Time: 2 Hours **Marks: 60**

Note: 1. Question No. 1 is Compulsory.
2. Attempt any 3 Questions from the remaining questions.
3. Scientific Calculator is allowed to use

Que. 1 Attempt any Five questions of the following

a. Solve $(\tan y + x)dx + (x\,sec^2 y - 3y)dy = 0$ **3**

b. Using Euler's method find approximate value of y for $x = 0.06\ given$ $\frac{dy}{dx} = x - y^2\ ; y(0) = 1\ take\ h = 0.02.$ **3**

c. Evaluate: $\int_{-1}^{1}\int_{0}^{z}\int_{x-z}^{x+z}(x + y + z)\,dydxdz$ **3**

d. Evaluate $\int_0^{\infty} xe^{-x^4}\,dx$ **3**

e. Evaluate: $\int_0^1\int_0^x (x^2 + y^2)x\,dydx$. **3**

f. Solve $(\frac{d^3y}{dx^3} - 5\frac{d^2y}{dx^2} + 8\frac{dy}{dx} - 4y) = 0$ **3**

Que. 2 a. Solve $\frac{dy}{dx} = x + 3y\ with\ x_0 = 0, y_0 = 1$ by Euler's modified method for $x = 0.05$ correct to three places of decimals.(in one step) **4**

b. Evaluate $\int_0^{\pi/6} sin^2 6\,x cos^3 3x dx$. **5**

c. Use method of variation of parameters to solve the differential equation $(D^2 + 3D + 2)y = e^{e^x}$ **6**

Que. 3 a. Evaluate $\int_0^{\pi}\int_0^{a(1+cos\theta)} r\,drd\theta$. **4**

b. Solve the differential equation $(x^4 + y^4)dx - xy^3dy = 0$ **5**

c. Solve $\frac{dy}{dx} = x^3 + y,\ x = 0, y = 2$ by Runge–kutta method of 4th order for $x = 0.2$. **6**

Que. 4 a. Solve $(D^2 + 4)y = x^2 + 1$ **4**

b. Find the mass of the lamina bounded by the curves $y^2 = x\ and$ $x^2 = y$ if the density of the lamina at any point varies as the square of its distance from origin. **5**

c. Solve $x\frac{dy}{dx} + y = x^3y^6$ **6**

Que. 5 a. Prove that $\int_0^1 \frac{x^{\alpha}-1}{\log x}\,dx = \log(1 + \alpha)\,, \alpha \geq 0$. **4**

b. Find by double integration the area inside the circle $r = a \sin\theta$ and outside the cardioid $r = a(1 - cos\theta)$. **5**

c. Evaluate by changing into polar coordinates $\int_0^1\int_x^{\sqrt{2x-x^2}}(x^2 + y^2)dydx$ **6**

Que. 6 a. Solve the differential equation $(D^2 - 4D + 4)y = e^{2x} \sin 2x$ **4**

b. Change the order of integration $\int_0^1\int_0^{\sqrt{1-x^2}} f(x, y)dydx$. **5**

c. Find the approximate value of $\int_0^6 e^x\,dx$ by using **6**
(1)Trapezoidal Rule
(2) Simpson's (1/3)rd rule and

****

(Time: 3 hours) **Max Marks: 80**

Note: (1) Question No. 1 is Compulsory.

(2) Answer any three questions from Q.2 to Q.6.

(3) Figures to the right indicate full marks.

Q1.

a) Solve $(2x^2 + 3y^2 - 7)x\,dx + (3x^2 + 2y^2 - 8)y\,dy = 0$ 5

b) Solve $\frac{d^2y}{dx^2} - y = e^{2x} + \sin 2x$ 5

c) Using Euler's method find the approximate value of y at $x = 0.5$ taking $h = 0.1$, $\frac{dy}{dx} = 2 + \sqrt{xy}$, $y(0) = 1$ 5

d) Change the order of integration $I = \int_0^2 \int_{\sqrt{2x}}^2 f(x, y)\ dy\,dx$ 5

Q2.

a) Solve $(D^3 - 2D + 4)y = 3x^2 - 5x$ 6

b) Solve $\cos x \frac{dy}{dx} + y \sin x = \sec^2 x$ 6

c) Evaluate $\int_0^6 e^x\ dx$ by using 8

(i) Trapezoidal rule, (ii) Simpson's 1/3rd rule, (iii) Simpson's 3/8th rule

Q3.

a) Using the Rule of DUIS prove that $\int_0^\infty \frac{\log(1+ax^2)}{x^2}\ dx = \pi\sqrt{a}$ 6

where $a \geq 0$ hence deduce $\int_0^\infty \frac{\log(1+x^2)}{x^2}\ dx = \pi$

b) Evaluate $\int\int xy\ dxdy$ over the region bounded by X-axis, line $x = 2a$ and the parabola $x^2 = 4y$ 6

c) Evaluate $\int_0^a \int_0^{b\left(1-\frac{x}{a}\right)} \int_0^{c\left(1-\frac{x}{a}-\frac{y}{b}\right)} z\,dz\,dy\,dx$ 8

Q4.

a) Find area of one loop of lemniscate $r^2 = a^2 \cos 2\theta$ 6

b) Using Runge-Kutta method of fourth order find the approximate value of y at $x = 0.1$ taking $h = 0.1$, $\frac{dy}{dx} = x + \sqrt{y}$ & y(0)=1 6

c) Evaluate $\int_0^3 \sqrt{3x - x^2}\ dx \cdot \int_0^\infty \frac{1}{(1+x^2)^{3/2}}\ dx$ 8

Q5.

a) Evaluate $\int\int\int (x^2 + y^2 + z^2) dx\, dy\, dz$ over the first octant of the sphere $x^2 + y^2 + z^2 = a^2$ 6

b) Solve $(x^2y^2 + 2)ydx + (2 - 2x^2y^2)xdy = 0$ 6

c) Solve by method of Variation of parameter

$(D^2 - 2D + 1)y = e^x \sin x$ 8

Q6.

a) Using Euler's modified method find the approximate value of y at $x = 1.2$ taking $h = 0.2$, $\frac{dy}{dx} = \log_e(x + y)$, $y(1) = 2$ correct upto 4 decimal places 6

b) Find the length of cardioide $r = a(1 - \cos\theta)$ which lies outside the circle $r = a\cos\theta$. 6

c) Change to polar coordinates and evaluate $\int_0^{2a} \int_0^{\sqrt{2ax - x^2}} \frac{x}{\sqrt{x^2+y^2}}\ dy\, dx$ 8

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Duration: 2 hrs **[Max Marks:60]**

N.B. : **(1) Question No 1 is Compulsory.**
(2) Attempt any three questions out of the remaining five.
(3) All questions carry equal marks.
(4) Assume suitable data, if required, and state it clearly.

