B.TECH. SEM -IV (CHEMICAL) 2014 COURSE (CBCS) :
WINTER - 2017
SUBJECT : ENGINEERING MATHEMATICS - III

Day : **Monday** Time : **02.30 PM TO 05.30 PM**
Date : **20/11/2017** **W-2017-2062** Max. Marks : 60

N.B.

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.
5) Draw neat and labeled diagrams **WHEREVER** necessary.

Q.1 Solve any **THREE:** **(10)**

i) $(D^2-4D+4)y = e^{2x}\sin 3x$

ii) $(D^4-m^4)y = \sin mx$

iii) $(D^2-D+1)y = x^3-3x^2+1$

iv) $(D^2+6D+9)y = \dfrac{e^{-3x}}{x^3}$

OR

a) The radial displacement 'u' in a rotating disc at a distance 'r' from axis is given by $\dfrac{d^2u}{dr^2}+\dfrac{1}{r}\dfrac{du}{dr}-\dfrac{u}{r^2}+kr=0$. Find the displacement if $u=0$ for $r=0,\ r=a$. **(05)**

b) Solve differential equation **(05)**

$$x^2\frac{d^2y}{dx^2}-4x\frac{dy}{dx}+6y=x^5 .$$

Q.2 A rectangular plate with insulated surface is 10 cm wide and so long to its width that may be considered infinite in length without introducing an appreciable error. If the temperature of the short edge $y=0$ is given by, **(10)**

$$u(x,0)=\begin{cases}20x, & 0\le x\le 5\\ 0, & 5\le x\le 10\end{cases}$$

and the two long edges $x=0,\ x=10$ as well as the other short edge are kept at 0°C, then find the steady state temperature distribution at any point (x, y).

OR

Solve the equations $\dfrac{\partial u}{\partial t}=\dfrac{\partial^2 u}{\partial x^2}$ if **(10)**

i) u is finite $\forall t$,

ii) $u=0$ when $x=0,\ \pi\ \forall t$

iii) $u=\pi x-x^2$ *when* $t=0$ and $0\le x\le\pi$.

Q.3 a) Find the Fourier cosine transform of the function $f(x)=2e^{-5x}+5e^{-2x}$. **(05)**

b) Find the Fourier sine transform of the function **(05)**

$$f(x)=\begin{cases}\sin x, & 0\le x\le a\\ 0, & x>a\end{cases} .$$

OR

Using inverse Fourier sine transform, find $f(x)$, if $F_S(\lambda)=\dfrac{\lambda}{1+\lambda^2}$. **(10)**

P.T.O.

Q.4 **a)** Find the Laplace transform of $\int_0^{\infty} e^{-t}\left(\frac{1-\cos 3t}{t}\right)dt.$ **(05)**

b) Find the Lapalce transform of $\cos(\omega t+\alpha)$. **(05)**

OR

a) Using partial fractions, find the inverse Laplace transforms of $\frac{4s-5}{s^2-s-2}$ **(05)**

b) Solve the differential equation by using Laplace transform $y''+y=0,\ y(0)=1,\ y'(0)=2.$. **(05)**

Q.5 **a)** Find directional derivative of $\phi = x^2yz+4xz^2$ at the point (1, -2, -1) in the direction of vector $2\vec{i}-\vec{j}-2\vec{k}$. **(05)**

b) Show that $\nabla^4(\log r)=\frac{2}{r^4}$. **(05)**

OR

a) Prove that $\vec{F}=\frac{1}{x^2+y^2}(x\vec{i}+y\vec{j})$ is solenoidal. **(05)**

b) If $\vec{F}=3xyz^2\vec{i}+4x^3y\vec{j}-xy^2\vec{k}$, then find $\text{grad}(Div\,\vec{F})$ at (-1, 2, 1). **(05)**

Q.6 Verify Green's theorem in the plane for $\oint_C (3x^2-8y^2)dx+(4y-6xy)dy$ where C is the boundary defined by $x=0, y=0, x+y=1.$. **(10)**

OR

Verify Stoke's theorem for $\vec{F}=xy^2\vec{i}+y\vec{j}+z^2x\vec{k}$ for the surface of rectangular lamina bounded by $x=0, y=0, x=1, y=2, z=0.$ **(10)**

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