transfer characteristics curve with proper voltage and current notations.
III. Mention output current expression.
f) Explain the principle of operation of a digital inverter.
g) I. If $\beta = 16.5$, $I_E = 1.8$ mA and $I_{CO} = 12\mu A$, calculate I_C and I_B when the transistor is used in the CE configuration.
II. For a p-n-p transistor in CE mode, $\beta = 100$. What is the value of α? If $I_{CO} = 10\mu A$,
III. What is the collector current for an emitter current of 2 mA?

h) Draw inverting configuration using Op-Amp. Calculate the voltage gain of the circuit for υ_i = 150 mV rms, R_f = 75 KΩ and R_i = 36 KΩ. For the same parameter, calculate the voltage gain of non-inverting amplifier.

i) Compute the output voltage of the circuit shown in figure-1 for Vin1 = 0.2 V, Vin2 = – 0.5V, Vin3 = 0.8V, R1 = 33KΩ, R2 = 22KΩ, R3 = 12 KΩ, and R4 = 68 KΩ.

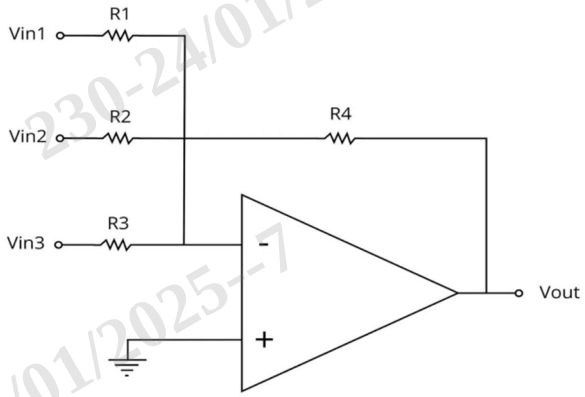


Figure-1

j) I. Subtract $(29)_{10}$ from $(15)_{10}$ using 2's complement method of subtraction.
II. Subtract $(25)_{10}$ from $(8)_{10}$ using 1's complement method of subtraction.

k) Convert the following:
I. $(FACE)_{16} = (?)_{10}$
II. $(65.45)_{10} = (?)_2$
III. $(1111011011011.11011)_2 = (?)_8$

l) With circuit symbol, Boolean expression and truth table explain all logic gates.

Part-III
Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 Explain the Ge-diode characteristics under forward and reverse biased conditions. Draw the V~I characteristic curve. Indicate important voltage and current parameter. Compare the V~I curve to that of a Si diode. Mention some application of diode. **(16)**

Q4 Explain with a neat sketch, the structure and the working of a n-channel JFET. Draw its drain and transfer characteristic curve. Mention its application. **(16)**

Q5 Describe the use of operational amplifier as inverting and non-inverting amplifier. **(16)**

Q6 $f_1 = \overline{\overline{AB + \overline{(A + BC)}} + \bar{A}BC}$ **(16)**

$f_2 = \overline{\overline{X\bar{Y} + XYZ} + X(Y + X\bar{Y})}$

(i) Simplify the above functions. Draw the original and simplified circuit.
(ii) Express f_1 *and* f_2 in standard SOP form.
(iii) Express f_1 *and* f_2 in standard POS form.