1		**Attempt any THREE**	[15]
	a	Explain linear and nonlinear data structures with suitable examples.	[5]
	b	Define ADT. Write ADT for Queue data structure.	[5]
	c	Differentiate between Linked List and array.	[5]
	d	Write an algorithm for reversing a string.	[5]
2	a	Write an algorithm to implement Stack using an array.	[8]
	b	Write a algorithm to reverse the singly linked list.	[7]
3	a	Write a algorithm to implement circular queue using an array.	[8]
	b	Design a Huffman tree for the word "CONSTRUCTION". Also write the Huffman code to represent each symbol.	[7]
4	a	Construct a Binary Search Tree for given numbers 45, 23, 76, 11, 30, 60, 90, 25, 50, 65.	[8]
	b	Write an algorithm for infix to postfix conversion. Convert the following expression to postfix (A + B) * C - D / E	[7]
5	a	Write an algorithm to implement singly linked list that performs the following functions 1. Insert a node in the beginning 2. Insert a node in the end 3. Display the linked list elements	[8]
	b	Draw the Stack structure for each case when the following operations are performed on an empty stack. 1. PUSH A, B, C, D, E, F 2. POP two letters 3. PUSH G 4. POP one letter 5. POP four letters 6. Pop one letter 7. PUSH I, J 8. POP one letter	[7]
6		**Write short notes on (any 3)** a) Doubly Linked List [5] b) Double Ended Queue [5] c) Types of Binary Tree [5] d) Priority Queue [5]	[15]

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(Time: 2 Hours) **[Total Marks: 60]**

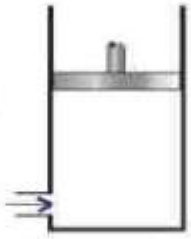
N.B. : (1) Question No.1 is compulsory
(2) Attempt any three from the remaining
(3) Figures to the right indicate full marks
(4) Assume suitable data if necessary

1	Solve any five :-		15
	(a)	Enlist different modes of transportation and explain its advantages in detail.	
	(b)	Explain role of Civil Engineer in Surveying.	
	(c)	Explain Ready Mix Concrete (RMC) and draw a flow chart of manufacturing process.	
	(d)	Write a short note on Building Sanitation along with its necessity.	
	(e)	Explain different types of Loads acting on building.	
	(f)	A plot owner proposed G+1 construction with 150m^2 Construction on each floor of size 14 X 19 m. Find ground coverage and FSI proposed. If margins from all sides are 2m and FSI is 1 as per bye laws, state with reason whether plan will be sanctioned or not?	
2	(a)	Explain manufacturing process of concrete in detail.	10
	(b)	Define Civil Engineering and Explain basics of Civil Engineering w.r.t Planning, Design, Construction and Maintenance.	05
3	(a)	Write a short note on Air Pollution in detail explaining its sources, classifications and causes.	05
	(b)	Explain field tests done on Bricks and Cement	05
	(c)	Write a short note on Classification of Buildings	05
4	(a)	Explain Principles of Planning in detail. Prepare a line plan of residential 1 BHK flat with all the details not to the scale mentioning the North direction.	10
	(b)	Classify Surveying based on Nature of survey and Primary division of survey.	05
5	(a)	Define Cement. What are different types of Cement? Explain Different tests done on Cement in lab.	05
	(b)	The following consecutive readings were taken with leveling instruments at interval of 20 m. 2.375, 1.730, 0.615, 3.450, 2.835, 2.070, 1.835, 0.985, 0.435, 1.630, 2.255 and 3.630 m The instrument was shifted after the fourth and eighth readings. The last reading was taken on a BM of RL 110.200 m. Find the RL's of all the points.	10
6	(a)	Write a short note on different disciplines of Civil Engineering.	10
	(b)	How is AI used in Civil Engineering? Explain with any one example	05

DURATION: 2 HOURS: **MAX MARKS: 60**

Instructions:

1. **Question No 1 is Compulsory.**
2. **Attempt any 3 out of remaining 5 Questions.**
3. **Each Question carry 15 Marks**

Q.NO	Attempt **any five**	Marks	BL	CO
1	a) **Define** the term prime mover and **State** its two example.	3	R	1
	b) **Differentiate** between S.I Engine and C I Engine	3	R	2
	c) **Show** with a diagram the arrangement of driver and driven pulleys, tension side, slack side in a simple belt drive.	3	R	3
	d) **Discuss** the properties of air that must be controlled during the air conditioning process	3	U	4
	e) **Define** a shaft and an axle, and **State** the functional difference between them.	3	R	5
	f) **Discuss** working of different components of robotics.	3	U	6
2	a) **Explain** various application of mechanical engineering.	4	U	1
	b) **Show** control volume and the types of boundaries in the given piston-cylinder diagram.	4	U	2
				
	c) **Explain** Stroke volume , clearance Volume and Total Volume with respect to Reciprocating I C engine with a neat sketch	7	U	2
3	a) **Identify** types of power cycle consists of following 1. Two constant volume process. 2. One constant volume and one constant pressure. 3. Two constant pressure process 4. Two adiabatic and two isothermal process	4	U	2
	a) State the types of gear used in gear drive with a neat sketch.	4	R	3
	b) **Explain** salient features of belt drive power transmission system	7	U	3

