Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai – 400058

End Semester/~~Re-Examination~~ December 2025/ ~~January 2026~~

Program: F.Y.B.Tech (Mechanical) Sem I **Duration: 3 Hours**

Course Code: BS-BTM101 **Maximum Points: 100**

Course Name: Differential Calculus and Complex Numbers 29/12/25

Semester: I

Note:

1. **Attempt Any Five Questions**
2. **Answers to the sub questions should** be grouped together

		Questions	Points	CO	BL	Module
1	a	If α and β are the roots of the quadratic equation $x^2-2x+4=0$, prove that $\alpha^n+\beta^n=2^{n+1}\cos\left(\frac{n\pi}{3}\right)$	6	2	BL2	3
	b	If $y=\frac{2x^2-x+1}{(x+1)^2(x+2)(x-3)}$, find y_n	6	1	BL3 ,5	SL
	c	If $u\cdot x+v\cdot y=0$ and $\frac{u}{x}+\frac{v}{y}=1$; Prove that $\left(\frac{\partial u}{\partial x}\right)_y-\left(\frac{\partial v}{\partial y}\right)_x=\frac{x^2+y^2}{y^2-x^2}$	8	1	BL3	1
2	a	Prove that $\tan 7\theta=\frac{7\tan\theta-35\tan^3\theta+21\tan^5\theta-\tan^7\theta}{1-21\tan^2\theta+35\tan^4\theta-7\tan^6\theta}$	6	2	BL3	3
	b	Evaluate $\int_1^{1.6}\frac{1}{2+\log_e x}dx$ by (i) Trapezoidal rule (ii) Simpson's $\frac{1}{3}^{rd}$ rule (iii) Simpson's $\frac{3}{8}^{th}$ rule	6	3	BL3 ,5	5
	c	If $y=\log\left[x+\sqrt{1+x^2}\right]$, prove that $(1+x^2)y_{n+2}+(2n+1)xy_{n+1}+n^2y_n=0$	8	1	BL3	SL

End Semester/Re-examination December 2025/ [redacted]

3	a	If $\sin(\alpha+i\beta)=x+iy$, Prove that $(i)\ \frac{x^2}{\cosh^2\beta}+\frac{y^2}{\sinh^2\beta}=1$ $(ii)\ \frac{x^2}{\sin^2\alpha}-\frac{y^2}{\cos^2\alpha}=1$	6	2	BL4	4
	b	Divide 150 into three parts so that the sum of their products taken two at a time will be maximum.	6	1	BL4 2,5	2
	c	Solve the following system of Equation using Gauss Jacobi's Iterative method $15x+2y+z=18$ $3x-6y+25z=22$ $2x+20y-3z=19$	8	3	BL3	5
4	a	Find the root of the equation $x^x=100$, correct to four places of decimals using Newton Raphson method	6	3	BL4	5
	b	If $\cot(\alpha+i\beta)=x+iy$, Prove that $(i)\ x^2+y^2-2x\cot 2\alpha-1=0$ $(ii)\ x^2+y^2+2y\coth 2\beta+1=0$	6	2	BL3 ,5	4
	c	If $z=x\log(x+r)-r$, where $r^2=x^2+y^2$. Prove that $\frac{\partial^2 z}{\partial x^2}+\frac{\partial^2 z}{\partial y^2}=\frac{1}{x+r}$	8	1	BL3	1
5	a	Prove that $\sin^{-1}\left(e^{i\theta}\right)=\cos^{-1}\left(\sqrt{\sin\theta}\right)+i\log\left(\sqrt{\sin\theta}+\sqrt{1+\sin\theta}\right)$	6	2	BL4 ,5	3
	b	Find the root of the equation $x^3-3x^2+5x-1=0$, correct to four places of decimals using Regula Falsi method	6	3	BL4	5
	c	Find the maximum and minimum value of the function $f(x,y)=x-2y+z$ on the sphere $x^2+y^2+z^2=9$	8	1	BL2 BL4	2
6	a	Find all the roots of the equation $x^7+x^4+ix^3+i=0$	6	2	BL3	4

	b	Find nth derivative of $y = \cos^4 x$	6	1	BL3	SL
	c	If u is a homogeneous function of degree n in two variables x and y, then prove that $(i)\ x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y}=nu$ $(ii)\ x^2\frac{\partial^2 u}{\partial x^2}+2xy\frac{\partial^2 u}{\partial x\partial y}+y^2\frac{\partial^2 u}{\partial y^2}=n(n-1)u$	8	1	BL1 ,3	1
7	a	If $u=x^2-y^2$, $v=2xy$ and $z=f(u,v)$, Prove that $\left(\frac{\partial z}{\partial x}\right)^2+\left(\frac{\partial z}{\partial y}\right)^2=4\sqrt{u^2+v^2}\left\{\left(\frac{\partial z}{\partial u}\right)^2+\left(\frac{\partial z}{\partial v}\right)^2\right\}$	6	1	BL2	1
	b	If $u=\tan^{-1}\left(\frac{x^3-y^3}{x+y}\right)$, Prove that $(i)\ x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y}=\sin 2u$ $(ii)\ x^2\frac{\partial^2 u}{\partial x^2}+2xy\frac{\partial^2 u}{\partial x\partial y}+y^2\frac{\partial^2 u}{\partial y^2}=2\sin u\cdot\cos 3u$	6	1	BL2	1
	c	If $u+iv=\frac{1}{i}\log\left[\frac{1+ie^{i\theta}}{1-ie^{i\theta}}\right]$, prove that $u=\frac{\pi}{2}$ and $v=\log(\sec\theta+\tan\theta)$	8	2	BL3	4

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~~End-Semester~~/Re-examination December 2025/ January 2026

Program: F.Y.B.Tech (Mechanical) **Duration: 3 Hours**

Course Code: BS-BTM101 **Maximum Points: 100**

Course Name: Differential Calculus and Complex Numbers

Semester: I

Note:

