

Registration No.:

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Total Number of Pages: 02

Course: B.Tech
Sub_Code: RBE2B001

2nd Semester Back Examination: 2025-26

SUBJECT: Basic Electrical Engineering

BRANCH(S): AE, AEIE, CIVIL, CSE, CSEAI, CSEAIML, CST, ECE, EEE, ELECTRICAL, ELECTRICAL & C.E, ETC, IT, MECH, METTA, MINING

Time: 3 Hours

Max Marks: 100

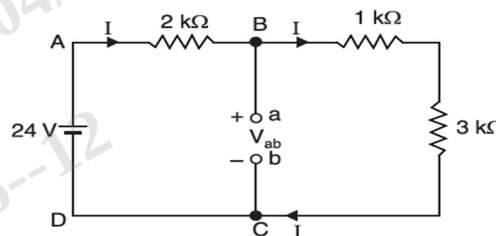
Q.Code: V596

Answer Q1 (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)

- An AC voltage is given by $v = 100 \sin(314t)$. Find its frequency.
- Distinguish between a branch and a node of a circuit.
- Mention the limitations of Ohm's Law.
- Convert $3 + j4$ into polar form and $10 \angle 30^\circ$ into rectangular form.
- What is power factor? Mention the expression.
- Use Kirchhoff's voltage law to find the voltage V_{AB} in the figure.

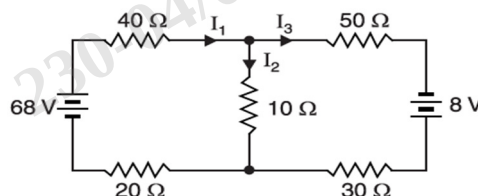


- Calculate magnetic field intensity if $\text{mmf} = 500 \text{ AT}$ and $\text{length} = 0.25 \text{ m}$.
- Why the field of a DC shunt motor never be open circuited?
- What will happen to primary current of a transformer, if secondary current increases? Justify your answer.
- What is the role of brush and commutator in a DC machine?

Part-II

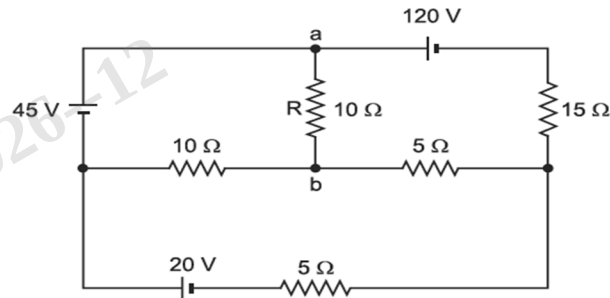
Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) (6 x 8)

- By performing an appropriate source conversion, find the voltage across 20Ω resistor in the circuit as shown in the figure.



- Distinguish between balanced and unbalanced loads. Explain with an example.
- Two impedances $(8 + j10) \text{ ohm}$ and $(7 + j9) \text{ ohm}$ are connected in parallel. Find magnitude and phase angle of total impedance. Another impedance $(5 - j2) \text{ ohm}$ is connected in series with above combination. Find overall impedance.

- d) Using Thevenin's theorem, find the current through resistance R connected between points a and b in the circuit as shown in the figure.



- e) Draw the phasor diagram with a onload 1-phase transformer with proper labeling at lagging load.
- f) Derive the emf equation of DC generator.
- g) A 4-pole, 3-phase induction motor operates from a supply whose frequency is 50 Hz. Calculate
- The speed at which the magnetic field of the stator is rotating
 - The speed of the rotor when the slip is 0.04
 - The frequency of the rotor currents when the slip is 0.03
 - The frequency of the rotor currents at standstill
- h) Give comparison between Magnetic and Electric circuit.
- i) A series RLC circuit with $R = 100$ ohms, $L = 1$ mH and $C = 1000$ picofarads is connected across a sinusoidal source of 20 V with variable frequency (i) Calculate the resonant frequency of the circuit (ii) Calculate the Q factor of the circuit at the resonant frequency, and (iii) Calculate the half power frequencies.
- j) Explain with sketch about different types of DC machine based on the excitation.
- k) A 100 kVA, 11000/400 V, 50 Hz transformer has 40 secondary turns. Calculate the number of primary turns and primary and secondary currents.
- l) Three equal impedances, each of $(4 + j5)$ ohms, are connected in star. This is further connected to a 440 V, 50 Hz, three-phase supply. Calculate (i) phase voltage, (ii) phase angle, (iii) phase current, and (iv) line current.