4	a)	**Draw** a Automobile layout showing all the parts.	**4**	R	5
	b)	**Write** a note on Rear wheel drive. Give example	**4**	U	5
	a)	**Discuss** on any one Indian Hybrid Electric Vehicle/Electric Vehicle.	**7**	U	5
5	a)	**Differentiate** between Augmented Reality and Virtual Reality.	**4**	R	6
	b)	**Write** a note on Automation	**4**	R	6
	c)	**Explain** working of refrigeration process with a neat-labelled diagram.	**7**	U	4
6	a)	**Define** air conditioning process and **State** types of air conditioning process used in summer and winter season respectively.	**4**	U	4
	b)	**State** the law that forms the basis of temperature measurement	**4**	U	2
	c)	**Discuss** slip phenomenon in the belt drive.	**7**	U	3

Time: 3 Hours **Max. Marks: 60**

General Instructions:

1. Question number 1 is compulsory
2. Attempt any **three** questions from the remaining **five** questions.
3. All dimensions are in mm.
4. Use first angle method of projection.
5. Assume suitable dimension if it is necessary.

Q.1. Solve ANY ONE questions from following.

a Draw the involute of a circle, 40 mm in diameter. Also, draw the tangent and normal at a point on the curve at a distance of 100 mm from the center of the circle. 09

b A square lamina of 50 mm side rests on one of its corners on the HP, and the sides containing the corner make equal angle with HP. The surface of lamina makes 45° to the HP. Draw the TV and FV of the lamina. 06

OR

Q.1. a Fig 1 shows the two views of an object. Draw the isometric view assuming the origin as suitable corner. 08

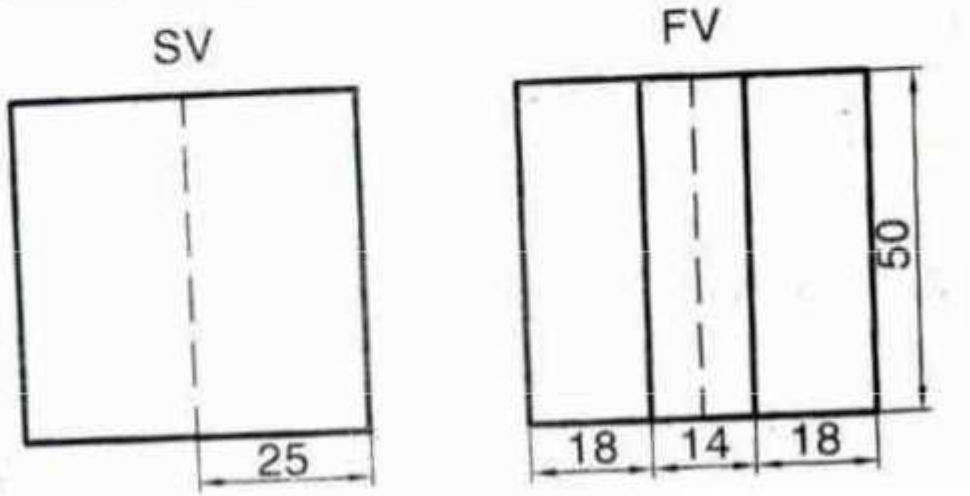


Fig 1: FV and SV of an object

b A hexagonal prism with a base side of 25 mm and an axis length of 70 mm is resting on the HP on one of its rectangular faces. Draw its projections when its axis is inclined to VP at 45°. 07

Q.2. A Pentagonal pyramid of 35 mm side of base and 75 mm height is resting on the HP with one of its triangular surface perpendicular to the HP, and parallel and nearer to the VP. Draw the projections. 15

Q.3. Draw the sectional FV, TV and LHSV of an object shown in fig 2. Also give overall dimensions. 15

