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Engineering Mathematics - III
(1010)

P. Pages : 3

Time : Three Hours **Max. Marks : 100**

Instructions to Candidates :
1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with blue ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. All questions are compulsory.
5. Figures to the right indicate full marks.
6. Use of non-programmable calculator and statistical table is allowed.

1. Solve **any four.** **20**

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

b) $(D^4 - 16)y = \sinh 2x + 2^x$

c) $(D^2 + 3D + 2)y = e^{e^x}$

d) $(D^2 + a^2)y = \tan ax$ using V.P. method

e) $(x+1)^2 \frac{d^2y}{dx^2} + (x+1)\frac{dy}{dx} + y = 3\sin \log (x+1)$

f) The whirling speed of shaft of length l is given by

$\frac{d^4y}{dx^4} - m^4 y = 0$, where $m^4 = \frac{Ww^2}{gEI}$

and y is displacement at a distance x from one end. If the ends of the shaft are contrained in long bearing, show that shaft will whirl when $\cos ml \cdot \cosh ml = 1$

2. Attempt **any two.**

a) i) A mechanical system with two degree of freedom satisfies the equation $2\frac{d^2x}{dt^2}+3\frac{dy}{dx}=4$, and $2\frac{d^2y}{dt^2}-3\frac{dx}{dt}=0$ obtain x and y in terms of t, given that $x=y=\frac{dy}{dt}=\frac{dx}{dt}=0$ at t = 0. **7**

ii) Solve : $\frac{dx}{xy}=\frac{dy}{y^2}=\frac{dz}{xyz-2x^2}$. **3**

b) i) Solve $\frac{\partial u}{\partial t}=C^2\frac{\partial^2 u}{\partial t^2}$ with the conditions. **7**

i) $u(0,t)=0$, ii) $u(l,t)=0$, iii) $u(x,0)=u_0$ for $0\le x\le l$
iv) u is finite for all t.

ii) Solve $\frac{dx}{1}=\frac{dy}{1}=\frac{dz}{(x+y)(1+xy+x^2y^2)z}$ **3**

c) An infinitely long plane uniform plate is bounded by two parallel edges in the y – direction and an end at right angles to them. The breadth of the plate is π. This end is mainted at temp. u_0 at all points and other edges at zero temp. Find the steady state temperature function u (x, y). **10**

3. Attempt **any four.** **20**

a) Find $L\left\{t\cdot\int_0^t e^{4t}\sin 3t\,dt\right\}$

b) Find $L\left\{\text{erf}\left(\sqrt{t}\right)\right\}$

c) Find $L^{-1}\left\{\frac{S^2}{(S^2+a^2)^2}\right\}$ using convolution theorem.

d) Evaluate $\int_0^\infty \frac{\cos 6t-\cos 4t}{t}\,dt$

e) Find $L^{-1}\left[\tan^{-1}\left(\frac{S-3}{2}\right)\right]$.

f) Solve $x''(t)+x(t)=\sin 3t$, with $x(0)=x'(0)=0$.

4. Attempt **any four.** **20**

a) Find the co-eff. of variation for the data

x	6	7	8	9	10	11	12
f	3	3	9	13	8	5	4

b) The first four central moments of distributions are 0, 9.2, -3.6 and 122. Comments on distribution.

c) Find the co-eff. of correlation between x and y from the following data.

x	56	55	58	58	57	56	60	54	59	57
y	68	67	67	70	65	68	70	66	68	66

d) Define : i) Skewness ii) Kurtosis and comment on it.

e) Two regression equations of variables x, y are $5x - 6y + 90 = 0$, $15x - 8y - 130 = 0$ Then find mean of x, y and co-eff of correlation between x and y.

f) Give the properties of χ^2 – distribution.

5. Attempt **any four :** **20**

a) Find Fourier integral representation of $f(x) = \begin{cases} 1; |x| < 1 \\ 0; |x| > 1 \end{cases}$.

b) A box contains 100 items, 20 of which are defective, 10 are selected for inspection. Find the probability that i) all 10 are defective, ii) all 10 are good.

c) Find Fourier sine transform of $f(x) = \frac{e^{-ax}}{x}$.

d) A manufacturer knows that razor blade he makes contain on average 0.5% of defective. He packs them in packets of 5. What is the probability that a packet picked at random will contain 3 or more faulty blades?

e) Find Fourier transform of $f(x) = e^{-|x|}$.

f) A sample of 100 dry battery cells tested to find the length of life produced the following results, $\bar{x} = 12$ hours, 6 = 3 hours. Assuming the data to be normally distributed, what percentage & battery cells are expected to have life i) more than 15 hours, ii) Less than 6 hours.
[Given P(2 = 1) = 0.3413, P (2 = 2) = 0.4772.]

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