Registration No.: | | | | | | | | | | |

Total Number of Pages: 02 **Course: B.Tech**
Sub_Code: RCH1A002

1st Semester Back Examination: 2024-25
SUBJECT: Chemistry
BRANCH(S): MINING, MECH, ELECTRICAL, ELECTRICAL & C.E, EEE, ETC, CSE, CSEAI, CSEAIML, ECE, CST, CSEDS, AEIE, CSIT, CIVIL, BIOTECH
Time: 3 Hours
Max Marks: 100
Q.Code: R469
Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) What do you mean by eigenvalue and Eigenfunction?
b) What is the effect of conjugation on the λ_{max} of the chromophore and why?
c) What is the main criterion for a molecule to Microwave active? Which of the following molecules will show a microwave rotational spectrum: HCl, CH_4, Br_2, and CO_2.
d) Why does the fusion curve of ice have a negative slope?
e) How does stainless steel maintain luster for a long period?
f) Why aluminum kitchen utensils corrode less readily than do iron ones?
g) Differentiate between gross calorific value and net calorific value.
h) Write the composition and uses of Water gas.
i) The percentage composition of a sample of bituminous coal was found to be as C = 75.4%; H = 5.3%; O = 12.6 %; N = 3.2%; S = 1.3 % and Ash = rest. Calculate the calorific value.
j) What are CNTs? Write any two applications of CNT.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Discuss the basic concepts and postulates of quantum chemistry.
b) Discuss the basic principle of UV-visible spectroscopy giving a detailed description of different types of transition.
c) Write the expression for vibrational frequency. The oscillation frequency of $^{1}H^{35}Cl$ is 8.667x 10^{13} sec^{-1}. Calculate the wave number and the force constant.
d) The separation of lines in the microwave spectrum of $^{12}C^{16}O$ molecules was found to be 298 m^{-1}. Calculate the rotational constant, bond length of the molecule, and the energy corresponding to first excited state energy level.
e) Define corrosion with an example. Discuss the factors affecting the corrosion.

f) The percentage of composition of a sample of bituminous coal was found to be C = 75.4%; H = 4.5%; O = 12.5 %; N= 3.1 %; S = 1.4 % and the rest being Ash. Calculate the minimum weight of air required for complete combustion of 1kg of coal and percentage composition of the dry products of combustion by weight.

g) Define a fuel. Mention the characteristics of a good fuel.

h) Discuss the proximate analysis of fuel.

i) Discuss the petroleum refining process with a neat diagram.

j) Discuss briefly the different classes of nanomaterials based on the macroscopic dimension with examples.

k) Discuss the environmental applications of nanomaterials.

l) Discuss the different approaches of nanomaterials synthesis using suitable examples.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 **a)** Write the Schrodinger wave equation and define the terms involved in it. **(4+8+4)**

b) Derive the expression for the wave function and energy of a particle in one dimension box using the application of the Schrodinger wave equation.

c) An electron is confined in a 1D box of width 2°A undergoes a transition from the ground state (n = 1) to the first excited state (n = 2). Calculate the transition energy.

Q4 **a)** Write the expression for Gibb's phase rule and condensed phase rule, and define different terms involved in it. Discuss the application of the phase rule to the Bi-Cd system using a neatly leveled phase diagram. **(8+8)**

b) What do you mean by invariant points? Discuss invariant points in water and sulfur systems with a diagram.

Q5 **a)** Define electrochemical corrosion. Discuss the theory of electrochemical corrosion. **(8+8)**

b) List the different methods of corrosion prevention with a detailed description of cathodic protection methods.

Q6 **a)** Write the principle of Microwave spectroscopy. Derive the expression for the radius of a diatomic molecule using the application of microwave spectroscopy. **(8+8)**

b) State Beers Law. Derive the expression for absorbance of a solution using the application of this law

Registration No.: | | | | | | | | | | |

Total Number of Pages: 02 **Course: B.Tech**
Sub_Code: RCE1E001

1st Semester Back Examination: 2024-25
SUBJECT: Communicative English
BRANCH(S): CIVIL, CSIT, AEIE, CSEAIML, CSEDS, CST, ECE, CSE, ETC, ELECTRONICS & C.E, EEE, ELECTRICAL & C.E, ELECTRICAL, MECH, MINING, PLASTIC
Time: 3 Hours
Max Marks: 100
Q.Code: R448
Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right-hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) What does IPA stand for?
b) How can body language contribute to delivering a confident presentation?
c) Define 'noise' in the communication process.
d) What is the importance of the 'channel' in communication?
e) Give two examples of a barrier to effective communication.
f) Why is active listening important?
g) What is falling intonation, and when is it used?
h) Give an example of contrastive stress in a sentence.
i) Write the phonemic transcription of the following words using IPA – “School”, “Book”.
j) Why is it important to know your audience when preparing a presentation?

