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

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

1st / 3rd Semester Regular/Back Examination: 2025-26
SUBJECT: Basic Mechanical Engineering
BRANCH(S): AUTO, BIOMED, C&EE, CHEM, CIVIL, CSE, CSEAI, CSEAIML, CSEDS, ECE, EEE, ELECTRICAL, ELECTRICAL & C.E, ETC, MECH, METTA, MINING, MMEAM, AE, AEIE, AERO, AIML, AUTO, BIOMED, BIOTECH, CHEM, CIVIL, CS, CSE, CSE(CS), CSEAI, CSEAIML, CSEDS, CST, CST, ECE, EEE, EEVDT, ELECTRICAL, ELECTRICAL & C.E, ELECTRONICS & C.E, ENV, ETC, MANUTECH, MECH, METTA, MINERAL, MINING, MME, PLASTIC
Time: 3 Hours
Max Marks: 100
Q.Code: U689
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)**

a) State the Zeroth Law of Thermodynamics and its importance.
b) Define entropy. State its unit.
c) State the significance of the critical point of a substance.
d) Distinguish between SI and CI engines.
e) Define specific gravity of a fluid.
f) Estimate the difference in pressure between 10 m of mercury column and 10 m of water column in Pascals.
g) What are the criteria for selection of manometric fluid.
h) What is hardness? Name the hardest and softest material in engineering.
i) State two advantages of belt drives.
j) What is meant by degree of freedom (DOF) of a robot?

Part-II

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

a) Explain the terms: process, path, state, and cycle in relation to thermodynamics with illustrative diagrams.
b) Discuss the limitations of the First Law of Thermodynamics. How are they addressed?
c) State and explain the Second Law of Thermodynamics with Kelvin–Planck and Clausius statements.
d) Explain the modes of heat transfer with suitable examples.
e) A hydraulic press has a ram of 15 cm in diameter and a plunger of 1.5 cm in diameter. What force would be required on the plunger to raise a weight of 25 kN on the ram?
f) Define viscosity. Discuss the causes of viscosity of a fluid. How does viscosity of a fluid vary with temperature?

g) Define vapor pressure of a liquid. How is it related to boiling? Highlight the parameters affecting vapor pressure of a liquid.

h) Discuss common casting defects, their causes, and remedies.

i) Explain the principle and working of arc welding with a neat sketch.

j) Compare hot working and cold working processes.

k) Explain the construction and working of gear drives.

l) Describe different types of clutches used in automobiles.

Part-III

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

Q3 **a)** During process A, system receives 20 kJ heat and produces 30 kJ work. The process B between same end conditions, receives of 15 kJ heat. Determine the change in internal energy during the process and work done in process. Prove that if the cycle is formed using processes A and B, the given data confirms to the first law of thermodynamics. **(8 + 8)**

b) Air at 12 °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.

Q4 **a)** A shaft of 6 cm in diameter and 60 cm long is pulled steadily a V = 0.6 m/s through a sleeve 6.02 cm in diameter. The clearance is filled with oil having kinematic viscosity of 0.006 m^2/s and specific gravity, S = 0.88. Estimate the force required to pull the shaft. **(8 + 8)**

b) An inverted U-tube manometer is connected to two pipes, A and B, transporting water (density, ρ_w = 1000 kg/m^3). The top of the manometer is filled with oil (specific gravity, S = 0.8). The center of pipe A is 30 cm higher than B. The oil-water interface in the left limb (connected to A) is 20 cm below the center of A. The oil-water interface in the right limb is 40 cm below the center of B. Find the pressure difference $P_A - P_B$.

Q5 **a)** Compare casting, welding, and forming processes. **(8 + 8)**

b) Discuss the role of material properties in manufacturing process selection.

Q6 **a)** Describe different types of brakes and their applications. **(8 + 8)**

b) Describe the anatomy of a robot with the help of a block diagram.

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

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

1st Semester Back Examination: 2025-26
SUBJECT: Chemistry
BRANCH(S): CIVIL, CSE, CSEAI, CSEAIML, CSIT, CST, ECE, EEE, ELECTRICAL, ELECTRICAL & C.E, ETC, MECH, MINING
Time: 3 Hours
Max Marks: 100
Q.Code: U583
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)**

a) Write the basic laws governing the quantum chemistry.
b) Arrange the following in increasing order of energy and wavelength:
X-ray, Visible, Gamma ray, Infrared, Microwave, Radiowave, Ultraviolet
c) How many vibrational modes are possible for CO_2, and state which of the vibrational modes are IR active?
d) 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_3Cl, SF_6
e) Define degree of freedom. Calculate the degrees of freedom in the Following system.
H_2O (s)↔ H_2O (l)↔ H_2O (g)
f) I. Electrochemical corrosion occurs in _____. (Anode/ Cathode)
II. Corrosion is an example of _____ (reduction/ oxidation/ neutralization/ precipitation) reaction.
g) Write the composition of producer gas and synthetic petrol.
h) Define a 0D nanomaterial with example.
i) What is pitting corrosion?
j) Write the full form and difference between LPG and CNG.

Part-II

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

a) What is meant by time independent wave function, Ψ of a particle? What is the physical significance of the wave function (ψ & ψ^2)? What do you mean by (i) Eigen value and (ii) Eigen function.
b) Define chromophore and auxochrome with example. Discuss the effect of conjugation on the chromophore.
c) i) State Lambert-Beer's Law. Write the expressions for the absorbance and define the different terms in it. ii) When a monochromatic radiation is allowed to fall on a solution of a compound with concentration 0.05 M, the intensity of the incident radiation reduces to one fifth of the initial value. If the path length is 1 cm, calculate the molar extinction coefficient.
d) i) Write down the zero-point energy expression for a vibrating diatomic molecule. Explain the terms. ii) The vibrational energy levels for a diatomic molecule are equispaced (according to SHO). Explain.
e) The separation of lines in the microwave spectrum of CO 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.

f) Write down the energy expression of allowed vibrational energy level in joules, in wavenumber and explain the terms (follow simple harmonic oscillator model). What are the selection rules for the vibrational transition?

g) Explain with the help of Clausius-Clapeyron equation; why transition curve of rhombic Sulphur has positive slope and that of fusion curve of water system is negative.

h) Draw a neat diagram and discuss the Water equilibrium system.

i) What is corrosion? How is it prevented for metallic materials by using cathodic protection method?

j) What is gross calorific value? When does GCV = NCV? A sample of coal has the following ultimate analysis by mass (on a dry, ash-free basis): Carbon (C) = 82.0 % Hydrogen (H) = 5.5 %, Sulfur (S) = 1.5 %, Oxygen (O) = 10.0 %, Nitrogen (N) = 1.0% (Inert, does not contribute to heating value) Calculate the GCV.

k) Distinguish between the Top-down and Bottom-up approaches to nanomaterial synthesis. List one common technique for each approach. Discuss two major advantages and two significant challenges/limitations associated with the Bottom-up approach compared to the Top-down method.

l) Write a short note on the Refining of petroleum.