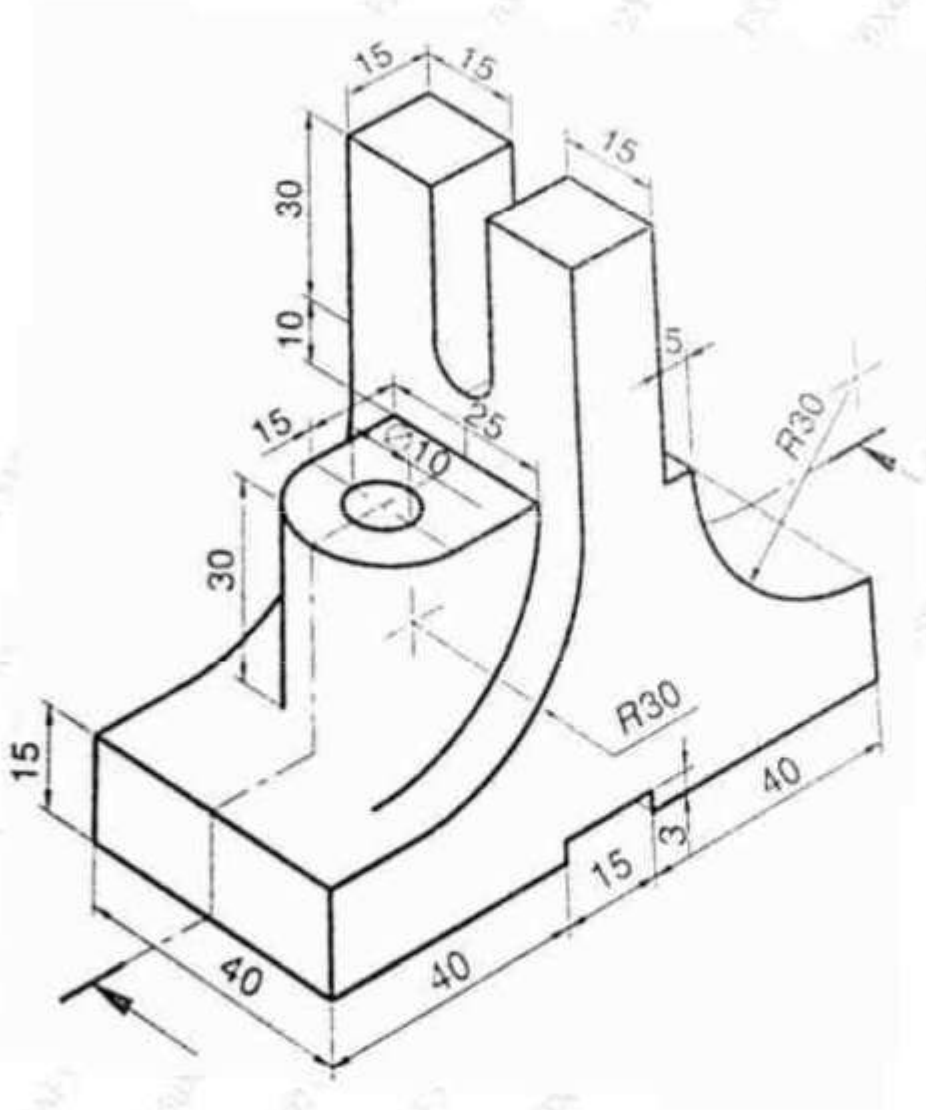


Fig 2 : Pictorial view of an object

Q.4 A tetrahedron of 55 mm long edges is lying on the H.P. on one of its faces with an edge of that face perpendicular to the V.P. It is cut by a section plane perpendicular to the both H.P. and V.P. in such a way that the true shape of a section is an isosceles triangle of 36 mm height. Draw elevation, plan and end view when the major part of an object is assumed to be retained. 15

Q.5. a. Fig 3 shows a pictorial view of an object. Using first angle projection, draw front view and top view. Give at least 10 dimensions. 09

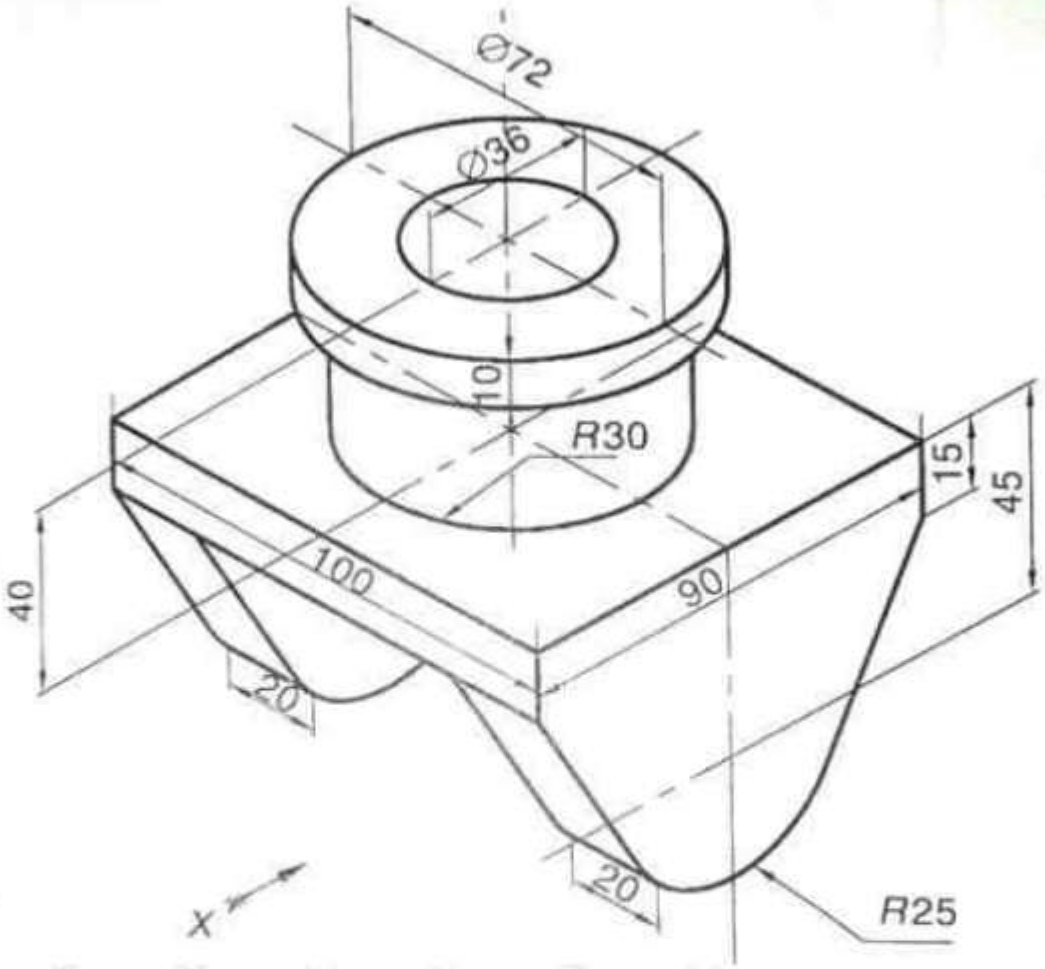


Fig 3 Pictorial view of an object

b. Fig 4 shows FV and SV of an object. Draw isometric view. The origin may be assumed at a suitable corner. 06