1. **Attempt Any Five Questions**
2. **Answers to the sub questions should be grouped together**

		Questions	Points	CO	BL	Module
1	a	If $\arg(z+1)=\frac{\pi}{6}$ and $\arg(z-1)=\frac{2\pi}{3}$, find z	6	2	BL2	3
	b	If $y=\cos^3 x\cdot\sin^2 x$, find y_n	6	1	BL3 ,5	SL
	c	If $u\cdot x+v\cdot y=0$ and $\frac{u}{x}+\frac{v}{y}=1$; Prove that $\frac{u}{x}\left(\frac{\partial x}{\partial u}\right)_v+\frac{v}{y}\left(\frac{\partial y}{\partial v}\right)_u=0$	8	1	BL3	1
2	a	Prove that $\tan 5\theta=\frac{5\tan\theta-10\tan^3\theta+\tan^5\theta}{1-10\tan^2\theta+5\tan^4\theta}$	6	2	BL3	3
	b	Evaluate $\int_0^3\frac{1}{\sqrt{x^3+1}}dx$ by (i) Trapezoidal rule (ii) Simpson's $\frac{1}{3}^{rd}$ rule (iii) Simpson's $\frac{3}{8}^{th}$ rule	6	3	BL3 ,5	5
	c	If $y=\left(\sin^{-1}x\right)^2$, prove that $\left(1-x^2\right)y_{n+2}-(2n+1)xy_{n+1}-n^2y_n=0$	8	1	BL3	SL

End Semester/Re-examination December 2025/ January 2026

3	a	Prove that $\cos^{-1}(ix)=\frac{\pi}{2}-i\log\left(x+\sqrt{x^2+1}\right)$	6	2	BL4	4
	b	Find the point on the surface $z^2=xy+1$, nearest to origin. Also find the distance.	6	1	BL4 2,5	2
	c	Solve the following system of Equation using Gauss Seidel's Iterative method $15x+2y+z=18$ $3x-6y+25z=22$ $2x+20y-3z=19$	8	3	BL3	5
4	a	Find the root of the equation $x^x=10$, correct to four places of decimals using Newton Raphson method	6	3	BL4	5
	b	If $\tan(\alpha+i\beta)=e^{i\theta}$, Prove that $\alpha=\frac{n\pi}{2}+\frac{\pi}{4}$ and $\beta=\frac{1}{2}\log\left[\tan\left(\frac{\pi}{4}+\frac{\theta}{2}\right)\right]$	6	2	BL3 ,5	4
	c	If $z=x\log(x+r)-r$, where $r^2=x^2+y^2$. Prove that $\frac{\partial^2 z}{\partial x^2}+\frac{\partial^2 z}{\partial y^2}=\frac{1}{x+r}$	8	1	BL3	1
5	a	If $\sin(\theta+i\phi)=\cos\alpha+i\sin\alpha$ prove that $\cos^4\theta=\sin^2\alpha=\sinh^4\phi$	6	2	BL4 ,5	3
	b	Find the root of the equation $2x^3-3x^2+5x-1=0$, correct to four places of decimals using Regula Falsi method	6	3	BL4	5
	c	Find the maximum and minimum distance of the point $(3,4,12)$ from the sphere $x^2+y^2+z^2=1$	8	1	BL2 BL4	2
6	a	If $x+iy=\tan\left(\frac{\pi}{3}+i\alpha\right)$, Prove that $x^2+y^2-\frac{2x}{\sqrt{3}}-1=0$	6	2	BL3	4

End Semester/Re-examination December 2025/ January 2026

	b	Find nth derivative of $y=\log\left[(1+2x)^3(3x-2)^2\right]$	6	1	BL3	SL
	c	State and Prove Euler's Theorem for homogeneous functions of 3 variables.	8	1	BL1 ,3	1
7	a	If $u=x^2-y^2$, $v=2xy$ and $z=f(u,v)$, Prove that $\left(\frac{\partial z}{\partial x}\right)^2+\left(\frac{\partial z}{\partial y}\right)^2=4\sqrt{u^2+v^2}\left\{\left(\frac{\partial z}{\partial u}\right)^2+\left(\frac{\partial z}{\partial v}\right)^2\right\}$	6	1	BL2	1
	b	If $u=\log\left(x^2y^3+xy^4+x^5+y^5\right)$, Prove that $(i)\ x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y}=5$ $(ii)\ x^2\frac{\partial^2 u}{\partial x^2}+2xy\frac{\partial^2 u}{\partial x\partial y}+y^2\frac{\partial^2 u}{\partial y^2}=-5$	6	1	BL2	1
	c	If $u+iv=\frac{1}{i}\log\left[\frac{1+ie^{i\theta}}{1-ie^{i\theta}}\right]$, prove that $u=\frac{\pi}{2}$ and $v=\log(\sec\theta+\tan\theta)$	8	2	BL3	4

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Munshi Nagar, Andheri (West), Mumbai – 400058.

End Semester/~~Re-Exam~~ Examination Sem I

~~Jan 2026/Feb 2026~~ DEC 2025

Total Marks: **100** | Duration: **3 Hrs**

CLASS/SEM : **F.Y.B.Tech Mechanical Sem.-I** | COURSE NAME : **ENGINEERING PHYSICS**

COURSE CODE: **BSBTM102**

31/12/25

- **Answer any FIVE questions out of SEVEN.**
- **Diagrams have to be drawn wherever necessary. Assume suitable data (if necessary) and state your assumptions clearly.**
- **Figures to the right indicate Mark, Module no (MN), Course Outcome (CO) and Bloom's Taxonomy level (BL) respectively.**
- **Marks will be given on the basis of what will be written in the paper irrespective of your intentions!**

Good luck!

