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B.Tech. (Sem. - 2nd)

ENGINEERING MATHEMATICS - II

SUBJECT CODE : AM - 102 (Upto 2K8 Batch)

Paper ID : [A0120]

[Note : Please fill subject code and paper ID on OMR]

Time : 03 Hours **Maximum Marks : 60**

Instruction to Candidates:

1) Section - A is **Compulsory**.
2) Attempt any **Five** questions from Section - B & C.
3) Selecting atleast **Two** questions from Section - B & C.

Section - A

Q1) ***(2 marks each)***

a) Test whether the subset S of R^3 is LI or LD, Given

$$S = \{(1, 0, 1), (1, 1, 0), (-1, 0, -1)\}$$

b) Obtain the symmetric matrix A for the quadratic form :

$$x_1^2 + 2x_1x_2 - 4x_1x_3 + 6x_2x_3 - 5x_2^2 + 4x_3^2$$

c) For what value of 'k' the differential equation

$$\left(1 + e^{k\,x/y}\right)dx + e^{x/y}\left(1 - \frac{x}{y}\right)dy = 0 \text{ is exact.}$$

d) Show that the frequency of free vibrations in a closed electrical circuit with inductance L and capacity C in series is $\frac{30}{\pi\sqrt{LC}}$ per minute.

e) Give the physical interpretation of curl of a vector point function $\vec{F}$.

f) Show that the vector field given by

$$\vec{V} = (-x^2 + yz)\hat{i} + (4y - z^2x)\hat{j} + (2xz - 4z)\hat{k} \text{ is soledoidal.}$$

g) Find the work done in moving a particle in the force field

$$\vec{F} = 3x^2\hat{i} + (2xz - y)\hat{j} + z\hat{k}$$

along the straight line from (0, 0, 0) to (2, 1, 3).

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h) The probability that a student passes a Chemistry test is $\frac{2}{3}$ and the probability that he passes both Chemistry and Physics test is $\frac{14}{45}$. The probability that he passes at least one of the two test is $\frac{4}{5}$. What is the probability that he passes the Physics test?

i) With the usual notations, find the probability p of success for a binomial variate X, if $n = 6$ and $9\,P(X = 4) = P(X = 2)$.

j) Define Type-I and Type-II errors occurring in sampling theory.

Section - B

(8 marks each)

Q2) (a) Find the value of λ and μ for which the system of equations : $3x + 2y + z = 6$, $3x + 4y + 3z = 14$, $6x + 10y + \lambda z = \mu$ has

(i) No solution.

(ii) Unique solution.

(iii) Infinitely many solutions.

(b) Verify Cayley-Hamilton theorem for the matrix

$$A = \begin{pmatrix} 1 & 2 & 0 \\ -1 & 1 & 2 \\ 1 & 2 & 1 \end{pmatrix}$$ and hence find A^{-1}.

Q3) (a) Solve the equation $(xy^2 - e^{1/x^3})dx - x^2y\,dy = 0$

(b) Find the solution of the equation $y - 2px = \tan^{-1}(xp^2)$ where $p = \frac{dy}{dx}$.

Q4) (a) Use the method of variation of parameters to find the general solution of the equation $y'' + 16y = 32 \sec 2x$.

(b) Solve the Cauchy-Euler equation : $x^2y'' - xy' + 2y = x \log_e x,\ x > 0$.

Q5) An L-C-R circuit with battery e.m.f E sinpt is tuned to resonance so that $p^2 = 1/LC$. If initially the current i and the charge q be zero, then for small values of R/L, find the current in the circuit at time t.

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Section - C

(8 marks each)

Q6) (a) The position vector of a moving particle at a time t is $\vec{R}(t) = t^2\hat{i} - t^3\hat{j} + t^4\hat{k}$. Find the tangential and normal components of its acceleration at time $t = 1$.

(b) If $\vec{F} = (2x^2 - 3z)\hat{i} - 2xy\hat{j} - 4x\hat{k}$, evaluate $\iiint_v \nabla \times \vec{F}\, dv$, where V is the region bounded by the co-ordinate planes and the plane $2x + 2y + z = 4$.

Q7) (a) State Stokes theorem and use it to evaluate

$$\oint_c [(x+y)dx + (2x - z)dy + (y+z)dz]$$

Where C is the boundary of the triangle with vertices (2, 0, 0), (0, 3, 0), (0, 0, 6).

(b) A fluid motion is given by vector field

$$\vec{V} = (y\sin z - \sin x)\hat{i} + (x\sin z + 2yz)\hat{j} + (xy\cos z + y^2)\hat{k}$$

Is the motion irrotational? If so, find the velocity potential.

Q8) (a) An irregular six-faced die is thrown and the expectation that in 10 throws it will give five even numbers is twice the expectation that it will give four even numbers. How many times in 10,000 sets of 10 throws each, would you expect it to give no even number.

(b) In the following table, x is the tensile force applied to a steel specimen in thousands of pounds and y is the resulting elongation in thousandths of an inch.

x:	1	2	3	4	5	6
y:	14	33	40	63	76	85

Find the equation of the least squares line and use it to predict the elongation when the tensile force is 3.5 thousand pound.

Q9) (a) The following random samples are measurements of the heat-producing capacity (in millions of calories per ton) of specimens of coal from two mines :

Mine 1 :	8260	8130	8350	8070	8340	
Mine 2 :	7950	7890	7900	8140	7920	7840

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Use the 0.01 level of significance to test whether the difference between the means of these two samples is significant. Given that $t_{.005}$ for 9 $d.f$ = 3.250, $t_{0.01}$ for 9 $d.f$ = 1.83, $t_{0.005}$ for 11 $d.f$ = 3.106.

(b) The demand for a particular spare part in a factory was found to vary from day-to-day. In a sample study the following information was obtained :

Days	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
No. of parts demanded	1124	1125	1110	1120	1126	1115

Test the hypothesis that the number of parts demanded does not depend on the day of the week. Given the values of χ^2 at 5, 6, 7, $d.f$ are respectively 11.07, 12.59, 14.07 at the 5% level of significance.

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