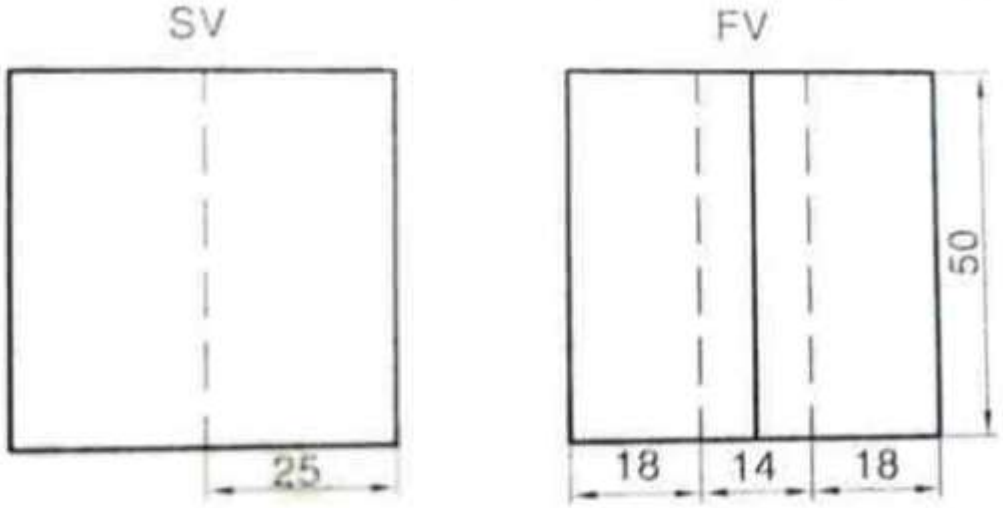


Fig 4 : FV and SV of an object

Q.6 a. A straight-line PQ equally inclined to the VP and the HP, has its end P in front of the VP and 20 mm above the HP. End Q is behind VP and 10 mm below HP. Draw the projections, true length of line and inclination of line with HP, if distance between projections of the ends is 60 mm. 08

b. A wheel of diameter 60 cm rolls on a straight horizontal line. Draw the locus of a point P on the periphery of the wheel, for one revolution of the wheel, if P is initially on the road. 07

Time: 2 Hours **Maximum Marks: 60**

i **Question number 1 is compulsory**

ii **Attempt any three questions from Q2 to Q6**

iii **Assume suitable data wherever required**

iv **Figures to the right indicate full marks for that question**

Q1 **Attempt any five out of six (3 marks each)** **15**

A What is a grating? What is a grating element? Define resolving power of an optical instrument. **3**

B Explain metastable state and population inversion. Draw a basic three level pumping scheme diagram to represent the states. **3**

C Draw a neat labeled diagram to represent a critical angle. Calculate the acceptance angle for an optical fibre with 1.44 and 1.4 as the refractive indices of core and cladding respectively. **3**

D Find the gradient at a point (-1, -1, -2) for a scalar field $F = \frac{1}{2}(x^3y - xy^3)$. **3**

E Find the fractional increase in mass of a particle moving with a velocity of 0.2 times the speed of light. **3**

F What is a transducer? What is the piezoelectric effect and inverse piezoelectric effect? **3**

Q2 **Attempt both the questions** **15**

A Discuss with diagram the phenomenon of Fraunhofer diffraction at a single slit and write the conditions for its maxima and minima. **8 (5+3)**
Find the order of diffraction if a diffraction grating is used at normal incidence for a line 'A' of wavelength 5600 Å in a certain order being superimposed on another line 'B' of the next higher order having wavelength 4200 Å. Now if the angle of diffraction for the line A is 45°, then how many lines per cm are there in this grating for the above obtained order?

B With the help of a neat labelled diagram explain the step index and graded index fibers. How does a ray of light travel in these fibres? **7 (4+3)**
What is the significance of the 'V' number? A multimode step index fibre with core RI 1.5 and cladding RI 1.45 has a core radius of 9 micrometre. Calculate the normalised frequency of the fibre and the number of guided modes at an operating wavelength of 7500 Å.

Q3 **Attempt both the questions** **15**

A What are scalar and vector fields? Give examples. Explain the term 'curl of a vector' and state its significance. **8 (4+4)**
Show that the divergence of the curl of a vector is zero.

B With neat and labelled diagrams explain the construction and working of a Nd:YAG laser. Give its application. **7**

Q4 **Attempt all three questions (5 marks each)** **15**

A What is diffraction? Illustrate by drawing a neat diagram of any one type of diffraction. How can the resolving power of a grating be increased? **5**
Find maximum order of diffraction if a grating having 6000 lines per cm is illuminated by a laser beam of wavelength 6000 Å.

B What is the divergence of a vector field? Give its physical significance. **5**
Find the divergence of a field $F = xz\,\hat{i} + y^2z^3\,\hat{j} - xyz\,k$ at a point (1, -1, 1). Interpret the result you obtain.

C What is the need of Nanotechnology? Classify nanomaterials on the basis of their dimensions? Explain the significance of surface area to volume ratio? **5**

Q5 **Attempt all three questions (5 marks each)** **15**

A What is time dilation? Derive it mathematically. **5**
The length of a moving rod is found to be one third of its length when at rest. What is the speed of the rod relative to the observer?

B With a neat labelled diagram, explain the construction and working of an transmission electron microscope. **5**

C With a neat labelled diagram explain the construction and working of a Photodiode Optical Sensor. **5**

Q6 **Attempt all three questions (5 marks each)** **15**

A Explain Gauss's laws for static electric and static magnetic fields in differential and integral forms. **5**

B Explain the two main types of approaches used to synthesise a nanomaterial. Discuss in detail any one method with reference to the top down approach. Give the advantage of this method over the other methods. **5**

C With a neat labelled diagram explain the construction and advantages of a PT100. **5**

Duration: 2 Hours **Total Marks: 40**

Instructions: Question number1 is compulsory.
Attempt any three from Question No.2 to 6
The figures to the right indicate full marks.
Answers to the sub-questions should be grouped together

Q1. Answer the following questions. (Any 5) **(10)**
a) Write any two merits and demerits of written communication.
b) Define barrier in communication. List any two types of barriers.
c) What is grapevine communication? Give suitable examples.
d) State the advantages and disadvantages of horizontal Communication
e) Explain the importance of feedback in communication process.
f) Explain gustatory communication with examples.

