

INTRODUCTION TO IT SYSTEMS

Time Allowed: 2.5 Hours

Full Marks: 60

Answer to Question No. 1 of Group A must be written in the main answer script. In Question No. 1, out of 2 marks for each MCQ, 1 mark is allotted for right answer and 1 mark is allotted for correct explanation of the answer.

Answer any Five (05) Questions from Group-B.

GROUP-A

1. Choose the correct answer from the given alternatives and explain your answer (any ten): 2x10=20

- (i) Which of the following is NOT a web browser?
 a) Google Chrome b) Mozilla Firefox
 c) Microsoft Word d) Microsoft Edge
- (ii) Which protocol is used for secure web communication?
 a) HTTP b) HTTPS c) FTP d) SMTP
- (iii) What is the invalid number representation?
 a) $(12)_{10}$ b) $(AB)_{16}$ c) $(10)_2$ d) $(87)_8$
- (iv) Which symbol is used to represent a decision in a flowchart?
 a) Rhombus b) Oval c) Parallelogram d) Rectangle
- (v) Hard copy means –
 a) Output on VDU b) Output on hard disk c) Output on paper d) None of these
- (vi) In Binary coded decimal, each digit of a decimal is represented with a group of _____.
 a) 3 binary digits b) 4 binary digits c) 5 binary digits d) 6 binary digits
- (vii) Which of the following is NOT a function of an operating system?
 a) Process management b) Memory management
 c) Compiling code d) File management
- (viii) Which HTML tag is used to create a hyperlink?
 a) `< link >` b) `< a >` c) `< h1 >` d) `< p >`
- (ix) Which of the following is not the characteristics of Computer?
 a) Accuracy b) Versatility c) Diligence d) IQ
- (x) Which of the following is an example of phishing?
 a) A hacker breaking into a system b) A fake email asking for personal details
 c) A computer virus spreading d) A software update notification
- (xi) Equivalent Gray Code representation of the Binary code 0110 is
 a) 0101 b) 1000 c) 1010 d) 1111
- (xii) A small program that gets loaded in the computer without the user knowledge and replicate itself repeatedly called:
 a) Worms b) Virus c) Browser d) None of these
- (xiii) The number of steps on Algorithm should be-
 a) Finite b) Infinite c) Fixed d) None of these
- (xiv) Which of the following is used for connecting computers in a large area such as country, continent etc.?
 a) LAN b) PAN c) MAN d) WAN

(xv) In how many ways can CSS be written in?

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

GROUP-B
Answer any Five (05) Questions.

5 x 8 = 40

2.(a) Describe De Morgan's law.

3 + 5

- (b) i) What do you mean by Universal Logic Gates?
ii) Implement AND gate using only NOR gate.

3.(a) Write down a flowchart to find the greatest among three given numbers.

3 + 5

- (b) Define algorithm? Write an algorithm to find out area of a Triangle.

4.(a) What are the differences between Primary Memory and Secondary Memory?

3 + 5

- (b) Write down the full form of *ASCII*, *SSD*, *WWW*, *UPS*, and *SMPS* in the context of computer system.

5.(a) What is operating system? Explain functions of an Operating System.

5 + 3

- (b) What are the differences between multiprogramming and time-sharing system?

6.(a) Subtract 25 – 16 using 2's complement method.

4 + 4

- (b) Perform the following conversion-

- (i) $(21C)_{16}$ to Octal Number
(ii) $(34.25)_{10}$ to Binary Number

7. (a) What is HTML? How many types of list in HTML?

1 + 2 + 5

- (b) Write down the HTML code to create the given table.

Animals	Birds	Fruits
Cow	Parrot	Banana
Dog	Pigeon	Mango
Horse	Crow	Apple
Deer	Cuckoo	Grapes

8.(a) What is CSS? Write the HTML code to implement CSS.

2 + 3 + 3

- (b) Design a HTML page with Java Script to calculate the sum of two integer numbers.

9.(a) How can you protect your computer from being hacked?

2 + 3 + 3

- (b) Write short note on Denial of service attack works.
(c) What is a Malware and types of Malwares?

4 + 4

10. (a) Differentiate Worm and Virus.

- (b) What do you understand by the term Fraud, Abuse and Cyber stalking?

Time Allowed: 2.5 Hours

Full Marks: 60

Answer to Question No. 1 of Group A must be written in the main answer script. In Question No. 1, out of 2 marks for each MCQ, 1 mark is allotted for right answer and 1 mark is allotted for correct explanation of the answer.
Answer any Five (05) Questions from Group-B.

GROUP-A

1. Choose the correct answer from the given alternatives and explain your answer (any ten): $2 \times 10 = 20$
- i) A wire has resistance of 16Ω . It is bent in the form of a circle. The effective resistance between two points on any diameter of the circle is a) 32Ω , b) 16Ω , c) 8Ω , d) 4Ω
 - ii) If $110V$ is applied across $220V$, $100W$ bulb, the power consumed by it will be a) $100W$, b) $50W$, c) $25W$, d) $12.5W$.
 - iii) A current of $10A$ enters a parallel combination of two resistances of 2Ω and 3Ω . Then the currents through resistances will be a) $4A$ and $6A$, b) $6A$ and $4A$, c) $2A$ and $8A$, d) $5A$ and $5A$
 - iv) The SI unit of reluctance is a) AT/Wb , b) AT/m , c) AT , d) N/Wb
 - v) A magnetic circuit requires $800 AT$ to produce certain amount of magnetic flux. If the magnetizing coil of 100 turns has 5Ω resistance, the voltage to be applied to the exciting coil must be a) $40V$, b) $20V$, c) $10V$, d) $5V$
 - vi) Which of the following is a correct representation of peak value in an AC Circuit?
a) RMS value / Peak factor
b) RMS value $\times$ Form factor
c) RMS value / Form factor
d) RMS value $\times$ Peak factor
 - vii) If the supply frequency increases, the value of inductive reactance _____.
a) decreases
b) increases
c) does not change
d) becomes zero
 - viii) The advantage of star-connected AC supply system is that a) line current is equal to phase current, b) it is a simple arrangement, c) voltages at two levels can be used, d) phase sequence can easily be changed.
 - ix) Transformer core is assembled with laminated sheet so as to a) reduce hysteresis loss, b) eddy current loss, c) reduce copper loss, d) ensure good magnetic coupling between the windings.
 - x) Which of the following dc motor is used in Railway Electric Traction? a) dc shunt motor b) dc series motor c) dc compound motor d) separately excited dc motor
 - xi) Potential barrier at a p-n junction is established due to a) majority carriers, b) minority carriers, c) both (a) and (b), d) donor and acceptor ions.
 - xii) In common emitter configuration, BJT acts as a a) voltage controlled voltage source b) current controlled voltage source c) voltage controlled current source d) current controlled current source

- xiii) CMRR for an OP-AMP should be a) as large as possible b) close to zero c) close to unity d) as small as possible.
- xiv) If two inputs of a NOR gate is tied up, it will act as a) NOT gate, b) OR gate, c) NAND gate, d) Ex-NOR gate
- xv) A bulb in a stair-case has two switches, one switch being at the ground floor and the other at the first floor. The bulb can be turned on and off by any one of the switches. The logic of switching of the bulb resembles
a) An AND gate, b) An OR gate, c) an XOR gate, d) A NAND gate.

GROUP-B

Answer any Five (05) questions.

2. (a) What is a parallel circuit?
(b) Why all electrical equipments are connected in parallel to the supply?
(c) A resistor of 6Ω is connected in series with a parallel combination of 15Ω and 10Ω resistors. The whole circuit is connected across a 30V supply. Determine current flowing through 15Ω resistor. [2+2+4]
3. (a) With neat diagrams state Fleming's Left Hand Rule.
(b) What is dynamically induced emf?
(c) An iron ring or toroid 0.2 m in diameter and 10 sq. cm cross-sectional area of the core is wound with 250 turns of wire. If the flux density in the core is to be 1 T and relative permeability of iron is 500, what is the exciting current required to be passed in the winding? Further, determine the self-inductance. [2+2+4]
4. (a) Define (i) cycle, (ii) frequency, (iii) form factor of a sinusoidally varying quantity and state their units (if any).
(b) A coil of resistance 10Ω and inductance 0.1 H is connected in series with a capacitor $10\mu\text{F}$. This whole combination is connected with 240V, 50 Hz supply. Calculate (i) impedance, (ii) current, (iii) angle of phase difference, (iv) power factor and (v) consumed power. [3+5]
5. (a) Define power factor. What is the range of power factor?
(b) In an AC circuit current $i = 20 \cos(2t - 30^\circ)$ and applied voltage $v = 200 \cos(2t + 30^\circ)$. Calculate (i) the impedance, (ii) the resistance, (iii) the reactance, (iv) the power factor, (v) the phase angle between voltage and current and (vi) the power absorbed. [2+6]
6. (a) With neat waveforms of sinusoidal supply voltage, circuit current and instantaneous power, show that average power consumed by a purely inductive circuit is zero.
(b) What do you understand by the term 3-phase balanced AC supply?
(c) A three-phase, star-connected AC motor draws 5.6 kW when the line voltage is 220 V and the line current is 18.2 A. Determine the power factor of the motor. [4+2+2]
7. (a) Why does a transformer has iron core?
(b) Among all electrical machines, efficiency of transformers is maximum. Why?
(c) A single phase, 50Hz, transformer has 50 and 250 turns on low voltage and high voltage windings respectively. If low voltage winding is connected to 230V, 50Hz AC supply, calculate (i) peak value of flux and (ii) flux density in the core with net cross-sectional area 250 sq.cm . (iii) Also determine the low voltage winding current when current in the other winding is 100A. [2+2+4]
8. (a) What is an ideal diode? Draw its V-I characteristic.
(b) Neatly draw forward and reversed biased characteristics of a practical diode.
(c) Why silicon is preferred over germanium while fabricating semiconductor devices. [3+3+2]

9.

(a) Draw the pin diagram of OP AMP IC 741 and label each pin.

(b) Write down the features of an ideal OP AMP.

[4+4]

10.

(a) Give the logic symbol, Boolean expression and truth table of (i) two input NAND gate and (ii) two input EX NOR gate.

(b) Explain the phrase-"NAND and NOR gates are called universal gates".

[(3+3)+2]



MATHEMATICS-II

Full Marks: 60

Time Allowed: 2.5 Hours

Answer to Question No. 1 of Group A must be written in the main answer script. In Question No. 1, out of 2 marks for each MCQ, 1 mark is allotted for right answer and 1 mark is allotted for correct explanation of the answer.

Answer any five (05) Questions from Group-B.

GROUP-A

1. Choose the correct answer from the given alternatives and explain your answer (any ten):

2×10=20

- i. If A be a square matrix of order 3 and $\det A$ is the determinant of A, then $\det(3A)$ equals to –
(a) $\det A$ (b) $3 \det A$ (c) $9 \det A$ (d) $27 \det A$.
- ii. Let A be any square matrix, then $A + A^T$ is always, (a) symmetric (b) skew-symmetric (c) diagonal (d) Null matrix.
- iii. The value of the determinant $\begin{vmatrix} 100 & 101 & 102 \\ 105 & 106 & 107 \\ 110 & 111 & 112 \end{vmatrix}$ is (a) 0 (b) 1 (c) 2 (d) None of these.
- iv. The distance between the lines $3x + 4y = 9$ and $6x + 8y = 15$ is – (a) $\frac{3}{2}$ (b) $\frac{3}{10}$ (c) 6 (d) None of these.
- v. The length of latus rectum of the parabola $y^2 + 48x = 0$ is (a) 12 (b) 24 (c) 48 (d) None of these.
- vi. Coordinates of centre of the circle $2x^2 + 2y^2 - 8x - 5 = 0$ is (a) (0,2) (b) (4,0) (c) (2,0) (d) (-4,0).
- vii. If $u(x, y) = \frac{x}{y}$, then the value of $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y}$ (a) $\frac{x}{y^2}$ (b) $-\frac{x}{y^2}$ (c) 0 (d) None of these
- viii. The order and degree of the differential equation $\{1 + (\frac{dy}{dx})^2\}^{\frac{2}{3}} = \frac{d^3y}{dx^3}$ are (a) 3 and 2 (b) 3 and 3 (c) 2 and 3 (d) 3 and 1.
- ix. The integrating factor of the differential equation $\frac{dy}{dx} = \frac{y}{x} + x^2$ is – (a) x (b) $\frac{1}{x}$ (c) $\log_e x$ (d) None of these.
- x. The median of the following data : 2.5, 2.0, 2.6, 2.2, 2.9 and 2.1 is (a) 2.2 (b) 2.383 (c) 2.35 (d) None of these.
- xi. Three coins are tossed at random. The probability of getting at least one tail is (a) $\frac{3}{8}$ (b) $\frac{7}{8}$ (c) $\frac{2}{9}$ (d) None of these.
- xii. Let A and B be two event and $P(A) = 0.3$, $P(B) = 0.2$ and $P(A \cap B) = 0.1$, then value of $P(A \cup B)$ is (a) 0.25 (b) 0.1 (c) 0.6 (d) 0.4
- xiii. The value of $\int_{-a}^a x^3 dx$ is – (a) a^3 (b) $2a^3$ (c) 0 (d) None of these.
- xiv. The value of the integral is $\int_0^1 \frac{dx}{1+x^2}$ (a) $\frac{\pi}{2}$ (b) $\frac{\pi}{4}$ (c) 0 (d) None of these
- xv. Area bounded by the straight line $y = 2x$ above x-axis from $x = 1$ to $x = 4$ is (a) 16 sq. unit (b) 15 sq. unit (c) 7.5 sq. unit (d) None of these.

GROUP-B

Answer any five (05) questions.

2. (i) Show that $\begin{vmatrix} 1 & 1 & 1 \\ a & b & c \\ bc & ca & ab \end{vmatrix} = (a-b)(b-c)(c-a)$

(ii) Find the inverse of the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 3 & 4 & 5 \\ 5 & 6 & 7 \end{bmatrix}$.

4+4

3. (i) Solve by Cramer's rule, $x + 4y + 3z = 2$, $2x - 6y + 6z = -3$, $5x - 2y + 3z = -5$.

(ii) Show that the matrix $A = \frac{1}{3} \begin{bmatrix} -1 & 2 & -2 \\ -2 & 1 & 2 \\ 2 & 2 & 1 \end{bmatrix}$ is orthogonal, i.e. $AA^T = A^T A = I_3$, hence find A^{-1} .

4+4

4. (i) Find the equation of the straight line which passes through the point of intersection of the straight lines $2x + 3y = 5$ and $3x + 5y = 7$ and makes equal intercepts upon coordinate axes.

4+4

(ii) Find the equation of the circles which touches both the axes and passes through (6,3).

5. (i) Evaluate $\int \frac{e^{x(1+x)}}{\cos^2(xe^x)} dx$.

(ii) Evaluate: $\int \frac{x-1}{(x-3)(x+2)} dx$

4+4

6. (i) Find the area bounded by the parabola $y^2 = 4ax$ and its latus rectum.

(ii) Show that $\int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \frac{dx}{1+\sqrt{\tan x}} = \frac{\pi}{12}$.

4+4

7. (i) Solve the differential equation: $(D^2 - 4D + 4)y = e^{-2x}$, where $D \equiv \frac{d}{dx}$.

(ii) Solve $x dy - y dx = (x^2 + y^2) dx$

4+4

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

(ii) Evaluate $\frac{\partial z}{\partial x}$ and $\frac{\partial z}{\partial y}$ where $z = x^2 y + xy^2$.

4+4

9. (i) Calculate mean and standard deviation from the following data:

Size of the item	6	7	8	9	10	11	12
Frequency	3	5	9	13	8	5	4

(ii) Find the probability of getting five Sundays in a month of January.

4+4

10. (i) Find the median from the following data:

Class	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50
Frequency	7	15	24	31	42	30	26	15	10

(ii) An urn contains 4 black, 5 white, and 6 red balls. A ball is drawn at random. Find the probability that it is
(a) black (b) black or red.

4+2+2

Handwritten calculations for probability:

Black	4/15
White	5/15
Red	6/15
Total	15/15

For (b) Black or red: $\frac{4}{15} + \frac{6}{15} = \frac{10}{15} = \frac{2}{3}$

APPLIED PHYSICS-II

Time Allowed: 2.5 Hours

Full Marks: 60

Answer to Question No. 1 of Group A must be written in the main answer script. In Question No. 1, out of 2 marks for each MCQ, 1 marks is allotted for right answer and 1 marks is allotted for correct explanation of the answer.

Answer any Five (05) Questions from Group-B.

GROUP-A

1. Choose the correct answer from the given alternatives and explain your answer (any ten): $2 \times 10 = 20$
 - i) The velocity of a particle vibrating in S.H.M.-
(a) is maximum at the mean position, (b) is minimum at the mean position, (c) remains constant at every point, (d) none of these.
 - ii) The equation of a plane progressive wave is $y = 6 \sin \frac{2\pi}{7}(14t-x)$. The frequency and amplitude of vibration is -
(a) 2, 7 (b) 2, 6 (c) 6, 2 (d) 7, 6.
 - iii) The wavelength of the ultrasonic sound-
(a) is same as that of audible sound, (b) is less compared to audible sound, (c) is larger compared to audible sound, (d) may be greater or less than audible sound.
 - iv) Focal length of a convex lens is 20cm. Power of the lens is -
(a)+5D, (b)-5D, (c) 0.05D, (d) -0.05D.
 - v) For which colour of light the refractive index of a medium is maximum?
(a) Green, (b) Yellow, (c) Red, (d) Violet.
 - vi) Force of repulsion between two point charges placed at a distance r is N . If the separation between them becomes $2r$, the force of repulsion will be (a) $2N$, (b) $\frac{N}{2}$, (c) $4N$, (d) $\frac{N}{4}$.
 - vii) Two capacitors of capacitance $6 \mu F$ and $3 \mu F$ are connected in series. The value of their equivalent capacitance is
(a) $9 \mu F$, (b) $2 \mu F$ (c) $18 \mu F$ (d) $0.5 \mu F$
 - viii) If the length of a copper wire is doubled by stretching it, its resistivity will
(a) be doubled (b) be halved (c) remain unchanged (d) be increased by 4 times
 - ix) When current is passed through a junction of two dissimilar metals, heat is evolved or absorbed at the junction. This process is called -
(a) Seebeck effect, (b) Joule effect, (c) Peltier effect, (d) Thomson effect.
 - x) A galvanometer can be converted into an ammeter by connecting it with a
(a) suitable high resistance in parallel, (b) suitable low resistance in parallel, (c) suitable high resistance in series, (d) suitable low resistance in series.