Part-III

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

- Q3** An iron ring has a mean diameter of 15 cm, a cross-section of 20 cm^2 and a radial gap of 0.5 mm cut in it. It is uniformly wound with 1500 turns of insulated wire and a magnetising current of 1 A produces a flux of 1 mWb. Neglecting the effect of magnetic leakage and fringing, calculate (i) reluctance of the magnetic circuit, (ii) relative permeability of iron, and (iii) inductance of the winding. (16)
- Q4** What is meant by Transformer? Explain about different types of transformers. Draw the circuit diagram for Single Phase Transformer and also explain the Principle, Construction, Working of it. (16)
- Q5** A symmetrical three-phase, three wire 400 V supply is connected to a delta connected load. Impedances in each branch are $Z_{RY} = 10\angle 30^\circ \Omega$, $Z_{YB} = 10\angle 45^\circ \Omega$ and $Z_{BR} = 2.5\angle 60^\circ \Omega$. Find its equivalent star-connected load. (16)
- Q6** Explain the B–H curve of magnetic materials and derive the expression for hysteresis loss. Discuss its significance and methods of reduction. (16)

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Course: B.Tech
Sub_Code: RCH2A002

2nd Semester Back Examination: 2025-26

SUBJECT: Chemistry

BRANCH(S): AUTO, CIVIL, CSE, CSEAIML, CSEDS, CSIT, CST, EEE, ELECTRICAL, ELECTRICAL & C.E., MECH, METTA, MINING, PLASTIC

Time: 3 Hours

Max Marks: 100

Q.Code: V521

Answer Q1 (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)

- State and explain Lambert Beer's Law.
- What are Chromophores?
- Write the Schrodinger wave equation and explain each term.
- Draw the phase diagram of water system.
- Explain the term component. How many components are present in the following system:
$$\text{Water} \rightleftharpoons \text{Water - vapour}$$
- What is cathodic protection?
- What is power alcohol?
- What is stress corrosion?
- What is producer gas?
- What is a nanomaterial? Explain.

Part-II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)

(6 x 8)

- Discuss the effect of conjugation on chromophores.
- Explain the triple point and eutectic point with examples.
- Explain with suitable examples the corrosion due to differential aeration and dry corrosion.
- A solution of chemical 'A' having its concentration 0.12 mol L^{-1} has an absorbance of 0.42. Another solution of 'A' under the same conditions has an absorbance of 0.56. What is the concentration of this solution of 'A'?
- Discuss the main features of the phase diagram of the water system, explaining especially why the slope of the solid-liquid line is negative for water.
- Classify the nanomaterials based on particle size and distinguish between 0D, 1D, and 2D nanomaterials.

- g) How G.C.V. and N.C.V. of a fuel calculated?
- h) Discuss the postulates of quantum mechanics.
- i) How is the calorific value of a fuel determined? Explain with a suitable example.
- j) Discuss the electrochemical theory of corrosion.
- k) Discuss cracking, knocking, and anti-knocking.
- l) Calculate the energy of a particle in a one-dimensional box of length 'a'. Also set up the Schrodinger wave equation for this system.

Part-III

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

- Q3** Explain the synthesis of nanomaterials by top-down and bottom-up approaches. Discuss the application of nanomaterials in environmental fields and electronic devices. (16)
- Q4** Discuss the energy levels, quantum numbers, and selection rules for a particle in a box. (16)
- Q5** What is corrosion? Discuss different types of corrosion and factors affecting corrosion. (16)
- Q6** What is the condensed phase rule? Discuss the phase diagram of the eutectic Bi-Cd system. (16)

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Total Number of Pages: 02

B.Tech
REM2B001

2nd Semester Back Examination: 2025-26

SUBJECT: Engineering Mechanics

BRANCH(S): AEIE, AERO, AG, BIOTECH, CHEM, CIVIL, CSE, CSEAI, CSEAIML, CSEDS, CSIT, CST, ECE, EEE, ELECTRICAL, ELECTRICAL & C.E, ETC, IT, MECH, METTA, MINING

Time: 3 Hours

Max Marks: 100

Q.Code: V669

Answer Q1 (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)

- State the Varignon's principle of moments.
- State the Lami's Theorem.
- Distinguish between center of gravity and centroid.
- Distinguish between static friction and dynamic friction.
- How would you distinguish between a deficient truss and a redundant truss?
- Define polar moment of inertia and relate it to rectangular moments of inertia.
- Define D'Alembert's principle and write the dynamic equilibrium equation.
- A particle starts from rest and moves with acceleration $a(t) = 6t \text{ m/s}^2$. Find its velocity at $t = 4\text{s}$.
- A stone is dropped from the top of a building, which is 65 m high. With what velocity will it hit the ground?
- A car starts from rest with an acceleration of 4 m/s^2 . What is the distance travelled in 8th second?