Part-III

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

Q3 **a)** Derive the complete wave function and total energy for a particle of mass *m* moving in a one-dimensional box of length *a* using Schrodinger time-independent wave equation. **(12)**

b) An electron is confined to a 1-micron thin layer of silicon. Assuming that the semiconductor can be adequately described by a one-dimensional quantum well with infinite walls, calculate the lowest possible energy within the material in units of electron volt. If the energy is interpreted as the kinetic energy of the electron, what is the corresponding electron velocity? (The effective mass of electrons in silicon is $m^* = 0.26\ m_0$, where $m_0 = 9.11 \times 10^{-31}$ kg is the free electron rest mass). **(4)**

Q4 **a)** The fundamental and first overtone transitions of $^{14}N^{16}O$ are centred at 1876.06 cm^{-1} and 3724.20 cm^{-1}, respectively. Evaluate the equilibrium vibrational frequency, the anharmonicity, the exact zero-point energy, and the force constant of the molecule. **(8)**

b) Define condensed phase rule. Draw and explain the phase diagram of bismuth –cadmium system. Explain the terms: eutectic point and eutectic mixture. If Bi-Cd eutectic mixture has 40 % of Cd by mass, then what would happen if a molten mixture of Bi and Cd containing 15 % of Cd is gradually cooled to the eutectic temperature of the system? **(8)**

Q5 **a)** Discuss electrochemical corrosion with mechanism. **(8)**

b) 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 minimum weight of air necessary for complete combustion of 1 kg of coal and the percentage composition of dry products of combustion by weight. **(8)**

Q6 **a)** (i) Write any three principles of Green Chemistry that are directly applied in green nanomaterial synthesis. (ii) Describe the general procedure for synthesizing nanoparticles using a plant-mediated green route. **(6)**

b) Compare the green synthesis method with a conventional chemical reduction method for producing metal nanoparticles with example. Highlight two comparative advantages of the green method from an environmental and economic standpoint. **(6)**

c) Why is achieving a narrow size distribution often more challenging in green synthesis compared to some precisely controlled chemical methods? **(4)**

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Total Number of Pages: 02

Course: B.Tech
Sub_Code: RMA1A001

1st Semester Back Examination: 2025-26
SUBJECT: MATHEMATICS-I
BRANCH(S): AE, AG, AUTO, CHEM, CIVIL, CSE, CSEAI, CSEAIML, CSEDS, CSIT, CST, ECE, EEE, ELECTRICAL, ELECTRICAL & C.E, ELECTRONICS & C.E, ETC, IT, MANUTECH, MECH, MINING, MME, PLASTIC
Time: 3 Hours
Max Marks: 100
Q.Code: U508

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 parallel asymptotes with examples.
b) Write the necessary condition for a function $f(x,y)$ to have an extremum.
c) Prove or disprove that the integrating factor for the non-exact ordinary differential equations (ODEs) is unique.
d) Solve the ODE $xdy - ydx = 0$.
e) Compute the value of the expression $\frac{1}{D}(logx)$.
f) Write the general form of Euler-Cauchy equation.
g) Write the power series of the function $f(x) = e^{-x^2}$.
h) Write the Bessel's equation of the first kind.
i) Find the Laplace transform of $\cosh at$.
j) Determine the inverse Laplace transform of 1.

Part-II

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

a) Find the asymptotes to the curve $x^3 + y^3 - 3axy = 0$.
b) Establish the relation between Beta function and Gamma function.
c) Solve the ODE $(3\,x^2y^4 + 2xy)dx + (2x^3y^3 - x^2)dy = 0$.
d) Check whether the ODE $(x^2 + y^2 + 2x)dx + 2ydy = 0$ is exact. Also solve it.
e) Find the general solution of the second order homogeneous ODE $4y'' + 4y' - 3y = 0$.
f) Find the general solution of the ODE $y''' + 4y'' + 4y = 8e^{-2x}$.
g) Solve the ODE $y'' + y = 0$ using power series method
h) Solve the ODE $y'' + y = 10e^{2x}$ using the method of undetermined coefficients.
i) Show that the Bessel's function of first kind satisfies the recurrence relation $J_{v+1} - J_{v-1} = -2J_v'$.
j) Find the Convolution $\sin \omega t * \cos \omega t$.

k) Solve the integral equation $y = \sin t - \int_0^t y(\tau)\sin(t-\tau)d\tau$.

l) Compute $L^{-1}\left\{\frac{3s-2}{s^2-4s+20}\right\}$.

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

Q3 a) Find the radius of curvature at any point of the curve (r, θ) for the curve $r = a(1 - cos\theta)$. **(8 x 2)**

b) Find the relative extrema and saddle point of the function $f(x, y) = 2x^2 + 2xy + y^2 - 2x - 2y + 5 = 0$.

Q4 Solve the ODEs (I) $\frac{dy}{dx} + 2xy = e^{-x^2}$ (II) $x\frac{dy}{dx} + y = xy^2$. **(8 x 2)**

Q5 a) Find the power series solution of the of the ordinary differential equations $y'' + y' - y = 0$ about the point $x = 2$. **(8 x 2)**

b) Show that $(2n + 1)\, xP_n(x) = (n + 1)P_{n+1}(x) + n\, P_{n-1}(x)$.

Q6 a) Use Laplace transform method to solve the initial value problem $y'' - 3y' + 2y = e^{2t}, y(0) = 3,\ y'(0) = 5$. **(8 x 2)**

b) Solve the ODE $y'' + 2y' + y = e^{-x}\log x$ using the method of variation of parameters.

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

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

1st Semester Back Examination: 2025-26
SUBJECT: PHYSICS
BRANCH(S): AEIE, AG, CIVIL, CSE, CSEAIML, CSEDS, CSIT, CST, EEE, ELECTRICAL, ELECTRICAL & C.E, ETC, MANUTECH, MECH, PT
Time: 3 Hours
Max Marks: 100
Q.Code: U585

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)**

a) What is meant by a coupled oscillatory system and why do these systems have more than one natural frequency?

b) What is meant by damping in vibrations? What happens to the natural frequency of an oscillator when damping is introduced?

c) Explain why alternate half-period zones produce waves of opposite phase at the observation point.

d) Why is monochromatic light preferred for observing clear interference fringes and state the condition for destructive interference in a two-source interference pattern.

e) How acceptance angle and numerical aperture are related and mention the factors on which the numerical aperture of an optical fibre depends?

f) Why does each set of parallel lattice planes in real space correspond to a single point in reciprocal space?

g) How does displacement current differ from conduction current?

h) State Maxwell's first equation in integral form and explain the physical significance of each term.

i) How does the Heisenberg uncertainty principle rule out the presence of electrons inside the nucleus?

j) A wave function is given by $\psi = A(x^2 + 1)$. Is it an acceptable wave function? Give reason.

Part-II

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

a) With the help of a resonance curve, explain the behaviour of amplitude of a forced oscillator at low, resonant, and high driving frequencies. If the bandwidth of a resonant system is 4 rad.s^{-1} and the resonant frequency is 100 rad.s^{-1}, calculate the quality factor of the system.

b) Derive differential equation of a damped harmonic oscillator and obtain its solution for the underdamped case. If the logarithmic decrement of an oscillator is 0.05, 0.05, find the ratio of amplitudes after 10 oscillations.

c) Derive an expression for the focal length of a zone plate and discuss the formation of multiple foci. A zone plate has a first-order focal length of 40 cm. Calculate the positions of the third and fifth order foci.

d) Describe the experimental arrangement of Fresnel's bi-prism for producing interference. If the fringe width observed is 1.2 mm, the distance between the sources and the screen is 1 m, and the wavelength is 500 nm calculate the separation between the virtual sources**.**

e) Explain the three basic atomic processes absorption, spontaneous emission, and stimulated emission using suitable energy-level diagrams. If an excited state has a mean lifetime of 10^{-8} s, calculate the spontaneous emission probability coefficient.

f) Explain the energy-level transitions involved in the operation of a Ruby laser. Why is a high pumping power required for Ruby laser operation? Calculate the energy of a photon emitted by a Ruby laser operating at a wavelength of 694.3 nm. ($h = 6.63 \times 10^{-34}$ J.s)

g) Explain the Bose–Einstein distribution function and discuss its characteristic features. Calculate the occupation probability of an electron at energy equal to the Fermi energy at 300 K.

h) Explain the significance of divergence and curl in electromagnetic theory. State the condition for a vector field to be solenoidal and irrotational. For the vector field $\vec{A} = yz\hat{i} + xz\hat{j} + xy\hat{k}$, verify whether the field is solenoidal and irrotational.

i) State Gauss's law of electrostatics in free space. Write the corresponding statement in a linear, homogeneous, isotropic dielectric medium and explain the physical significance of permittivity. Calculate the electric field intensity at a distance of 0.2 m from a point charge of 1×10^{-9} C placed in free space.

j) State and explain the Poynting theorem. Define the Poynting vector and explain its physical significance in electromagnetic energy flow.

k) Explain the phenomenon of Compton scattering and describe the experimental arrangement used to observe it. Calculate the Compton shift when X-rays are scattered through an angle of 90°. (Given: Compton wavelength of electron $\lambda_c = 2.43 \times 10^{-12}$ m)

l) Explain why a particle in a harmonic oscillator potential cannot have zero energy. Relate this to the Heisenberg uncertainty principle. Calculate the minimum energy of a quantum harmonic oscillator if its angular frequency is $\omega = 1 \times 10^{13}$ rad.s^{-1}

Part-III

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

Q3 Consider a system of two coupled oscillators with masses m_1 and m_2 and spring constants k_1 and k_2. **(8 + 4 + 4)**

a) Obtain the coupled differential equations for the displacements x_1 and x_2.

b) Find the normal frequencies of oscillation.

c) Sketch the mode shapes for in-phase and out-of-phase oscillations.