Values of some fundamental constants: $h=6.63*10^{-34}$J-s, $m_e=9.31*10^{-31}$kg, $m_p=1.67*10^{-27}$kg, $e=1.6*10^{-19}$C, $k=1.38*10^{-23}$J/K, $N_A=6.023x10^{23}$ /gm-mole

		Mark	MN	CO	BL
Q1.	**(20 mark)**				
a.	The uncertainty in the location of a particle is equal to its de Broglie wavelength if you consider wavelength output from a Ruby laser. Calculate the uncertainty in momentum. Also find the energy of the laser beam.	**5**	1,5	1	3
b.	A drop of oil of R.I. 1.20 floats on water R.I. 1.33 surface and is observed from above by reflected light. The thickness of the drop at the edge is very small, almost zero and gradually increases towards the middle of the drop. 1. Will the thinnest outer region correspond to a dark or bright band? Why? 2. What will be the thickness of the oil drop where the wavelength of 4800 A° is intensified in the reflected light for the third order?	**5**	3	3	4
c.	For a STIN fiber, core and cladding refractive indices are 1.44 and 1.42 respectively. Calculate the acceptance angle in air, for rays that change direction by 120° at each reflection.	5	5	5	3
d.	Zinc has an HCP structure. The height of the unit cell is 0.494nm. The atomic weight of zinc is 65.37. Calculate radius of the zinc atom, APF and density of zinc.	5	4	4	3
Q2.	**(20 mark)**				
a.	Arrive at Schrodinger's time dependent equation and reduce it to the time independent form.	8	2	2	2
b.	Calculate the number of photons emitted within 1ms, by an Nd:YAG laser of output power 1 mW. Compare this with the He-Ne laser and comment on the result.	6	5	5	3,5

c.	A beam of light consists of two wavelengths 590.159nm and 590.220 nm, which are to be resolved with a diffraction grating. If the grating has lines across the width 3.8 cm, what is the minimum number of lines required for the two wavelengths to be resolved in the second order? At what angle is the second order minima observed?	**6**	3	3	3
Q3.	**(20 mark)**				
a.	Define Total Internal Reflection and hence derive an expression for critical angle in optical fibres.	**8**	5	5	3
b.	A 7 kg dog is running at a rate of 2.3 m/s. What is the uncertainty in the position of the dog if its speed is measured within 0.01 m/s? Also calculate uncertainty in its Energy assuming it to be a quantum mechanical particle.	**6**	1	1	3
c.	Draw the following: $(3\bar{3}0)$, $[\bar{2}01]$,(121)	**6**	4	4	3
Q4.	**(20 mark)**				
a.	State expression for Intensity when light undergoes Fraunhofer diffraction through a single slit of width a. Also derive conditions for prineipal maximum, minima and secondary maxima. Plot diffraction curve.	**8**	3	3	1, 4
b.	X-rays with a wavelength of 1.54 Å are used to calculate the spacing of (200) planes in aluminium. Bragg angle for this reflection is 22.4°. What is the size of the unit cell of aluminium crystal? Also calculate the radius of the aluminum atom given it forms a BCC structure.	**6**	4	4	2,5
c.	Explain the working of a three level pumping scheme in LASERs.	**6**	5	5	3,5
Q5.	**(20 mark)**				
a.	Explain construction and working of a He-Ne laser in detail explaining clearly the construction and pumping schemes.	**8**	5	5	1,2
b.	Plot a diffraction curve when light undergoes Fraunhofer diffraction through N=4, considering b=a.	**6**	3	3	3
c.	An electron is confined to a potential well of width L=10fm. Calculate the probability and energy of the particle between x=0 and x=L/4 in the first excited state. Find the energy of the particle in the said excited state and also the wavelength if it does a transition to the immediate lower energy state..	**6**	2	2	3,4
Q6.	**(20 mark)**				
a.	Draw diamond unit cell and hence describe all the unit cell properties of the same.	**8**	4	4	2
b.	Derive an expression for path difference when light falls on a film of uniform thickness in the reflected system. Also derive conditions of constructive and destructive interference.	**6**	3	5	3
c.	Derive Heisenberg's uncertainty principle of Energy and Time from position and momentum relationship or vice versa.	**6**	1	1	3
Q7.	**(20 mark)**				
a.	Derive the Energy Eigen values and Eigen functions for a particle moving in an infinite height and of width L. Also draw a schematic diagram of the probabilities of the first and second energy state.	**8**	2	2	3
b.	Explain co-ordination number of an HCP structure considering the corner atom and reference. Gold belongs to cubic monoatomic crystal structure. Its density is 19320 kg/m^3 and the lattice constant a=4.08A°. Atomic weight is 197. Determine the type of cubic structure to which gold belongs.	**6**	4	4	3
c.	Using Heiscnberg's uncertainty principle of position and momentum, provc that an electron can never be a nucleon.	**6**	1	1	3

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END SEM EXAMINATION DECEMBER 2025-26