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) How does non-verbal communication differ from verbal communication?
b) Which English sounds are commonly problematic for Indian speakers of English? Give examples.
c) Explain how the use of contrastive stress in the following sentence changes its meaning and helps highlight the product's unique selling point.
Example sentence: "This product is MUCH faster than any other on the market."
d) Explain the importance of body language in communication. How does body language impact the message you are trying to convey? Provide one example of positive and negative body language in a professional setting.
e) Explain how intonation can influence the meaning of a sentence in everyday conversation. Use an example where rising intonation, falling intonation, or a combination of both changes the meaning of the statement.
f) What are some common mistakes candidates make during interviews? Offer tips for mastering the art of giving interviews.

g) How should you manage conflicting opinions in a group discussion while maintaining a constructive and collaborative environment? Provide an example of how to handle such situations?

h) What techniques did Swami Vivekananda's use in Chicago to address the diverse audience, and how did his words promote unity and understanding?

i) Examine Toni Morrison's Nobel Prize Acceptance Speech. How did her personal experiences and reflections on literature shape her message?

j) Email communication has become a common medium in the professional world. Discuss the structure and tone of a formal email.

k) Correct the errors in the following sentences. If there is no error then write No Error.

I. The data collected during the survey have been analyzed thoroughly.
II. Each of the students in the class have submitted their assignments on time.
III. The software solutions offered by the company are highly effective for businesses.
IV. None of the participants were able to answer the final question correctly.
V. The manager, along with his colleagues, were planning the new marketing strategy.
VI. The number of employees working from home has increased significantly.

l) Describe the role of motivation in team management. How can a leader ensure the team remains motivated and productive throughout the project lifecycle?

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 You are applying for a *software development internship* at a leading tech company. Write a CV highlighting your academic qualifications, technical skills, projects, and any relevant internship or work experience. Make sure to focus on the skills and experiences that are most relevant to the role of a software developer, such as proficiency in programming languages, software tools, and any contributions to open-source projects or personal projects. **(16)**

Q4 You are an intern at AQT Solutions, a Tech Startup, and you have been asked to prepare a report on the feasibility of implementing a new feature in the company's mobile application. The feature is intended to improve user engagement. Write a *short report* outlining the feasibility study, key findings, and recommendations. **(16)**

Q5 You are a student representative in your College Tech Club, and you need to inform all members about an upcoming Hackathon. The Hackathon is scheduled to take place in two weeks, and you need to send out an *official notice* to the members with all relevant details such as the date, time, registration process, and theme. **(16)**

Q6 Your company, OM Software Solutions, recently purchased a batch of laptops from a vendor, but many of the devices have shown defects after a few weeks of use. As the Purchase Manager, write a *complaint letter* to the supplier, detailing the issues with the laptops, requesting a replacement or refund, and outlining any actions you would like them to take. Ensure the tone is assertive but professional. **(16)**

Registration No.: | | | | | | | | | | |

Total Number of Pages : 02 **Course: B.Tech/IDD**

Sub_Code: RMA1A001

1st Semester Back Examination: 2024-25

SUBJECT: Mathematics-I

BRANCH(S): PLASTIC, MME, CSE, CSE, CSEAI, CSEAIML, CST, CSEDS, ECE, ECE, CIVIL, CHEM, CE, BIOTECH, AUTO, AG, CSIT, AE, AEIE, METTA, MINING, MECH, ME, MANUTECH, IT, ELECTRONICS & C.E, ETC, ELECTRICAL, EEE, ELECTRICAL & C.E

Time: 3 Hours

Max Marks: 100

Q.Code: R423

Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.