Q4 **a)** Derive the electromagnetic wave equation for the electric field E and B in free space starting from Maxwell's equations. **(6 + 6 + 4)**

b) Derive the ground state wave function of a one-dimensional quantum harmonic oscillator.

c) Show that the Heisenberg uncertainty principle is satisfied in the ground state.

Q5 A student performs a Newton's rings experiment with a plano-convex lens of known radius of curvature R using sodium light. **(6 + 4 + 6)**

a) Derive the relation between the diameter of the m^{th} dark ring and the wavelength of light.

b) Explain the graphical method for determining the wavelength using the squared diameter vs. ring number plot.

c) How would the presence of a liquid of refractive index n between the lens and plate modify the observed ring diameters?

Q6 **a)** With a suitable diagram describe the construction and the working principle of a semiconductor laser. **(7 + 5 + 4)**

b) Discuss the role of p-n junction and stimulated emission in laser action.

c) Mention two engineering applications of semiconductor lasers in telecommunication and data storage

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

1st Semester Regular/Back Examination: 2025-26
SUBJECT: Basic Civil Engineering
BRANCH(S): AE, AEIE, AERO, AG, AI, AIML, AME, AUTO, BIOTECH, CIVIL, CSE, CSEAI, CSEAIML, CSEDS, CSIT, CST, CST, ECE, EEE, EEVDT, ELECTRICAL, ELECTRICAL & C.E, ETC, IT, MECH, METTA, MINING, MME, MMEAM
Time: 3 Hours
Max Marks: 100
Q.Code: U691
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) Name two different types of water demands a city may have.
b) Define the term “detention period”.
c) Write the main function of traffic separator.
d) State two elements included in road margins.
e) Write two disadvantages of irrigation.
f) Name two common building stones available in your country.
g) State two uses of steel in buildings.
h) Define the term “gravity dam”
i) Write the ingredients of concrete.
j) State the functions of foundation in a structure.

Part-II

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

a) Write short notes on importance of interdisciplinary approach in the development of infrastructures.
b) Differentiate between rigid pavements and flexible pavements with examples.
c) State the important uses of cement mortar.
d) Write short notes on any four types of glasses.
e) Name and state the uses of any three types of non-ferrous metals.
f) State about the various ingredients of the plastics and mention about their uses.
g) Provide a detailed classification of urban roads.
h) Differentiate between plain sedimentation and sedimentation aided with coagulation.
i) Write short note on disinfection process of water treatment.

j) State in detail about the purpose of construction of dams.
k) Provide a basic lay out of public water supply system.
l) Explain in detail about of different types timber used in construction.

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

Q3 State and explain with sketches about different components of canal irrigation system. **(16)**

Q4 Write an explanatory note on the general types of foundations with suitable sketches. **(16)**

Q5 State and explain with sketches about basic components of buildings and state also their functions. **(16)**

Q6 Discuss in detail about classification of bricks. Explain also about the different uses of bricks. **(16)**

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

1st Semester Regular/Back Examination: 2025-26
SUBJECT: BASIC ELECTRICAL ENGINEERING
BRANCH(S): AE, AEIE, AERO, AG, AI, AIML, AME, AUTO, BIOMED, BIOTECH, CHEM, CIVIL, CSE, CSE(CS), CSEAI, CSEAIML, CSEDS, CSIT, CST, CST, ECE, EEE, ELECTRICAL, ELECTRICAL & C.E, ELECTRONICS & C.E, ENV, ETC, IT, MANUTECH, MECH, METTA, MINING, MME, MMEAM, PLASTIC
Time: 3 Hours
Max Marks: 100
Q.Code: U726

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)**

a) What is meant by an ideal voltage and current sources?
b) A resistor of 12 ohm is connected in series with a combination of 15 Ω and 20 Ω resistor in parallel. When a voltage of 120 V is applied across the whole circuit. Find the current taken from the supply.
c) The equation of alternating current is $i = 42.4 \sin 628t$. Then find the average value of current.
d) Two waveforms have periods of $T_1 = 10$ ms and $T_2 = 50$ ms respectively. Which has the higher frequency? Compute the frequencies of both waveforms.
e) What happens to the power factor of a series R-L-C circuit when the frequency of the supply is varied above and below the resonant frequency?
f) If $Z_1 = 3 + j8$ and $Z_2 = 4 + j6$, then find (Z_1/Z_2).
g) A DC generator is found to develop an armature voltage of 220 V. If the flux is reduced by 25 % and speed is increased by 40 %, what will be the armature generated voltage?
h) What is the purpose of performing open circuit test and short circuit test on a single-phase transformer?
i) Name any two conventional and two non-conventional sources of electrical power.
j) What is the need for high-voltage transmission of electrical power?

Part-II

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

a) Determine the voltage 'v' in the circuit shown in Figure 1. Use nodal analysis method.

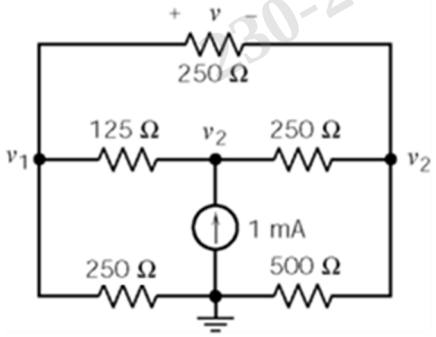

Figure 1

b) Describe with a neat diagram, the principle of operation of three phase induction generator.

c) Find the equivalent resistance between terminal a and b (R_{ab}) in the circuit shown in Figure 2.

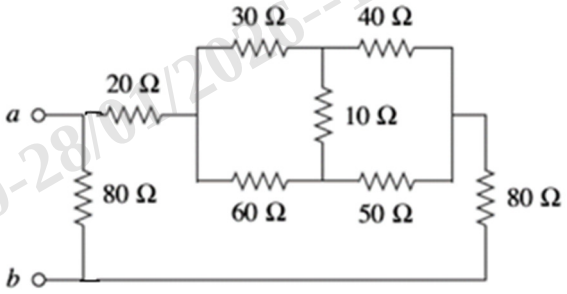

Figure 2

d) Find the form factor of the waveform as shown in Figure 3.

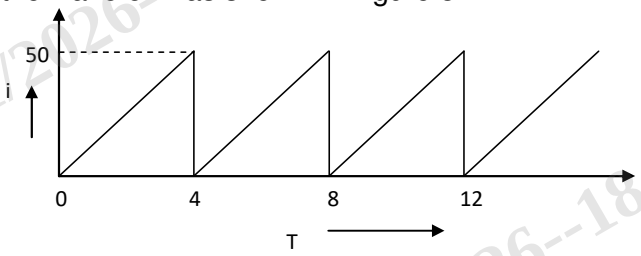

Figure 3

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

f) Three equal star-connected inductors take 8 kW at a power factor 0.8 when connected across a 460 V, 50 Hz, 3-phase, 3-wire supply. Find the circuit constants of the load per phase.

g) Define the term magneto-motive-force (MMF), reluctance, permeance, and reluctivity. Also find those analogous electrical quantities.

h) Distinguish between self-excited and separately exited DC Generators. Give the circuit diagrams of Self excited DC Generators.

i) Explain speed control methods of a DC shunt motor. Draw the characteristic curves.

j) A three-phase induction motor run at a speed of 950 rpm at full load when supplied with power from a 50 Hz three phase line. The synchronous speed is 1000 rpm. Determine,

I. The number of poles of the motor.
II. What is the percentage slip at full load?
III. What is the corresponding frequency of rotor voltages?
IV. What is the rotor frequency at the slip of 10 percent?

k) Draw the layout of electric power supply system? Explain function of its elements.

l) With neat diagram explain the layout of hydro-electric power plant. What are the main components of hydroelectric power plant? Explain.