F4. B.Tech Sem I

Program:Mechanical Engineering

Duration: 03 hour

21/12/26

Course Code: ES-BTM101

Maximum Points:100 marks

Course Name:Engineering Graphics

Semester:I

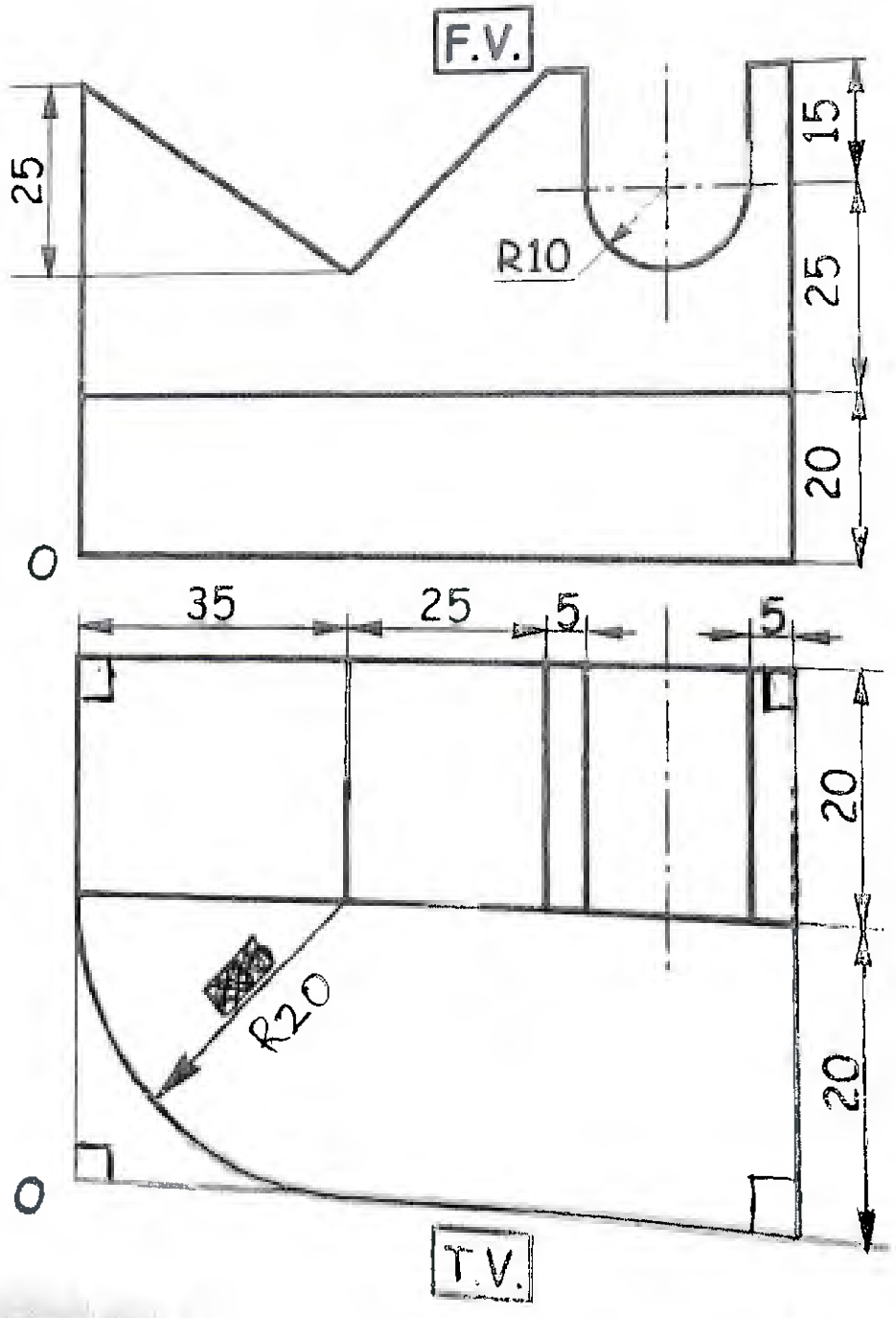
Notes: AutoCAD file name for each question should be **:**
SEATNO_ENDSEM_JAN2026_Q1(Example:M25100XX_ENDSEM_JAN26_Q1)

1. **Question No 1 is compulsory**
2. **Attempt any four questions out of the remaining six.**
3. Draw neat schematic diagrams,**highlight** important points.
4. Assume suitable data if necessary and mention it.
5. **Use first angle method of projection only.**
6. **Return question paper** to Invigilator. VP: (Vertical plane) , HP ((Horizontal plane).

Exam Seat No	
Reg.NO.	
Machine NO.	
Sign of Invigilator	

Q. NO	Questions	Marks	CO	BL	M
Q1 A	A square prism with 40 mm sides of base and 60 mm axis length rests on HP on one of its comers of the base such that the two base edges containing the corner on which it rests make equal inclinations with HP. Draw the projections of the prism when the axis of the prism is inclined to HP at 35° and to V.P. (Vertical plane) at 45°.	10	2	2	4

END SEM EXAMINATION DECEMBER 2025-26

Q1 B	Draw an isometric view of the following Figure using natural scale. 	10	1, 2	2	5