The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) What can you say about the radius of curvature of a circle?

b) Find the asymptotes parallel to the co-ordinate axes of the curve $y = \frac{x}{x^2-1}$.

c) Solve $(x + y)dx + dy = 0$.

d) What can you say about the number of integrating factor of the differential equation $M(x, y)dx + N(x, y)dy = 0$.

e) Solve the ode $y'' - 4y' + 4y = 0$.

f) If $y_1(x)$ and $y_2(x)$ are solutions of $y'' + p(x)y' + q(x)y = 0$, then can you say $c_1y_1(x) + c_2y_2(x)$ also a solution? Justify your answer.

g) Define Legendre polynomial.

h) Write two properties of Bessel's function.

i) Prove or disprove that $f(t) * 1 = f(t)$.

j) Find the Laplace transform of $f(t) = t^2 \sin t$.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Find the radius of curvature at any point of the cycloid $x = a(t + \sin t), y = a(1 - \cos t)$.

b) Find the maximum and minimum value of the function

$$f(x, y) = x^3 + y^3 - 3x - 12y + 20.$$

c) Find all asymptotes of the curve $xy(x-2) - (x+3)(x-1) = 0$.

d) Solve the initial value problem $(2xCosy + 3x^2y)dx + (x^3 - x^2Siny - y)dy = 0$; $y(0) = 2$.

e) Solve the ode $y'+\frac{y}{x}=\frac{y^2}{x}\log x.$

f) Solve Euler Cauchy equation $x^2y'' + xy' - 4y = 0.$

g) Reduce the ode $y' + y = y^2$ to a linear ode and solve it.

h) Solve the ode $y'' - 2y' + y = e^x sinx.$

i) Show that $J_{-1/2}(x)=\sqrt{\left\{\left(\frac{2}{\pi x}\right)\right\}}\cos x$.

j) Find the power series solution of the differential equation $y''+8xy'-4y=0$.

k) Find inverse Laplace transform of $F(s)=\ln\left(1+\frac{\omega^2}{s^2}\right).$

l) Solve the initial value problem $y''+9y=0, y(0)=0, y'(0)=1.$

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 **a)** State Gamma and Beta function. Using the relation between them show that **(8x2)**

$$\Gamma\left(\frac{1}{2}\right)=\sqrt{\pi}.$$

b) Find the current in the simple circuit with $C=\infty$ and $E(t)=E_0\sin\omega t$.

Q4 **a)** Solve the ode $y'' + y' = cosec\ x$ by variation of parameter. **(8x2)**

b) Find the general solution of the ode $y''' - 2y'' - 4y' + 8y = e^{-3x} + 8x^2$ using the method of undetermined coefficients

Q5 **a)** Show that $P_n(-x)=(-1)^n P_n(x)$. Hence deduce that $P_n(-1)=(-1)^n$. **(8x2)**

b) Prove that $\sqrt{\left(\frac{\pi x}{2}\right)}J_{3/2}=\frac{1}{x}\sin x-\cos x$.

Q6 **a)** Solve the integral equation $y=1-\sinh t+\int_0^t(1+\tau)\,y(t-\tau)\,d\tau$. **(8x2)**

b) Using Convolution determine the Inverse Laplace transform of

$$F(s)=\frac{s}{(s^2+1)(s^2+4)}$$

Registration No.: | | | | | | | | | | |

Total Number of Pages: 03 **Course: B.Tech**
Sub_Code: RPH1A001

1st Semester Back Examination: 2024-25
SUBJECT: PHYSICS
BRANCH(S): ETC, ELECTRICAL, EEE, ELECTRICAL & C.E, MINING, METTA, MECH, MANUTECH, CIVIL, AEIE, CSIT, AE, CSE, CSEAI, CSEAIML, CST, CSEDS, ECE, PT, PLASTIC
Time: 3 Hours
Max Marks: 100
Q.Code: R468

Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) What is the logarithmic decrement in a damped oscillatory system? Why it is important in engineering?

b) What happens to the amplitude of oscillation if the driving frequency is much smaller than the natural frequency?

c) Mention the principle behind the Fresnel bi-prism experiment and write the formula for the separation of virtual sources in the bi-prism experiment?

d) How does a zone plate work? Determine the total number of zones in a zone plate with a diameter of 10 mm, focal length of 25 cm, and wavelength of 700 nm.

e) What is atomic excitation? Explain why electrons in an atom occupy discrete energy levels.

f) Why is the lattice parameter important in determining the structure of a crystal? The lattice parameter of a face-centered cubic (FCC) crystal is a = 0.4 nm. Calculate the atomic radius (r).