Part-II

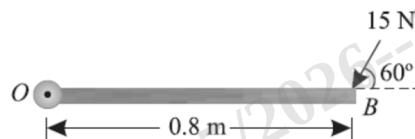
Q2

Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)

(6 x 8)

- Find the angle between two equal forces P, when their resultant is equal to (i) $P/2$ and (ii) $P/4$.
- A force of 15 N is applied at an angle of 60° to the edge of a door 0.8 m wide as shown in Fig.
1. Find the moment of this force.

Fig. 1



- Three forces acting on a particle are in equilibrium. The angles between the first and second is 90° and that between the second and third is 120° . Find the ratio of the forces.
- Find the centroid of an inverted T-section with flange $60 \text{ mm} \times 10 \text{ mm}$ and web $50 \text{ mm} \times 10 \text{ mm}$.
- Derive an expression for the moment of inertia of a triangular section about an axis passing through the C.G. of the section and parallel to the base.
- Calculate the moment of inertia of an I-section having equal flanges $30 \text{ mm} \times 10 \text{ mm}$ and web also $30 \text{ mm} \times 10 \text{ mm}$ about an axis passing through its centroid and parallel to X-X and Y-Y axes.
- State and prove the theorem of perpendicular axis applied to moment of inertia.
- A force of 250 N pulls a body of weight 500 N up an inclined plane, the force being applied parallel to the plane. If the inclination of the plane to the horizontal is 15° , find the coefficient of friction.

- i) A projectile is fired from ground at 40° with speed 180 m/s. Find: (i) time of flight, (ii) maximum height, and (iii) horizontal range.
- j) Ball A (mass 3 kg, velocity 8 m/s) collides head-on with stationary ball B (mass 5 kg). If $e = 0.65$, find post-impact velocities, energy lost, and impulse on each ball.
- k) A stone is dropped from the top of a cliff 120 m high. After one second, another stone is thrown down and strikes the first stone when it has just reached the foot of the cliff. Find the velocity with which the second stone was thrown.
- l) A wheel rotating about a fixed axis at 24 r.p.m. is uniformly accelerated for 70 seconds, during which time it makes 50 revolutions. Find (i) angular velocity at the end of this interval, and (ii) time required for the speed to reach 150 r.p.m.

Part-III

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

- Q3** Two smooth spheres of weight ' W ' and radius ' r ' each are in equilibrium in a horizontal channel of A and B vertical sides as shown in Fig. 2. Find the force exerted by each sphere on the other. Calculate these values, if $r = 200$ mm, $b = 800$ mm and $W = 100$ N.

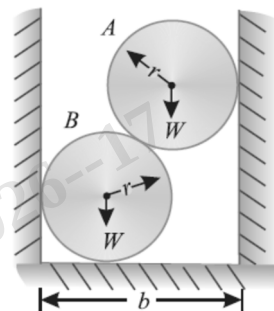


Fig. 2 (16)

- Q4** The cross-section of a beam is shown in Fig. 3. Find the moment of inertia of the section about the horizontal centroidal axis.

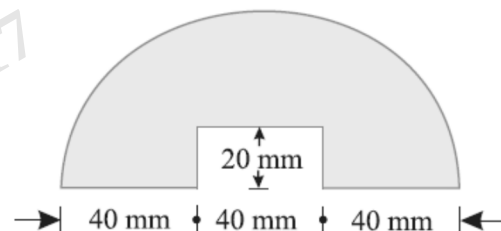


Fig. 3 (16)

- Q5** The truss ABC shown in Fig. 4 has a span of 5 m. It is carrying a load of 10 kN at its apex. Find the forces in the members AB, AC, and BC.