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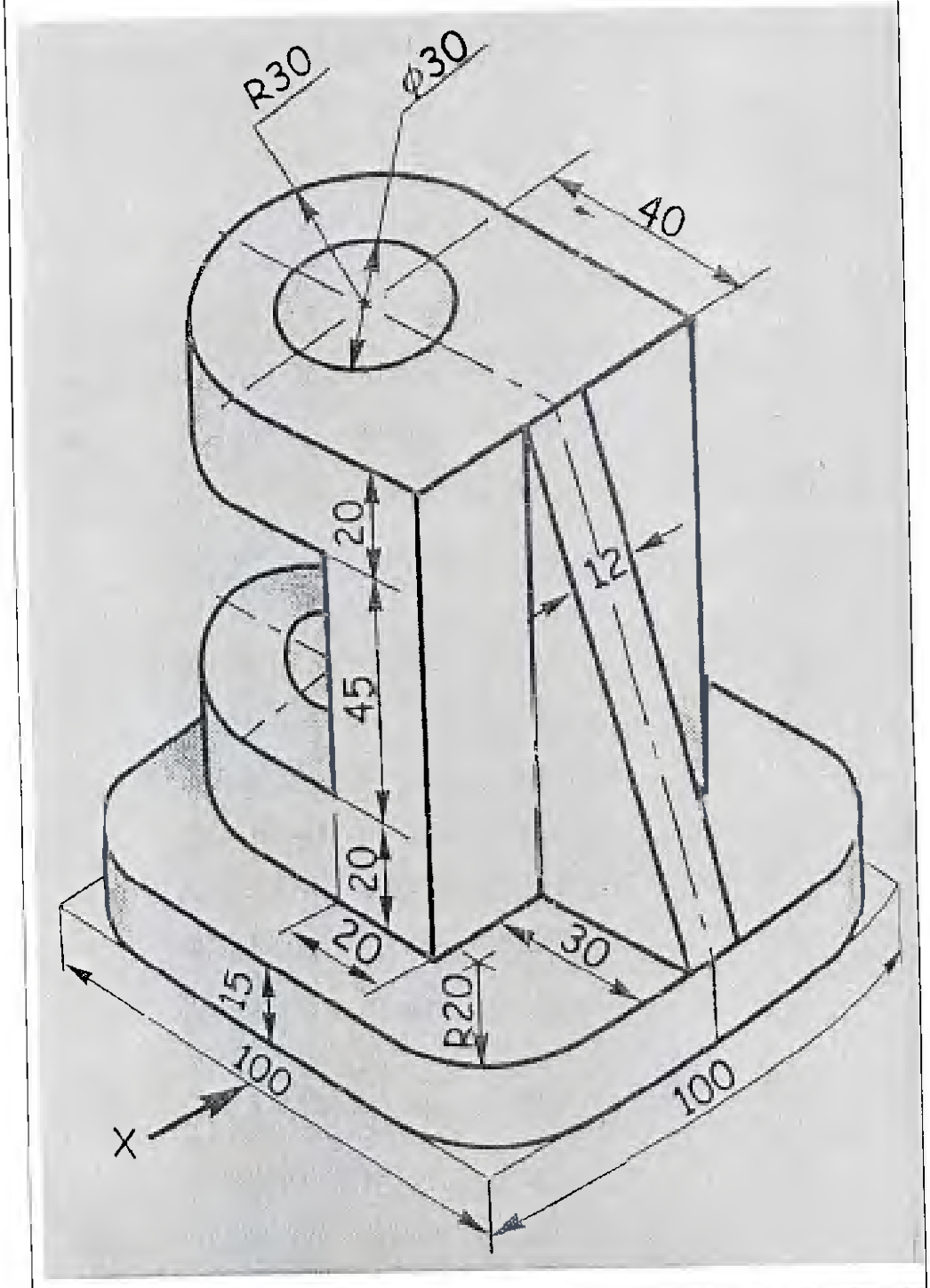
END SEM EXAMINATION DECEMBER 2025-26

Q2 A	The plan 'MN' of a straight line MN is 135 mm long, and it makes an angle of 40 degrees with refrence line XY. The end M is in the V.P. and 80mm from the H.P the end N is 20mm from the H.P. and the whole line is in the fourth quadrant. Draw the projection of the line. Determine the true length and inclination of the line.	10	1, 2	2	2
Q2 B	A circular lamina of 60mm diameter rests on HP on point 1 of the circumference. The lamina is inclined to HP such that the top view of it is an ellipse of minor axis 35 mm. The top view of the diameter through point 1 makes an angle of 45^0 with VP. Draw the Projections and determine the angle made by lamina with HP.	10	1, 2	2	3
Q3 A	The end A of a straight line AB 90mm long is in the first quadrant, and 15 mm from both HP and V.P. The line is inclined at 30 degrees with the H.P. and distance between end projector 60mm. Draw the projections of the line, and find its inclination with the V.P.	10	1, 3	2	2
Q3 B	Rhombus of the longer diagonal of 60mm and smaller diagonal 40mm is resting on the corner of a larger diagonal on the V.P. such that the front view is a square of 40mm diagonals. Draw its projection if the front view of the larger diagonal makes an angle of 45° with the H.P.	10	2, 3	2	3
Q4 A	Draw ellipse by Rectangle method. Take major axis 100 mm and minor axis 70 mm long.	10	1	2	1
Q4 B	A square pyramid side of a base of 40mm and an axis length of 60mm has one of the sides of the base in the H.P. The axis of the solid is inclined to the H.P. at an angle of 30°. The TV of an axis is inclined at an angle of 45° with the V.P. Draw its projections when away from the observer.	10	1, 2	2	4
Q5 A	A ball thrown in air attains 150 m hieght and covers horizontal distance 225 m on ground. Draw the path of the ball (projectile) (Draw parabola using Rectangle methoid)	10	1, 2	2	1
Q5 B	Draw a involute of circle whose diameter is 250 mm, If String length is equal to the circumference of circle.	10	1	2	1

END SEM EXAMINATION DECEMBER 2025-~~26~~

Q6	Draw the following orthographic projection view of the below Figure; 1}FRONT VIEW 2} TOP VIEW 3} LHSV	20	1 , 2 , 3	2	5