Part-III

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

Q3 **a)** Derive EMF equation of a DC generator. **(8)**

b) A DC shunt generator gives an open circuit voltage of 240 V. When loaded, the terminal voltage falls to 220 V. Determine the load current in case armature-circuit and field-winding resistances are 0.1 Ω and 50 Ω respectively. **(8)**

Q4 What is DC motor? Derive its torque equation. Draw the speed-torque characteristics of DC shunt, series, and compound motors in one figure and compare them. Which characteristic is more suitable for traction purposes and why? **(16)**

Q5 State Thevenin's Theorem. Find current through R_L = 10 ohms of the network shown in Figure 4 using Thevenin's theorem? Also, find Norton's equivalent circuit. **(16)**

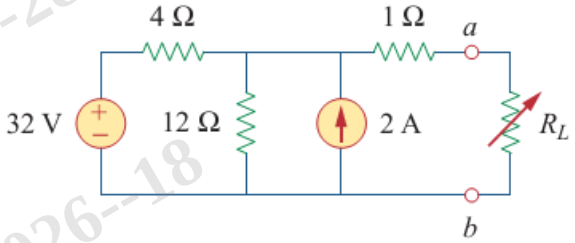

Figure 4

Q6 Discuss the working principle of a single-phase transformer. Also, draw the phasor diagram of a single-phase transformer on load (lagging, leading, and unity power factor cases) considering with winding resistance and leakage reactance. **(16)**

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Total Number of Pages: 02

Course: B.Tech/IDD
Sub_Code: 23ES1002

1st Semester Regular/Back Examination: 2025-26
SUBJECT: BASIC ELECTRONICS
BRANCH(S): AE, AEIE, AERO, AIML, AUTO, BIOTECH, CHEM, CIVIL, CS, CSE, CSEAI, CSEAIML, CSEDS, CSIT, CST, CST, ECE, EEE, EEVDT, ELECTRICAL, ELECTRICAL & C.E, ELECTRONICS & C.E, ETC, IT, MECH, METTA, MINERAL, MINING, MME
Time: 3 Hours
Max Marks: 100
Q.Code: U728

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)**

a) Mention few properties of semiconductor.
b) What do you understand by depletion region? How it is formed in a diode?
c) Define leakage current in CB configuration.
d) Compare between a BJT and a JFET.
e) What type of gate voltage is necessary in an n-channel D-MOSFET and n-channel E-MOSFET to cause current flow?
f) What is the significance of the term “monolithic IC”?
g) Define slew rate in connection with an OP-AMP.
h) Add the binary numbers 10111 and 111.
i) Represent $(-5)_{10}$ in sign magnitude and 1’s complement form.
j) Implement NOT using NAND.

Part-II

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

a) For a transistor, $I_C = 7$ mA, $I_{CO} = 25$ μA and $I_B = 0.1$ mA. Calculate α, β, and I_E.
b) Draw the CB output characteristics of a transistor. Answer the followings.
(i) Indicate all region of operation
(ii) mention biasing and current expressions
c) With neat sketch, describe the operation of a center-tapped FWR.
d) The reverse saturation current at 300 K of a p-n junction Ge diode is 5 μA. Find the voltage to be applied across the junction to obtain a forward current of 50 mA.
e) Mention the relationship between V_{GS}, V_P, and $V_{D,Sat}$. An n-channel JFET has the following parameters: $I_{DSS} = 10$ mA and $V_P = -4$V. If $V_{GS} = -2.5$ V, find the drain current?
f) State the limitations of integrated circuits.

g) Mention characteristics of ideal OP-AMP. Discuss the concept of virtual ground in OP-AMP circuits and explain its significance in circuit analysis.

h) Is negative feedback reducing the gain of an amplifier? Justify your answer with suitable block diagram.

i) Convert the followings:
i) $(FACE)_{16} = (?)_{10}$
ii) $(15.45)_{10} = (?)_{2}$
iii) $(1010110110 11.1101)_{2} = (?)_{8}$

j) Simplify the following Boolean expressions.
(i) $Y(A, B, C, D) = A\bar{C} + \bar{B}D + \bar{A}CD + ABCD$
(ii) $Y(A, B, C) = (\overline{A + B})(\bar{A} + \bar{C})(\bar{B} + \bar{C})$

k) Differentiate between conventional CRO and DSO.

l) What is amplitude modulation? Obtain an expression for an AM wave with sinusoidal modulation.

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

Q3 Describe the forward bias and reverse bias operation of p-n junction diode using suitable diagrams. Draw the characteristics curve. **(16)**

Q4 With a neat sketch, explain the construction and principle of operation of p-channel D-MOSFET. **(16)**

Q5 With suitable diagram, describe the use of an OP-AMP as subtractor. **(16)**

Q6 Draw the block diagram of a DSO. Explain the function of each block. **(16)**

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

Total Number of Pages: 03

Course: B.Tech/IDD
Sub_Code: 23BS1003

1st Semester Regular/Back Examination: 2025-26
SUBJECT: Chemistry
BRANCH(S): ECE, EE, AE, AEIE, AERO, AG, AIML, AUTO, BIOMED, BIOTECH, CHEM, CIVIL, CS, CSE, CSE(CS), CSEAI, CSEAIML, CSEDS, CSEIOT, CSIT, CST, CST, ECE, EEE, ELECTRICAL, ELECTRICAL & C.E, ELECTRONICS & C.E, ETC, IT, MECH, METTA, MINERAL, MINING, MME
Time: 3 Hours
Max Marks: 100
Q.Code: U582

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)**

a) An element 'X' has a very high ionization energy and a highly negative electron affinity. Predict its most common oxidation state and its character (metallic/non-metallic) without naming the element.

b) Compare the polarizability of the Cl^-, Br^-, and I^- ions. Using this concept, predict, and justify the trend in the melting points of their silver salts (AgCl, AgBr, AgI)

c) A certain reaction is exothermic ($\Delta H < 0$) but results in a decrease in the disorder of the system ($\Delta S_{sys} < 0$). Under what temperature condition can this reaction still be spontaneous? Justify using a free energy argument.

d) The entropy of a substance increases during the phase transition from ice to liquid water at 0°C. Identify the two primary physical reasons for this increase.

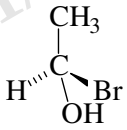
e) Calculate the number of vibrations in carbon dioxide molecule. Explain why one of the vibrations in this molecule is infra-red inactive.

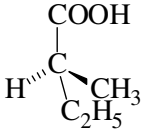
f) Calculate the vibrational absorption frequency of the carbonyl (>C=O) group, if the force constant for the double bond is 1×10^6 dynes cm^{-1}.

g) Differentiate between chromophore and auxochrome with examples.

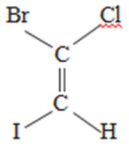
h) Give one similarity and one difference between meso compounds and racimic mixture with one example.

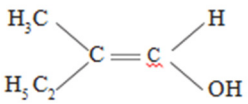
i) Assign the R, S configurations of the following compounds:





j) Assign E and Z nomenclature to the following compounds





Part-II

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

a) I. Define "penetration effect" and "shielding effect." With the help of an energy level diagram, explain why, for n = 4, the orbital energy order is 4s < 4p < 4d < 4f, but the filling order for the first few elements is 4s → 3d → 4p.