- xi) Magnetic dipole moment of a current carrying loop is independent of
(a) number of turns in the coil, (b) area of the loop of the coil, (c) current in the coil, (d) magnetic field in which it is placed.
- xii) A hydrogen atom makes a transition from 1st excited state to ground state. The energy of the photon in eV, emitted in this process is (a) 2.20, (b) 10.20, (c) 12.09, (d) 12.75.
- xiii) In X-ray tube, the penetrating power of the X-rays can be increased by
(a) increasing the filament voltage, (b) decreasing the filament voltage, (c) increasing the voltage across the electrodes, (d) decreasing the voltage across the electrodes.
- xiv) N-type semiconductor is obtained on doping intrinsic germanium by-
(a) gold, (b) boron, (c) aluminium, (d) phosphorous.
- xv) In a transistor the base region is -
(a) highly doped, (b) moderately doped, (c) lightly doped, (d) none of these.

GROUP - B

Answer Any Five (05) questions

2. (a) Write down the characteristics of SHM. (b) The equation of a plane progressive wave propagating along positive X direction is given by, $y = 10 \sin \left(100\pi t - \frac{2\pi}{7} x \right)$ cm, where x is in meter and t in second. Calculate the amplitude, frequency, wavelength and speed of the wave. (c) Write down two applications of ultrasonic wave. 2+4+2
3. (a) Establish the relation between critical angle and absolute refractive index of the two medium. (b) With necessary ray diagram state the position and nature of image formed by an extended object placed in between principal focus and optical center of a convex lens. (c) The radius of curvature of a plano-convex lens is 20cm. Calculate its focal length if the absolute refractive index of the material of the lens is 1.5. 2+3+3
4. (a) State Gauss' law in electrostatics. Using this law, derive an expression for the electric field intensity at an outside point of a uniformly charged sphere. (b) Calculate how many electrons are present in one coulomb of charge? (c) State the factors on which the capacitance of a conductor depends. (2+2)+ 2+2
5. (a) On which factors does the resistance of a conductor depend and how? Define resistivity. (b) Three resistors 6 Ω , 4 Ω and 8 Ω are connected in sides AB, BC and AC respectively in a triangle ABC. A 12 V dc battery is connected across 6 Ω resistor. With necessary diagram find the equivalent resistance between A and B and the current through 8 Ω resistor. (c) Show that equivalent resistance in parallel combination of resistances is less than the smallest resistance in the combination. (2+1)+3+2
6. (a) State and explain Kirchhoff's current law & Kirchhoff's voltage law. (b) Define neutral temperature & inversion temperature for a thermo couple. (c) Draw the thermo e.m.f. vs. temperature graph for a thermo couple & show the position of neutral temperature and temperature of inversion. 3+3+2
7. (a) State and explain Biot - Savart Law in electromagnetism. (b) A circular wire of radius 10 cm is carrying a current of 2A. Calculate the magnetic field at the centre of the coil. (c) Which rule gives the direction of the force on a current carrying conductor when placed in a magnetic field? State & explain the rule. (d) "Magnetic force on a charge particle does no work" - explain. 2+2+ (1+1) +2

8. (a) State & explain Faraday's law of electromagnetic induction. (b) A galvanometer of resistance 20Ω gives full scale deflection when a current of 0.5mA passes through it. Explain with proper circuit diagram how can this be converted to an ammeter reading up to 5A . (c) "The Curie point of Iron is 770°C " - Explain. 3+3+2

9. (a) Write down the differences between insulator, semiconductor and conductor. (b) With necessary diagram and drawing input and output waveform explain the working of p-n junction diode as full wave rectifier using two diodes. (c) What is LED? 3+ 4+1

10. (a) State & explain the postulates of Bohr's atomic model. (b) Explain the working principle of an optical fiber with a proper diagram. (c) Draw the curve showing the variation of intensity with wavelength of X-rays obtained from X-ray tube and mark cut-off wavelength (λ_{min}), continuous & characteristic X-rays. (d) Write two uses of LASER 2+2+2+2

ENGINEERING MECHANICS*Time Allowed: 2.5 Hours**Full Marks: 60*

Answer to Question No. 1 of Group A must be written in the main answer script. In Question No. 1, out of 2 marks for each MCQ, 1 mark is allotted for right answer and 1 mark is allotted for correct explanation of the answer.

Answer any Five (05) Questions from Group-B.

GROUP-A

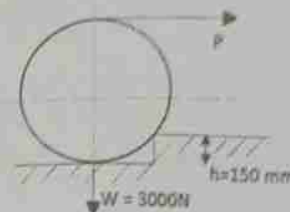
1. Choose the correct answer from the given alternatives and explain your answer (any ten): 2x10=20
- (i) According to the Principle of Transmissibility of Force, the effect of a force on a rigid body remains unchanged if (a) the force is removed from the body (b) the force is applied to a different body (c) the force is shifted along its line of action (d) the force is doubled.
 - (ii) Which of the following is **NOT** a condition for the equilibrium of a co-planar system of non-concurrent parallel forces? (a) Sum of all horizontal forces must be zero (b) Sum of all vertical forces must be zero (c) Sum of all moments about any point must be zero (d) The forces must always be equal in magnitude.
 - (iii) A force of 100 N is acting at an angle of 60° with the horizontal. What is the vertical component of the force? (a) 50 N (b) 86.6 N (c) 100 N (d) 43.3 N
 - (iv) The unit of a couple is: (a) N/m^2 (b) N/m (c) N-m (d) N.
 - (v) The resultant in parallelogram law of forces has maximum value when the angle between two forces is equal to: (a) 30° (b) 90° (c) 0° (d) 180° .
 - (vi) A block resting on a rough plane having angle of friction 12° will impend motion, if the inclination of the surface with the horizontal is: (a) 11° (b) 12° (c) 13° (d) 15° .
 - (vii) The stability of an object increases when: (a) Its centre of gravity is raised (b) Its base is made smaller (c) Its centre of gravity is lowered (d) It is tilted.
 - (viii) Limiting force of friction is the (a) ratio of limiting friction and normal reaction (b) the friction force acting when the body is in motion (c) the friction force acting when the body is just about to move (d) all of the above.
 - (ix) In the law of simple machine, $P = mW + C$, the constant C denotes (a) effort lost in friction under load W (b) effort lost in friction under no load (c) effort lost in friction when M.A. is maximum (d) none of the above.
 - (x) If a wheel rotates at 10 rad/s, what is the linear velocity of a point on its rim if the radius is 0.5 m? (a) 2 m/s (b) 5 m/s (c) 10 m/s (d) 20 m/s.
 - (xi) A machine has a power rating of 500 W. How much work does it do in 30 seconds? (a) 1500 J (b) 1000 J (c) 15kJ (d) 150 kJ.
 - (xii) If efficiency of a lifting machine is kept constant, then its V.R. is directly proportional to its (a) effort applied (b) M.A. (c) machine friction (d) all of the above.

- (xiii) If a semi-circular lamina has diameter 12cm then the distance of its C.G. from the base is (a) $\frac{8}{\pi}$ cm (b) $\frac{12}{\pi}$ cm (c) $\frac{4}{3\pi}$ cm (d) $\frac{8}{3\pi}$ cm.
- (xiv) The co-efficient of friction depends on (a) area of contact (b) shape of surfaces (c) strength of surfaces (d) nature of surfaces.
- (xv) A projectile is fired at an angle θ with the horizontal. The maximum height will be reached when θ is (a) 0° (b) 45° (c) 90° (d) 60° .

GROUP-B

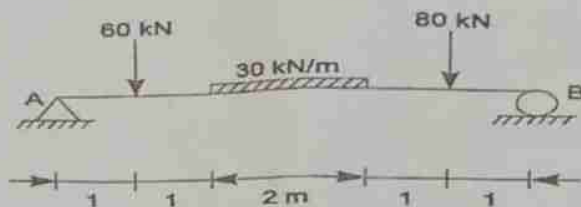
2. (a) State and prove Varignon's theorem.
 (b) Four forces equal to 10N, 20N, 30N and 40N are respectively acting along the four sides (1 m each) of a square ABCD, taken in order. Find the magnitude, direction and position of the resultant force. [3+5]

3. (a) A uniform wheel of diameter 600 mm and weight 3 kN is to be pulled over a rigid rectangular block of height (h) 150 mm by a horizontal force P applied to the end of a string wound around the circumference of the wheel shown in the Fig. Find the least pull required just to turn the wheel over the corner of the block.

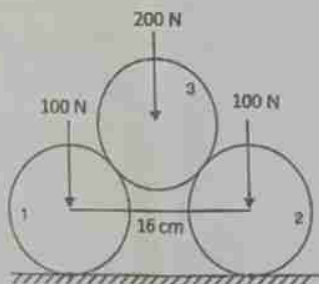


- (b) ABCDEF is a regular hexagon. Forces of magnitude 2 N, $4\sqrt{3}$ N, 8 N, $2\sqrt{3}$ N and 4 N act at in the direction of AB, AC, AD, AE and AF respectively. Determine the resultant and its direction. [4+4]

4. (a) State and explain the parallelogram law of forces.
 (b) Find out the reactions at supports for the beam shown in the fig. [3+5]

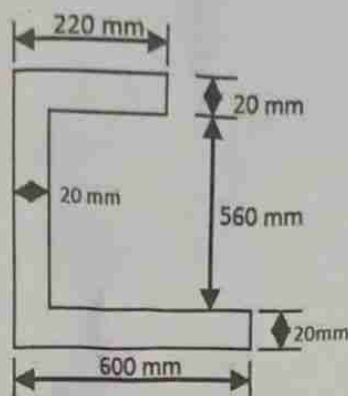


5. Two smooth circular cylinders, each of weight 100N and diameter 12cm are connected at their centres by a string of length 16cm, rest upon a horizontal plane, supporting above a third cylinder of weight 200N and diameter 12cm, find the tension in the string and reaction produced by the horizontal plane at the point of contacts. [8]



6. (a) State the Coulomb's law of friction.
 (b) An effort of 200 N is required just to move a certain body up an inclined plane of 15° , the force acting parallel to the plane. If the angle of inclination of the plane is made 20° , the effort required, again applied parallel to the plane, is found to be 230 N. Find the weight of the body and co-efficient of friction. [3+5]

7. (a) What is the relationship between effort and the load lifted of a simple lifting machine? Plot the graph of effort vs load lifted for actual machine.
 (b) In a lifting machine, the effort of 15 N lifted a load of 700 N. Find the velocity ratio (V.R.) if the efficiency at this load is 60%. If a load of 1300 N is lifted by an effort of 25 N by the same machine, find the law of the machine. What will be effort required to lift the load of 1000 N? Determine maximum Mechanical Advantage (M.A.) and maximum efficiency. [3+5]
8. (a) Derive a relationship for the distance travelled by a body in the 'n'th second.
 (b) A motorist rushing at 15 m/sec, finds a block on the road 40 m ahead. He instantly applies brakes to stop the car within 5 m of the block, calculate: (i) retardation and (ii) time required to stop the car. [4+4]
9. (a) Define centre of gravity, centroid and centre of mass.
 (b) Locate the centroid of the lamina given in the fig below. [3+5]



10. (a) Deduce the condition for self-locking of a machine.
 (b) A load of 2 kN is to be lifted by a screw-jack, having threads of 10 mm pitch. The efficiency of the jack at load is 50%. Determine the effort applied at the end of the handle of 50 cm length. [3+5]
11. (a) Write mathematical expression of potential energy and kinetic energy with SI units. Give one example of each of potential energy and kinetic energy.
 (b) Water from a tank of capacity 18000 litres is to be lifted in 20 minutes by a pump through a height of 12m. If the efficiency of the pump is 65%, find the power of the pump. (Take 1 litre = 1 kg). [4+4]

INTRODUCTION TO IT SYSTEMS

Time Allowed: 3 Hours

Full Marks: 60

Answer to Question No. 1 of Group A must be written in the main answer script. In Question No. 1, out of 2 marks for each MCQ, 1 marks is allotted for right answer and 1 marks is allotted for correct explanation of the answer. However, no marks will be given for wrong explanation of the answer of each MCQ type question. Answer any Five (05) Questions from Group-B.

GROUP-A

1. Choose the correct answer from the given alternatives and explain your answer (any ten): 2x10=20
 - i) The number of steps on algorithm should be-
 - a) Finite b) Infinite c) Fixed d) Floating
 - ii) Minimum number of bits required to represent 15 different characters individually:
 - a) 15 b) 4 c) 5 d) 3
 - iii) Which of the following memory is used to design BIOS?
 - a) RAM b) ROM c) Cache d) Virtual Memory
 - iv) Logical operations are performed in computer using-
 - a) Memory Unit b) ALU c) CD d) ROM
 - v) Equivalent Binary representation of the Gray code 0111 is
 - a) 0101 b) 1000 c) 1010 d) 1111
 - vi) Best choice of the tools to create dynamic web page-
 - a) CSS b) JavaScript c) Java d) paint.
 - vii) Best choice of the tools to introduce different style in a web page-
 - a) CSS b) JavaScript c) Java d) Power point.
 - viii) Operating Systems used in the computer system for _____.
 - a) File management b) Process management c) Device management d) All of these
 - ix) Free and efficient operating system is _____.
 - a) UNIX b) Windows c) MAC d) None of these.
 - x) DNS is-
 - a) Horizontal naming system b) Vertical naming system c) client server system d) None of these
 - xi) A simple tool that helps you create, organize, and analyze data.
 - a) Browser b) Web viewer c) Spreadsheet d) Web server
 - xii) The result of the expression $29 + 1 =$
 - a) 11101 b) 11110 c) 11000 d) 10001
 - xiii) Example of Universal Gate-
 - a) NAND b) XOR c) OR d) AND
 - xiv) Which of the following is used for connecting computers in a large area such as country, continent etc
 - a) LAN b) WAN c) MAN d) PAN
 - xv) Which of the following not a browser ?
 - a) Safari b) Android c) Chrome d) Edge

GROUP-B
Answer any Five (05) questions

8x5=40

2. a) Define algorithm with a suitable example.
b) Write the advantages of using flow chart.
c) Draw a flow chart to calculate the factorial of an integer. 3 + 1 + 4
3. a) Explain the advantages of multi-user and multitasking OS.
b) Write down the differences between system software and application software. 2 + 2 + 4
c) Describe the general architecture of an operating system.
4. a) Why computer security is important?
b) What is cyber stalking?
c) What is computer hacking?
d) Can you protect your personal computer from being hacked ? How? 2 + 2 + 2 + 2
5. a) What is CSS?
b) Identify the ways to integrate CSS on a web page.
c) Explain the differences between <picture> tag and tag used in HTML. 1 + 3 + 4
6. a) Explain the utility of JavaScript.
b) What are the key difference between java and JavaScript?
c) Differentiate between an ordered list and an unordered list used in HTML with proper example. 2 + 2 + 4
7. a) Draw the block diagram of a digital computer specifying all parts of it .
b) Define ROM, PROM, EPROM and EEPROM.
c) What is Booting? 3 + 4 + 1
8. a) Why we use web browser? 2 + 2 + 2 + 2
b) Why are search engines important ?
c) Write down the full form of e-mail and www.
d) Write down the objectives of Digital India.
9. a) State and prove the De-Morgan's Law in Boolean algebra.
b) Convert $(10110)_2$ to its equivalent gray code. (2+3) + 2+1
c) Represent $(5)_{10}$ using 2-4-2-1 BCD code.
10. a) Define universal gates. Why those gates are termed as universal gates ?
b) Convert the following as indicated:
i) $(175.25)_{10} = (?)_8$ ii) $(1011.101)_2 = (?)_{10}$
c) Represent $(-14)_{10}$ in 2's complement form using 8-bits representation. (1+1) + (2+2) + 2

Answer to Question No. 1 of Group A must be written in the main answer script. In Question No. 1, out of 2 marks for each MCQ, 1 mark is allotted for right answer and 1 mark is allotted for correct explanation of the answer. However, no marks will be given for wrong explanation of the answer of each MCQ type question.

Answer any Five (05) Questions from Group-B.

GROUP-A

1. Choose the correct answer from the given alternatives and explain your answer (any ten): 2x10=20

i) The cofactor of the element '3' of the Determinant, $\begin{vmatrix} 1 & -1 & 3 \\ 0 & 2 & 6 \\ 1 & 5 & 2 \end{vmatrix}$ is (a) 2 (b) -2 (c) 0 (d) 1.

ii) If $2 \begin{bmatrix} x & 2 \\ 7 & y+5 \end{bmatrix} + \begin{bmatrix} 3 & 4 \\ 1 & 2 \end{bmatrix} = \begin{bmatrix} 3 & 8 \\ 15 & 14 \end{bmatrix}$, then find the value of (x, y) is - (a) (0, 0) (b) (1, 0) (c) (1, 1) (d) (0, 1).

iii) The value of the Determinant, $\begin{vmatrix} 1 & -1 & 3 \\ 1 & -1 & 3 \\ 1 & 5 & 2 \end{vmatrix}$ is - (a) 3 (b) 0 (c) 6 (d) None of these.

iv) If $A = \begin{bmatrix} 2 & m-3 \\ 3 & 6 \end{bmatrix}$ is singular, then the value of m is (a) 3 (b) -3 (c) 7 (d) -7.

v) The value of p for which the points (1, 2), (3, 6), (p, 4) are collinear is (a) 2 (b) 3 (c) 1 (d) -1.

vi) The Cartesian co-ordinates of a point are $(-\sqrt{3}, 1)$, its polar co-ordinates are (a) $(2, \frac{\pi}{6})$ (b) $(2, -\frac{\pi}{6})$ (c) $(2, \frac{5\pi}{6})$ (d) $(2, -\frac{5\pi}{6})$.

vii) The value of $\int_0^{\frac{\pi}{2}} \sin x \, dx$ is (a) 1 (b) 0 (c) -1 (d) None of these.

viii) The value of the integral is $\int_0^1 \frac{dx}{1+x^2}$ (a) $\frac{\pi}{2}$ (b) $\frac{\pi}{4}$ (c) 0 (d) None of these.

ix) $\int \frac{\sin x \, dx}{\cos x}$ is equal to (a) $\log \sin x + c$ (b) $\log x + c$ (c) $\sin x + c$ (d) None of these.

x) The order and degree of the differential equation $\left(\frac{d^3y}{dx^3}\right)^2 + \left(\frac{dy}{dx}\right)^5 + y = 3\sin x$ are - (a) 3 and 2 (b) 1 and 5 (c) 2 and 3 (d) None of these.

xi) Complementary Function of the differential equation $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = e^x$ is - (a) $(c_1 + c_2)e^x$ (b) $(c_1 + c_2x)e^x$ (c) $(c_1 + c_2)e^{-x}$ (d) $(c_1 + c_2x)e^{-x}$.

xii) If $f(x, y) = \frac{x}{y}$, then find the value of $x \frac{\partial f}{\partial x} + y \frac{\partial f}{\partial y}$ is equal to (a) f (b) -f (c) 1 (d) 0.

xiii) An urn contains 12 white balls and 6 black balls. A ball is drawn at random. What is the probability of being it to be a white? - (a) $\frac{2}{3}$ (b) $\frac{1}{2}$ (c) $\frac{4}{9}$ (d) 1.

xiv) If $\text{Var}(X) = 3$ and $Y = 2X + 3$ then $\text{Var}(Y)$ is equal to - (a) 6 (b) 12 (c) 15 (d) 9.

xv) Let 'A' be any event then $P(A)$ is always - (a) $0 \leq P(A) \leq 1$ (b) $1 \leq P(A) \leq 0$ (c) $-1 \leq P(A) \leq 1$ (d) $1 \leq P(A) \leq 2$.