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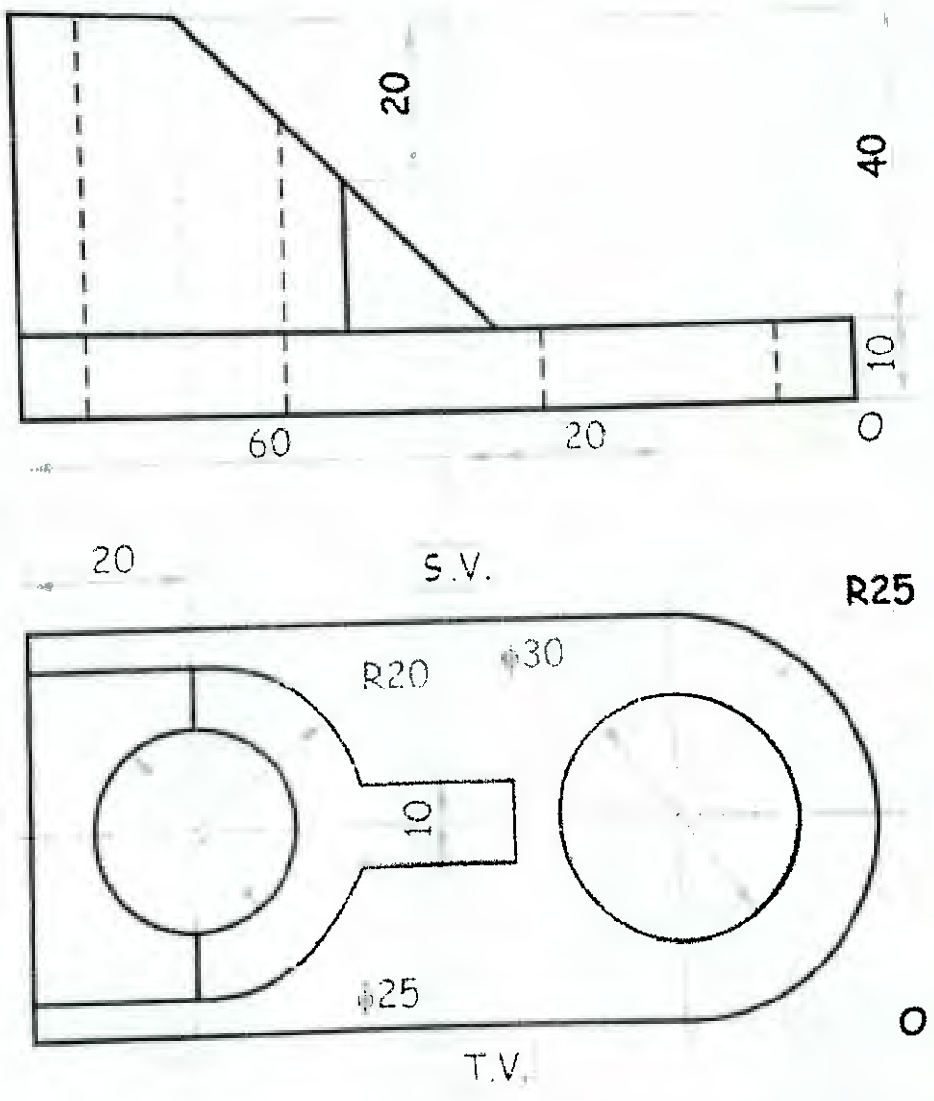
END SEM EXAMINATION DECEMBER 2025-26

Q7 A	The end projectors of line AB are 55mm apart. point A is 55 mm below the H.P. and 60 mm behind the V.P. point B is 30 mm above the H.P. and 25 mm in front of the V.P. draw the projections of AB and find its true length and its true inclination with the H.P. and V.P.also locate its traces.	10	3	2	2
Q7 B	Draw an isometric view of the following Figure using natural scale. 	10	3	2	5

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5/1/26

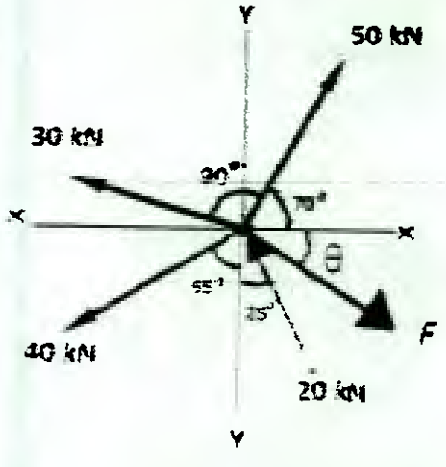
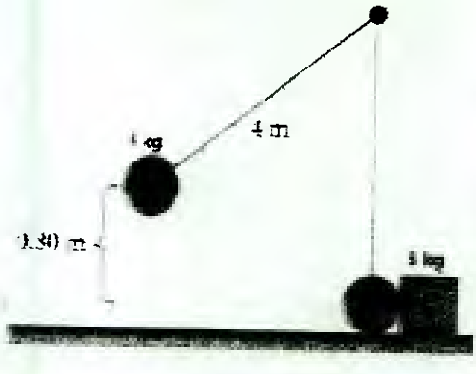
END SEMESTER December 2025 / RE - EXAM February 2026

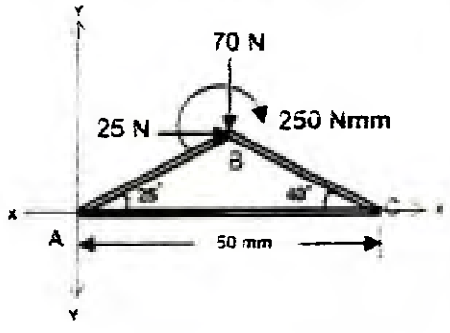
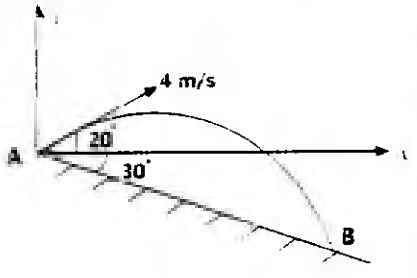
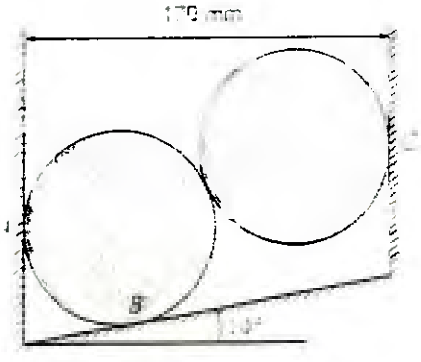
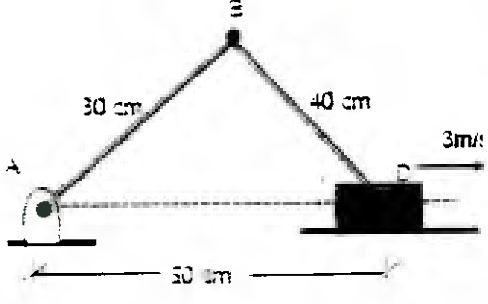
Program: F.Y.BTech (Mechanical) Sem I
Course Code: ES-BTM102
Course Name: Engineering Mechanics-I (R23)