II. Write the electronic configurations of the following species and justify the anomalies in their ground state:

i. Chromium (Cr, Z = 24)

ii. Copper (Cu, Z = 29)

III. How do these anomalous configurations directly influence the common oxidation states exhibited by chromium and copper in their compounds?

b) State Fajans' Rules. Define polarizing power and polarizability. List the factors affecting each. Apply these concepts to compare and explain the following observed trends:

I. The thermal stability order: NaF > NaCl > NaBr > NaI.

II. The solubility order in water: AgF (highly soluble) > AgCl > AgBr > AgI (highly insoluble).

III. The melting point order: MgO > CaO > SrO > BaO.

c) I. Show that a thermodynamically irreversible process is always accompanied by an increase in entropy of the system and surroundings taken together.

II. 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 pressure of the gas over this temperature range is 6.189 cal deg^{-1}.

d) I. Show that

$$\ln\frac{P_2}{P_1}=\frac{\Delta H_V}{R}\left[\frac{T_2-T_1}{T_1T_2}\right]$$

II. For the following reaction, H_2 (g) + O_2 (g) → H_2O (l), the value of enthalpy change and free energy change are –68.32 and –56.69 kcal respectively at 25 °C. Calculate the value of free energy change at 30 °C.

e) Define vibrational frequency. Explain in detail the various factors affecting the vibrational frequency of the molecules.

f) Explain in detail the various transitions taking place in UV-visible spectroscopy. Explain the effect of polarity of the solvent on each of these transitions.

g) The pure rotational spectrum of gaseous $^{1}H^{35.5}Cl$ shows a series of equally spaced spectral lines separated by 20.80 cm^{-1}. Calculate the bond length of the HCl.

h) Discuss the formation, structure, and stability of carbocations.

i) Compare and contrast S_N1 and S_N1 reactions with suitable example.

j) Define enantiomers and diastereomers. Explain with the help of 2-bromo-3-chlorobutane.

k) Define conformational isomerism. Draw the potential energy diagram for the various conformations of *n*-butane.

l) Give mechanism and stereochemistry of the following reaction:

$$CH_3CH_2Br+NaOH \xrightarrow{\text{aq. medium}} CH_3CH_2OH$$

Part-III

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

Q3 **a)** Explain how effective nuclear charge (Z_{eff}) arises from the combined effects of actual nuclear charge and electron shielding. How do the concepts of orbital penetration and the relative energies of s, p, d, and f orbitals for a given principal quantum number (n) logically follow from this understanding? Use this to justify why, for example, the 4s orbital is filled before the 3d orbital in the first-row transition metals. **(5)**

b) Derive the following relations **(6)**

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

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

c) Calculate the entropy of mixing of 1 mole of N_2 and 2 moles of O_2, assuming the gases to be ideal. Express the result in S.I. units. **(5)**

Q4 **a)** Write Beer-Lambert's Law. Derive the expression for the absorbance of a homogeneous absorbing solution based on the application of this law. **(6)**

b) Calculate the molar absorptivity of a 0.5×10^{-3} M solution, which has an absorbance of 0.17, when the path length is 1.3 cm. **(2)**

c) Discuss the theory of electronic spectroscopy. Give the various types of transitions involved in this technique with one example in each case. **(8)**

Q5 **a)** Give a note on the conformations of cyclohexane and their stability. **(6)**

b) Considering the example of tartaric acid and explain the following terms (i) enantiomer, (ii) diastereomers, (iii) mesomers, (iv) Racemic Mixture **(6)**

c) List the basic requirements for a molecule to show (i) Geometrical isomerism, and (ii) Optical isomerism. **(4)**

Q6 Discuss the following reaction and detailed mechanism with one suitable organic reaction example each that involves: **(4 x 4)**

(a) Nucleophilic substitution via carbocation intermediate.
(b) Addition reaction involving a free radical intermediate.
(c) Elimination reaction generating a carbanion intermediate.
(d) Electrophilic Substitution reaction

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

Total Number of Pages: 03 **B.Tech/IDD**
23ES1004

1st Semester Regular/Back Examination: 2025-26
SUBJECT: Engineering Mechanics
BRANCH(S): AE, AERO, AG, AIML, AUTO, BIOTECH, CHEM, CIVIL, CSE, CSEAI, CSEAIML, CSEDS, CSEIOT, CSIT, CST, CST, ECE, EEE, EEVDT, ELECTRICAL, ELECTRICAL & C.E, ELECTRONICS & C.E, ETC, IT, MECH, METTA, MINERAL, MINING, MME
Time: 3 Hours
Max Marks: 100
Q.Code: U638
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)**

a) Differentiate between moment and couple.
b) What is the difference between static and kinetic friction?
c) Find the resultant of two forces equal to 50 N and 30 N acting at an angle of 60°.
d) State the Varignon's principle of moments.
e) Find the moment of inertia of a rectangular section 30 mm wide and 40 mm deep about X-X axis and Y-Y axis.
f) How will you distinguish between static friction and dynamic friction?
g) What is zero-force member in a truss? Give one example.
h) A force of 50 N acts at an angle of 60° to the direction of virtual displacement of 0.2 m. Find the virtual work done.
i) A bullet is fired with a velocity of 100 m/s at an angle of 45° with the horizontal. How high the bullet will rise?
j) A body of mass 10 kg is moving with a velocity of 15 m/s. Find its kinetic energy and momentum.

Part-II

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

a) Find the angle between two equal forces P, when their resultant is equal to (i) P and (ii) P/2.
b) A body is in equilibrium under the action of three concurrent forces of 100 N, 150 N, and 200 N. The angle between the first two forces is 60°. Find the angles between the remaining forces.
c) A ball overtakes another ball of twice its own mass and moving with $1/7^{th}$ 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.
d) A bar AB supported at both ends of length 4 m is subjected to a point force of 10 kN at a distance of 1.5 m from A. Using principle of virtual work, determine the reactions at the two supports.

e) A projectile is fired from the ground with a velocity of 40 m/s at an angle of 30° with the horizontal. Find: (a) Maximum Height, (b) Time of flight, (c) Maximum Range

f) A roller of radius 300 mm and weight 2000 N is to be pulled over the curb of height (h) of 150 mm by horizontal pull force (P), applied at the end of the string, wound around the circumference of the roller as shown in Fig. 1. Find the magnitude of the pull force (P) required to start the roller over the curb.

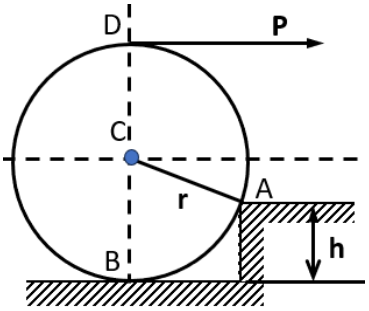


Fig. 1

g) For the frame shown in Fig. 2, find the relation between force P and Q to keep the frame in the equilibrium. The length of each member is "a".

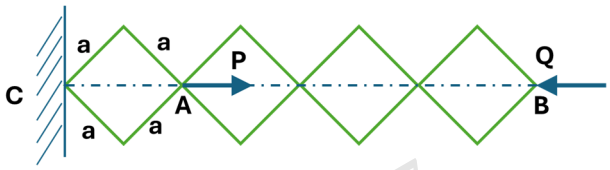


Fig. 2

h) Find the moment of inertia of a triangular lamina of base *'b'* and height *'h'* about its centroid axis.

i) A uniform lamina shown in Fig. 3 consists of a rectangle, a circle and a triangle. Determine the centroid of the lamina. All dimensions are in mm.

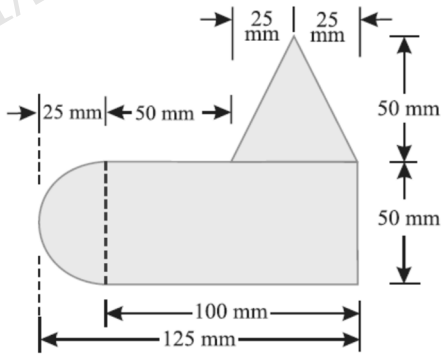


Fig. 3

j) Find the moment of inertia about the centroidal X-X and Y-Y axes of the angle section shown in Fig. 4.