GROUP-B
Answer any Five (05) questions.

2. a) Evaluate by Chio's method

$$\begin{vmatrix} 0 & -1 & 2 & 3 \\ 1 & 2 & -1 & 1 \\ 1 & 1 & 2 & 3 \\ 3 & 2 & 1 & 0 \end{vmatrix}$$

b) Show that the matrix $A = \frac{1}{3} \begin{bmatrix} -1 & 2 & -2 \\ -2 & 1 & 2 \\ 2 & 2 & 1 \end{bmatrix}$ is orthogonal, i.e. $AA^T = A^T A = I_3$.

4 + 4

3. a) Solve the following system of linear equations by Cramer's Rule.

$$2x + y + z = -2$$

$$x + 2y + z = 1$$

$$x - 2y - 3z = 1$$

b) Show that the matrix $A = \begin{bmatrix} 2 & 0 & 2 \\ 4 & 6 & 0 \\ 0 & 2 & 4 \end{bmatrix}$ satisfies the equation $A = \frac{1}{2}(A + A^T) + \frac{1}{2}(A - A^T)$.

4 + 4

4. a) Find the St. Line passes through the point (1, 0) and parallel to the St. Line $2x + 3y = 6$

b) Prove the triangle formed by the lines $x + y = 0$, $3x + y = 4$ and $x + 3y = 4$ is an isosceles triangle.

4 + 4

5. Evaluate: $\int \frac{(x-1)}{(x-3)(x+2)} dx$.

b) Show that $\int_0^{\frac{\pi}{2}} \frac{\sin x dx}{\sin x + \cos x} = \frac{\pi}{4}$.

c) Evaluate: $\int_0^1 e^{2x} dx$.

3 + 3 + 2

6. a) Evaluate: $\int_0^{\frac{\pi}{2}} \frac{\cos x dx}{(1 + \sin x)(2 + \sin x)}$.

b) Find the area bounded by the circle $x^2 + y^2 = 4$ and the st. line $x = y$ in the first quadrant and x-axis.

4 + 4

7. a) If $u = \cos^{-1} \left(\frac{x+y}{\sqrt{x+y}} \right)$, then show that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} + \frac{1}{2} \cot u = 0$.

b) $u = \log(x^3 + y^3 + z^3 - 3xyz)$ then show that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = \frac{3}{x+y+z}$.

3 + 3 + 2

8. a) Solve the differential equation: $\frac{d^2 y}{dx^2} - 10 \frac{dy}{dx} + 25y = 0$.

b) Solve the differential equation $\frac{d^2 y}{dx^2} - 10 \frac{dy}{dx} + 25y = e^{5x}$.

4 + 4

9. a) There are two identical urns containing 4 white and 3 red balls; 3 white and 7 red balls. An urn is chosen at random and a ball is drawn from it. Find the probability that the ball is white. What is the probability that it is from the first urn if the ball drawn is white?

b) Two dice are rolled. What is the probability that the sum total of the points on the dice is 6?

c) If $P(A) = u$, $P(B^c) = 0.7$, $P(A \cup B) = 0.8$ and $P(A \cap B) = 1 - u$, then find the value of u .

3 + 3 + 2

10. a) The table below given the weights of 50 school students nearest to kilogram. Calculate mean and standard deviation from the following data:

Wt. in kg (x)	40-42	43-45	46-48	49-51	52-54	55-57	58-60
No. of boys (f)	3	6	9	13	8	7	4

b) P can hit a target 4 times in 5 shots, Q 3 times in 4 shots and R twice in 3 shots. They fire a volley. What is the probability that two shots at least hit the target?

4 + 4

FUNDAMENTALS OF ELECTRICAL & ELECTRONICS ENGINEERING

Time Allowed: 3 Hours

Full Marks: 60

Answer to Question No. 1 of Group A must be written in the main answer script. In Question No. 1, out of 2 marks for each MCQ, 1 mark is allotted for right answer and 1 mark is allotted for correct explanation of the answer. However, no marks will be given for wrong explanation of the answer of each MCQ type question.

Answer any Five (05) Questions from Group-B.

GROUP-A

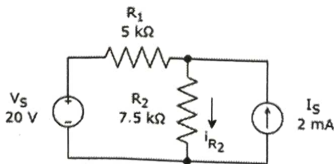
1. Choose the correct answer from the given alternatives and explain your answer (any ten): 2x10=20
- i. An ideal current source has (a) zero internal resistance (b) infinite internal resistance (c) low value of voltage (d) large value of current.
 - ii. The resistance of a conductor increases if its (a) length increases (b) area of cross-section increases (c) length as well as area of cross-section increases (d) value of specific resistance is kept constant.
 - iii. Energy stored by a coil is doubled when its current is increased by percent (a) 25 (b) 50.5 (c) 41.4 (d) 100.
 - iv. A coil with 500 turns carries a current of 2 A. The value of MMF of the coil is (a) 20 AT (b) 200 AT (c) 1000 AT (d) 55 AT
 - v. Inductive reactance of a coil of inductance 0.2 H at 50 Hz is (a) 62.8 Ω (b) 628 Ω (c) 0.2 Ω (d) 10 Ω
 - vi. The power factor of a purely resistive circuit is (a) zero (b) unity (c) lagging (d) leading.
 - vii. A sinusoidal voltage is represented by $v = 141.4 \sin(314.18\pi/2)$. Its rms value of voltage is (a) 141.4 V (b) 100 V (c) 87.92 V (d) 200 V.
 - viii. Voltage per turn in both primary and secondary windings of a transformer is (a) high in high voltage winding (b) low in low voltage winding (c) same (d) can't be determined.
 - ix. Transformer rating are given in (a) KVA (b) HP (c) KVAR (d) kW
 - x. A transformer transforms – a) Power b) Voltage c) current d) frequency
 - xi. When PN junction diode is in forward bias, by increasing the battery voltage (a) Circuit resistance increases (b) Current through P-N junction increases (c) Current through P-N junction decreases (d) None of the above happens.
 - xii. An ideal OPAMP is an ideal (a) current controlled current source (b) current controlled voltage source (c) voltage controlled voltage source (d) voltage controlled current source
 - xiii. When the two input of a NAND gate is high, the output of the gate will be (a) high (b) low (c) toggle between high & low (d) none of the above
 - xiv. A diode is a/an (a) bidirectional device (b) unidirectional device (c) both (a) and (b) (d) none of the above
 - xv. Which of these sets of logic gates are known as universal gates? (a) XOR, NAND, OR (b) OR, NOT, XOR (c) NOR, NAND, XNOR (d) NOR, NAND

GROUP-B

Answer any Five (05) questions.

8x5

2. (a) Write the unit of resistivity. Name the factors affecting the resistance of a conductor.
 (b) Using source transformation, find out the current through the resistance R_2 in the figure below.



3. (a) Define Magnetic Flux Density and MMF
 (b) State Faraday's Laws of Electromagnetic Induction

1+2+5

4+4

4. (a) Draw and explain hysteresis loop for magnetic material. 6+2
 (b) Discuss the causes of hysteresis loss.
5. (a) For sinusoidally varying alternating quantity, state the relation between (i) rms value and maximum value, (ii) average value and maximum value.
 (b) Show that current in a pure inductive circuit lags the voltage by 90 degree. 2+4+2
 (c) Define active power and reactive power.
6. A coil of resistance $20\ \Omega$ and inductance 100 mH is connected in series with a capacitance of $40\ \mu\text{F}$ across 100 V , 50 Hz ac supply. Calculate (i) the magnitude of current, (ii) power factor, (iii) phase angle between voltage and current, (iv) voltage across each element. 2+2+2+2
7. (a) Derive the emf equation of a transformer.
 (b) A single phase transformer is required to step down the voltage from 1100 V to 400 V at 50 Hz . The core has a cross-sectional area of 25 cm^2 and the maximum flux density is 5 Wb/m^2 . Determine the number of turns of the primary and secondary windings. 4+4
8. (a) With respect to Energy band diagram differentiate between Conductors, Semiconductor & Insulator. 6+2
 (b) Distinguish between an intrinsic and extrinsic semiconductor material.
9. (a) Draw the circuit diagram of an op-amp non-inverting amplifier and derive the expression for output voltage. 5+3
 (b) Draw the pin diagram of IC 741 OPAMP.
10. (a) State De-Morgan's Theorem. 2+3+3
 (b) Draw the logic symbol and truth table of a 2-input NAND gate and EX-OR gate.

ENGINEERING MECHANICS

Full Marks: 60

Time Allowed: 3 Hours

Answer to Question No. 1 of Group A must be written in the main answer script. In Question No. 1, out of 2 marks for each MCQ, 1 mark is allotted for right answer and 1 mark is allotted for correct explanation of the answer. However, no marks will be given for wrong explanation of the answer of each MCQ type question.

Answer any Five (05) Questions from Group-B.

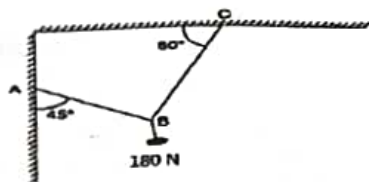
GROUP-A

1. Choose the correct answer from the given alternatives and explain your answer (any ten): $2 \times 10 = 20$
 - i) A force can be represented by---
 - a) Direction b) magnitude c) direction and magnitude ~~d) any one of the above~~
 - ii) Lami's theorem deals with the equilibrium of a body under the action of three---
 - a) Coplanar forces b) non- coplanar forces c) coplanar non-concurrent forces ~~d) coplanar concurrent forces~~
 - iii) The algebraic sum of moments of forces about any point in their plane is equal to the moment of their resultant about the same point- this is the statement according to-----
 - ~~a) Varignon's theorem~~ b) lami's theorem c) coplanar force theorem d) triangular theorem
 - iv) For conditions of equilibrium, Lami's theorem is applicable when the number of forces acting at a point is---~~a) two~~ b) three c) four d) any number
 - v) Newton's which law is known as inertia law---~~a) first law~~ b) second law c) third law d) fourth law
 - vi) When two forces of magnitude 3N and 4N acts at right angles to each other their resultant is
 - a) 14N b) 10N c) 2N ~~d) 5N~~
 - vii) Unit of moment in S.I. system is - a) kg-mm b) N-mm c) kg-m ~~d) N-m~~
 - viii) The point, through which the whole weight of the body acts, irrespective of its position, is known as
 - (a) Moment of inertia (b) Center of gravity (c) Center of percussion ~~(d) Center of mass~~
 - ix) The magnitude of frictional force depends upon---a) area b) shape ~~c) nature of the contacting surfaces~~ d) none of these
 - x) Efficiency of a lifting machine is the ratio of -a) P/W b) $V.R./M.A.$ c) $M.A./V.R.$ ~~d) $M.A. \times V.R.$~~
 - xi) An ideal machine is one whose efficiency is - a) 50% b) 50% to 70% c) $< 50\%$ d) 100%
 - xii) The maximum mechanical advantage of a lifting machine is given by---a) $1 + m$ b) $1 - m$ c) m/VR d) $1/m$
 - xiii) The distance travelled by a body moving with an uniform acceleration in the n^{th} second is equal to---
 - a) $2u + a(2n - 1)$ b) $u + a/2(2n - 1)$ c) $un + \frac{1}{2}an^2$ d) none of these
 - xiv) The energy which a body possesses by virtue of its position or configuration is called---
 - a) Kinetic Energy b) Potential Energy c) Heat Energy d) Chemical Energy
 - xv) For maximum range of a projectile, the angle of projection should be--- a) 90° b) 60° c) 30° d) 45°

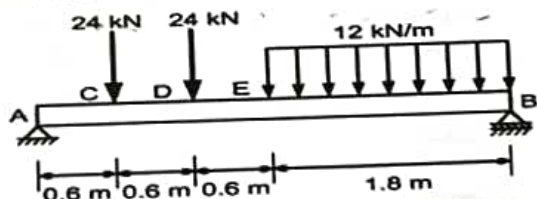
GROUP-B

Answer any Five (05) questions. $5 \times 8 = 40$

- State and explain Lami's Theorem. Find the Forces (tension) developed in the wire AB & CB, supporting an electric fixture as shown in the adjacent Fig. [3+5]



- The following forces act a point — i) 20N inclined at 30° towards north of east ii) 25N towards north iii) 30 N towards north of west and iv) 35N inclined at 40° towards south of west. Find the magnitude and direction of the resultant of the force system. [8]
- Write the general expression of Mechanical Advantage (MA) & Velocity Ratio (VR) of simple lifting machine. Deduce the condition of reversibility of a machine. What do you mean by non-reversible or self-locking machine. [3+3+2]
- What is Friction? Define Coefficient of Friction and Angle of Repose. A body is resting on rough horizontal plane. It requires a pull of 170 Newtons inclined plane at 27° , to the plane just to move it, while a push of 190 Newtons inclined at 27° to the plane just to move it. Determine weight of the body and the coefficient of friction. [3+5]
- Write the mathematical expression of potential and kinetic energy. A particle is projected at an angle 45° with the horizontal with velocity of projection 150 m/s. Determine i) the maximum height attained by the projectile, ii) the horizontal range of projectile, iii) time of flight [3+5]
- State the unit of angular velocity, angular acceleration and angular displacement. A body moving with uniform acceleration covers 20 m in 4^{th} second and 30 m in 8^{th} second. find i) the initial velocity and ii) the acceleration of the body. [3+5]
- What are the advantages of a lifting machine? Define work, power and energy. Mention the S.I units of them [2+3+3]
- Draw the sketches of the types of support in beam. Determine the reactions of the support A & B in the adjacent Fig [2+6]



- Write the expression of VR of a simple screw jack. The efficiency of a lifting machine is 80% when an effort 50 N is required to lift a load of 1 kN. Find the mechanical advantage and velocity ratio of the machine. [2+6]
- Differentiate between centroid and C.G. locate the centroid of the I-section shown in figure. [2+6]



Time Allowed: 3 Hours

Full Marks: 60

Answer to Question No. 1 of Group A must be written in the main answer script. In Question No. 1, out of 2 marks for each MCQ, 1 mark is allotted for right answer and 1 mark is allotted for correct explanation of the answer. However, no marks will be given for wrong explanation of the answer of each MCQ type question.

Answer any Five (05) Questions from Group-B.
GROUP- A

1. Choose the correct answer from the given alternatives and explain your answer (any ten): $2 \times 10 = 20$

- (i). What happens to the wavelength of a sound wave in air medium if its frequency increases?
(a) The wavelength decreases, (b) The wavelength increases, (c) The wavelength remains constant, (d) The wavelength becomes zero
- (ii). What is the beat frequency if two waves of frequencies 400 Hz and 405 Hz interfere?
(a) 5 Hz, (b) 400 Hz, (c) 405 Hz, (d) 805 Hz.
- (iii). The working of an optical fibre for transmission of light waves is based on -
(a) total internal reflection, (b) refraction, (c) interference, (d) diffraction.
- (iv). What is the nature of the image formed by a convex lens when the object is placed at twice the focal length?
(a) Real and inverted, (b) Virtual and erect, (c) Real and erect, (d) Virtual and inverted
- (v). Velocity of light in vacuum is 3×10^8 m/s. Velocity of light in glass of refractive index 1.5 will be -
(a) 3×10^8 m/s, (b) 4.5×10^8 m/s, (c) 2×10^8 m/s, (d) 2×10^7 m/s.
- (vi). Which of the following factors does capacitance depend on?
(a) Voltage, (b) Current, (c) Area of plates, (d) Resistance.
- (vii). The S.I. unit of resistivity of a conductor is -
(a) Ohm-m^2 , (b) ohm-m^1 , (c) Ohm-m^{-1} , (d) Unit-less.
- (viii). If three currents of 1A, 2A, and 3A enter a junction, the total current leaving the junction according to KCL is -
(a) 6A, (b) 5A, (c) 3A, (d) 0A.
- (ix). An electric lamp is marked 100W, 220V. Its resistance is -
(a) 22Ω , (b) 484Ω , (c) 576Ω , (d) 2.2Ω .
- (x). The correct dimensional formula of electric field ($E = F/q$) is -
(a) $[M^1 L^1 T^{-3} I^{-1}]$, (b) $[M^1 L^1 T^{-3} C^{-1}]$, (c) $[M^1 L^1 T^{-2} I^{-1}]$, (d) $[M^1 L^1 T^{-2} C^{-1}]$.
- (xi). The weber/m^2 (Tesla) is the unit of -
(a) magnetic field, (b) magnetic flux density, (c) magnetic flux, (d) none of these.
- (xii). In a p-n-p or n-p-n transistor, the correct statement is
(a) Emitter region is highly doped (b) Base region is moderately doped (c) Collector region is lightly doped.
(d) none of these.

GROUP-B

Answer any Five (05) questions.