Duration: 3 hours
Maximum Points: 100
Semester: I

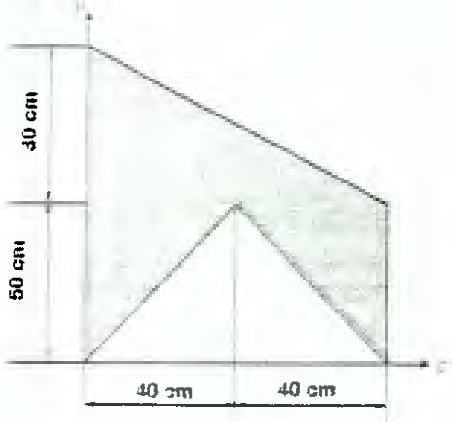
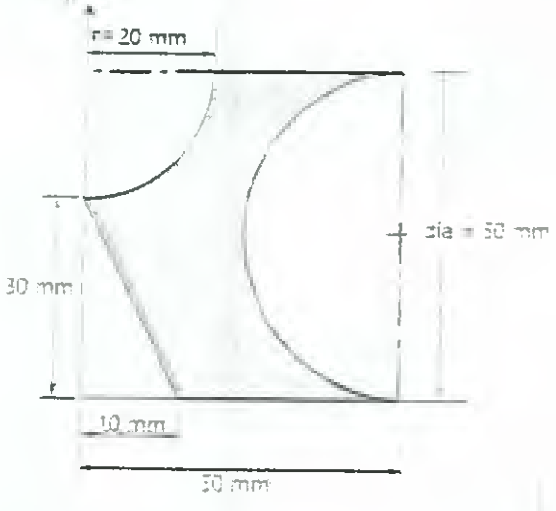
Notes:

1. Attempt **any five** out of the seven questions.
2. Start each new question on a new page. All sub-questions should be written grouped together.
3. Assume suitable data if necessary and state it clearly.
4. Use of scientific calculator is permitted.

Q.No.	Questions	Points	CO	BL	Module No.
Q.1 (a)	Four concurrent forces act on a body as shown in the figure. Compute the fifth force ***F*** and its direction θ, that needs to be applied to make the resultant of all the forces equal to zero 	10	1	2,3	1
Q.1 (b)	A sphere of mass 4 kg is released from rest and strikes a block of mass 5 kg resting on a horizontal surface as shown in figure. How far will the block move after the impact? Take coefficient of restitution e = 0.6 and the coefficient of friction between the block and the floor as 0.3 	10	4	2,3	5

Q.2 (a)	Calculate (i) the magnitude and (ii) the direction of the resultant of the forces acting on triangular bracket as shown in diagram. Also calculate (iii) X-intercept and (iv) Y-intercept		10	1	3	1
Q.2 (b)	A ball is projected from A with a speed of 4 m/s at an angle of 20 degree with horizontal as shown in figure. Determine the coordinate of point B at which the ball will hit the inclined pane which is at angle 30 degrees below the horizontal.		10	3	2,3	3
Q.3 (a)	Two identical cylinders of diameter 100 mm and each weighing 200 N are placed as shown in figure below. All the contact surfaces are smooth. Find the reactions at A, B, and C		10	1	3	1
Q.3 (b)	Block D shown in figure moves with a speed of 3 m/s towards right. Determine (i) the angular velocities of links BD and AB and (ii) velocity of point B at the instance shown. Also (iii) Locate the instantaneous center of rotation of link BD		10	3	3	3

END SEMESTER December 2025 / RE - EXAM February 2026

Q.4 (a)	Calculate the center of gravity of following composite area 	10	2	3	2
Q.4 (b)	Explain the following concepts with appropriate diagrams: (i) Product of inertia (ii) Radius of gyration (iii) Lami's theorem	10	1,2	1,2	2,3
Q.5 (a)	Calculate the moment of inertia of the following shaded area about (i) XX- axis and (ii) YY-axis 	15	2	3	2
Q.5 (b)	Explain the following with appropriate diagram: (i) D'alemberts principle of dynamic equilibrium (ii) Parallel axis theorem	5	3	2,3	3

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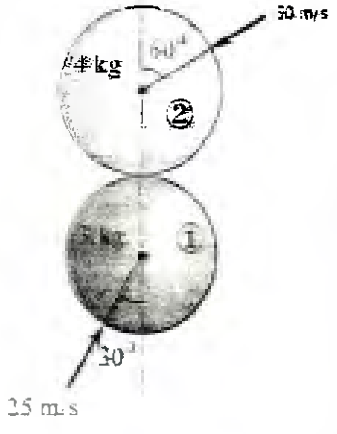
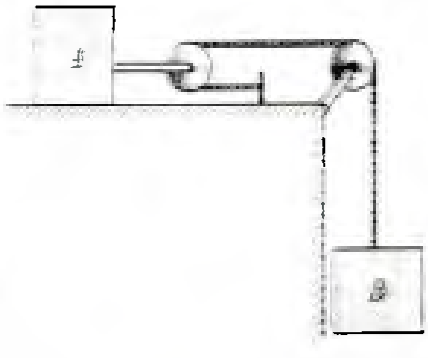
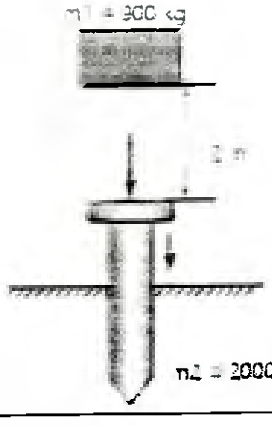
(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W), Mumbai - 400053