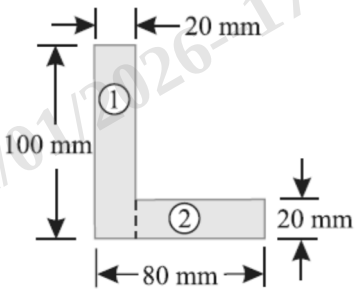


Fig. 4

k) A car of mass 1000 kg is moving at 15 m/s. The brakes apply a constant force of 3000 N. Find the stopping distance.

l) Two bodies of masses 5 kg and 3 kg move along a straight line with velocities 10 m/s and 4 m/s respectively in the same direction. Find their common velocity after collision if they stick together.

Part-III

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

Q3 A block of mass 20 kg slides down a rough inclined plane inclined at 30° to the horizontal from a height of 5 m. The coefficient of friction between the block and the plane is 0.25. Using the work–energy principle, determine the velocity of the block at the bottom of the plane. **(16)**

Q4 A ladder 5 m long rests on a horizontal ground and leans against a smooth vertical wall at an angle of 65° with the horizontal. The weight of the ladder is 800 N and acts at its center of gravity. The ladder is at the point of sliding, when a man weighing 650 N stands on a bar of the ladder 1.5 m from the bottom of the ladder. Calculate the coefficient of friction between the ladder and the floor. **(16)**

Q5 Determine the nature and magnitude of the forces in the members BC, GC, and GF of the truss shown in Fig. 5. **(16)**

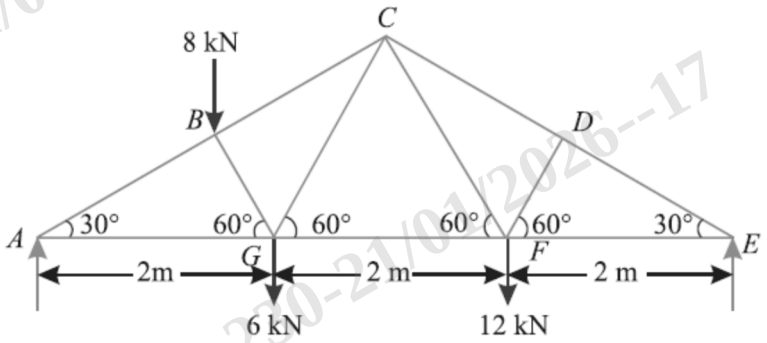


Fig. 5

Q6 A man weighing 712 N stands in a boat so that he is 4.5 m from a pier on the shore (Fig. 6). He walks 2.4 m in the boat towards the pier and then stops. How far from the pier will he be at the end of this time? The boat weighs 890 N, and there is assumed to be no friction between it and the water. **(16)**

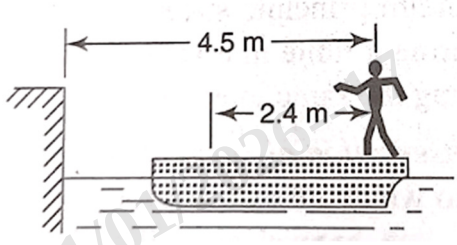


Fig. 6

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

Total Number of Pages: 02

Course: B.Tech/IDD
Sub_Code: 23HS1002

1st Semester Regular/Back Examination: 2025-26
SUBJECT: English for Technical Writing
BRANCH(S): ECE, EE, AE, AEIE, AERO, AG, AIML, AUTO, BIOTECH, CHEM, CIVIL, CS, CSE, CSEAI, CSEAIML, CSEDS, CST, CST, ECE, EEE, ELECTRICAL, ELECTRICAL & C.E, ELECTRONICS & C.E, ETC, MANUTECH, MECH, METTA, MINERAL, MINING, MME, PLASTIC
Time: 3 Hours
Max Marks: 100
Q.Code: U538

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) Define barriers to communication.
b) What is cross-cultural communication?
c) Define vowel sounds.
d) What are the Seven Cs of professional writing?
e) What is an agenda?
f) Which skill is most important during an interview?
I) Memorization
II) Communication
III) Silence
IV) Speed writing
g) The train _____ at platform number three at 6:30 every morning.
I) arrives
II) is arriving
III) has arrived
IV) was arriving
h) Which document is used for internal communication?
I) Resume
II) Memo
III) Advertisement
IV) Job Application letter
i) Which barrier arises due to personal emotions and attitudes?
I) Physical barrier
II) Psychological barrier
III) Semantic barrier
IV) Organizational barrier
j) By next July, she _____ at the company for over ten years.
I) will work
II) will be working
III) will have worked
IV) has worked

Part-II

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

a) Discuss verbal and non-verbal communication with suitable workplace examples.
b) Identify common problem sounds for Indian speakers and suggest remedies.
c) Explain agenda and minutes of a meeting with examples.
d) Explain the purpose and types of report writing.
e) Discuss important interview skills required for professional success.
f) Explain briefly the components of a CV.
g) Explain the role of feedback in the communication process. Illustrate with an example.
h) Discuss the importance of cross-cultural communication in multinational organizations.
i) Explain how bias-free language contributes to ethical communication.
j) Explain word stress and sentence stress with examples.
k) How does intonation influence meaning in spoken English?
l) Suggest practical techniques to improve pronunciation for Indian learners.

Part-III

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

Q3 Your college is hosting international exchange students from the United Sates who are visiting your campus for 3 months. You are part of the student coordination team that is in charge of acquainting the students with Indian way of life and with the rules and regulations of the college. **(16)**
a) Explain the importance of cross-cultural communication in this context.
b) Identify cultural challenges that may arise.
c) Discuss the role of bias-free language in creating an inclusive environment.
d) Suggest strategies to communicate effectively with students from different cultures.

Q4 Your college placement cell is organizing a CV review workshop for first-year students. **(16)**
a) Explain the objectives of a good CV for engineering students.
b) Discuss how students can highlight skills, certifications, and extracurricular activities.
c) Explain the role of action verbs and formatting in CV writing.
d) Suggest guidelines for preparing an ATS-friendly CV.

Q5 Your department conducted a one-day industrial visit to a manufacturing unit. You are asked to submit a report to the Head of the Department. Write a structured report including introduction, objectives, observations, and conclusion. **(16)**

Q6 You are the class representative of your section. Write a formal letter to the principal requesting permission to organize a technical workshop. **(16)**

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

Total Number of Pages: 02

Course: B.Tech/IDD
Sub_Code: 23BS1001

1st Semester Regular/Back Examination: 2025-26
SUBJECT: MATHEMATICS-I
BRANCH(S): AE, AEIE, AERO, AG, AI, AIML, AME, AUTO, BIOMED, BIOTECH, CHEM, CIVIL, CS, CSE, CSE(CS), CSEAI, CSEAIML, CSEDS, CSEIOT, CSIT, CST, CST, ECE, EEE, EEVDT, ELECTRICAL, ELECTRICAL & C.E, ELECTRONICS & C.E, ENV, ETC, IT, MANUTECH, MECH, METTA, MINERAL, MINING, MME, MMEAM, PLASTIC
Time: 3 Hours
Max Marks: 100
Q.Code: U507

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)**

a) Compute $\Gamma\left(\frac{7}{2}\right)$.

b) Define an Improper Integral with an example.

c) Describe the geometrical interpretation of Rolle's theorem.

d) Write the Maclaurin series expansion for $f(x) = cosx$.

e) If $u = x^2y + y^2x$ find $\frac{\partial^2 u}{\partial x \partial y}$.

f) Define the Hessian Matrix for a function $f(x, y)$.

g) Explain Linear Dependence of a set of vectors with a suitable example.

h) Find the Rank of the matrix $A = \begin{pmatrix} 1 & 1 & 3 \\ 2 & 1 & 1 \\ 4 & 3 & 7 \end{pmatrix}$.

i) State the Cayley-Hamilton Theorem.

j) If λ is an eigenvalue of a non-singular matrix A, what is the eigenvalue of A^{-1}?