2. (i). State the characteristics of simple harmonic motion.
(ii). Define free & damped vibration.
(iii). Write down the differences between transverse & longitudinal waves.
(iv). Define reverberation in acoustics. 2+2+3+1
3. (i). Define a) Critical angle, b) Refractive index, c) 1 dioptre c) Optical centre of a lens.
(ii). State the conditions for total internal reflection.
(iii). An object is placed at a distance of 30cm from a convex lens. A real image is formed at a distance of 60 cm from the lens. Find the focal length. 4+2+2
4. (i). State Gauss' law in electrostatics.
(ii). Define Electric potential and Electric flux.
(iii). In a circuit, two capacitors $C_1 = 6 \mu F$ and $C_2 = 4 \mu F$ are connected in parallel, and this combination is connected in series with another capacitor $C_3 = 8 \mu F$. The circuit is connected to a 12 volt battery. Determine the equivalent capacitance of the circuit. 2+(2+1)+3
5. (i). Define resistivity of a material.
(ii). Explain balanced condition of Wheatstone Bridge. Circuit diagram is Essential.
(iii). Two resistance R_1 and R_2 are connected in parallel and their equivalent resistance is R . Prove that $R < R_1$ or $R < R_2$. 2+3+3
6. (i). Define Electrical energy and Power. Write the practical unit of electrical energy.
(ii). Distinguish between Peltier effect and Joule effect.
(iii). State Kirchhoff's Voltage law. 3+3+2
7. (i). Write the expression of Lorentz force.
(ii). Explain with circuit diagram how a galvanometer is converted into an ammeter.
(iii). Distinguish between diamagnetic, paramagnetic and ferromagnetic materials. 2+ 3+3
8. (i). State the difference between P-type and N-type Semiconductor.
(ii). Define stimulated emission of radiation.
(iii). What is solar cell ? Why solar cell is ideal for remote rural areas ? 3+2+3
9. (i). Distinguish between insulator, semiconductor and conductor in terms of energy band diagram.
(ii). Draw with proper labelling the V-I characteristics curve for a P-N junction Diode.
(iii). Define Cut-in-Voltage
(iv). Write one drawback of Bohr atomic model. 3+3+1+1
10. (i). What do you mean by the term LASER?
(ii). State the characteristics of LASER.
(iii). Write two uses of X-rays in scientific and research.
(iv). Draw the symbol of a PNP transistor with proper labeling. 1+3+2+2

JULY 2023

APPLIED PHYSICS-II

Time Allowed: 2.5 Hours

Full Marks: 60

Answer to Question No. 1 is compulsory and Answer any Five (05) Questions from the rest.

1. Answer the following questions (any five):

3x5

- i. In which position the velocity of a particle executing SHM is maximum? Explain.
- ii. On what factors does the focal length of a lens depend?
- iii. Is the electric potential necessarily be zero at a point where the electric field strength is zero? Explain.
- iv. What are the differences between Peltier effect and Joule effect?
- v. A wire cuts across a flux of 0.002 Weber in 0.12 seconds. What is the emf induced in the wire?
- vi. Write down the basic principle of operation of a solar photo voltaic cell.
- vii. What are the unique properties of LASER?
- viii. Mention three uses of nanotechnology.

2. (a) The equation of a particle vibrating in SHM is $y = 5 \sin 2\pi/5(10t+x)$, where y and x are in m and t is in s. Find out the frequency and amplitude of vibration.
 (b) Write down a few differences between Oscillatory and Periodic motion.
 (c) What is ultrasonic wave? Write down the properties and applications of it. 2+3+(1+3)
3. (a) A lens is composed of different layers made of two different materials. A point object is placed on the axis. How many images of the object will be formed and why?
 (b) Calculate the speed of light in a medium whose critical angle is 45° .
 (c) Draw a ray diagram to show image formation when the convex lens produces a real, inverted and magnified image of the object.
 (d) Write two features to distinguish between the interference patterns in Young's double slit experiment with the diffraction pattern obtained due to a single slit. 3+2+2+2
4. (a) Compare conductor, semiconductor and insulator in terms of energy band diagram.
 (b) A student wants to use two p-n junction diodes to convert alternating current into direct current. Draw the labelled circuit diagram he/she would use and explain it.
 (c) Draw the typical input and output characteristics of an n-p-n transistor in CE configuration. Show how these characteristics can be used to determine (i) the input resistance (r_i), and (ii) current amplification factor (β). 3+(2+1)+3
5. (a) State Lenz's law. Does it obey the principle of conservation of energy?
 (b) Deduce an expression for the magnitude of the magnetic field at the centre of a circular coil of N turns.
 (c) A straight wire carrying current of 12A is bent into a semi-circular arc of radius 0.02m. Find the magnitude of the magnetic field at the centre of the arc. (2+2)+2+3

6. (a) State Biot-Savart law and express this law in the vector form.
(b) An electron travelling with velocity 30 cms^{-1} enters a region of uniform magnetic field 0.2T , acting perpendicular to its path. Calculate the magnitude of force on the electron, (charge of electron = $1.6 \times 10^{-19}\text{C}$).
(b) State and explain Lenz's law.
(d) A galvanometer of resistance 100Ω gives full scale deflection when a current of $500\mu\text{A}$ passes through it. How can this be converted to a voltmeter reading up to 5V ? Draw necessary circuit diagram. (2+1)+2+2+2
7. (a) What are the differences between intrinsic and extrinsic semiconductors ?
(b) Calculate the tube voltage required to be applied to an X-ray tube to get minimum wavelength $1\text{\AA}$. (Planck's constant $h = 6.626 \times 10^{-34} \text{ J.s}$)
(c) Define population inversion. Discuss some method to achieve population inversion. 3+2+(1+3)
8. (a) Draw the curve showing the variation of intensity with wavelength of X-rays and mark cut off wavelength, continuous & characteristic X-rays. Write down two important applications of X-rays.
(b) Draw the energy level diagram of He-Ne Laser.
(c) State some advantages of optical fibre over conducting wire. (3+2)+2+2
-

ENGINEERING MECHANICS

Time Allowed: 2.5 Hours

Full Marks: 60

Answer to Question No. 1 is compulsory and Answer any Five (05) Questions from the rest.

1. Answer the following questions (any five):

3×5=15

- (i) Explain the principle of transmissibility.
- (ii) Write the conditions for equilibrium of forces.
- (iii) Show with diagram: Uniformly distributed load and uniformly varying load.
- (iv) State the Coulomb's laws of friction.
- (v) What is cone of friction? Draw the cone.
- (vi) Write the advantages of friction.
- (vii) What is Reversible & Non-reversible machine?
- (viii) What do you mean by 'effort lost in friction' and 'frictional resistance'?
- (ix) A train was moving at a constant velocity of 80 km/h, as it approached a station, the loco-pilot applied brakes at a constant retardation of 0.74 m/sec^2 and stopped it at the station. How much time will it take to stop?
- (x) A ball is thrown vertically upwards from ground, with an initial velocity of 2m/s. Find the greatest height attained by the ball.

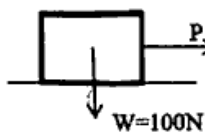
2. (a) State Varignon's theorem. Explain Bow's notation.

(b) Two forces of magnitude '2P' and 'P' act on a particle. If the first force be doubled and the second force is increased by 12 kN, the direction of their resultant remains unaltered. Find the value of P. [4+5]

3. (a) Define co-efficient of friction and limiting friction.

(b) A body of weight 500N is lying on a rough plane inclined at an angle of 25° with the horizontal. It is supported by an effort (P) parallel to the plane. Determine the minimum value of P, for which the equilibrium can exist, if the angle of friction is 20° . [4+5]4. The law of wheel and axle machine is $P = 0.2 W + 50$. The diameter of wheel is 600 mm and radius of axle is 50 mm. Determine (a) Mechanical Advantage, (b) Effort required to lift a load of 2000 N, (c) Maximum Efficiency, (d) Maximum Mechanical Advantage and (e) Load to be lifted by an effort of 520 N. [9]

5.(a)

Find the friction force developed in the given figure for $P = 20\text{N}$, 50N and 60N . Coefficient of static friction $\mu_s = 0.5$ and Coefficient of kinetic (or dynamic) friction $\mu_d = 0.4$.

(b)



Two smooth spheres each of radius 100mm and weighing 100N, rest in a channel having smooth vertical walls, the distance between which is 360 mm. Find the reactions at the points of contacts.

[4+5]

6. (a) What is the difference between centre of gravity and centre of mass?

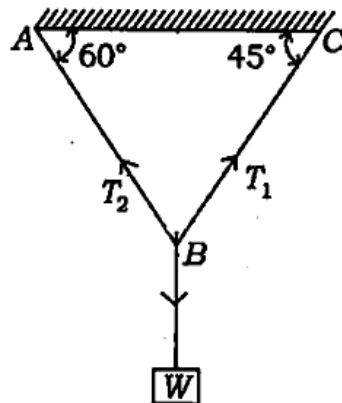
(b) Find the centroid of an I-section having the following dimensions:

Top flange = 160 mm X 20 mm, Web = 80 mm X 30 mm and bottom flange = 200 mm X 10 mm. [2+7]

7. (a) State the Newton's law of motion. Deduce the relationship $P = mf$.(b) Derive a relationship for the distance travelled by a body in the n th second. [5+4]

8. (a) Define (i) Angle of Friction, (ii) Angle of Repose.
(b) What load will be lifted by an effort of 12 N, if the velocity ratio is 18 and efficiency of the machine at this load is 60%? If the machine has a constant friction resistance, determine the law of the machine. [4+5]

9. (a) Define work, power and energy with their SI units. Give one example of each of potential energy and kinetic energy.
(b)



A weight of 2 kN is supported by two strings as shown below. Find the tensions in the strings.

[5+4]

FUNDAMENTALS OF ELECTRICAL & ELECTRONICS ENGINEERING*Time Allowed-2.5 Hours**Full Marks: 60***Answer to Question No. 1 is compulsory and Answer any Five (05) Questions from the rest.**

1. Answers any five question from the following :- (3×5=15)
 - a) What do you mean by capacitance of a capacitor? What is its unit?
 - b) State Fleming's left hand rule and its application.
 - c) What is power factor? Write the value of power factor for purely resistive circuit.
 - d) What do you mean by voltage transformation ratio of a transformer?
 - e) Draw the symbols of PNP and NPN transistor with proper notation.
 - f) Draw the pin diagram of IC741 op-amp with proper leveling. What is virtual ground?
 - g) What is the full form of SOP and POS form of logic gates? Draw the symbol of two input Ex-NOR gate.

2. a) Define ideal current source and ideal voltage source with proper symbol. ~~×~~
 b) What are active and passive components? Give examples for each.
 c) How can you convert a voltage source into current source and vice-versa? (2+3+4)

3. a) State and explain Faraday's Laws of Electromagnetic Induction.
 b) Write down the similarities between magnetic & electric circuit.
 c) What do you mean by permeability? (4+4+1)

4. a) Define (any four): i) RMS value, ii) Frequency, iii) Flux density, iv) Form factor v) MMF
 vi) Reluctance vii) Hysteresis loss.
 b) A series RLC circuit having resistance of $10\ \Omega$, inductance of $0.1\ \text{H}$ and capacitance of $150\ \mu\text{F}$ are connected in series across $230\ \text{V}$, $50\ \text{Hz}$ AC supply. Calculate: i) Impedance ii) current, iii) power factor, iv) Active power, v) Voltage drop across inductor. (4+5)

5. a) Write down the working principle of two winding transformer.
 b) A $100\ \text{KVA}$ single phase transformer has 300 turns in primary side and 30 turns in secondary side. The primary is connected to a $11\ \text{kV}$, $50\ \text{Hz}$ AC supply. Calculate: i) secondary emf, ii) primary and secondary full load current and iii) maximum flux in the core.
 c) Write four main parts of DC motor.
 d) Give the applications of DC series motor. (2+4+2+1)

6. a) State and explain De- Morgan's theorem.
 b) Draw the NOR gate and write down its truth table.
 c) What are universal logic gates? Give examples. (4+3+2)

7. a) What are the characteristics of an ideal OP- AMP?
 b) Draw the circuit diagram of an inverting amplifier and derive the expression for output voltage.
 c) Explain the op-amp acts as a adder circuit. (2+4+3)

8. a) Explain energy level diagram of insulator, conductor and semi - conductor.
 b) Draw and explain the forward and reverse biased characteristics of P-N junction diode. (4+5)

JULY 2023

INTRODUCTION TO IT SYSTEMS

Time Allowed: 2.5 Hours

Full Marks: 60

Answer to Question No. 1 is compulsory and Answer any Five (05) Questions from the rest.

1. Answer any five questions:

(3×5=15)

- How many type of Software? Give some example.
- What is meant by a cache memory? Explain.
- What are the characteristics of computers?
- Give some importance functions of Operating System.
- What is cyber stalking? What is Spam?
- How many ways you can apply CSS to an HTML document?
- Explain De Morgan's Theorem.

- Prove: $\bar{A}\bar{B}\bar{C} + \bar{A}B\bar{C} + A\bar{B}\bar{C} + ABC = C$
 - What is the difference between Batch Processing System and Realtime Processing System?
 - Convert Binary to Gray Code: $(1101101)_2 = (?)_G$

3

4

2

- Write down the various formatting tags in HTML.
 - Write an HTML code to display in Web Browser following table:

4

5

MATH	PHYSICS	IT
80	90	95
65	78	65
89	76	70

- Draw a flow Chart to find out Largest number of three given number.
 - Algorithm & Flowchart to convert temperature from Celsius to Fahrenheit.
 - Distinguish between loop and branching statements.

3

4

2

- Name some CSS style components.
 - Design a HTML page with Java Script to calculate sum of n natural numbers.

4

5

- Draw the logic diagram of an Ex-NOR gate and discuss its operation.
 - Simplify the Boolean expression: $(X + Y)(X + \bar{Y})(\bar{X} + Z)$
 - Draw the logic diagram the Boolean expression: $AB + ABC + \bar{A}\bar{B}C + A\bar{C}$

3

4

2

- What is a Malware and types of Malwares?
 - What is DoS Attack? What are the security measures against DoS attack?
 - What is Computer Hacking?

3

4

2

- Convert : $(27.23)_{10} = (?)_2$ and $(542)_8 = (?)_{16}$
 - Write the main difference between Multitasking and Multiprogramming.
 - What are ASCII and EBCDIC Codes?

4

3

2

- State the difference between (a) HDD and SDD memory (b) DRAM and SRAM
 - Name the gates that are used as universal gates.

8

1

JULY 2023
MATHEMATICS-II

Time Allowed: 2.5 Hours

Full Marks: 60

Answer to Question No. 1 is compulsory and Answer any Five (05) Questions from the rest.

1. Answer any five questions.

3×5=15

- a) Find the probability that getting at least two heads in a toss of unbiased coin 3 times.
- b) Evaluate: $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} x^2 \sin x^3 dx$.
- c) Check the exactness: $(xy - 2x^2) + xy \frac{dy}{dx} = 0$.
- d) Check whether the points $(-3, 4)$, $(0, -1)$ and $(1, 2)$ are the co-linear.
- e) Find the inverse of the matrix $\begin{bmatrix} 2 & 3 \\ 1 & 5 \end{bmatrix}$.
- f) State Euler's theorem on homogeneous function with two variables.
- g) Find the median of the data: 1, 2, 3, 4, 1, 2, 3, 4, 1, 2, 3, 4, 1, 2, 1.

2. (a) Solve by Cramer's rule:

$$x + 2y + 3z = 5$$

$$3x - 2y + z = -1$$

$$4x + 2y + z = 13$$

5

- (b) Find the area bounded by the parabola $y^2 = 4x$ above x-axis and ordinate at $x=2$.

4

3. (a) Find the equation of the straight line making 60° angle with positive direction of x-axis and passing through the point of the points $(7, 8)$. 5

- (b) If $U = \sin^{-1} \frac{x-y}{\sqrt{x}+\sqrt{y}}$ show that $x \frac{\partial U}{\partial x} + y \frac{\partial U}{\partial y} = \frac{1}{2} \tan U$. 4

4. (a) Solve: $\frac{d^2y}{dx^2} + 5\frac{dy}{dx} + 6y = x^2e^x$. 5

(b) Evaluate: $\int \frac{\cos x}{(2 \sin x - 3)(\sin x + 2)} dx$. 4

5. (a) If $A = \frac{1}{3} \begin{pmatrix} -1 & 2 & -2 \\ -2 & 1 & 2 \\ 2 & 2 & 1 \end{pmatrix}$ show that $AA^T = A^T A = I_3$. Hence find A^{-1} . 5

(b) An urn contains 2 white and 4 red balls. Two balls are drawn randomly one after another without replacement. What is the probability that the drawn balls are red? 4

6. (a) Solve: $(x + 2y)\frac{dy}{dx} = y$. 4

(b) Find the median of the distribution given below:

x :	15 - 19	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	45 - 49
f :	4	8	18	20	25	16	9

5

7. (a) The line segment $x + y = 1$, $0 \leq y \leq 1$ is revolved about y axis to generate a cone. Find the volume of the cone. 5

(b) Evaluate: $\int_0^{\frac{\pi}{2}} \frac{\sqrt{\tan x}}{\sqrt{\tan x} + \sqrt{\cot x}} dx$. 4

8. (a) A can hit a target 5 times out of 4, B 4 times out of 3 and C 2 times out of 3. Each is allowed to shoot once. What is the probability that the target is hit? 5

(b) Solve: $\cos y dx + (1 + 2e^{-x}) \sin y dy = 0$. 4

9. (a) Without expanding prove that $(a+b+c)$ is a factor of the determinant

$$\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$$

5

(b) Find the equation of the ellipse whose eccentricity is $4/5$ and axes are along the coordinate axes and with foci at $(0, \pm 4)$. 4