g) Can the gradient of a scalar field be zero at multiple points? Justify with an example.

h) A parallel plate capacitor with a plate area of 1 m^2 and plate separation of 0.01 m is connected to a battery supplying a voltage of 10 V. Calculate the displacement current if the capacitor is charging at a rate of 0.02 C/s.

i) What is the Compton effect? A photon is scattered such that its wavelength increases by 0.01 nm. Calculate the scattering angle.

j) How does increasing the angular frequency affect the ground state energy of a harmonic oscillator? Calculate the ground state energy of a quantum harmonic oscillator with a mass m = 9.1×10^{-31} kg and angular frequency ω = 2×10^{15} rad/s.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) With a suitable diagram derive an expression for refractive index of liquid using Newton's ring method.

b) Explain why electrons cannot exist inside the nucleus based on Heisenberg's Uncertainty Principle.

c) With a brief concept of damped harmonic oscillation derive the differential equation for it. The amplitude of a damped harmonic oscillator decreases to half of its initial value after 4 seconds. Determine the damping constant if the mass of the oscillator is 1 kg and the spring constant is 100 N/m.

d) Define normal modes and normal coordinates in a system of coupled oscillators. Derive the equations of motion for a system of two coupled oscillators

e) State Huygens's principle, Derive the condition for the first minimum in Fraunhofer diffraction for a single slit.

f) What is zone plate? Show that zone plate has multiple foci.

g) Define population inversion. Describe the conditions necessary to achieve population inversion.

h) Write down the significance of Miller Indices. Establish the relationship between Miller Indices and interplanar spacing in a cubic crystal.

i) State Amperes circuital law. With necessary modification obtain Ampere-Maxwell modified law.

j) Write down the difference between solenoidal and irrotational vector field. Prove that the divergence of the curl of any vector field F is zero using $F = x^2i - yzj + xyk$

k) Explain the de Broglie hypothesis and derive the expression for the wavelength of matter waves.

l) What is population inversion and its significance in laser operation? Describe the methods used to achieve population inversion in a laser system.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 **a)** Explain the phenomenon of forced oscillations. Derive the equation of motion for a damped harmonic oscillator subjected to a periodic driving force. Discuss the conditions under which resonance occurs in such a system. **(2+8+2)**

b) A driven damped harmonic oscillator has a mass m = 5 kg, spring constant k = 200 N/m and damping coefficient b = 5 kg/s. **(2+2)**

i. Find the driving frequency at which velocity resonance occurs.

ii. Calculate the maximum velocity of the oscillator at velocity resonance if the driving force amplitude is $F_0 = 50$ N.

Q4 **a)** Explain the concept of half-period zones. Derive the expression for the radius of the nth half-period zone in a circular aperture. Explain how the concept of half-period zones leads to the formation of alternate transparent and opaque zones. **(3+6+2)**

b) A zone plate has a focal length $f_1 = 0.5$ m for light of wavelength $\lambda = 600$ nm. **(1+2+2)**

i. Calculate the positions of the second and third-order foci.

ii. If the zone plate is illuminated with light of $\lambda = 400$ nm, find the new position of the first-order focus.

iii. if the zone plate produces constructive interference at its first-order focus, determine the phase difference for light passing through adjacent zones.

Q5 **a)** Explain the principle of light propagation in optical fibers based on total internal reflection. Define numerical aperture and derive its expression in terms of the refractive indices of the core and cladding. How is numerical aperture related to the acceptance angle? **(2+6+2)**

b) Describe the formation of energy bands in solids. Why do solids not have discrete energy levels like isolated atoms? **(6)**

Q6 **a)** Derive the electromagnetic wave equation for the electric field (E) and magnetic field (B) in free space using Maxwell's equations. **(4+4)**

b) Derive an expression for the energy and momentum conservation during Compton scattering. **(5)**

c) Explain the phenomenon of pair production. What are the conditions necessary for it to occur? **(3)**