Part-II

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

a) Find the length of the arc of the curve $y = ln(sec\, x)$ from $x = 0$ *to* $x = \frac{\pi}{3}$.

b) Find the volume of the solid generated by revolving the region bounded by $y = x^2$ and $y = 4$ about the y-axis.

c) Show that $\beta(m, n) = \frac{\Gamma(m)\,\Gamma(n)}{\Gamma(m+n)}$.

d) Verify the Mean Value Theorem for $f(x) = x^3 - 5x^2 - 3x$ in the interval [1,3].

e) Use the First Derivative Test to find the local extrema of $f(x) = x^3 - 6x^2 + 9x + 15$.

f) Using Taylor's series, derive the Maclaurin expansion of $\ln(1-x)$.

g) If $u = tan^{-1}\left(\frac{x^3+y^3}{x-y}\right)$, then show that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = sin\, 2u$.

h) Find the Jacobian $\frac{\partial(u,v)}{\partial(n,y)}$ if $u = x(1-y)$ and $v = xy$.

i) Expand the set of vectors $\{(1,1,0)\}$ to a basis of $\mathbb{R}^3$.

j) Solve the system of equations $2x + y + z = 10, 3x + 2y + 3z = 18, x + 4y + 9z = 16$ using Gauss Elimination method.

k) Find the inverse of the matrix $A = \begin{pmatrix} 2 & 1 \\ 5 & 3 \end{pmatrix}$ using the Gauss-Jordan Method.

l) Show that the matrix $A = \frac{1}{3}\begin{pmatrix} 1 & 2 & 2 \\ 2 & 1 & -2 \\ -2 & 2 & -1 \end{pmatrix}$ is orthogonal.

Part-III

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

Q3 a) Find the area of the surface formed by revolving the astroid $x^{2/3} + y^{2/3} = a^{2/3}$ about the x-$axis$. **(8 x 2)**

b) Define Mean value theorem. Prove that between any two real roots of $e^x\, sin\, x = 1$, there is at least one real root of $e^x\, cos\, x + 1 = 0$.

Q4 a) Find the maximum and minimum values of the function $f(x,y) = x^3 + y^3 - 3xy$. Determine the nature of the saddle point if it exists. **(8 x 2)**

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

Q5 a) Find the values of $\lambda\, and\, \mu$, so that the system of equations $x + y + z = 6, x + 2y + 3z = 10$, $x + 2y + \lambda z = \mu$ has (i) no solution, (ii) a unique solution, (iii) infinite solutions. **(8 x 2)**

b) Find the basis and dimension of the subspace spanned by the vectors (1,2,3), (2,3,4), (3,5,7).

Q6 a) Find the eigenvalues and eigenvectors of the matrix $A = \begin{pmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{pmatrix}$. **(8 x 2)**

b) Verify the Cayley-Hamilton Theorem for the matrix $A = \begin{pmatrix} 1 & 2 & 0 \\ 2 & -1 & 0 \\ 0 & 0 & -1 \end{pmatrix}$ and use it to find A^{-1}.

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

Total Number of Pages: 03 **Course: B.Tech/IDD**
Sub_Code: 23BS1002

1st Semester Regular/Back Examination: 2025-26
SUBJECT: PHYSICS
BRANCH(S): CE, CSE, ME, AE, AEIE, AERO, AI, AIML, AME, AUTO, BIOTECH, CIVIL, CSE, CSEAI, CSEAIML, CSEDS, CSIT, CST, CST, ECE, EEE, EEVDT, ELECTRICAL, ELECTRICAL & C.E, ELECTRONICS & C.E, ENV, ETC, IT, MANUTECH, MECH, METTA, MINING, MME, MMEAM, PLASTIC
Time: 3 Hours
Max Marks: 100
Q.Code: U584
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)**

a) Define the term resonance in a forced damped harmonic oscillator and explain how does damping affects the amplitude of steady-state oscillations.

b) Why does an LC (tank) circuit produce electrical oscillations, whereas RC and RL circuits do not?

c) State the two conditions required for two sources to be coherent and give one practical method of producing coherent sources.

d) What is meant by order of diffraction? Light of wavelength 600 nm is incident normally on a grating with spacing 2×10^{-6} m. Calculate the maximum order of diffraction possible.

e) Mention the condition for the charge free conducting medium and write down the dissipative terms present in EM wave in a conducting medium.

f) Write Maxwell's fourth equation in integral form. Why was Maxwell's displacement current term introduced?

g) Why is wave–particle duality important in quantum mechanics? An electron is accelerated through a potential difference of 100 V. Calculate its de Broglie wavelength.

h) Write the normalization condition for a one-dimensional wave function. A particle is described by a wave function $\psi(x) = Ae^{-x^2}$. Find the value of "*A*" using the normalization condition.

i) What physical processes represented by Einstein's coefficients A_{21}, B_{12}, and B_{21}? If the Einstein coefficient A_{21} is doubled, how does the lifetime of the excited state change?

j) What is lasing action? State the two essential conditions required for laser action.

Part-II

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

a) Explain the concept of a forced electrical oscillator using a series LCR circuit driven by an alternating emf and hence derive the condition for resonance in a series LCR circuit.

b) Distinguish between light damping, critical damping, and heavy damping. Show that the energy of a lightly damped oscillator decays exponentially with time.

c) Distinguish between interference in reflected light and transmitted light from a thin film and explain why color patterns are observed in soap bubbles and oil films.

d) What is meant by logarithmic decrement? Derive the relation between logarithmic decrement and damping constant. If the logarithmic decrement of an oscillator is 0.05, calculate the ratio of energies after two successive oscillations.

e) Explain the physical meaning of the wave equation. Obtain the general solution of the one-dimensional wave equation. A progressive wave has an amplitude of 2 cm, wavelength 0.5 m, and frequency 20 Hz. Find its maximum particle velocity.

f) Why are circular fringes obtained in Newton's rings experiment? Explain the effect of introducing a liquid between the lens and glass plate. If the diameters of a particular dark ring are 0.60 cm in air and 0.52 cm in liquid, calculate the refractive index of the liquid.

g) What is meant by a solenoidal vector field? Show that the divergence of a curl of any vector field is zero. Calculate the divergence of $\vec{A} = (x^2y)\hat{\imath} + (y^2z)\hat{\jmath} + (z^2x)\hat{k}$.

h) State Gauss' divergence theorem and explain the physical significance of it. Using Gauss' divergence theorem, find the flux of the vector field $\vec{F} = x\hat{\imath} + y\hat{\jmath} + z\hat{k}$ out of a sphere of radius a.

i) Distinguish between phase velocity and group velocity**.** Write the expressions for phase velocity and group velocity in terms of ω and k. For a wave packet, if $\omega = 6k^2$, find the expressions for phase velocity and group velocity.

j) What are expectation values? Find the expression for the expectation value of position ⟨x⟩ for a particle in a box. Calculate the expectation value of position for a particle in a box of length 1 nm in the ground state.

k) Compare three-level and four-level lasers. State one example each of a three-level and a four-level laser. In a four-level laser, the lifetime of the metastable state is 3×10^{-3} s. Calculate the spontaneous emission probability from that level.

l) What is meant by pumping in a laser? Explain the role of a metastable state in laser action. If the lower laser level of a four-level system has only 2 % population, calculate the population inversion when the upper laser level has 30 % population.