APPLIED PHYSICS - II

Time Allowed: 2.5 Hours

Full Marks: 60

Answer the following questions from Group A, B & C as directed

GROUP - A

1. Choose the correct answer (Any ten):

1 x 10 = 10

- (i) The equation of a particle executing S.H.M. is $y = 5 \sin \frac{2\pi}{5} (10t + x)$. The frequency and amplitude of vibration is (a) 10, 5 (b) 5, 2 (c) 2, 5 (d) $\frac{5}{\pi}$, 5
- (ii) If two progressive waves given by $y_1 = 6 \sin 250\pi t$ and $y_2 = 3 \sin 256\pi t$ superpose, the number of beats formed per second is (a) 3 (b) 5 (c) 6 (d) 8
- (iii) The focal lengths of a convex lens for blue and yellow light are f_b and f_y respectively. The correct relation is (a) $f_b = f_y$ (b) $f_b > f_y$ (c) $f_b < f_y$ (d) $f_b \ll f_y$
- (iv) The speed of light in air is $3 \times 10^8 \text{ ms}^{-1}$. Its speed in diamond of refractive index 2.4 is (a) $3 \times 10^8 \text{ ms}^{-1}$ (b) $7.2 \times 10^8 \text{ ms}^{-1}$ (c) $1.25 \times 10^8 \text{ ms}^{-1}$ (d) none of these
- (v) If the current flowing through a circuit is 0.5 A in 5 mins, the amount of charge flowing through it is (a) 216 C (b) 300 C (c) 150 C (d) 25 C
- (vi) Specific resistance of the material of wire is $45 \times 10^{-8} \Omega \text{ m}$. The length of the wire (radius 0.25 mm) required to make a resistance of 8 Ω is (a) 5 m (b) 4.5 m (c) 3.5 m (d) 2.5 m
- (vii) A Carbon resistor has three strips of red colour and a gold strip. What is the value of the resistor? (a) $(200 \pm 5\%) \Omega$ (b) $(2000 \pm 5\%) \Omega$ (c) $(2200 \pm 5\%) \Omega$ (d) $(2220 \pm 5\%) \Omega$
- (viii) The formula for the magnetic field well inside a long solenoid of length L & total number of turns N, carrying a current I is (a) $\mu_0 NI/2$ (b) $\mu_0 NI/2L$ (c) $\mu_0 NI/L$ (d) None of these
- (ix) Lenz's law in electromagnetic induction is another form of the law of (a) Conservation of energy (b) Conservation of charge (c) Conservation of mass (d) None of these
- (x) Which of the following does not exist? (a) Static charge (b) Moving charge (c) Magnetic dipole (d) Magnetic monopole
- (xi) In transistor the base is doped (a) heavily (b) moderately (c) lightly (d) randomly
- (xii) If the voltage of X-ray tube is doubled, the intensity of X-rays will become (a) half (b) doubled (c) four times (d) unchanged
- (xiii) Which of the following is a unique property of laser? (a) Low level of directionality (b) Polychromatic (c) High coherence (d) Low intensity
- (xiv) If I_{diff} and I_{drift} are the diffusion current and drift current in an unbiased p-n junction diode, then (a) $I_{\text{diff}} = I_{\text{drift}}$ (b) $I_{\text{diff}} > I_{\text{drift}}$ (c) $I_{\text{diff}} \gg I_{\text{drift}}$ (d) $I_{\text{diff}} < I_{\text{drift}}$
- (xv) The energy of the first excited state of hydrogen atom is (a) -13.6 eV (b) -3.4 eV (c) -1.51 eV (d) none of these

2. Fill in the blanks (Any ten):

1 x 10 = 10

- i) The absorption coefficient of an open window is _____.
- ii) In case of _____ wave, direction of vibration of the particles is perpendicular to the direction of propagation of the wave.
- iii) Two or more light waves are said to be coherent if they are in same _____.
- iv) For total internal reflection, light should travel from _____ medium to _____ medium.
- v) The electric field inside a hollow charged sphere is _____.
- vi) Keeping the charge same, if the capacitance of a capacitor is increased, the potential difference across it will _____.
- vii) The equivalent resistance in parallel combination of three resistances 7 Ω , 5 Ω , 3 Ω is _____.
- viii) Seebeck effect is a _____ process.
- ix) The SI unit of magnetic flux density is _____.
- x) In a moving coil galvanometer _____ is produced to rotate the pointer. — —
- xi) Doping of Indium to silicon leads to _____ type semiconductor.
- xii) X-rays are produced by hitting a target (heavy metal) with a stream of _____.
- xiii) In the depletion region of a p-n junction, there is a shortage of _____ and _____.

- xiv) A semiconductor has _____ temperature coefficient of resistance.
 xv) Staying time of atoms in metastable states is normally _____ seconds.

3. Answer the following questions in one or two sentences (Any ten):

$1 \times 10 = 10$

- i) If A & ω are the amplitude and the angular frequency respectively of a particle in SHM, then write down the formula for the maximum acceleration of the particle.
- ii) In which medium transverse wave cannot propagate?
- iii) If a lens is immersed in water what will happen to its focal length?
- iv) Which one of the core and cladding in an optical fiber has higher refractive index?
- v) Find out the equivalent capacitance for two capacitors of capacitance $30\mu\text{F}$ and $50\mu\text{F}$ connected in series.
- vi) If the voltage across a bulb is decreased by 1%, what will be the percentage change in its power?
- vii) If a static charge is placed inside a magnetic field, will there be any force acting on it?
- viii) Why induced emf is also called back emf?
- ix) Among K_α and K_β X-ray which has higher energy?
- x) Two parallel wires carry same current in same direction. What will happen?
- xi) Which one of Silicon or Germanium has higher energy band gap?
- xii) Which bias causes breakdown in p-n junction diode?
- xiii) Which type of biasing gives a semiconductor diode very high resistance?
- xiv) Name two types of pumping mechanism in laser production.
- xv) Write the full form of CNT in respect to nanotechnology?

GROUP-B

4. Answer the following questions (Any six):

$2 \times 6 = 12$

- i) Will there be any change in critical angle if the colour of light is changed? Give reason.
- ii) What happens to the capacitance of a capacitor when a dielectric slab is placed between its plates? Explain with relevant formula.
- iii) Out of resistance (R) and specific resistance (ρ), which one is more fundamental and why?
- iv) State the factors on which the thermo-emf developed in a thermocouple depends.
- v) What are the measures to be taken to reduce the reverberation in a hall?
- vi) Are Electromotive force and Potential Difference same for a cell? Explain.
- vii) What will happen if a very high resistance, instead of a low resistance, is connected in parallel to a galvanometer to convert it into an ammeter?
- viii) Draw the necessary circuit diagram for studying the forward bias characteristic curve ($V - I$ curve) of a p-n junction diode.
- ix) What are the different types of breakdown in p-n junction diode?
- x) Describe briefly the phenomenon of Stimulated emission.

GROUP-C

5. Answer the following question (Any one of (i), (ii) & (iii)):

- i)
 - a) What are damped and forced vibrations?
 - b) Determine the focal length of the lens of refractive index 1.7 when placed in air. The radii of curvature of the two spherical surfaces of the lens are 20cm and 35cm. (2+2+2)
 - c) Write down the characteristics of simple harmonic motion.
- ii)
 - a) A particle executing S.H.M has a maximum displacement of 4 cm and its acceleration at a distance of 1.0 cm from its mean position is 3 cm/s^2 . What will be its velocity when it is at a distance of 2cm from its mean position?
 - b) Indicate in ray diagram the kind of lens needed, the position of the object and the position of the image to obtain a magnified virtual image. (2+2+2)
 - c) Define optical center of a lens with diagram.
- iii)
 - a) The equation of a progressive wave is given by $y = 5 \sin(100\pi t - 0.4\pi x)$ where y and x are in m and t is in s. Find out the wavelength, frequency and velocity of the wave.
 - b) Write down the conditions for total internal reflection of light.
 - c) An object is placed at a certain distance from a convex lens of focal length 20 cm. Find the distance of the object if the image obtained is magnified 4 times. (2+2+2)

6. Answer the following question (Any one of (i), (ii) & (iii)):

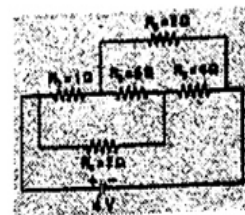
- i)
 - a) Two point charges A and B , having charges $+Q$ and $-Q$ respectively, are placed at certain distance apart and force acting between them is F . If 25% charge of A is transferred to B , then what will be the force between them.

- ~~b)~~ Prove that the energy stored in parallel plate capacitor is $\frac{1}{2}CV^2$.
~~c)~~ Write the differences between Peltier Effect and Joule effect.

(2+2+2)

ii)

- a) What is an equipotential surface? Why work done in taking a charge from one point to another on such surfaces is zero?
 b) Five resistances are connected to a cell of potential difference 4V as shown in the figure. Find the current drawn from the cell in the given network.
 c) An electric heater of resistance $200\ \Omega$ connected to 220 V power supply is immersed in water of mass 1 kg. How long the electrical heater has to be switched on to increase the temperature of water from 30°C to 80°C . (The specific heat of water is $s = 4200\ \text{J kg}^{-1}$)



(1+1+2+2)

iii)

- a) Define neutral temperature, inversion temperature in respect to thermo-emf. What is relation between them?
 b) Calculate the voltage of a battery connected to a parallel plate capacitor with a plate area $2.0\ \text{cm}^2$ and a plate separation $2.0\ \text{mm}$ if the charge stored on the plates is $4.0\ \text{pC}$.
 c) What are meant by ohmic and non ohmic conductor?

(1+1+1+2+1)

7. Answer the following question (Any one of (i), (ii) & (iii)):

i)

- ~~a)~~ State Faraday's laws of electromagnetic induction.
~~b)~~ Draw the circuit diagram of a full wave rectifier (Centre taped) using p-n junction diode and give its input and output wave forms.
 c) Write one advantage and one disadvantage of solar cell.

(2+2+2)

ii)

- a) State Biot-Savart's law and write down its mathematical form in SI unit.
 b) Draw the circuit diagram of a CE mode amplifier using n-p-n transistor. Show the input and output wave forms.
 c) What is meta-stable state in lasing action?

(2+3+1)

iii)

- a) Calculate the tube voltage required to be applied to an X-ray tube to get minimum wavelength $2.0\ \text{\AA}$. ($h = 6.626 \times 10^{-34}\ \text{Js}$)
 b) A proton enters a uniform magnetic field of strength $0.500\ \text{T}$ with a velocity of $2.0 \times 10^5\ \text{m/s}$. The magnetic field is directed along the Y-axis and the velocity is directed along X-axis. Find the magnitude of the force acting on the proton and its acceleration. (charge of proton = $1.60 \times 10^{-19}\ \text{C}$, mass of proton = $1.67 \times 10^{-27}\ \text{kg}$)
 c) Draw the energy level diagram of He-Ne Laser.

(2+2+2)

November 2022

ENGINEERING MECHANICS

Time Allowed: 2.5 Hours

Full Marks: 60

Group-A**1. Choose the correct alternatives (Answer any ten)****[1 × 10 = 10]**

- (i) Moment of a force
(a) Varies directly with its distance from the pivot, (b) Varies inversely with its distance from the pivot, (c) Is independent of its distance from the pivot, (d) None of the above.
- (ii) A couple consist of
(a) Two like parallel forces of same magnitudes, (b) Two like parallel forces of different magnitudes, (c) Two unlike parallel forces of same magnitudes, (d) Two unlike parallel forces of different magnitudes.
- (iii) Lami's theorem is applicable to
(a) Coplanar forces; (b) Concurrent forces; (c) Coplanar and concurrent forces; (d) Like parallel forces.
- (iv) In linear motion, the rotational analogue of force is
(a) Torque, (b) Couple, (c) Moment of inertia, (d) None of the above.
- (v) If a body is in equilibrium, we may conclude that
(a) No force is acting on it is zero, (b) The moment of the forces about any point is zero, (c) The resultant of all the forces acting on it is zero, (d) Both (b) and (c)
- (vi) Co-efficient of friction is the ratio of
(a) Normal reaction to limiting friction
(b) Limiting friction to the weight of the body to be moved
(c) Limiting friction to normal reaction
(d) None of the above.
- (vii) Friction always
(a) Opposes motion (b) Helps in moving the objects, (c) Opposes relative motion, (d) None of these.
- (viii) Axis passing through the centroid is known as
(a) Parallel axis, (b) Perpendicular axis, (c) Centroidal axis, (d) None of these.
- (ix) To find out the centroid of the given triangular area (height = 90, base = 60), $\bar{y} =$
(a) 30 (b) 20 (c) 45 (d) 15
- (x) The velocity ratio of a simple wheel and axle with 'D' and 'd' as the diameters of effort wheel and load axle, is (a) $D + d$, (b) $D - d$, (c) $D \times d$, (d) D/d
- (xi) In simple lifting machine, Load vs. Effort graph is –
(a) Straight-line (b) Parabolic curve (c) Hyperbolic curve (d) none of these.
- (xii) In a simple lifting machine, the following parameter remains constant –
(a) Efficiency (b) velocity ratio (c) mechanical advantage (d) All of these.

~~(xiii)~~ Newton's first law of motion gives the concept of (a) Work; (b) Force; (c) Inertia; (d) Energy.

(xiv) A jet engine works on the principle of conservation of (a) Mass; (b) Energy; (c) Linear Momentum; (d) Angular Momentum

2. Fill in the blanks (Answer any ten)

[1 × 10 = 10]

- (i) _____ relates to bodies in motion without any reference to forces.
- ~~(ii)~~ A body which does not deform under the action of applied forces is called the _____.
- ~~(iii)~~ _____ is a method of designating a force by writing two capital letters on either side of the force.
- ~~(iv)~~ Maximum value of static friction is known as _____ friction.
- ~~(v)~~ The maximum angle which an inclined surface makes with horizontal when a body placed freely on it, is just on the verge of moving down; is called angle of _____.
- ~~(vi)~~ A lifting machine is said to be reversible if its efficiency is _____ than 50%.
- ~~(vii)~~ Efficiency of a self-locking lifting machine is _____.
- ~~(viii)~~ The centre of gravity a T-section 100 mm × 150 mm × 50 mm from its bottom is _____.
- ~~(ix)~~ Frictional force encountered after commencement of motion is called _____.
- ~~(x)~~ In actual machines, Mechanical advantage is _____ than velocity ratio.
- ~~(xi)~~ Unit of angular velocity is _____.
- ~~(xii)~~ Final velocity of a stone, falling freely from a height of 5 m to the ground, will be _____ m/s.
- ~~(xiii)~~ Linear velocity is the product of angular velocity and _____.
- ~~(xiv)~~ The energy possessed by a body, for doing work by virtue of its position, is called _____.
- ~~(xv)~~ A man lifts a suitcase of 5 kg mass from ground level to a 10.193 m high rooftop. Change in potential energy in that suitcase is = _____ Joules.

3. Answer the following questions (Answer any ten)

[1 × 10 = 10]

- ~~(i)~~ Explain Bow's notation.
- ~~(ii)~~ State the law of superposition.
- ~~(iii)~~ State the parallelogram law of vector addition.
- ~~(iv)~~ What do you mean by resolution of a force?
- ~~(v)~~ State the Lami's theorem.
- ~~(vi)~~ Define moment of a force.
- ~~(vii)~~ What do you mean by "angle of limiting friction"?
- ~~(viii)~~ What is the relationship between angle of repose and angle of friction?
- ~~(ix)~~ Name the types of loads usually considered on beams.
- ~~(x)~~ What is law of machine?
- ~~(xi)~~ If two concurrent forces of 4 N and 6 N are acting at an angle of 60°, find the magnitude of their resultant. *8.71*
- ~~(xii)~~ What is an ideal machine?
- ~~(xiii)~~ Write the law of conservation of momentum.
- ~~(xiv)~~ What is the centripetal force?
- ~~(xv)~~ What are the Basic Units?

Group-B

4. Answer the following questions (Answer any SIX)

[2 × 6 = 12]

- ~~(i)~~ Explain the principle of transmissibility.
- ~~(ii)~~ Write the conditions for equilibrium of forces.
- ~~(iii)~~ Show with diagram: Uniformly distributed load and Uniformly varying load.
- ~~(iv)~~ State the Coulomb's laws of friction.

- (v) What is cone of friction? Draw the cone.
~~(vi) Write the advantages of friction.~~
~~(vii) What is Reversible & Non-reversible machine?~~
~~(viii) What do you mean by 'effort lost in friction' and 'frictional resistance'?~~
 (ix) A train was moving at a constant velocity of 80 km/h, as it approached a station, the loco-pilot applied brakes at a constant retardation of 0.74 m/sec^2 and stopped it at the station. How much time will it take to stop?
 (x) A ball is thrown vertically upwards from ground, with an initial velocity of 2m/s. Find the greatest height attained by the ball.

Group-C

5. Answer any one of the following questions

[6 × 1 = 6]

- (a) The resultant of two forces P and Q is R . If Q is doubled, the new resultant is perpendicular to P . Prove that $Q = R$.
 (b) Four forces equal to P , $2P$, $3P$ and $4P$ are respectively acting along the four sides of a square $ABCD$, taken in order. Find the magnitude, direction and position of the resultant force.
 (c) A horizontal bridge (AB) of 18 m long weigh 18 kN and rest on two supports at its ends. What will be the pressure on each support when a lorry of weight 5 kN starting from A is two third of the way across the bridge?

6. Answer any one of the following questions

[6 × 1 = 6]

- (a) A uniform wheel of diameter 600 mm and weight 3 kN is to be pulled over a rigid rectangular block of height (h) 150 mm by a horizontal force P applied to the end of a string wound around the circumference of the wheel shown in the Figure 6(a). Find the least pull required just to turn the wheel over the corner of the block.

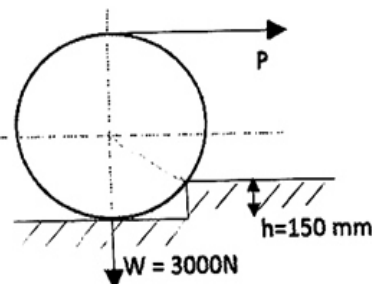


Fig. 6(a)

- (b) A weight of 25 N is pulled up a rough inclined plane whose inclination to the horizontal is 30° by a force of 18 N acting parallel to the plane. Calculate the coefficient of friction.
 (c) Find out the reactions at supports by equations of statics for beam of Figure 6(c).

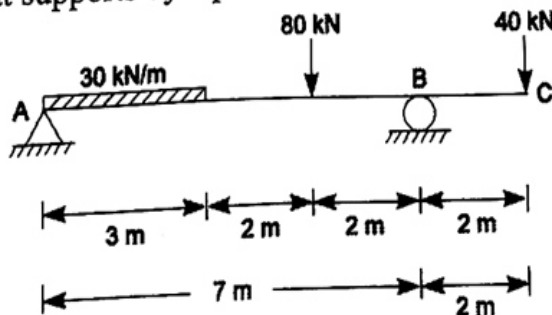


Fig. 6(c)

7. Answer any one of the following questions

[6 × 1 = 6]

- (a) Find the centroid of the cross section shown in Figure 7(a). All dimensions are in mm.

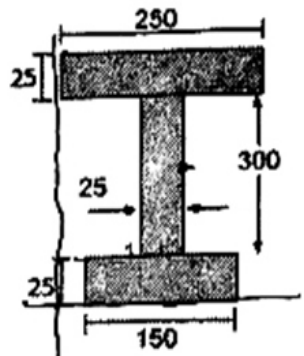


Fig. 7 (a)

- (b) What is the minimum effort P required to lift a load W by a screw jack when helix angle is α and coefficient of friction is $\tan \phi$ where ϕ is the angle of friction? A simple screw jack has a thread of pitch of 10 mm, find the mechanical advantage and efficiency, if an effort of 20 N is applied at the end of an arm 500 mm long to lift a load 2.6 kN.