Q2. Answer the following questions: **(10)**
a) "You recently purchased a DSLR camera from an online store. Upon receiving the package, you noticed that the camera was damaged. Write a formal letter of complaint to the customer service department of the online retailer, requesting a replacement or suitable compensation. **(6)**

b) What are the elements of communication? Explain the process of communication with the help of a neat labelled diagram. **(4)**

Q 3. a) Identify the errors in the following sentences and rewrite the correct ones. **(5)**
i) The book is kept over the table.
ii) The sun rises in the east is an universal truth.
iii) Neither Jay nor I were able to complete the work.
iv) Each of the bottles are empty.
v) I reached the park a hour early.

b) Explain psychological barriers. How can they be overcome? **(5)**

Q 4. a) What are the features of an effective E-mail? **(5)**

b) What is proxemics? Explain the four zones. **(5)**

Q. 5 Answer the following questions: **(10)**
a) Identify the barrier in the following sentences: **(4)**
i) A foreign tourist struggled to communicate effectively with an Indian resident due to language differences.
ii) A successful businesswoman refused to consider the sales pitch of a salesman promoting a newly launched product.
iii) Jaydeep interrupted Srushtee, asking her to stop narrating a story because he was feeling sleepy.
iv) An email was drafted and the 'SEND' button was clicked, but the message failed to send due to a server outage.

b) Explain any four Cs effective written communication. **(4)**

c) Write a short note on "You Attitude". **(2)**

Q 6. a) Read the following passage and answer the questions given below:

Discipline, precisely, means to act in life according to certain rules or norms of society. Primarily, these rules relate to our social code of conduct. Discipline demands a strict control over man's sense of freedom, which if unchecked, may bring disorder and anarchy in the normal life of a country. Hence, discipline has to be true.

Nature is the best mirror of perfect discipline to all of us. Every object in nature moves according to a strictly regulated plan. One can easily notice a perfect order prevailing in the movement of the Sun, the Moon and the other planets. Seasons change according to a certain plan. Tides in the oceans, crops in the fields, animals in the forest, all follow a certain pattern which is extremely essential to sustain life.

There is hardly any sphere of life in which the value of discipline is not realized sooner or later. Life in a house or an office just becomes a mess if a proper sense of discipline is not cultivated among its members. In our social life also certain norms of behavior are necessary to maintain smooth running of the social order. People must demonstrate a sense of discipline even in the small things like boarding buses and trains, buying cinema tickets or even consumer goods. It saves time and work is done easily and quickly. In the political life of a nation, discipline is its backbone. A disciplined nation is definitely better placed in all respects than an undisciplined one which can hardly make any progress.

Questions: **(5)**

i) What does discipline demand?
ii) What will happen if there is no discipline in a house or an office?
iii) How is discipline advantageous?
iv) Give antonyms of: a) perfect b) essential
v) What is discipline?

b) Write the user instructions for operating a washing machine. **(5)**

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Duration: 1 ½ Hr **Marks: 45**

Note: (1) Q.1 is compulsory
(2) Attempt any two from remaining
(3) All Questions are of 15 marks.

Q.1 Attempt any five **[15M]**

(a) Define the term Calibration. Write 2 points regarding its significance in measurements.

(b) Justify the statement: "Concept of Interference yields better results when employed as measuring Instrument"

(c) Fill in the gap: Full form of LVDT is Linear Variable _____Transformer. It works on the principle of _____. It measures_____.

(d) Draw the diagram to measure Hall Voltage of a semiconductor slab. Clearly indicating width "w", thickness "t", current "I" passing through it and Applied Magnetic field Intensity B Tesla.

(e) Describe Seebeck effect .What is the approximate range of potential difference it generates?

(f) Assuming that atoms are perfect spheres of radius R, Write the expression of Surface to volume ratio. Also find the surface to Volume ratio if the atom is a perfect cube with edge "s"

(g) Write three points as the comparison for Accuracy and Precision.

Q.2 (a) In an experiment to find Resistance a student performed it for five times and the results are 38Ω, 51Ω, 46Ω, 79Ω, 57Ω. Find the standard Deviation. **[5M]**

(b) Apply the knowledge of monochromatic light in interference and explain its application to determine the flatness of the surface. **[5M]**

(c) Draw neat diagram and explain how LVDT works **[5M]**

Q.3 (a) Using a neat diagram. Derive the expression that measures Hall Voltage for a semiconductor under the magnetic field intensity B Tesla. **[5M]**

(b) Write the formula that can explain variation of Resistance with respect to temperature. Sketch the variation of Resistance with respect to temperature in case of material with (1) Positive temperature coefficient (2) Negative temperature coefficient **[5M]**

(c) Apply the knowledge of optical microscope to determine its limitation to study nano particles. Explain Transmission Electron Microscope (TEM) works in study of nano particles. **[5M]**

Q.4 (a) A straight line is to be drawn using x and y coordinates as mentioned below. Using the concept of least square fit find the equation of straight line. **[5M]**

X	1	2	3	4	5	6	7	8	9
Y	4	7	8	11	12	15	17	21	20

(b) Define (1) Transducer (2) Piezo electric effect.How Piezo electric Transducer works? Write at least three applications of Piezo electric Transducer. **[5M]**

(c) What is heat? Write at least two points as the difference between heat and Temperature. Explain the use of Bimetallic thermometer for measurements of temperature. **[5M]**

Q.5 (a) Explain why optical interferometry is one of the best concept for testing the flatness of a surface? **[5M]**

(b) A sample of a n-type Silicon has a donor density of 10^{20} /m^3. It is used in the Hall effect experiment. If the sample of width 4.5 mm is kept in a magnetic field of 0.55T with current density of 500 A/m^2 . Find Hall voltage developed. **[5M]**

(c) Draw the neat diagram and explain how AFM works. **[5M]**

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Time: 3-hour 00 minutes **Max. Marks: 60**

General Instructions:

I) Solve any four questions

II) Figure indicates full marks

III) Use First angle method of projection.