Part-III

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

Q3 **a)** Explain the motion of a forced damped harmonic oscillator subjected to a sinusoidal external force. **(4)**

b) Starting from the equation of motion, obtain the expression for the steady-state amplitude of oscillation and discuss its dependence on driving frequency. **(8)**

c) A mechanical oscillator stores 2 J of energy and loses 0.05 J of energy per cycle due to damping. Calculate the quality factor of the oscillator and state whether it is lightly or heavily damped. **(4)**

Q4 **a)** State the difference between Fresnel and Fraunhoffer diffraction. **(3)**

b) With a suitable theory derive the expression for the intensity distribution and explain the formation of principal maxima and minima, and intensity distribution curve. **(9)**

c) A parallel beam of monochromatic light of wavelength 600 nm is incident normally on a single slit of width 0.2 mm. Calculate the angular position of the first minimum and the angular width of the central maximum. **(4)**

Q5 **a)** What do you mean by Maxwell's electromagnetic wave equation? Write down Maxwell's electromagnetic equations in differential form in free space. **(4)**

b) Set up EM wave equation in an ionized medium and explain why the EM waves cannot propagate through conducting medium. **(9)**

c) If the electric field amplitude of an electromagnetic wave in vacuum is 300 V m^{-1}, calculate the corresponding magnetic field amplitude. (Given: $c = 3 \times 10^8$ m.s^{-1}) **(3)**

Q6 **a)** Derive the time-dependent Schrödinger wave equation and explain the physical significance of the wave function ψ. **(6)**

b) Define Einstein's A and B coefficients and explain their physical meaning. Derive the relation between them using Planck's radiation law. **(7)**

c) Describe how population inversion is achieved in a He–Ne laser and explain its laser action. **(3)**

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

Total Number of Pages: 02

Course: B.Tech/IDD
Sub_Code: 23ES1003

1st Semester Regular/Back Examination: 2025-26
SUBJECT: Programming in C and Data Structure
BRANCH(S): CE, AE, AEIE, AERO, AI, AIML, AME, AUTO, BIOMED, BIOTECH, CHEM, CIVIL, CS, CSE, CSE(CS), CSEAI, CSEAIML, CSEDS, CSIT, CST, ECE, EEE, ELECTRICAL, ELECTRICAL & C.E., ENV, ETC, IT, MANUTECH, MECH, METTA, MINING, MME, MMEAM, PLASTIC
Time: 3 Hours
Max Marks: 100
Q.Code: U639
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)**

a) Differentiate between for and do-while loops with an example.
b) Distinguish between binary search and linear search.
c) Explain the difference between structure and union.
d) What is a variable? How do we declare a variable in C?
e) Define conditional operator along with its syntax.
f) Differentiate between branching and looping with an example.
g) Define a static variable. When can we use it? Give an example.
h) Distinguish between pointer to array and array of pointers.
i) Differentiate between a stack and a queue along with their applications.
j) Explain about calloc() and realloc() functions.

Part-II

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

a) Write a C program to add two numbers using recursion.
b) Differentiate between bubble sort and quick sort. Which one is better and why? Give an example.
c) Explain different kinds of operators in C.
d) Write a C program to reverse a string without using **strrev()** function.
e) What is pseudo-code? Explain with an example.
f) Draw a flowchart and write the algorithm to compute the simple interest.
g) Write a C program to print the numbers from 4 to 10 and their squares.
h) Write a C program to check whether a given number is a palindrome or not.
i) Write a C program that takes the three coeficients of a quadratic equation and compute all possible roots and print them with appropriate messages.

j) What is dangling else problem? Explain how to handle this with an example.

k) Write a C program to read 20 numbers into an array and compute their average.

l) Explain array of structure and structure within structure with an example.

Part-III

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

Q3 Discuss the advantage of "switch-case" statement in C. Write a C program using switch-case to design a calculator. **(16)**

Q4 Define recursion. Write a C program for multiplying two integers using recursion. **(16)**

Q5 Write a C program using pointers to compute the sum, mean and standard deviation of all the 30 elements stored in an array. **(16)**

Q6 Construct a binary search tree with the following sequence: **(16)**
B, R, A, N, C, H, E, and S.

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

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

Sub_Code: 23HS1001

1st Semester Regular/Back Examination: 2025-26

SUBJECT: Universal Human Values

BRANCH(S): CE, CSE, ME, AE, AEIE, AERO, AI, AIML, AME, AUTO, BIOMED, BIOTECH, CIVIL, CSE, CSE(CS), CSEAI, CSEAIML, CSEDS, CSIT, CST, CST, ECE, EEE, EEVDT, ELECTRICAL, ELECTRICAL & C.E, ENV, ETC, IT, MECH, METTA, MINING, MME, MMEAM

Time: 3 Hours

Max Marks: 100

Q.Code: U539

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) Distinguish between Natural Acceptance and Acceptance, with a few examples.

b) Distinguish between 'animal consciousness' and 'human consciousness' with suitable examples.

c) What is the process for value education? How does it work?

d) What are the two realities to explore while exploring harmony in the human being? How can one distinguish between them based on their needs?

e) How do you define Trust in relationships? Can anyone trust everyone as per the proposal?

f) "The other is similar to me" refers to which value in relationships? Justify your answer.

g) Define the feelings of "Gratitude" and "Reverence".

h) Distinguish between "Love" and "Infatuation" as per the proposal discussed in the textbook.

i) State the desired common human goals to live in a society.

j) What do you understand by the term 'profession' and 'professional ethics'?

Part-II

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

a) What is the content of Value Education? Discuss the need for it in technical and other professional institutions. Explain the basic guidelines for Value Education. What is the need for these guidelines? List any three implications of Value Education. Explain how they are related to your life.

b) Why is right understanding required in relationship for mutual happiness? Illustrate with the help of two examples from your life. Similarly, why is right understanding required for ensuring physical facility? How does it result in mutual prosperity? Illustrate with the help of two personal examples.

c) Critically examine the prevailing notions of happiness and prosperity in the society. What are the consequences of these notions? What can be your approach to overcome these consequences?

d) What is trust? Distinguish between 'reaction' and 'response' with the clarity of feeling of trust. Give one example of each for a particular case of relationship with any junior/senior/friend/family relative.

e) "I am the seer, doer, and enjoyer. The body is an instrument". Explain with example.

f) Explain the activities of the Self with a diagram. With the help of an example, show how are they related. Is imagination related to body or Self? Is it taking place continuously or is it a temporary activity that you can start and stop at will? Justify your answer with some examples. List the various sources of imagination in the Self. Elaborate with a few examples.

g) What do you mean by respect? State the evaluations we are doing today in the name of respect. What are its consequences? What can be the right approach to ensure respect in continuity?

h) Define excellence. Is working for competition the same as working for excellence? Explain your answer with the help of examples.

i) Elaborate and explain "Society", "Crowd", and "Battlefield" as discussed in the proposal. What is desirable in our society and where are we today? How can we proceed towards harmony from family order to world family order?

j) Explain why it is essential to study about nature. Why is the human order, by and large, not mutually fulfilling for any of the four orders? Is your natural acceptance to be fulfilling for all four orders? What does human being need to do to be mutually fulfilling for each of the four orders?

k) What is meant by 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. Describe the role of human being in this existence. What would be the natural outcome of fulfilling this role?

l) As per the prevailing world-view, what are usually the expectations from a good professional career? Evaluate these in the context of right understanding. What, according to you, can be a fool-proof measure to ensure professional ethics? Give justification.

Part-III

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

Q3 What do you mean by Education-Sanskar? How do you see current development- Is it a holistic development or just a development in physical facility? Share your perspective on current trends in development compared to holistic development. Do these trends help individuals to achieve their full human potential? 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 What do you mean by "Understanding harmony in the Self"? What are the dynamic and state activities of the Self? Explain with suitable sketches of activities in the Self (within), including the activity in B1 & B2 Blocks. How are these activities indicative of human behaviour and work. **(16)**

Q5 Is it possible to live in relationship without understanding relationship? How is a family the basic ground for understanding relationships? Explain. How can you understand relationship? What are nine feelings in relationship? Distinguish between intention and competence. What is the outcome when we confuse between the two and we doubt the intention of the other? What is the outcome when we are able to see them separately and trust the intention of the other? **(16)**

Q6 What do you understand by the term 'holistic technology' and 'holistic management system'? "Values effect both the structure as well as the utilisation of technologies". Do you agree? Give justification for your response. What, in your opinion, has gone wrong so as to make many of the modern technology gadgets anti-ecological as well as contrary to real human welfare? After all, all these developments have been made for the good of people and with great dexterity. Suggest some of the solution centric approaches to technology for holistic development. **(16)**