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Total No. of Pages : 3

Seat No.	

S.E. (Mechanical Engg.) (Semester - III) (Revised) Examination, April - 2018
ENGINEERING MATHEMATICS -III
Sub. Code :63350

Day and Date : Tuesday, 24- 04 - 2018 **Total Marks : 100**

Time : 2.30 p.m. to 5.30 p.m.

Instructions :
1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Use of non-programmable calculator is allowed.
4) Assume suitable data if necessary.

SECTION - I

Q1) Attempt any Three of the following.

a) Solve $\left(D^2-4D+4\right)y=x^3+\cos 2x$ **[6]**

b) Solve $\left(D^3-7D^2+10D\right)y=e^{2x}\sin x$ **[6]**

c) Solve $\dfrac{d^2y}{dx^2}+3\dfrac{dy}{dx}+2y=\sin e^x$ **[6]**

d) Solve $x^2\dfrac{d^3y}{dx^3}+3x\dfrac{d^2y}{dx^2}+\dfrac{dy}{dx}+\dfrac{y}{x}=x^2\log x$ **[6]**

Q2) Attempt any one of the following.

a) The differential equation of a shaft which is whirling with the line bearings horizontal is given by $EI\dfrac{d^4y}{dx^4}-\dfrac{W\omega^2}{g}y=W$, where W is the weight of the shaft and ω is the whirling speed. Taking the shaft of length $2l$ with the origin as its centre and short bearing at both ends i.e. for $x=\pm l, y=\dfrac{d^2y}{dx^2}=0$ show that $y=\dfrac{g}{2\omega^2}\left[\dfrac{\cos mx}{\cos ml}+\dfrac{\cosh mx}{\cosh ml}-2\right]$, where $m^4=\dfrac{W\omega^2}{EIg}$ **[16]**

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b) A spring at the upper end supports a weight of 980 gm at its lower end. The spring stretches ½ cm under a load of 10 gm and the resistance (in gm wt.) to the motion of the weight is numerically equal to the 1/10 of the speed of weight in cm/sec. The weight is pulled down ¼ cm below its equilibrium position and then released. Find the expression for the distance of weight from its equilibrium position at time t during its first upward motion. **[16]**

Q3) Attempt any four of the following.

a) Show that $\vec{V} = 2xyz\vec{i} + \left(x^2z + 2y\right)\vec{j} + x^2y\vec{k}$ is irrotational and hence find a scalar potential function $u(x, y, z)$ such that $\vec{V} = \text{grad } u$ **[4]**

b) Find angle between surfaces $x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$ at a point $(2, -1, 2)$ **[4]**

c) If $\vec{a}$ is a constant vector and $\vec{r} = x\vec{i} + y\vec{j} + z\vec{k}$ then prove that

i) $div\left(\vec{a} \times \vec{r}\right) = 0$

ii) $curl\left(\vec{a} \times \vec{r}\right) = 2\vec{a}$ **[4]**

d) If $\vec{F} = (x+y+1)\vec{i} + \vec{j} - (x+y)k$, find the value of $\vec{F}$. curl $\vec{F}$ **[4]**

e) If $\vec{r} = x\vec{i} + y\vec{j} + z\vec{k}$ and $r = \sqrt{x^2 + y^2 + z^2}$ then prove that $\nabla\left(r^2e^r\right) = \left(r + 2\right)e^r\vec{r}$ **[4]**

SECTION - II

Q4) Attempt any three questions from the following.

a) Find Laplace transform of $\frac{1}{t}(\cos 6t - \sin 4t)$ **[6]**

b) Find Inverse Laplace transform of $\frac{3s+1}{(s-1)(s^2+1)}$ **[6]**

c) Solve using Laplace transform method $\frac{dy}{dt} + 3y + 2\int_0^t y\,dt = t$, given that $y(0) = 0$ **[6]**

d) Find the Laplace transform of $\frac{te^{3t}\sin t\cos t}{2}$ **[6]**

Q5) Attempt any two from the following.

a) Obtain Fourier series for $f(x)=\begin{cases} 1+\dfrac{2x}{\pi}, & -\pi \le x \le 0 \\ 1-\dfrac{2x}{\pi}, & 0 < x \le \pi \end{cases}$ and hence deduce that $\dfrac{1}{1^2}+\dfrac{1}{3^2}+\dfrac{1}{5^2}+\ldots=\dfrac{\pi^2}{8}$ **[8]**

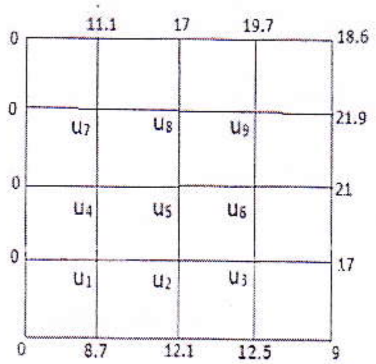
b) Obtain the Fourier series expansion for the function $f(x)=x+x^2$ in $(-1, 1)$. **[8]**

c) Find half range sine series for $f(x)=\begin{cases} x, & 0<x<\pi/2 \\ \dfrac{\pi}{2}, & \pi/2<x<\pi \end{cases}$. **[8]**

Q6) Attempt any one from the following.

a) An elastic string stretched between two fixed points at a distance 'l' apart. One end is taken at origin and at a distance $\dfrac{2l}{3}$ from this end the string is displaced a distance k transversely and is released from rest when in this position. Find $y(x, t)$ the vertical displacement, if y satisfies the equation $\dfrac{\partial^2 y}{\partial t^2}=c^2\dfrac{\partial^2 y}{\partial x^2}$ **[16]**

b) Solve the Laplace equation $\dfrac{\partial^2 u}{\partial x^2}+\dfrac{\partial^2 u}{\partial y^2}=0$ for the following square mesh with boundary values as shown in figure by Gauss-Siedal iterative method by performing four iterations. **[16]**



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