

Model Question Paper-I with effect from 2022 (CBCS Scheme)

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First Semester B.E Degree Examination

Mathematics-I for Mechanical Engineering stream (22MATM11)

TIME: 03 Hours

Max. Marks: 100

Note: Answer any FIVE full questions, choosing at least ONE question from each module.

Module - 1			Marks
Q.01	a	Find the angle of intersection of the curves $r = \sin \theta + \cos \theta$ and $r = 2 \sin \theta$	06
	b	Find the pedal equation of the curve $r^2 = a^2 \sec 2\theta$.	07
	c	Find the radius of curvature of the curve $x^4 + y^4 = 2$ at the point (1, 1)	07
OR			
Q.02	a	Derive the radius of curvature for polar curve $r = f(\theta)$ in the form $\rho = \frac{(r^2 + r_1^2)^{3/2}}{r^2 + 2r_1^2 - rr_2}$	06
	b	Find the angle between the radius vector and the tangent and also find the slope of the tangent $r = a(1 + \cos \theta)$ at $\theta = \pi/3$.	07
	c	Find that the radius of curvature of $a^2 y = x^3 - a^3$ at the point where the curves cut the X-axis.	07
Module-2			
Q. 03	a	Expand $\log \cos x$ by Maclaurin's series up to the term containing x^6	06
	b	If $z = \frac{x^2 + y^2}{x + y}$, show that $\left(\frac{\partial z}{\partial x} - \frac{\partial z}{\partial y}\right)^2 = 4\left(1 - \frac{\partial z}{\partial x} - \frac{\partial z}{\partial y}\right)$	07
	c	If $u = x + y + z$, $uv = y + z$, $uvw = z$, evaluate $\frac{\partial(x,y,z)}{\partial(u,v,w)}$	07
OR			
Q.04	a	Evaluate (i) $\lim_{x \rightarrow 0} \left(\frac{\sin x}{x}\right)^{1/x^2}$ (ii) $\lim_{x \rightarrow 0} (\tan x)^{\tan x}$	6
	b	If $u = f(ax - by, by - cz, cz - ax)$, show that $\frac{1}{a} \frac{\partial u}{\partial x} + \frac{1}{b} \frac{\partial u}{\partial y} + \frac{1}{c} \frac{\partial u}{\partial z} = 0$	07
	c	Find the extreme values of $f(x, y) = x^3 + 3x^2 + 4xy + y^2$	07
Module-3			
Q. 05	a	Solve $\frac{dy}{dx} - y \tan x = y^2 \sec x$	06
	b	Water at temperature 10°C takes 5 minutes to warm up to 20°C at room temperature of 40° . Find the temperature of the water after 20 minutes.	07
	c	Solve $\frac{dy}{dx} - \frac{dx}{dy} = \frac{x}{y} - \frac{y}{x}$	07
OR			

Q. 06	a	Solve $(y \log y)dx + (x - \log y)dy = 0$	06
	b	Find the orthogonal trajectories of the family curve $r = 2a(\cos\theta + \sin\theta)$.	07
	c	Find the general and singular solutions of $xp^2 + xp - yp + 1 - y = 0$	07
Module-4			
Q. 07	a	Solve $(D^3 - 6D^2 + 11D - 6)y = e^{2x}$	06
	b	Solve $\frac{d^2y}{dx^2} - 4y = \cos 2x$	07
	c	Solve by variation of parameters method $(D^2 + 1)y = \sec x$	07
OR			
Q. 08	a	Solve $(D^2 + D + 1)y = x^2 + 1$	06
	b	Solve $(D - 2)^2y = 8(x^2 + \sin 2x + e^{2x})$	07
	c	Solve $x^2 \frac{d^2y}{dx^2} + 4x \frac{dy}{dx} + 2y = \log x$	07
Module-5			
Q. 09	a	Find the rank of the matrix $\begin{bmatrix} 1 & 2 & 3 & 1 \\ 2 & 1 & -1 & 0 \\ 3 & 3 & 2 & 1 \\ 2 & 4 & 6 & 2 \end{bmatrix}$	06
	b	Solve the system of equations by using the Gauss elimination method $3x + y + 2z = 3,$ $2x - 3y - z = -3,$ $x + 2y + z = 4.$	07
	c	Using the Gauss-Seidel iteration method, solve the equations $27x + 6y - z = 85,$ $6x + 15y + 2z = 72,$ $x + y + 54z = 110.$ Carryout four iterations starting with the initial approximations $(0, 0, 0)$	07
OR			
Q. 10	a	Test for consistency and solve $5x + 3y + 7z = 4,$ $3x + 26y + 2z = 9,$ $7x + 2y + 10z = 5$	06
	b	Using Gauss-Jordan method, solve $x + y + z = 11,$ $3x - y + 2z = 12,$ $2x + y - z = 3$	07
	c	Find the largest eigenvalue and the corresponding eigenvector of $\begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$ with the initial approximate eigenvector $[1 \ 0 \ 0]^T$. Carry out 4 iterations.	07

Table showing the Bloom's Taxonomy Level, Course Outcome and Program Outcome					
Question		Bloom's Taxonomy Level attached	Course Outcome	Program Outcome	
Q.1	(a)	L1	CO 01	PO 01	
	(b)	L2	CO 01	PO 01	
	(c)	L3	CO 01	PO 02	
Q.2	(a)	L1	CO 01	PO 01	
	(b)	L2	CO 01	PO 01	
	(c)	L3	CO 01	PO 02	
Q.3	(a)	L2	CO 02	PO 01	
	(b)	L2	CO 02	PO 01	
	(c)	L3	CO 02	PO 02	
Q.4	(a)	L2	CO 02	PO 01	
	(b)	L2	CO 02	PO 01	
	(c)	L3	CO 02	PO 03	
Q.5	(a)	L2	CO 03	PO 02	
	(b)	L3	CO 03	PO 03	
	(c)	L2	CO 03	PO 01	
Q.6	(a)	L2	CO 03	PO 02	
	(b)	L3	CO 03	PO 03	
	(c)	L2	CO 03	PO 01	
Q.7	(a)	L2	CO 04	PO 02	
	(b)	L2	CO 04	PO 02	
	(c)	L2	CO 04	PO 02	
Q.8	(a)	L2	CO 04	PO 02	
	(b)	L2	CO 04	PO 02	
	(c)	L2	CO 04	PO 02	
Q.9	(a)	L2	CO 05	PO 01	
	(b)	L3	CO 05	PO 01	
	(c)	L3	CO 05	PO 02	
Q.10	(a)	L2	CO 05	PO 01	
	(b)	L3	CO 05	PO 01	
	(c)	L3	CO 05	PO 02	
Lower order thinking skills					
Bloom's Taxonomy Levels	Remembering (Knowledge): L ₁		Understanding (Comprehension): L ₂	Applying (Application): L ₃	
	Higher-order thinking skills				
	Analyzing (Analysis): L ₄		Valuating (Evaluation): L ₅	Creating (Synthesis): L ₆	