[2 + 4]

- (c) A wheel rotating about a fixed axis at 20 revolutions per minute is uniformly accelerated for 70 sec. during which it makes 50 revolutions. Find the (i) angular velocity at the end of this interval and (ii) time required for the velocity to reach 100 revolutions per minute.

FUNDAMENTAL OF ELECTRICAL & ELECTRONICS ENGINEERING

Time Allowed: 2.5 Hours

Full Marks: 60

GROUP- A**1. Choose the correct answer from the given alternatives (any ten) 1 x 10 = 10**

- i. Rectifier is used to convert (a) DC signal to AC signal (b) AC signal to Pulsating DC signal (c) Reducing the amplitude of DC signal (d) Generation of AC signal
- ii. The current through a series RLC circuit under resonance condition will be (a) V/R (b) V/X_C (c) V/X_L (d) none of these
- iii. Transformer ratings are given in :a) kVA b) HP c) kVAR d) kW
- iv. Two sinusoidal emfs are given as $e_1 = A \sin(\omega t + \pi/4)$ and $e_2 = B \sin(\omega t - \pi/6)$. The phase difference between the two quantities in degrees is a) 15 b) 45 c) 75 d) 30.
- v. For a DC voltage, an inductor (a) is virtually a short circuit. (b) is an open circuit. (c) Depends on polarity. (d) Depends on voltage value.
- vi. The flux in transformer core a) increases with load, (b) decreases with load, (c) remains constant irrespective of load, d) none of the above.
- vii. The number of valence electrons in the outermost shell of semiconductor are (a) 6 (b) 4 (c) 6 (d) 7.
- viii. The potential barrier of a silicon diode is (a) 0.3 V (b) 0.7 V (c) 1 V (d) 5V.
- ix. Which of the following does not change in a transformer? (a) Current (b) Voltage (c) Frequency (d) All of the above.
- x. When two input of a NAND gate is high, the output of the gate will be (a) High (b) Low (c) Toggle between high & low (d) none of above
- xi. In an auto-transformer, power is transferred, through a) Conduction process only (b) Induction process only (c) Both conduction and induction processes (d) Mutual coupling.
- xii. The number of flip flops required in a decade counter is a) 2 (b) 3 (c) 4 (d) 10.
- xiii. The maximum possible number of states in a ripple counter with 5 flip-flops is (a) 32 (b) 15 (c) 10 (d) 5.
- xiv. An ideal OP-AMP has the following characteristics- (R_{in} = input resistance, A = open loop gain, R_{out} = output resistance) a) $R_{in} = \infty$, $A = \infty$ and $R_{out} = 0$ b) $R_{in} = 0$, $A = \infty$ and $R_{out} = 0$ c) $R_{in} = \infty$, $A = 0$ and $R_{out} = \infty$ d) $R_{in} = 0$, $A = \infty$ and $R_{out} = \infty$.
- xy. $\overline{A + B}$ is equivalent to a) $A + B$ b) $A.B$ c) $\overline{A}.\overline{B}$ d) $\overline{A} + \overline{B}$

2. Fill in the Blanks (any ten) 1x10 = 10

- i. FET is a _____ controlled device
- ii. Transformer cores are laminated in order to _____.
- iii. The number of junctions in an NPN transistor are _____.
- iv. Fleming's Left hand rule gives the direction of _____.
- v. Conductance in Electric circuit is analogous to _____ in Magnetic Circuit.
- vi. The CMRR of an OP-Amp is the ratio of _____.
- vii. The majority charge carrier in n-type material is _____.
- viii. Weber is the unit of _____.
- ix. Energy is stored by the capacitor in the form of _____.
- x. The time constant of a series R-C circuit is given by _____.
- xi. If two capacitance of $10\mu F$ & $15\mu F$ are connected in parallel then the equivalent capacitance will be _____ μF .
- xii. The output of AND gate will be HIGH only when both the input is _____.
- xiii. The full form of TTL is _____.
- xiv. A motor converts electrical energy into _____ energy.

xv. If the reverse bias of gate in JFET is increased, the width of the conducting channel is _____.

3. Answer the following question in one or two sentences (any ten) : $1 \times 10 = 10$

- i. Give two examples of insulating material.
- ii. What is the frequency of a D.C signal?
- iii. Define the term form factor.
- iv. Calculate the time period of a periodic signal whose frequency is 60Hz.
- v. Name the two input terminals of OP-AMP?
- vi. What is a dependent Source?
- vii. Draw the symbol of X-OR Gate.
- viii. What is the unit of inductance?
- ix. Why is doping done on Semiconductor?
- x. Name any two types of Flip-Flop.
- xi. Name one doping material for creation of N-Type Semiconductor.
- xii. What are the types of Rectifier available?
- xiii. On which principle the transformer works?
- xiv. What is the unit of reactive Power?
- xv. What type of DC Motor used in traction?

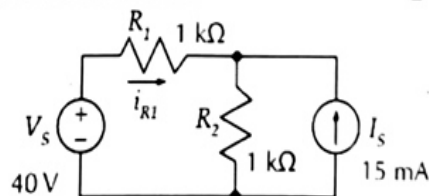
GROUP-B

4. Answer the following question (any six) : $2 \times 6 = 12$
- i. Define the term Semiconductor.
 - ii. Draw the symbol of PNP transistor with proper labeling of its terminals.
 - iii. Define Lenz's Law?
 - iv. What is an ideal current source?
 - v. What is mutual inductance?
 - vi. State Fleming's Right hand Rule?
 - vii. A 250V bulb passes a current of 0.3A. Calculate the power consumed by the lamp.
 - viii. Define the term Flip Flop?
 - ix. Define the term Virtual Ground.
 - x. Define the term Universal Gate.

GROUP-C

5. Module I : Answer the following Questions (any one) : $6 \times 1 = 6$

- i) a) Draw the load current vs Load voltage curve of an ideal voltage source. b) Using Source transformation principle find out the current through the resistance R_1 . $2 + 4 = 6$



- ii) a) State Faraday's Laws of Electromagnetic Induction? b) Derive the expression for the energy stored in the magnetic field of an inductor. $2 + 4$
- iii) A rectangular shape iron core has an air gap of 0.01cm. The mean length of the flux path through iron is 39.99 cm. The relative permeability of iron is 2000. The coil has 1000 turns. The cross-sectional area of the core is 9 cm^2 . Calculate the current required to produce a flux of 1mWb in the core.

6. Module II :Answer the following Questions (any one) : $6 \times 1 = 6$

- i) A R-L-C series circuit comprises of resistance of 15Ω inductance 0.15 H and capacitance of $100 \mu\text{F}$ is connected across a 230V , 50 Hz supply. Calculate current, power factor and power consumed by the circuit. 6
- ii) a) Show that the current leads the voltage in phase by $\pi/2$ in an a.c. circuit containing an ideal capacitor. b) Draw STAR & DELTA connections. Also write voltage and current relations for both types. 6
- iii) a) A 30 KVA single phase transformer has 500 primary turns and 30 secondary turns. The primary is connected to a 3300V , 50 Hz single phase supply. Calculate i) the maximum flux in the core; ii) secondary e.m.f; iii) primary and secondary full load current. b) Name different types of DC motors. $4 + 2 = 6$

7. Module III :Answer the following Questions (any one) : $6 \times 1 = 6$

- i) With respect to Energy band diagram differentiate between Conductors, Semiconductor & Insulator. 6
- ii) Draw the circuit diagram of an inverting amplifier & Derive the expression for output voltage. 6
- iii) a) State the two laws De Morgan's Theorem along with the truth table. simplify the expression using Boolean algebra and realize the same by using logic gates. $Y = (A + \overline{B} + \overline{C}) \cdot (A + \overline{B} \cdot C)$ $3 + 3 = 6$
-

INTRODUCTION TO IT SYSTEMS*Time Allowed: 2.5 Hours**Full Marks: 60***Answer questions from Group-A, B & C as directed.****GROUP-A****1. Choose the correct answer from the given alternatives (Any Ten):****1 X 10 = 10****(i) A web browser is an application that is used to**

- (a) find and retrieve webpage. (b) send e-Mail (c) prepare a document (d) none of these.

(ii) In any search engine user can

- (a) use of two or more keywords (b) use of + (c) use of And (d) All of these.

(iii) A small program that gets loaded in the computer without the user knowledge and replicate itself repeatedly called:

- (a) Worms (b) Virus (c) Browser (d) None of these.

(iv) What is the term for unsolicited email?

- (a) Spam (b) Worm (c) Browser (d) News Group.

(v) Rules to exchange data between computers are called

- (a) Procedure (b) protocols (c) hyperlink (d) program

(vi) CPU scheduling is the basis of

- (a) Large memory size system (b) Multiprogramming system
(c) Multiprocessing system (d) none of the above.

(vii) Which of the following errors will be handled by the operating system?

- (a) Lack of paper in printer (b) Connection failure in the network
(c) Power failure (d) All of the mentioned above.

(viii) Decimal equivalent of 16 in hexadecimal

- (a) 22_{10} (b) 16_{10} (c) 10_{10} (d) 20_{10}

(ix) The number of bits used to store a BCD digit is

- (a) 2 (b) 1 (c) 4 (d) 8

(x) What is the resultant binary equivalent of the decimal problem $49 + 1 =$

- (a) 00110010 (b) 01010101 (c) 00110001 (d) 00110101

(xi) Flowcharts and Algorithms are used for

- (a) better programming
- (b) easy testing and debugging
- (c) efficient coding
- (d) all of these.

(xii) Which of the following HTML tag is used for inserting the largest heading in HTML?

- (a) <h1>
- (b) <h3>
- (c) <h5>
- (d) <h6>

(xiii) In how many way can CSS be written in?

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

(xiv) When a user views a page containing a JavaScript program, which machine actually executes the scripts?

- (a) The user machine running a web browser
- (b) The web server
- (c) A central machine deep within Netscape office
- (d) none of the above

(xv) Which of the following is not a cybercrime?

- (a) Denial of Service
- (b) Man in the middle
- (c) Malware
- (d) AES.

2. Fill in the Blanks (Any Ten):

1 X 10 = 10

- i. _____ is a type of software that is embedded in hardware.
- ii. Universal gates are those gates that can be used for implementing any _____ function without any other types of gates.
- iii. $A + 0 = A$ is an example of _____ Law.
- iv. The Operating System _____ is responsible for interacting with hardware.
- v. In _____ scheduling, each process is given a small amount of time to execute.
- vi. _____ attack is an attempt to make a computer resource unavailable to its intended.
- vii. _____ is a batch file stored in the root directory of the hard-disk.
- viii. A group of four bits is called a _____.
- ix. The advantage of DRAM over SRAM is that it is _____, can hold more data per chip and generate less heat.
- x. _____ software is machine independent.
- xi. _____ is a service that automatically converts domain names into IP addresses.
- xii. Gray code equivalent of 1001 in Binary code is _____.
- xiii. A _____ language is computer language that uses tags to define elements within a document.
- xiv. When designing a flowchart, each step in the process is depicted by a _____ and is associated with a short description.
- xv. Number of types of errors in JavaScript's is _____.

$$1 \times 10 = 10$$

3. Answer the following questions (Any Ten):

- ~~i.~~ What is the maximum number of outputs a logic gate can have?
- ~~ii.~~ Write De Morgan's first Law.
- ~~iii.~~ Identify the device which receives analog data and creates its digital equivalent.
- iv. Define Booting.
- ~~v.~~ What is the first page of a website called?
- ~~vi.~~ Write the full form of HTTP.
- ~~vii.~~ Is it possible to run a computer without operating system? Write your opinion.
- ~~viii.~~ Write the full form of SSD.
- ix. Differentiate between Data and Information.
- ~~x.~~ What is BIOS?
- xi. Write the utility of Cache Memory.
- ~~xii.~~ Define Truth Table.
- xiii. Write the utility of Command Line Interpreter.
- ~~xiv.~~ Write the full form of URL.
- ~~xv.~~ What is Malware?

GROUP-B

4. Answer the questions (Any Six):

$$2 \times 6 = 12$$

- i. Write the differences between SRAM and DRAM.
- ~~ii.~~ Why should we use more than one search engine simultaneously?
- iii. How is 8-4-2-1 code different from 4-2-2-1 code?
- iv. "Two's complement is the most popular technique to represent signed number". Justify the statement.
- v. Is there any difference between compiler and an interpreter?
- ~~vi.~~ With the help of an example, explain the use of flow chart.
- ~~vii.~~ Does all HTML tags have an end tag?
- ~~viii.~~ Write the utility of a scripting language.
- ~~ix.~~ How does a virus get installed in a computer?
- x. Define source code and Executable code.

GROUP-C

5. Answer the questions (Any One):

$$6 \times 1 = 6$$

- (a) ~~(i)~~ How can two numbers be subtracted only through addition?
- ~~(ii)~~ What do you mean by Universal Logic Gates?
- Why Universal Logic Gates are called Universal?
- ~~(iii)~~ Why SSD is faster than Hard Disk?

$$2 + (1+2) + 1 = 6$$

- (b) (i) Write the utility of Excess-3 code.
- ~~(ii)~~ Convert the number $(5674)_8$ into the hexadecimal system.
- ~~(iii)~~ Write the advantages of multiprocessing operating system.

$$1 + 3 + 2 = 6$$

- (c) (i) What are the basic function of an Operating System ? $2 + 2 + 2 = 6$
 (ii) Write the differences between Primary Memory and Secondary Memory.
 (iii) What are the difference between multiprogramming and time sharing System?

6. Answer the questions (Any One):

6 X 1 = 6

- (a) (i) Why algorithm is used before any programming ? $2 + 4 = 6$
 (ii) Draw a flow chart to find out highest number among the three different numbers.

- (b) (i) Write the advantages of the flowcharts.
 (ii) Describe the use of different symbols used in any flow chart with suitable example. $1 + 3 + 2 = 6$
 (iii) How an image can be inserted using suitable tags of HTML in any web page?

- (c) (i) What are Style Sheets ?
 (ii) Define cascading.
 (iii) Write proper syntax to introduce Style Sheet in HTML.
 (iv) Why do we use JavaScript? $1 + 1 + 2 + 2 = 6$

7. Answer the questions (Any One):

6 X 1 = 6

- (a) (i) Write the differences between internet browser and search engine.
 (ii) Is worm a computer virus? Write your opinion.
 (iii) How does a computer worm work? $2 + 2 + 2 = 6$

- (b) (i) What do you mean by the term 'Ethical Hacking' ?
 (ii) Write the advantages of Ethical Hacking.
 (iii) Write a short note on Denial of Service (DoS) attack. $2 + 2 + 2 = 6$

- (c) (i) Write the differences between Phishing and Spamming.
 (ii) Why Firewalls have become so important today?
 (iii) How does a virus get installed in a computer? $2 + 2 + 2 = 6$

MATHEMATICS-II

Time Allowed: 2.5 Hours

Full Marks : 60

Answer the following questions from Group A, B & C as directed**Group A****1. Choose the correct alternatives(any ten) :****1×10**

- i) The value of $\begin{vmatrix} 100 & 101 & 102 \\ 105 & 106 & 107 \\ 110 & 111 & 112 \end{vmatrix}$ is (a) 2 (b) 0 (c) -1 (d) none of these.
- ii) Determinant value of any skew symmetric matrix of order 2×2 is
(a) strictly positive (b) strictly negative (c) 0 (d) none of these.
- iii) The co-factor of the element 5 in $D = \begin{vmatrix} 1 & 3 & 4 \\ -1 & 0 & 2 \\ 3 & 5 & 8 \end{vmatrix}$ is (a) 5 (b) 6 (c) 0 (d) -6.
- iv) The value of k for which the points $(1, 2)$, $(k, 4)$ and $(3, 6)$ are collinear is
(a) 1 (b) 2 (c) 3 (d) none of these.
- v) The value of k for which the line $2x + 3y + 4 + k(6x - y + 11) = 0$ is parallel to the y -axis is
(a) $\frac{1}{3}$ (b) $-\frac{1}{3}$ (c) 3 (d) none of these.
- vi) Coordinates of centre of the circle $2x^2 + 2y^2 - 8x - 5 = 0$ are
(a) $(0, 2)$ (b) $(2, 0)$ (c) $(4, 0)$ (d) $(-4, 0)$
- vii) $\int e^{1-\log x} dx$ is equal to (a) $ex + c$ (b) $e \log|x| + c$ (c) $x \log e + c$ (d) none of these.
- viii) $\int \frac{\cos x}{\sqrt{1+\cos 2x}} dx =$ (a) $x + c$ (b) $\frac{x}{2} + c$ (c) $\frac{x}{\sqrt{2}} + c$ (d) none of these.
- ix) The order and degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^5 - x^3\left(\frac{dy}{dx}\right)^3 = 0$ are
(a) 1 and 2 (b) 2 and 5 (c) 2 and 3 (d) none of these.
- x) The Integrating Factor (IF) of the differential equation $\frac{dy}{dx} + \frac{1}{x}y = \sin x$ is
(a) x (b) $\frac{1}{x}$ (c) $\log_e x$ (d) none of these.
- xi) General solution of the differential equation $\frac{dy}{dx} = 1$ is
(a) $y = c$ (b) $x = 0$ (c) $y = x$ (d) none of these.
- xii) The differential equation whose general solution is $y = A \cos x + B \sin x$ is
(a) $\frac{d^2y}{dx^2} = y$ (b) $\frac{d^2y}{dx^2} = -y$ (c) $\frac{d^2y}{dx^2} = 0$ (d) none of these.
- xiii) If $u = 5x^2 + 7xy + 3y^2$, then $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y}$ equals to
(a) u (b) $2u$ (c) $4u$ (d) none of these.

- xiv) The median of the data 6, 4, -1, 0, 4, 8, 9 is
 (a) 0 (b) 4 (c) 6 (d) none of these.
- xv) Two coins are tossed. The probability of getting at least one head is
 (a) $\frac{3}{4}$ (b) $\frac{1}{2}$ (c) $\frac{1}{4}$ (d) none of these.