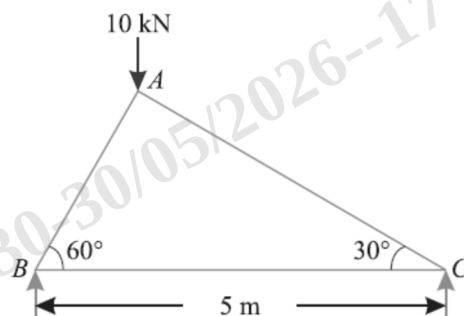


Fig. 4 (16)

- Q6** The relation between the angle of rotation (θ) in radians and time (t) in seconds of a rotating body is given by the equation. $\theta = 2t^3 + 3t^2 + 10$. Find displacement, angular velocity and angular acceleration after 5 seconds.

(16)

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Total Number of Pages: 02

Course: B.Tech
Sub_Code: RMA2A001

2nd Semester Back Examination: 2025-26

SUBJECT: Mathematics -II

BRANCH(S): AE, CIVIL, CSE, CSEAI, CSEAIML, CSIDS, CSIT, CST, ECE, EEE, ELECTRICAL, ELECTRICAL & C.E, ETC, MANUTECH, MECH

Time: 3 Hours

Max Marks: 100

Q.Code: V384

Answer Q1 (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)

- Find the rank of the matrix $\begin{bmatrix} 1 & 2 \\ 2 & 4 \end{bmatrix}$.
- Solve $x + y = 2, x - y = 0$ using Gauss elimination.
- Find the eigen values of $\begin{bmatrix} 2 & 0 \\ 0 & 3 \end{bmatrix}$.
- Check whether the matrix $\begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$ is symmetric.
- Find divergence of $\vec{F} = x^2z\hat{i} + xy\hat{j} - yz^2\hat{k}$ at $(1, -1, 1)$.
- Find gradient of $\phi = x^2 + y^2 + z^2$.
- Verify Green's theorem for simple region.
- Find the flux of $\vec{F} = xi + y\hat{j} + z\hat{k}$ through unit sphere.
- Determine whether the function $f(x) = x^3$ is even/odd.
- What is meant by periodic function.

Part-II

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

- Find the inverse of a matrix $\begin{bmatrix} 2 & 1 & 1 \\ 1 & 3 & 2 \\ 1 & 0 & 0 \end{bmatrix}$ using Gauss-Jordan method.
- Find the rank of a matrix $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 6 \\ 1 & 1 & 1 \end{bmatrix}$ using row reduction.
- Find eigen values and eigen vector of $\begin{bmatrix} 4 & 1 \\ 2 & 3 \end{bmatrix}$.
- Show that the matrix $\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$ is orthogonal and find its inverse.
- Verify green's theorem for $\oint (x^2 - y^2)dx + 2xy dy$.

- f) Discuss unitary matrices and their important properties with examples.
- g) Define arc length of a curve and derive its formula.
- h) Find half range sine series for $f(x) = x, 0 < x < \pi$.
- i) Define conservative vector field and derive necessary condition.
- j) Find the gradient and directional derivative of $\varphi = x^2y + yz^2$ at $(1,1,1)$ in direction of $\hat{i} + \hat{j} + \hat{k}$.
- k) Show that eigenvectors corresponding to distinct eigen values are linearly independent.
- l) Find Fourier series of the periodic function

$$f(x) = \begin{cases} 1, & 0 < x < \pi \\ -1, & -\pi < x < 0 \end{cases}$$

Part-III

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

- Q3** a) Test for consistency and solve the following system using Gauss Elimination: (8)
- $$\begin{aligned} 5x + 3y + 7z &= 4 \\ 3x + 26y + 2z &= 9 \\ 7x + 2y + 10z &= 5 \end{aligned}$$
- b) Show that the matrix (8)
- $$A = \begin{bmatrix} \cos \theta & \sin \theta \\ -\sin \theta & \cos \theta \end{bmatrix}$$
- is an orthogonal matrix.
- Q4** Find the eigenvalues and eigenvectors of the matrix (16)
- $$A = \begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$$
- Also, find the modal matrix P and verify that $P^{-1}AP = D$, where D is the diagonal matrix.
- Q5** Find the Fourier series for the function $f(x) = x^2$ in the interval $(-\pi, \pi)$. Using the series (16)
- obtained, deduce that:
- $$\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \dots = \frac{\pi^2}{6}.$$
- Q6** Verify Gauss Divergence Theorem for the vector field $\vec{F} = 4xz \hat{i} - y^2 \hat{j} + yz \hat{k}$ taken over (16)
- the cube bounded by the planes $x = 0, x = 1, y = 0, y = 1, z = 0, z = 1$.