END SEMESTER December 2025 / RE - EXAM February 2026

Q.6 (a)	A car travels along a depression in a road. The equation of depression is $x^2 = 100y$. The speed of the car is constant 60 kmph. Calculate (i) the acceleration of the car at the deepest point in the depression. (ii) Also find the radius of curvature of the depression at this point	10	3	2,3	3
Q.6 (b)	Two smooth balls are moving with velocities as shown in the figure below before impact. Calculate the magnitude and direction of the velocities of these balls after the impact. Take coefficient of restitution e =) 7 	10	4	2,3	5
Q.7 (a)	Two blocks are connected with cord and pulley system as shown in the diagram. Using D'Alemberts equation of dynamic equilibrium, determine the acceleration of each block when the system is started from rest. Assume all surfaces are smooth. Take Mass of A = 20 kg and mass of B = 50 kg 	10	3	3	4
Q.7 (b)	A 300 kg hammer falls from a height of 2m onto the top of a pile of mass 2000 kg as shown in figure. The pile is driven 100 mm into the ground due to the impact. Assume perfectly plastic impact. Determine the resistance force of the ground to this penetration. 	10	3	3	5

Bharatiya Vidya Bhavan's

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END SEMESTER December 2025 / RE - EXAM February 2026

Program: F.Y.B. Tech Mech Sem I
Course Code: BS-BTC/M/E-103
Course Name: BIOLOGY FOR ENGINEERS

Duration: 2 hrs.
Maximum Points: 50
Semester: I

7/11/26

Notes: Attempt any five questions out the following.

Q.No.	Questions	Points	CO	BL	Module No.
1.	a) Explain the role of fossils in understanding evolutionary relationships of organisms.	5	1	1	1
	b) State the importance and requirements of biology for engineering students.	5	2	4	1
2.	Describe Mendel's dihybrid cross taking two contrasting characters in pea plants.	10	1	1	2
3.	Explain the process of DNA replication.	10	1	1	3
4.	Echolocation is widely applied in technologies such as ultrasonography and SONAR. Discuss the working principle, advantages, and engineering significance of echolocation-based systems.	10	1/2	1/4	4
5.	a) What is a bionic leaf? Explain its working principle and state its importance.	5	3/4	2	4
	b) What are HBOCs? How do they function as artificial blood substitutes? Discuss their advantages and uses.	5	1/4	1/3	4
6.	a) Explain how 3D printing technology is used to create artificial ear and bone structures.	5	2/4	2/4	5
	b) Describe the mechanism of crack healing in Bio concrete.	5	4	4	5
7	a) Explain how an electrical nose helps in identifying food adulteration.	5	2/4	1/4	5
	b) What is interphase? Describe the different stages of interphase with suitable points?	5	1	1	2

Bhartiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING
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END Semester 2025 Examinations
DECEMBER 2025
Design Thinking and Innovation SET II

9/11/25

Semester I

Program: First Year B. Tech CME Sem I

Duration 02 Hours

Code: SE BTC 101

Marks 50

Instructions

1. **Question 01 is compulsory**
2. **Attempt any 04 questions out of remaining 06**
3. Each question carries **10 marks.**
4. Figures to the right indicate full marks.
5. Support answers with examples wherever necessary.

Sr.No	Questions	Marks	Module	BL
Q.1.	An Ed-Tech startup wants to redesign their **online examination integrity system** due to rising concerns such as cheating, camera privacy issues, poor internet connectivity and student anxiety. Apply **all five stages of Design Thinking** to propose: • Key research steps • Data synthesis approach • Ideation strategy • Prototype types • Comprehensive testing plan	**10**	**01to 05**	**5,6**
Q. 2.	You are designing a solution for managing long queues at hospital OPD registration counters. List **any five empathic research methods** and describe **how each will help you understand user pain points.**	**10**	**02**	**1,2**
Q.3.	The government wants to redesign the **public transportation ticketing system** due to long queues, system crashes, and inconvenience for tourists. a) Perform a **root cause analysis** using Empathy Mapping. Write **two different POV (Point of View) statements** from the perspectives of: 1. A daily office commuter. 2. A foreign tourist with no local language knowledge	**10**	**01,02**	**2,3**
Q.4.	Use **Six Thinking Hats** to generate insights for designing a solution to reduce **campus food waste** in college canteens. Present your response under **each Hat.**	**10**	**03**	**3,4**

Q.5.	**Multiple Choice Questions:** 1. Empathy maps typically include all of the following EXCEPT: a) Says b) Does c) Thinks d) Rewards 2. A meaningful POV statement must include: a) Insight, Need, User b) Budget, Timeline, Scope c) Data, Validation, Evidence d) Persona, Demographics, Design brief 3. Divergent & convergent thinking are critical in: a) Only ideate stage b) Throughout process c) Only prototype stage d) Only testing stage 4. The **5-Whys technique** is primarily used for: a) Ideation b) Problem definition c) Market launching d) User testing 5. In Six Thinking Hats, the **Black Hat** symbolizes: a) Creativity b) Positive judgement c) Critical judgement d) Emotions 6. The primary purpose of a **high-fidelity prototype** is: a) Conceptual understanding b) Quick sketches c) Final user experience simulation d) Low-cost basic model 7. Which testing approach ensures **real-world scenario validation**? a) Lab experiment b) Field trial c) Simulation only d) Brainstorm review 8. A design failure due to ignoring user emotions represents a breakdown in: a) Ideate stage b) Empathize stage c) Prototype stage d) Test stage 9. **Critical-to-quality (CTQ)** metrics are most relevant in: a) Prototype validation b) Mind mapping c) Persona design d) Empathy interviewing 10. Which statement best reflects **convergent thinking**? a) Expanding options without judgement b) Choosing the best alternative among many c) Encouraging wild ideas d) Generating diverse solutions	**10**	**1 to 5**	**1,2,3**
Q.6.	A company is developing a **wearable stress-monitoring wristband** for corporate employees. a) Propose **two low-fidelity prototypes** and **two high-fidelity prototypes** and justify the purpose of each. b) Evaluate the **risk-benefit trade-offs** that should be considered before scaling the prototype for real-market launch.	**10**	**04**	**3,4**
Q.7.	A prototype AI-based **smart library recommendation system** has been developed to assist students in book selection. a) Design a **pilot testing plan** including sampling strategy, testing tools, success metrics, and feedback capture mechanisms.	**10**	**05**	**3,5**
	All the Best			