Registration No.: | | | | | | | | | | |

Total Number of Pages: 02 **Course: B.Tech/IDD**
Sub_Code: 23ES1006

1st / 3rd Semester Regular/Back Examination: 2024-25
SUBJECT: Basic Mechanical Engineering
BRANCH(S): CE, CHEM, CHEM, CIVIL, BIOTECH, BIOMED, AE, AERO, AEIE, AUTO, CIVIL, CSE, CSE, CSEAI, CSEAIML, CSEDS, CSEDS, ECE, ECE, ECE, CST, ETC, ETC, EE, EEE, EEE, ELECTRICAL & C.E, ELECTRICAL, ELECTRICAL, MECH, METTA, MECH, METTA, MINERAL, MINERAL, IT, MANUTECH, MINING, MINING, MMEAM, MME, MME, PLASTIC, PT, CSEIOT, EEVDT
Time: 3 Hours
Max Marks: 100
Q.Code: R543
Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

- **a)** What are thermodynamic properties? Differentiate between intensive and extensive properties.
- **b)** State the Zeroth Law of Thermodynamics and explain its significance.
- **c)** Define entropy and explain its physical significance.
- **d)** Differentiate between a 2-stroke and a 4-stroke internal combustion engine.
- **e)** Define the term “specific gravity” of a fluid.
- **f)** How does the viscosity of fluid vary with temperature?
- **g)** What is thermal conductivity? How does it vary for solids and gases?
- **h)** Mention the advantages of metal forming process over other manufacturing processes.
- **i)** Mention the key principles of a robot.
- **j)** Differentiate between shaft and axle in power transmission devices.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

- **a)** Using the First Law of Thermodynamics, derive the energy balance equation for a closed system undergoing a cyclic process.
- **b)** Discuss the importance of the Second Law of Thermodynamics in determining the direction of spontaneous processes.
- **c)** What is a polytropic process? Derive an expression for the work done during a polytropic process in terms of pressure and volume.
- **d)** Illustrate the working cycle of a 4-stroke internal combustion engine with a schematic diagram. Explain each stroke in detail.
- **e)** Differentiate between (I) Laminar vs Turbulent Flow, (II) Uniform vs Non-uniform Flow, (III) Steady vs Unsteady Flow, and (iv) Compressible vs Incompressible Flow.

f) Name the fluid properties responsible for the following actions in fluid mechanics: (I) transport of water from root to the leaves of a plant, (II) spherical form of water bubbles, (III) small insects being able to walk on water surface, (IV) cavitation, (V) no-slip condition, and (VI) boiling of water below 100 ^{0}C temperature.

g) Explain the classification of heat transfer processes, and discuss how convection heat transfer is influenced by fluid motion.

h) Classify engineering materials and describe their characteristics with examples. Discuss the advantages and limitations of composite materials.

i) Highlight the requirements of a good gating system in the casting process.

j) Discuss the commonly encountered defects in sand casting process.

k) Discuss the advantages and disadvantages of spur gears and helical gears used for power transmission between two shafts.

l) Highlight different industrial applications of robots.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 **a)** Air at 12 ^{0}C and 85 kPa enters the diffuser of jet engine steadily with a velocity of 220 m/s. The inlet area of the diffuser is 0.38 m^2. The air leaves the diffuser at a negligible velocity compared to inlet velocity. Calculate (i) mass flow rate of air (ii) the temperature of air leaving the diffuser. **(8+8)**

b) A heat pump is used to heat the house in the winter. A house requires 50 kJ/s heat for heating in winter which is delivered by heat pump from outside air. Work required to operate the heat pump is 8 kW. Calculate COP of heat pump and heat abstracted from the outside.

Q4 **a)** Two parallel plates are separated by a fluid layer of thickness 0.01 m. The lower plate is stationary, and the upper plate is subjected to a force of 10 N over an area of 0.2 m^2. The fluid has a dynamic viscosity of 0.8 Pa. Determine the velocity of the upper plate. **(8+8)**

b) What is the vapor pressure of a liquid? How is it related to cavitation? Explain the factors that influence the vapor pressure of a liquid.