Q1. **a.** A circle of 40 mm diameter rolls on a straight line without slipping. Draw the curve traced out by a point P on the circumference for one complete revolution of the circle. Name the curve. Draw a tangent to the curve at a point on it 35 mm from the directing line. 6

b. Figure 1 shows a pictorial view of an object. Draw the following views: i) Front view ii) Top view and Dimensions. 9

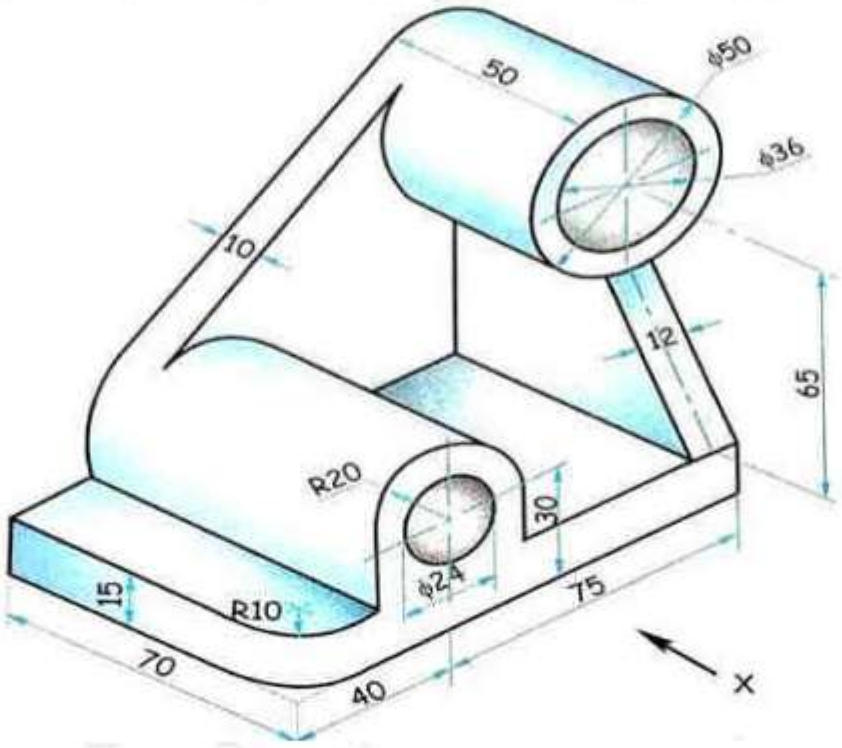

Figure 1

15

Q2. Figure 2 shows isometric view of a machine component. Draw following views
(i) Sectional F.V. looking in the direction X. (Section A-A) (ii) R.H.S.V.

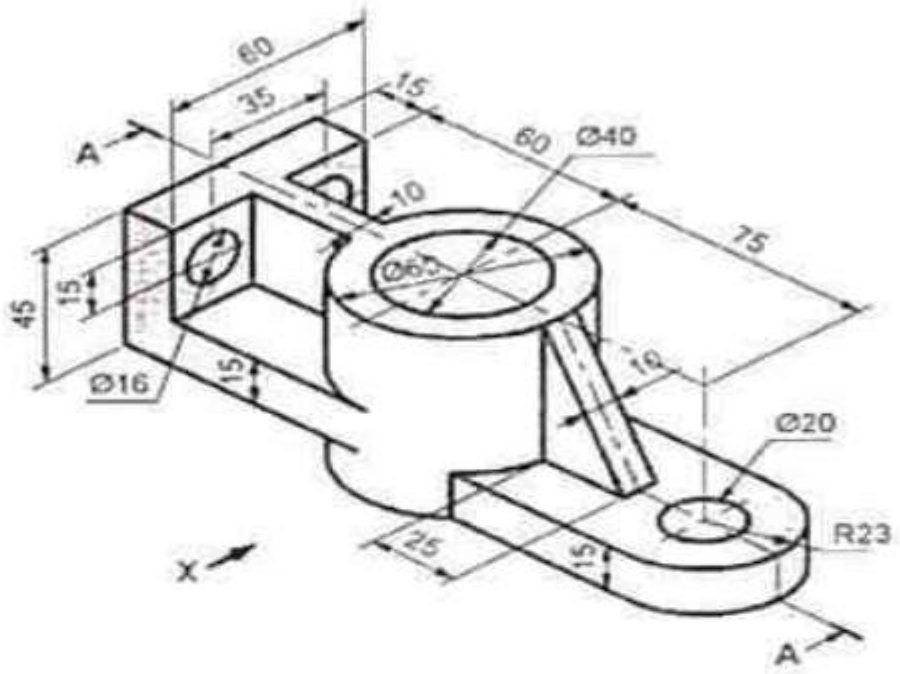

Figure 2

Q3 A cone of base 60 mm diameter and axis 66 mm long is lying on one of its generators on the V.P. with its F.V. of an axis making an angle at 50° with the H.P. Draw its projections considering the apex nearer to observer. 15

Q4. **a.** A square prism side of base 40 mm and axis length 60 mm is kept on the HP. On a corner of its base such that its axis makes an angle 30 degree to HP. Draw the projection of Prism. 6

9

b. Draw Isometric view for following Figure 3 Orthographic Views of component.