2. Fill in the blanks(any ten) :

1 × 10

- i) For a matrix $A = \begin{pmatrix} 3 & 2 & 1 \\ 2 & 0 & 5 \end{pmatrix}$, $A^T =$ _____.
- ii) Matrix $(1 \ 2) \begin{pmatrix} -2 & 5 \\ 3 & 2 \end{pmatrix} \begin{pmatrix} 1 \\ 2 \end{pmatrix}$ is equal to _____.
- iii) The area bounded by the curves $4x + 3y = 12$, $y = 0$ and $x = 0$ is _____.
- iv) If the length of the diameter of the circle $x^2 + y^2 + 4x - 6y - k = 0$ is 4 then value of k is _____.
- v) $x^2 - y^2 = 2022$ represents a _____.
- vi) If $\frac{d}{dx}[\phi(x)] = f(x)$, then $\int f(x) dx$ is _____.
- vii) $\int_0^1 |x| dx =$ _____.
- viii) $\int_0^1 \frac{1-x}{1+x} dx =$ _____.
- ix) Particular Integral(PI) of the differential equation $\frac{d^2y}{dx^2} + 4y = 5e^{2x}$ is _____.
- x) If the differential equation $(2x^2 + 4y)dx + k(4x + y - 1)dy = 0$ is exact then value of k is _____.
- xi) The Complementary Function(CF) of $\frac{d^2y}{dx^2} - 16 = xe^{3x}$ is _____.
- xii) $y = c_1 + c_2 e^x$ is the solution of the differential equation _____.
- xiii) If $u = e^{xy}$, then the value of $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y}$ is _____.
- xiv) If the mean of $x - 2$, 10, $x + 3$, 7 is 9, then $x =$ _____.
- xv) The probability of getting an even number from the numbers up to 50(Including 50) is _____.

3. Answer the following questions(any ten) :

1 × 10

- i) Find x and y such that $\begin{pmatrix} 3 & x+1 \\ y+2 & 5 \end{pmatrix} = \begin{pmatrix} 3 & 2 \\ 7 & 5 \end{pmatrix}$.
- ii) What is symmetric matrix?
- iii) Find the value of x for which $A = \begin{pmatrix} 2 & x \\ 3 & 6 \end{pmatrix}$ is singular matrix.
- iv) Find slope of the line be $2x - 3y = 3$.
- v) Find length of major axis of the ellipse $9x^2 + 16y^2 = 144$.
- vi) Integrate : $\int \cot^2 x dx$.

vii) Evaluate : $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \sin^9 x \cos^5 x \, dx$.

viii) Evaluate: $\int_1^2 \log x \, dx$.

ix) If the roots of Auxiliary Equation(AE) of a linear differential equation of 2nd order with constant coefficients be $2 \pm 3i$, find the Complimentary Function(CF).

x) Find $\frac{1}{D^2 + 5}(\sin 2x)$.

xi) If $u = 7xy^2$, find $\frac{\partial^2 u}{\partial x \partial y}$.

xii) State Euler's theorem on homogeneous function.

xiii) If $y = 2x - 5$ and $\bar{x} = 7$, find the value of $\bar{y}$.

xiv) Find the mode of the data: 7, -1, 2, 3, 5, 0, 2, 3, 2, 3, 0, 4, 2, 5, 1

xv) Let A and B be two events and $P(A) = 0.3$, $P(B) = 0.2$ and $P(A \cap B) = 0.4$, find the value of $P(A \cup B)$.

Group B

4. Answer the following questions(any six) :

2×6

i) If $A = \begin{pmatrix} 3 & 2 \\ 1 & 4 \end{pmatrix}$, find $A(\text{adj } A)$.

ii) Show that $\begin{vmatrix} 1 & \alpha & \alpha^2 \\ 1 & \beta & \beta^2 \\ 1 & \gamma & \gamma^2 \end{vmatrix} = - \begin{vmatrix} \alpha^2 & \beta^2 & \gamma^2 \\ \alpha & \beta & \gamma \\ 1 & 1 & 1 \end{vmatrix}$

iii) Transfer the Cartesian form of the equation $x^2 + y^2 = 2ax$ to its polar form.

iv) If the lines joining the points (a, -2) and (4, -a) be parallel to the line joining (2, 1) and (3, 4), find the value of a.

v) Integrate: $\int \frac{dx}{1 - \cos x}$.

vi) Evaluate : $\int_0^1 \frac{\sin^{-1} x}{\sqrt{1-x^2}} dx$.

vii) Solve : $x dy - y dx = (x^2 + y^2) dx$

viii) Verify Euler's Theorem for the function $f(x, y) = 3x^2 + 4y^2$.

ix) Find the variance of : 5, 6, 7, 8, 10.

x) An urn contains 12 white balls and 6 red balls. A ball is drawn at random. What is the probability of being it to be a white?

Group C

5. Answer the following question(any one) :

i)

- a) If A be a skew symmetric matrix then prove that A^2 is symmetric. 2

- b) Evaluate the determinant $\begin{vmatrix} 0 & -1 & -1 & 1 \\ 4 & 5 & 1 & 1 \\ 3 & 9 & 4 & 1 \\ 4 & 4 & 4 & 1 \end{vmatrix}$ using Chio's method. 4

ii)

- a) Without expanding prove that $\begin{vmatrix} 1 & a & b+c \\ 1 & b & c+a \\ 1 & c & a+b \end{vmatrix} = 0$. 2

- b) If $A = \begin{pmatrix} 3 & 2 \\ 2 & 1 \end{pmatrix}$, prove that $A^2 - 4A - I = 0$, where I is the unit matrix of order 2

and hence find A^{-1} . 4

- iii) A straight line passes through the point (7, 3) and has intercepts on the axes in equal magnitude but opposite in sign. Find its equation. Also find the co-ordinates of the point on the line at which the abscissa is triple the ordinate. 6

6. Answer the following question(any one) :

- i) Evaluate : a) $\int \frac{e^{4\log x} - e^{3\log x}}{e^{\log x} - 1} dx$ b) $\int_0^{\frac{\pi}{2}} \frac{\cos x}{(1 + \sin x)(2 + \sin x)} dx$. 2 + 4

- ii) Solve : $\frac{d^2 y}{dx^2} - 4a \frac{dy}{dx} + 4a^2 y = x^2 e^{2ax}$. 6

- iii) Mark the area bounded by $y^2 = 2x$, $x = 1$ and $x = 4$ and find the enclosed area. 6

7. Answer the following question(any one) :

- i) A distribution consists of three components with frequencies 200, 250, 300 having means 25, 10 and 15; standard deviation 3, 4 and 5 respectively. Prove that the mean of the combined distribution is 16 and its standard deviation is 7.2 approximately. 6

- ii) A coin and a die are thrown simultaneously. Find the probabilities of occurrence of
a) head and even face b) tail and multiple of three. 6

- iii) If $u = \cos^{-1} \frac{x+y}{\sqrt{x} + \sqrt{y}}$, prove that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} + \frac{1}{2} \cot u = 0$. 6

January 2022

APPLIED PHYSICS-II

Time Allowed: 1.5 Hours

Full Marks: 60

Answer to Question No.1 is compulsory and Answer any two questions from the rest.

1. Choose the correct answer from the given alternatives (any twenty): 20x2
- i) If The length of a conducting wire be made half and the area of cross section be made double ,the resistance becomes- (a) four times (b) two times (c) halved (d) one-fourth
 - ii) LASER is the acronym for
(a) Light Amplification by Stimulated Absorption of Radiation
(b) Light Amplification by Stimulated Emission of Radiation
(c) Light Amplification by Spontaneous Emission of Radiation
(d) None of these
 - iii) X-rays are deflected by-
(a) electric field
(b) magnetic field
(c) both magnetic field and electric field
(d) neither electric field nor magnetic field
 - iv) The specific resistance of a copper conductor depends on- (a) Length (b) area of cross-section
(c) temperature (d) all of these
 - v) A moving charge produces-
(a) an electric field only
(b) a magnetic field only
(c) Both electric and magnetic field
(d) either electric field or magnetic field
 - vi) If the forward bias voltage across a p-n junction be increased, the width of the depletion region
(a) decrease (b) increase (c) remains same (d) increases proportionally to the applied voltage
 - vii) The SI unit of resistivity is- (a) ohm.m⁻¹ (b) volt.m⁻¹ (c) volt.m (d) ohm.m
 - viii) In germanium crystal ,the energy band gap is- (a) 0.068 eV (b) 6.8 eV (c) 68 eV (d) 0.68 eV
 - ix) The output of a full wave rectifier is- (a) an AC voltage (b) a constant DC voltage
(b) zero (d) a pulsating unidirectional voltage
 - x) The power of two is +5D and -2.5 D. The focal length of the two lenses in contact will be
(a) +40 cm (b) -40 cm (c) +40 m (d) none of these
 - xi) The SI unit of magnetic flux is- (a) weber (b) gauss (c) oersted (d) none of these
 - xii) The phase difference between any two points situated on a wave front is
(a) π (b) 2π (c) 0 (d) $\frac{\pi}{2}$
 - xiii) If the potential difference applied to an X-ray tube be doubled ,the cut off (minimum) wavelength
(a) becomes halved (b) becomes doubled (c) becomes four time(d) remains same
 - xiv) Two resistances of 6 Ω and 8 Ω are connected in parallel and the combination is connected across a 24 volt battery. The total power consumed is- (a) 48 watt (b) 84 watt (c) 168 watt (d) 36 watt

- xv) For obtaining a p-type semiconductor ,doping is to be done with impurity material which is
(a) tetravalent (b) pentavalent (c) trivalent (d) none of these
- xvi) The lasing action is based on
(a) Stimulated emission
(b) Spontaneous emission
(c) absorption
(d) none of these
- xvii) The induced emf in a 1 millihenry inductor in which the current changes from 5A to 3A in 10^{-3} s is
(a) 2×10^{-6} V (b) 8×10^{-6} (c) 2V (d) 8V
- xviii) The focal length of a convex lens is maximum for the colour of light- (a) blue (b) yellow (c) green (d) red
- xix) In the interference fringe, if width of dark band is β_1 and that of the bright band is β_2 , then
(a) $2\beta_1 = \beta_2$ (b) $2\beta_2 = \beta_1$ (c) $\beta_1 = \beta_2$ (d) $\beta_1 + 3\beta_2 = 1$
- xx) If a conductor moves across a magnetic field ,the direction of induced emf is obtained from
(a) Laplace's law (b) Fleming's left and rule (c) Fleming's right hand rule (d) none of these
- xxi) If a lens is surrounded by a medium denser than air, the focal length of the lens
(a) decreases (b) increases (c) remains same (d) cannot be determined
- xxii) For destructive interference the path difference of the waves emitted from the two sources is equal to- (a) odd multiple of $\frac{\lambda}{2}$ (b) even multiple of $\frac{\lambda}{2}$ (c) any multiple of $\frac{\lambda}{2}$ (d) any other number
- xxiii) A source of emf 2 volt sends 0.2 amp current to an external circuit for 5s. The energy used by the source is- (a) 0.2 joule (b) 0.4 joule (c) 4.0 joule (d) 2.0 joule
- xxiv) The intensity of X-rays produced by an X-ray tube can be increased by- (a) increasing the tube voltage (b) decreasing the tube voltage (c) decreasing the filament current (d) increasing the filament current
- xxv) In He-Ne laser pumping is done b-y
(a) optical method
(b) Thermo-chemical reaction
(c) atom-atom inelastic collision through electrical discharge
(d) none of these

2.
 - a) What do you mean by free and damped oscillations?
 - b) What are beats? Prove that, the number of beats per second produced by two sources of sound is equal to the difference in the frequencies of the two sources.
 - c) What are the requirements of good acoustic in a auditorium?
 - d) Write down the medical applications of ultrasonic waves. 2+(1+3)+2+2
3.
 - a) State the criteria for the phenomenon of total internal reflection of light to take place.
 - b) How does focal length of a lens change when red light incident on it is replaced by violet light? Give reason for your answer.
 - c) Draw a ray diagram of a compound microscope. Write the expression for its magnifying power.
 - d) How will the interference pattern in Young's double slit experiment get affected, when
 - (i) distance between the slits S_1 and S_2 reduced and
 - (ii) the entire set up is immersed in water? Justify your answer. 2+2+(3+1)+2
4.
 - a) State Gauss' law in electrostatics. Using this law, derive an expression for the electric field due to a uniformly charged sphere.
 - b) Why electrostatic potential is constant throughout the volume of the conductor and has the same value as on its surface?

- c) Net capacitance of three identical capacitors in series is $1\mu\text{F}$. What will be their net capacitance if connected in parallel?
- d) Define electric flux. Write its SI unit. (1+2)+2+2+(2+1)
5. a) Define the term electrical resistivity of a material. Write its SI unit.
 b) State Kirchhoff's rules for an electric network.
 c) Draw a circuit diagram for a Wheatstone bridge. For a Wheatstone bridge, use Kirchhoff's laws to obtain its balance condition.
 d) A wire of 15Ω resistance is gradually stretched to double its original length. It is then cut into two equal parts. These parts are then connected in parallel across a 3V battery. Find the current drawn from the battery. 2+2+ (1+2)+3
6. a) State Biot-Savart's law in vector form expressing the magnetic field due to an element carrying current at a distance from the element. A circular coil of radius R carries a current I. Derive the expression for the magnetic field due to this coil at its centre. What is the effect of increasing the number of turns on magnetic field produced to a circular coil?
 b) State the Faraday's law of electromagnetic induction.
 c) A galvanometer of resistance 50Ω gives full scale deflection when a current of $500\mu\text{A}$ passes through it. It is to be converted into a voltmeter reading up to 10V. Explain how this can be done? Circuit diagram is essential. (2+2+1)+2+3
7. a) Distinguish between an intrinsic semiconductor and p-type semiconductor.
 b) With the help of circuit diagrams, distinguish between forward biasing and reverse biasing of a p-n junction diode.
 c) Draw a labeled diagram of a full wave rectifier circuit. Show the input-output waveforms.
 d) Draw the circuit diagram of an illuminated photodiode in reverse bias. How is photodiode used to measure light intensity. 2+2+3+3
8. a) Write any two distinguishing features between conductors, semiconductors and insulators on the basis of energy band diagrams.
 b) State two advantages of LED lamps over conventional incandescent lamps.
 c) Draw a circuit diagram of n-p-n transistor amplifier in CE configuration.
 d) Why GaAs is most commonly used in making of a solar cell? 3+2+3+2
9. a) What is the main difference between ordinary light and LASER?
 b) Write a short note on 'population inversion'.
 c) How continuous and characteristic X-rays are produced in Coolidge tube? Explain.
 d) Explain the mechanism of light propagation through optical fiber. 2+3+3+2
-

January 2022

ENGINEERING MECHANICS

Time Allowed: 1.5 Hours

Full Marks: 60

Answer to Question No.1 is compulsory and Answer any two questions from the rest.

1. Fill in the blanks:

20x2= 40

- (i) Coefficient of friction depends upon _____.
- (ii) Example of vector quantity is _____.
- (iii) The product of either force of couple with the arm of the couple is called _____.
- (iv) A heavy string attached at two ends at same horizontal level and when central dip is very small approaches the following curve _____.
- (v) The centre of gravity a T-section 100 mm × 150 mm × 50 mm from its bottom is _____.
- (vi) The mechanical advantage of a lifting machine is the ratio of _____.
- (vii) From a circular plate of diameter 6 cm is cut out a circle whose diameter is a radius of the plate. Find the e.g. of the remainder from the centre of circular plate _____.
- (viii) In ideal machines, mechanical advantage is _____ velocity ratio.
- (ix) Frictional force encountered after commencement of motion is called _____.
- (x) The coefficient of friction depends upon _____.
- (xi) The angular velocity (in rad/s) of a body rotating at N revolutions per minute is _____.
- (xii) A machine having an efficiency greater than 50%, is known as _____.
- (xiii) The algebraic sum of moments of the forces forming couple about any point in their plane is _____.
- (xiv) The skidding away of the vehicle on a level circular path can be avoided if the force of friction between the wheels and the ground is _____ the centrifugal force.
- (xv) The slope on the road surface generally provided on the curves is known as _____.
- (xvi) On a ladder resting on smooth ground and leaning against vertical wall, the force of friction will be _____.
- (xvii) The velocity of a body on reaching the ground from a height h, is _____.
- (xviii) The ratio of static friction to dynamic friction is always _____ than one.
- (xix) A flywheel on a motor goes from rest to 1000 rpm in 6 sec. The number of revolutions made is nearly equal to _____.
- (xx) The angle which an inclined plane makes with the horizontal when a body placed on it is about to move down is known as angle of _____.

2. (a) Define Scalar & Vector quantity. 2
 (b) The following forces are acting at a point. (i) 20N inclined at 30° towards north of east. (ii) 25 N towards north. (iii) 30N towards north of west and (iv) 35N inclined at 40° towards south of west. Find the magnitude and resultant of the force system. 8
3. (a) The resultant of a force P of 40N and an unknown force Q, is known to be perpendicular to P. If P is replaced by a force of 70N in the same line of action, the resultant would be inclined at 45° to the force of 70N. Find the magnitude and direction of unknown force Q. 8
 (b) State and show by a sketch Varignon's Theorem. 2
4. (a) State the conditions of equilibrium. 3
 (b) Forces each of 4N in magnitude act along AB and CD of a square ABCD and forces each of 6N in magnitude act along the sides AD and CB respectively in the same square. Find the moment of the couple which will produce equilibrium. Length of each sides of the square is 80mm. 7
5. (a) The resultant of two forces is 10N and it is inclined at 60° to one of the forces whose magnitude is 5N. Find the magnitude and direction of the other force. 8
 (b) State Triangle Law and Parallelogram Law of forces. 2
6. (a) State Lami's Theorem. 2
 (b) ABCDEF is a rectangular hexagon, forces of 3, P, Q, 5 and 4N are acting along AB, CA, AD, AE and FA respectively and are in equilibrium. Determine the value of P & Q. 8



- (a) Determine the CG of the section above. 8
 (b) Define CG of any section. 2
8. (a) What is Law of machine? 2
 (b) To lift a load of 1500N, an effort of 200N is applied to a machine. The load is lifted by a distance of 0.2m while the effort is moved by a distance of 2m. Find the VR, MA and efficiency of the machine. Find also the ideal effort, effort lost due to friction, ideal load and frictional load. 8
9. (a) In a double purchase crab winch, no of teeth on pinions are 20 & 30 and that of spur gears are 60 & 80. Radius of the load drum is 200 mm and length of the handle is 300mm. Find the efficiency of the machine, if the effort 100N is required to lift a load of 750N. 8
 (b) What are the advantages of a Lifting Machine? 2

10. (a) A body is moving with uniform acceleration and it covers 20m in 4th second and 30m in 8th second. Find (i) the initial velocity, (ii) the acceleration of the body. 8
(b) Define Velocity and Acceleration. 2
11. A string is wound round a pulley of 0.30m diameter. A weight attached to the free end of the string, describes a distance of 8m after starting from rest within 4 secs. Find the angular velocity of the pulley. Also find the total distance travelled by the weight to make the pulley rotate at 400rpm. 6+4
-

January 2022

FUNDAMENTALS OF ELECTRICAL & ELECTRONICS ENGINEERING

Time Allowed: 1.5 Hours

Full Marks: 60

Answer to Question No.1 is compulsory and Answer any two questions from the rest.

