Total No. of Questions – [ 8 ]  Total No. of Printed Pages :03

| G.R. No. | |
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Paper Code- U218-151 (BE-FS)

MAY-2019

**S. Y. B. TECH. (MECHANICAL ENGINEERING) (SEMESTER - I)**

**COURSE NAME: Engineering Mathematics III**

**COURSE CODE: MEUA21171**

**(PATTERN 2017)**

Time: [**2 Hours**]  [Max. Marks: **50**]

**Instructions to candidates:**

1) **Answer Q.1, Q.2, Q.3, Q.4, Q.5 OR Q.6, Q.7 OR Q.8**
2) **Figures to the right indicate full marks.**
3) **Use of scientific calculator is allowed**
4) **Use suitable data where ever required**

Q.1 A Solve $x^2 \frac{d^2y}{dx^2} + 5x\frac{dy}{dx} + 3y = \frac{\log x}{x^2}$ 6

OR

B Solve $\frac{d^2y}{dx^2} + y = \operatorname{cosec} x$ ( by variation of parameters) 6

Q.2 A Find Fourier transform of $f(x) = \begin{cases} 1 - x^2, & |x| \le 1 \\ 0, & |x| > 1 \end{cases}$ Hence evaluate : 6

$\int_0^\infty \left( \frac{x\cos x - \sin x}{x^3} \right) \cos\left(\frac{x}{2}\right) dx$

OR

B Find Laplace transform $f(t) = \frac{e^{-3t}(\cos 2t - \cos 3t)}{t}$ 6

Q.3 A The following are the marks obtained by 10 students in statistics and economics 6

| No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Marks in Economics | 25 | 28 | 35 | 32 | 31 | 36 | 29 | 38 | 34 | 32 |
| Marks in Statistics | 43 | 46 | 49 | 41 | 36 | 32 | 31 | 30 | 33 | 39 |

Marks are out of 50 .Obtained regression equation to estimate marks in statistics if marks in economics are 30.

OR

B) On an average a box containing 10 articles is likely to have 2 defective s. If we consider a consignment of 100 boxes , how many of them are excepted to have 3 or less defectives . 6

Q.4 A Prove that : $\nabla^2\left[\nabla\bullet\left(\frac{\bar{r}}{r^2}\right)\right]=\frac{2}{r^4}$ 4

OR

B If the directional derivative of $\varphi = axy + byz + czx$ at the point (1,1,1)has maximum magnitude 4 in the direction parallel to x- axis find the values of a, b & c. 4

Q.5 A Evaluate $\iint_s (\nabla\times\bar{f})\bullet \bar{ds}$ , $\bar{F}=(x^3-y^3)\bar{i}-xyz\bar{j}+y^3\bar{k}$ 4

and s is the surface $x^2+4y^2+z^2-2x=4$ above the plane x=0

B A vector field is given by $\bar{F}=3x^2\,\bar{i}+2(2xz-y)\,\bar{j}+z\bar{k}$, Evaluate $\int_c \bar{F}\bullet \bar{dr}$ along the straight line joining (0,0,0) and (2,1,3). 4

C Verify divergence theorem for : $\bar{f}=4xz\bar{i}+xyz^2\bar{j}+3z\bar{k}$ 6

Over the region above the xoy plane bounded by the cone $z^2=x^2+y^2$ and the plane z=4

OR

Q.6 A Find the work done in moving the particle once round the ellipse $\frac{x^2}{25}+\frac{y^2}{16}=1$, z = 0 under the field of force given by 4

$\bar{F}=(2x-y+z)\bar{i}+(x+y-z^2)\bar{j}+(3x-2y+4z)\bar{k}$

B Prove that : 4

$\int_c (\bar{a}\times\bar{r})\bullet \bar{dr} = 2\bar{a}\bullet\iint_s \bar{ds}$

C Use divergence theorem to evaluate : $\iint_S (yz\bar{i} + xz\bar{j} + yx\bar{k}) \bullet d\bar{s}$ 6

Where s is the upper part of the sphere $x^2 + y^2 + z^2 = 16$ above XOY plane.

Q.7 A Solve $\frac{\partial u}{\partial t} = k\frac{\partial^2 u}{\partial x^2}$ if i) u is finite for all t , ii) u = 0 when x = L for all t 6

iii) $\frac{\partial u}{\partial x} = 0$ when x = 0 for all t ,iv)u=$u_0$ for all values between o to L.

B A string is stretched and fastened to two points L apart. Motion is started by displacing the string in the form $u = -a\sin\frac{\pi x}{L}$ from which it is released at time t = 0 . State the conditions in mathematical form. 4

C Find the displacement u(x, t) from one end. Differential equation satisfied by displacement of the string is 4

$\frac{\partial^2 u}{\partial t^2} = a^2 \frac{\partial^2 u}{\partial x^2}$ . With the conditions in Q.7B.

OR

Q.8 A Solve $\frac{\partial^2 u}{\partial t^2} + \frac{\partial^2 u}{\partial y^2} = 0$ with conditions i) u=0 when $y \to +\infty$ for all x. , 6

ii) u = 0 when x = 0 for all y.

iii) u=o when x = l for all y ,

iv)u=x When y = 0 for 0<x<1.

B A homogeneous rod of conducting material of length 100cm has its ends kept at zero temperature and the temperature initially is $u(x, 0) = x^2 \quad , 0 \le x \le 50$ and $u(x, 0) = 100 - x \quad , 50 \le x \le 100$. State the conditions in mathematical form. 4

C Find the temperature at any time in Q.8. B. 4