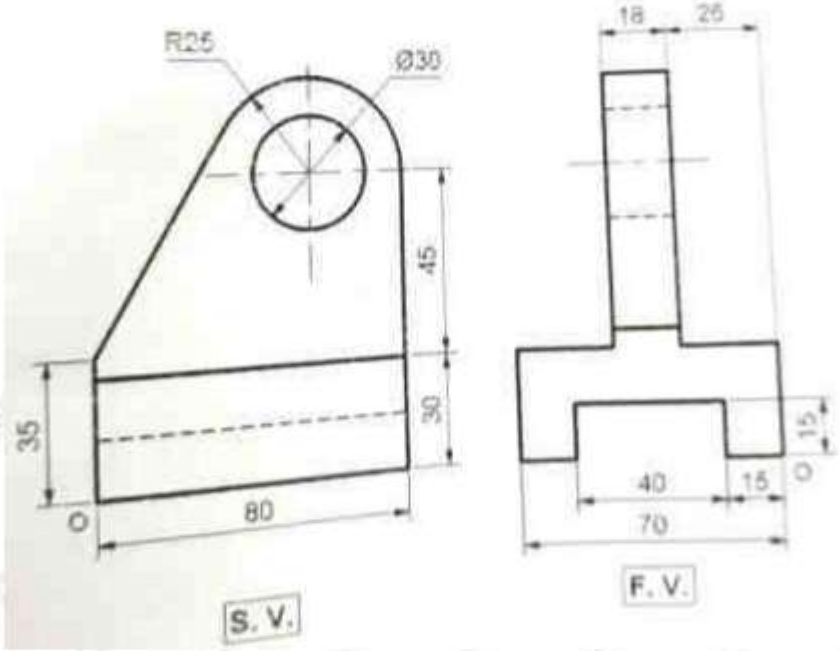

Figure 3

Q5. A hexagonal pyramid base 30 mm side, axis 65mm long has its base on H.P. with an edge of base parallel to V.P. A section plane perpendicular to V.P. and inclined at 60^0 to H.P. bisects the axis of the pyramid. Draw front view, sectional top view and true shape Of the section. 15

Q6. **a.** A line AB, 70 mm long is inclined at an angle of 45° to the H.P. and 30° to the V.P. Its end point 'A' is on the H.P. and 25 mm in front of the V.P. Draw the projections of the line AB assuming it to be in the first quadrant. (Four locus are 4 marks & TL, PL, EL are 5 marks) 9

6

b. Draw the isometric view of the given view Figure 4.

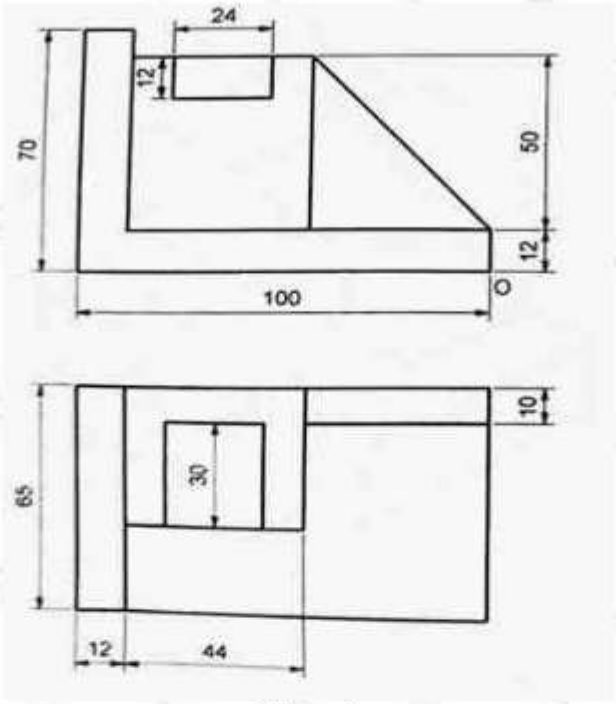

Figure 4

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Time: 2 hours **Max. Marks 60**

N.B.

1. **Question No.1 is compulsory**
2. Attempt any **Three** Questions from the remaining Five Questions
3. Figures to the right indicate full marks
4. Atomic weight: C = 12, H = 1, O = 16, N = 14, S= 32, Cl =35.5

Q.1 **Answer any five from the following:** **15**

a. Explain Fluorescence phenomena in brief.

b. Define electrochemistry and explain redox reaction.

c. Define fuels. Give characteristics of good fuel.

d. Why Galvanizing is preferred over tinning?

e. Explain 'Design for energy efficiency' principle of Green Chemistry.

f. Explain any two selection rules of spectroscopy.

g. 2.5g of coal sample on combustion in Bomb's calorimeter produced 0.28 g of $BaSO_4$ precipitate. Calculate the percentage of sulphur.

Q.2 a) Explain how does following factors affect rate of corrosion: 6

i) pH of the medium.
ii) Relative area of anodic and cathodic parts of metal.
iii) Position of metal in galvanic series.

b) Explain the conventional and greener pathway for the synthesis of Indigo. 5
Mention the principle associated with this synthesis

c) Write the cell reaction for $Ni \mid Ni^{2+}$ and $Cu^{2+} \mid Cu$ half cells and calculate standard potential if, $E^0_{Ni} = -0.257V$ and $E^0_{Cu} = 0.337V$. 4

Q.3 a) What is Flame photometry? Explain it with respect to principle, working, diagram and applications. 6

b) What is reference electrode? Differentiate between Electrolytic and galvanic cell. 5

c) Calculate % atom economy for the following reaction: 4

$CH_3\text{-}CH_2\text{-}CH_2\text{-}OH \xrightarrow{ACID} CH_3\text{-}CH{=}CH_2 + H_2O$

Propanol Propene

Q.4 a) Calculate the volume and weight of air required for complete combustion of $1m^3$ of gaseous fuel having the following composition: $H_2 = 30\%$, $CH_4 = 50\%$, $N_2 = 7\%$, $CO_2 = 10\%$, $O_2 = 3\%$ (Molecular weight of air =28.94). 6

b) Explain trans-esterification method for preparation of biodiesel from vegetable oil with reaction and give its advantages. 5

c) Differentiate between absorption and emission spectra. 4

Q.5 a) Explain the mechanism of dry corrosion due to oxygen gas with the help of diagram and reactions. 6

b) A sample of coal was found to contain C = 82%, H = 4%, S = 1%, O = 1%, N = 2%, Ash=10%. Calculate HCV and LCV using Dulong's Formula. 5

c) Draw a well labelled Jablonski diagram. 4

Q.6 a) Explain Sacrificial anode cathodic protection method to control corrosion of metal pipeline with its principle, diagram and applications. 6

b) 2.5 gm of air-dried coal sample was taken silica crucible, after heating it in an oven at 110°C for 1hr the residue weighed 2.45g. The residue was then ignited at 750°C for half an hour and weighed after cooling, constant weight of 0.101 g was obtained. Calculate % Moisture content and % Ash in this sample of coal. 5

c) Draw a well labelled diagram of electromagnetic spectrum showing various regions. 4

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