Registration No.:

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Total Number of Pages: 02

Course: B.Tech
Sub_Code: RPH2A001

2nd Semester Back Examination: 2025-26

SUBJECT: PHYSICS

BRANCH(S): AEIE, BIOTECH, CIVIL, CSE, CSEAI, CSEAIML, CSEDS, CSIT, CST, EEE,
ELECTRICAL, ELECTRICAL & C.E, ETC, IT, MECH, MME, PLASTIC

Time: 3 Hours

Max Marks: 100

Q.Code: V523

Answer Q1 (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)

- What do you mean by sharpness of resonance? What is the phase difference between the velocity and the driving force of a driven oscillator at resonance?
- What is the logarithmic decrement in a damped oscillatory system?
- Differentiate between Fresnel and Fraunhofer diffraction.
- State the conditions for sustained interference.
- Calculate the interplanar spacing for a (321) plane in a simple cubic lattice whose lattice constant is 0.42 nm.
- Distinguish between spontaneous emission and stimulated emission.
- State Ampere's circuital law in integral and in differential form.
- If $V = 3x^2y - y^3x^2$, calculate grad V at point (1, -2, -1)?
- The energy required to remove an electron from sodium is 3.1 eV. Does sodium show a photoelectric effect for orange light with $\lambda = 680$ nm? Justify.
- Write down time-independent Schrodinger's equation for a free particle of mass 'm' moving in X-axis.

Part-II

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

- Setup the differential equation for a one-dimensional simple harmonic oscillator. Show that the total energy of the oscillator is constant in time.
- Define coupled oscillation. Formulate the differential equation for the coupled oscillation and establish the normal mode equations.
- With a suitable ray diagram, explain the formation of Newton's rings. Why are the fringes in Newton's rings interference pattern circular?
- Construct a half-period zone. Find the radii and areas of the half-period zones.

- e) Write down the significance of Miller Indices. Establish the relationship between Miller indices and interplanar spacing in a cubic crystal.
- f) State the difference between mono-mode and multi-mode fibres. What is the acceptance angle?
- g) Write Bragg's law of X-ray diffraction. State its significance. A beam of X-rays of wavelength 0.073 nm is diffracted by the (110) plane of rock salt with a lattice constant of 0.3 nm. Find the glancing angle for the second-order diffraction.
- h) Derive the electromagnetic wave equation in terms of the electric vector when the wave is propagating in charge free non-conducting medium. Obtain an expression for its velocity.
- i) State and explain the Poynting theorem. Write the direction and SI unit of the Poynting vector.
- j) What do you mean by Compton shift? In the Compton effect, the incident photon has a wavelength 2×10^{-10} m and angle of scattering $\theta = 90^\circ$. Calculate the wavelength of the scattered photon.
- k) Explain the de Broglie hypothesis and derive the expression for the wavelength of matter waves.
- l) Determine the normalization constant A for the following eigenfunction of a particle confined in a box of length L: $\Psi_n(x) = A \sin(n\pi x/L)$, $0 < x < L$.

Part-III

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

- Q3** a) What is a Bi-prism? How can the wavelength of monochromatic light be measured with the help of a Fresnel's Bi-prism? Explain it in detail. (8)
- b) What is a zone plate? Write down the differences and similarities between the zone plate and the convex lens. (8)
- Q4** a) Write the four Maxwell's equations in differential form in vacuum. Discuss the significance of each of Maxwell's equations. (10)
- b) Define divergence of a vector field. Write its physical significances. Find out the divergence and curl of the given vector field $\mathbf{v} = (xyz)\hat{i} + (3x^2y)\hat{j} + (xz^2 - y^2z)\hat{k}$ at $(2, -1, 1)$. (6)
- Q5** a) What do you mean by photoelectric effect? Find out Planck's constant from Einstein's photoelectric equation. (8)
- b) Define Heisenberg's uncertainty principle. Prove that the ground state energy of the simple harmonic oscillator is non-zero. (8)
- Q6** a) Explain the working mechanism of a He-Ne laser. What is the meaning of resonance transfer in a He-Ne laser? What are the advantages and limitations of a He - Ne laser? (12)
- b) Show diagrammatically and differentiate the valence and conduction bands for insulators, conductors, and semiconductors. (4)