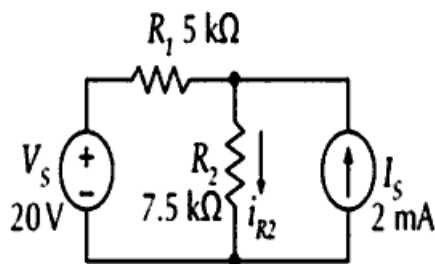
1. Answer the following questions (any twenty): 20x2

- i) Which component opposes any change in current?
 - a) Resistor
 - b) Capacitor
 - c) Inductor
 - d) Diode
- ii) The duration of one cycle known as _____
 - a) waveform
 - b) peak value
 - c) instantaneous value
 - d) period
- iii) In case of ideal current sources, they have _____
 - a) zero internal resistance
 - b) low value of voltage
 - c) large value of current
 - d) infinite internal resistance
- iv) The unit of magnetomotive force is-
 - a) ampere-turn
 - b) weber
 - c) mho
 - d) Maxwell
- v) The property of a material which opposes the creation of magnetic flux is called-
 - a) permeability
 - b) permittivity
 - c) reluctance
 - d) resistance
- vi) The energy stored in a magnetic field is given by (L = self inductance, I = current)-
 - a) $\frac{1}{2} LI^2$
 - b) $\frac{1}{2} IL^2$
 - c) IL^2
 - d) LI^2
- vii) Eddy current loss is directly proportional to (f = frequency , B_m = maximum flux density)-
 - (a) f^2 and B_m^2
 - (b) f and B_m
 - (c) f and B_m^2
 - (d) f^2 and B_m

- viii) The direction of induced emf is such that it will oppose the cause to which it is created, is related to _____ law of electromagnetic induction.
- Faraday's
 - Lenz's
 - Ohm's
 - Ampere's
- ix) The unit of inductive reactance is—
- Henry
 - Farad
 - Ohm
 - Joule
- x) In an ac circuit ' $V \sin \theta$ ' represents—
- Active power
 - Reactive power
 - Apparent power
 - True power
- xi) When sinusoidal voltage is applied across a pure capacitor the current in the capacitor—
- lags applied voltage by 90°
 - leads applied voltage by 90°
 - is in phase with applied voltage
 - is in phase opposition with applied voltage
- xii) Peak factor for a sine wave is—
- 1
 - 1.414
 - 1.11
 - 2
- xiii) The maximum value of sine wave current is 100 A, the rms value of current in the circuit will be—
- 70.7 A
 - 100 A
 - 50 A
 - 70.7 mA
- xiv) Voltage per turn in both primary and secondary winding of a transformer is—
- high in high voltage winding
 - low in low voltage winding
 - same
 - cannot determine
- xv) A 10 KVA, 1100/400 V, 50 Hz single phase transformer has 100 turns in the secondary winding. The number of turns in primary winding is _____. (Fill in the blank)
- xvi) Direction of rotation of the motor armature/rotor can be determined by applying Fleming's left hand rule .(True/False)
- xvii) A diode is a/an—
- bidirectional device
 - unidirectional device
 - both (a) and (b)
 - none of the above
- xviii) Free electrons in p type material —
- are majority carrier
 - are minority carriers
 - both (a) and (b)
 - none of the above

- xix) At absolute temperature an intrinsic semiconductor has-
- few free electrons
 - few holes
 - many holes and free electrons
 - no holes and free electrons
- xx) An ideal OP-AMP has the following characteristics- (R_{in} =input resistance, A = open loop gain, R_{out} = output resistance)
- $R_{in} = \infty$, $A = \infty$ and $R_{out} = 0$
 - $R_{in} = 0$, $A = \infty$ and $R_{out} = 0$
 - $R_{in} = \infty$, $A = 0$ and $R_{out} = \infty$
 - $R_{in} = 0$, $A = \infty$ and $R_{out} = \infty$
- xxi) The expression of voltage gain in an inverting amplifier using ideal OP-AMP is (R_f =feedback resistance, R_i = input resistance)-
- $-R_f/R_i$
 - R_f/R_i
 - $1 + R_f/R_i$
 - $-(1 + R_f/R_i)$
- xxii) The expression of voltage gain in a non- inverting amplifier using ideal OP-AMP is (R_f =feedback resistance, R_i = input resistance)-
- $-R_f/R_i$
 - R_f/R_i
 - $1 + R_f/R_i$
 - $-(1 + R_f/R_i)$
- xxiii) Which of these sets of logic gates are known as universal gates?
- XOR, NAND, OR
 - OR, NOT, XOR
 - NOR, NAND, XNOR
 - NOR, NAND
- xxiv) A digital circuit that can store only 1 bit information-
- NOR gate
 - XOR gate
 - Flip flop
 - AND gate
- xxv) The logical sum of two or more than two logical products is termed as
- OR operation
 - POS
 - SOP
 - NAND operation

2. a) Define periodic & non-Periodic waveform with one example of each.
 b) Using Source transformation principle find out the current through resistance R2.



4+6

3. a) Calculate the RMS and average values of a purely sinusoidal current having peak value 15A.
 b) Draw STAR & DELTA connections. Also write voltage and current relations for both types.
 4+6
4. a) Define self & mutual inductance.
 b) State Faradays law of electromagnetic Induction.
 5+5
5. a) Define true & reactive power.
 b) Show that in a pure capacitive circuit the current leads the applied voltage by 90 degree. Also show the phasor diagram for the same.
 4+6
6. a) Define a Transformer.
 b) A single phase 50Hz transformer has 80 turns on the primary winding & 400 turns on the secondary winding. If the primary winding is connected to a 240 volt, 50 Hz supply, determine the e.m.f induced in the secondary winding.
 4+6
7. a) Differentiate between Intrinsic & Extrinsic semiconductor.
 b) Define the term Doping. Give examples of material for creation of p & n-type material.
 5+5
8. a) Why is transistor termed as current controlled device?
 b) Explain with diagram the principle of operation of an NPN transistor.
 4+6
9. a) Draw the circuit diagram of a non inverting amplifier with feedback using op-amp & derive the expression of gain.
 b) Define Flip-Flop.
 7+3
10. Draw the pin diagram of IC 741 OP AMP & describe the function of each pin.
 10
11. a) State De Morgan's Theorem.
 b) Draw the NOR gate & write down its truth table.
 6+4

INTRODUCTION TO IT SYSTEMS

Time Allowed: 1.5 Hours

Full Marks:60

Answer to Question Nos. 1 is compulsory and Answer any two questions from the rest.

1. Answer the following questions (any twenty): 20x2
- i) A hard disc is divided into tracks, which are further sub divided into –
 - a. Clusters
 - b. Sectors
 - c. Vectors
 - d. Heads
 - ii) Binary equivalent of 97_{10} is–
 - a. 1100000
 - b. 1100001
 - c. 1100010
 - d. 1100011
 - iii) Portion of information processing cycle in which computer acquires data from some source is called –
 - a. Input
 - b. Output
 - c. Processing
 - d. Storage
 - iv) The expression $Y = (A + B)(B + C)(C + A)$ shows the _____ operation.
 - a. AND
 - b. POS
 - c. SOP
 - d. NAND
 - v) Type of software used to create slideshow is –
 - a. Web design software
 - b. Presentation software
 - c. Word-processing software
 - d. Spreadsheet software
 - vi) Smart phone is an example of –
 - a. Personal computer
 - b. Analog computer
 - c. Mainframe computer
 - d. Super computer
 - vii) Top listed super computer is –
 - a. Sunway taihulight
 - b. Sequoia
 - c. Cori
 - d. Mira
 - viii) Which of the following is an example of a Real Time Operating System –
 - a. MAC
 - b. MS-DOS
 - c. Windows 10
 - d. Process Control

- ix) Which of the following is not an operating system?–
- Windows
 - Linux
 - Oracle
 - DOS
- x) A detailed flowchart is called _____.
- Stack
 - Macro
 - Micro
 - Micro
 - Union
- xi) Flowcharts and algorithms are used for –
- Better programming
 - Easy testing and debugging
 - Efficient coding
 - All of the above
- xii) The operation represented by parallelogram –
- Input/output
 - Assignment
 - Comparison
 - Condition
- xiii) Which of the following is a pictorial representation of an algorithm? –
- Pseudocode
 - Program
 - Flowchart
 - None
- xiv) tag makes the enclosed text bold. What is other tag to make text bold?
-
 - <dar>
 - <black>
 - <emp>
- xv) All html tags are must be enclosed in –
- ? And !
 - < And >
 - { And }
 - # And #
- xvi) CSS stands for –
- Cascade style sheets
 - Color and style sheets
 - Cascading style sheets
 - None of the above
- xvii) If we want define style for a unique element, then which css selector will we use?
- Id
 - text
 - class
 - name
- xviii) Inside which HTML element do we put the JavaScript?
- <js>
 - <script>
 - <scripting>
 - <javascript>
 -

- xix) Tags and text that are not directly displayed on the page are written in _____ section.
- <html>
 - <head>
 - <title>
 - <body>
- xx) What will the following code return:
Boolean(10 > 9)
- NaN
 - true
 - false
- xxi) Which of the following CSS property is used to set the blend mode for each background layer of an element?
- background-blend-mode property
 - background-collapse property
 - background-transform property
 - background-origin property
- xxii) In ethical hacking and cyber security, there are _____ types of scanning.
- 1
 - 2
 - 3
 - 4
- xxiii) Which of the following is a programs that copy themselves throughout a computer or network?
- Worms
 - Trojans
 - Viruses
 - Rootkits
- xxiv) Which of the following port and IP address scanner famous among the users?
- Cain and Abel
 - Angry IP Scanner
 - Snort
 - Ettercap
- xxv) Which of the following transmission directions listed is not a legitimate channel?
- Simplex
 - Half Duplex
 - Full Duplex
 - Double Duplex
2. a) What are the meant by 1's and 2's complements of a binary number? Add the following numbers using the 2's complement method:
(i) -48 and +31
(ii) -64 and +46 2 + 2 + 1
5
- b) Name the gates that are used as universal gates. Explain with example.
3. a) What is operating system?
b) What are the basic services provided by the operating system?
c) What is CPU and I/O bound jobs? 3 + 4 + 3
4. a) What are the main advantages of algorithm? Write an algorithm that will read input temperature in Centigrade and convert to Fahrenheit. Draw a Flowchart that will reads two values and determines the largest value and prints the largest value. 2 + 2 + 2
- b) What is time sharing operating system? 4

5. a) What is malicious software? Give example of malicious program. 3 + 3
 b) Define a worm. 2
 c) List some properties of virus. 2
6. a) Draw the logic diagram of an Ex-OR gate and discuss its operation. 2 + 2
 b) What do you mean by client server architecture Explain? 4
 c) Prove that:
 $\overline{A} \overline{B} \overline{C} + \overline{A} B \overline{C} + A \overline{B} \overline{C} + A B \overline{C} = C$ 2
7. a) What is a gray code? Why is it important? Express the following number in Gray code form:
 (i) 15 (ii) 27 (3 + 3 + 1 + 1)
 b) What are the advantages of multiprocessor system? 2
8. a) Write a program to create HTML table with the following output: 5
- | Name | Department | Mobile Number |
|-------------|------------|---------------|
| Rahul Das | DME | 9123443518 |
| Sanjib Paul | DCE | 8513546728 |
| Sibnath Dey | DSE | 9175354578 |
- b) What is a bootstrap program in OS? What is Batch Operating System? 3 + 2
9. a) What is the difference between static and dynamic web pages? 3
 b) Write a short note on Types of OS. 5
 c) What are the advantages of using JavaScript? 2
10. a) Write a JavaScript Program to Find HCF or GCD. 5
 b) In how many ways a JavaScript code can be involved in an HTML file? 3
 c) What is the difference between the operators '=' & '==='? 2
11. a) Prove that: 5
 $AB + \overline{A}C + A\overline{B}C(AB + C) = 1$
 b) Write short note on type of software. 3
 c) What is a denial of service attack? 2

MATHEMATICS-II

Time Allowed: 1.5 Hours

Full Marks: 60

Answer to question number 1 is compulsory and Answer any two questions from the rest.

1. Answer any twenty questions from the following with proper justification of each:

20x2=40

i) Solve: $\frac{ydy+xdx}{x^2+y^2} = 0$.

ii) In the matrix $\begin{bmatrix} 1 & 1 & 1 \\ 2 & 1 & 0 \\ -1 & 2 & 1 \end{bmatrix}$ minor of "--1" is _____.

iii) If $u(x, y) = \sqrt{\frac{x^2}{x+y}}$. Then $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = ?$

iv) The area of the region bounded by $y = 2x - x^2$ and $y = x$ is_____.

v) Is the matrix $\begin{bmatrix} 1 & -1 & 2 \\ 1 & 0 & 3 \\ -2 & -3 & 1 \end{bmatrix}$ non-singular? (Yes or No)

vi) Is the differential equation homogeneous: $\frac{dy}{dx} = \frac{3xy^2+2x^2y}{5y^3+x^2}$? Yes/No

vii) Check the co-linearity of the points: (2, 5), (0, 0) and (-1, -2.5).

viii) If two coins are tossed, the probability of getting at most one head is _____.

ix) If $P(A) = 0.4, P(B) = 0.35$, Find $P(\bar{A}) + P(\bar{B}) - 1 = ?$.

x) $\int_{-2}^{+2} x^3 dx = ?$

xi) Find particular Integral (P.I.) of the differential equation $\frac{d^2y}{dx^2} - y = 1$.

xii) Find the probability of obtaining at least one '6' in a game of throwing of two dice.

xiii) Is the matrix $\begin{pmatrix} \cos \theta & \sin \theta \\ \sin \theta & \cos \theta \end{pmatrix}$ orthogonal? (Yes/No)

xiv) The mode of the data: 10, 12, 8, 10, 12, 11, 10, 12, 7, 11, 12 is_____.

xv) Find the angle between the lines $x + 2y = 5$ and $y = 2x$.

xvi) Write the degree of the differential equation $\left(1 - 9 \frac{d^2y}{dx^2}\right)^{5/7} + 7xy \frac{dy}{dx} - y^2 = 0$.

xvii) Compute the median of the data: 10,5,9, 6,4,8,7,6, 5.

xviii) The value of the determinant $\begin{vmatrix} 0 & \omega & -\omega^2 \\ -\omega & 0 & \omega^3 \\ \omega^2 & -\omega^3 & 0 \end{vmatrix}$ is _____.

xix) $2 \int_0^{\pi/2} \frac{\sqrt{\cos x}}{\sqrt{\sin x} + \sqrt{\cos x}} dx = ?$

xx) Test the differential equation $(ye^x - 5x) dx - (e^x + 5y) dy = 0$ is exact or not.

xxi) The cofactor of 6 in the determinant $\begin{vmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{vmatrix}$ is _____.

xxii) Find the adjoint of the matrix $\begin{pmatrix} 5 & 0 \\ 1 & -2 \end{pmatrix}$.

xxiii) Evaluate: $\int_1^e \log_e x \, dx$.

xxiv) Find the integrating factor (I.F.) of $\frac{dy}{dx} + 2xy = 9x$.

xxv) Find the length of the semi- latus rectum of the hyperbola $\frac{x^2}{25} - \frac{y^2}{16} = 1$.

2. a) Evaluate by Chio's method $\begin{vmatrix} 1 & 2 & -2 & 0 \\ 0 & 1 & 0 & 0 \\ -2 & 0 & 1 & 1 \\ 1 & 0 & -1 & 0 \end{vmatrix}$. 5

b) Evaluate $\int \frac{x \, dx}{(x-1)(2x+1)}$. 5

3. a) Solve: $2xy + 3x^2 = \frac{dy}{dx}(2y - x^2 + 1)$ 5

b) If p_1 and p_2 be the length of perpendicular from the origin upon the lines $-4y - 5 \sin \alpha = 0$ and $3y + 4x = 5 \cos \alpha$, prove that $p_1^2 + p_2^2 = 1$. 5

4. a) Solve the equations by crammer's rule $x + y + z = 3$; $2x + z = 5$; $x + 2y = -1$. 5

b) If $z = \tan^{-1} \left(\frac{x-y}{\sqrt{x}+\sqrt{y}} \right)$, show that $x \frac{\partial z}{\partial x} + y \frac{\partial z}{\partial y} = \frac{1}{4} \sin 2z$ 5

5. a) Evaluate $\int e^x \cos x \, dx$. 5

b) Solve: $\frac{d^2y}{dx^2} + 2 \frac{dy}{dx} + y = x^3$. 5

6. a) Solve: $y \, dy = (y^2 - 1)(x + 1) \, dx$. 5
 b) A straight line forms a right angle triangle with the coordinate axes. If the area of triangle is 6 and the hypotenuse is 5, find the equation of the straight line. 5
7. a) Find A^{-1} ; if $A = \begin{pmatrix} 0 & -1 & 0 \\ 1 & 1 & 4 \\ 0 & -1 & 1 \end{pmatrix}$ and show that $AA^{-1} = I_3$. 3+2
 b) Solve: $\frac{dy}{dx} + xy = xy^3$. 5
8. a) Find the volume of the solid generated by revolving; the area bounded by the curve $y = \sin x$, $x = 0$, $x = \frac{\pi}{2}$ about the x-axis. 5
 b) What is the probability that the sum of outcomes is 13, when three dice are rolled? 5
9. a) A circle has radius 4 unit and its center lies on $x+y=0$ and it passes through (1, 1). Find its equation. 5
 b) Find the median of the distribution given below: 5
- | | | | | | | |
|---------|--------|--------|--------|--------|--------|--------|
| $x :$ | 01– 10 | 11– 20 | 21– 30 | 31– 40 | 41– 50 | 51– 60 |
| $f_i :$ | 3 | 10 | 9 | 13 | 7 | 15 |
-