Q5 **a)** The velocity vector in a fluid flow is given as: **(8+8)**

$$V = 4x^3\,\hat{i} - 10x^2 y\,\hat{j} + 2t\,\hat{k}$$

Find the velocity and acceleration of a fluid particle at (2, 1, 3) at time t = 1.

b) A plane wall of 10 cm thickness and 3 m^2 area is made of a material whose conductivity is 8.5 W/mK. The temperatures of the wall surfaces are steady at 100 ^{0}C and 30 ^{0}C respectively. Find the temperature gradient and heat flow across the wall.

Q6 **a)** Define and explain the following mechanical properties: elasticity, plasticity, toughness, and hardness. Provide examples where these properties are critical in material selection. **(8+8)**

b) Explain the types of joints commonly used in robots, such as prismatic, revolute, and spherical joints. Provide examples of where each type is used.

Registration No.: | | | | | | | | | | |

Total Number of Pages: 02

Course: B.Tech/IDD
Sub_Code: RBM1B001

1st / 3rd Semester Back Examination: 2024-25
SUBJECT: Basic Mechanical Engineering
BRANCH(S): CSE, CSE, CIVIL, CSEAI, ECE, ECE, CSEAIML, CSEDS, CIVIL, BIOTECH, CSIT, MINING, MECH, MECH, ELECTRICAL, ELECTRICAL & C.E, EEE, ELECTRICAL, EEE, ETC, MME, PLASTIC
Time: 3 Hours
Max Marks: 100
Q.Code: R542
Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) Differentiate between microscopic and macroscopic view point of thermodynamics.
b) State Zeroth law of thermodynamics with example.
c) State the first law of thermodynamics.
d) What is PMM2?
e) What is the relation between the COP of refrigerator and heat-pump?
f) Define dryness fraction.
g) Write different types of power transmission system.
h) What is Robot Anatomy?
i) What is entropy principle?
j) Explain the purpose of compressor in a refrigeration system.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Show that energy is a property of a system.
b) Define enthalpy. Why does the enthalpy of an ideal gas depend only on temperature?
c) When a stationary mass of gas was compressed without friction at constant pressure, its initial state of 0.4 m^3 and 0.105 MPa was found to change to final state of 0.20 m^3 and 0.105 MPa. There was a transfer of 42.5 kJ of heat from the gas during the process. What was the change in internal energy of the gas?
d) Derive the steady flow energy equation (SFEE) for a single stream entering and a single stream leaving a control volume.

e) An inventor claims to have developed an engine that takes in 105 MJ at a temperature of 400 K, rejects 42 MJ at a temperature 200 K and delivers 15 kWh of mechanical work. Would you advise investing money to put this engine in the market?

f) Show that for an ideal gas, the slope of the constant volume line on the T-s Diagram is more than that of the constant pressure line.

g) Which is more effective way to increase the efficiency of a Carnot engine: to increase T_1, keeping T_2 constant; or to decrease T_2, keeping T_1 constant?

h) Explain the different types of coupling.

i) Explain the principle and working of vapour compression refrigerator system.

j) Explain briefly about different types of brakes.

k) Explain working of pitot tube with neat sketch.

l) Explain different types of Robot Configuration.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 A large insulated vessel is divided into two chambers, one containing 5 kg of dry saturated steam at 0.2 MPa and the other 10 kg of steam, 0.8 quality at 0.6 MPa. If the partition between the chambers is removed and the steam is mixed thoroughly and allowed to settle, find the final pressure, steam quality, and entropy change in the process. **(16)**

Q4 A reversible polytropic process begins with a fluid at pressure of 10 bar, temperature of 200°C and ends at pressure of 1 bar. The exponent n has the value 1.15. Find the final specific volume, the final temperature and the heat transfer per kg of fluid if (a) the fluid is air, and (b) the fluid is steam. **(16)**

Q5 **(a)** Explain the working of steam power plant and give its layout. **(8x2)**

(b) Explain the working of four stroke petrol engine with neat sketch.

Q6 **(a)** Explain the principle of single stage reciprocating air compressor and heat pump with sketch. **(8x2)**

(b) Explain the principle of force and torque measuring methodology with sketch.