



SEM 2 – 1 (RC – 16-17)

F.E. (Semester – II) (RC 2016-17) Examination, May/June 2018 ENGINEERING MATHEMATICS – II

Duration : 3 Hours

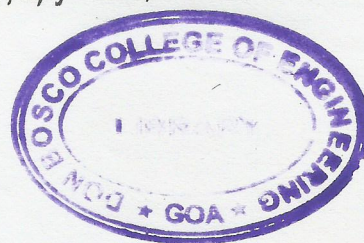
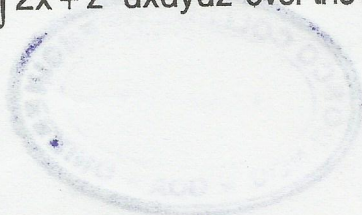
Total Marks : 100

- Instructions :** i) Attempt **five** questions, two **each** from Part – A and Part – B and **one** from Part – C.
ii) Assume suitable data, **if necessary**.
iii) Figures to the **right** indicate **full** marks.

PART – A

1. a) Evaluate $\int_0^{\infty} \frac{\tan^{-1}(ax)}{x(1+x^2)} dx$ by applying differentiation under the integral sign. 8
b) Find the perimeter of the curve $r = 2a \sin \theta$. 6
c) Evaluate $\int_0^1 \int_{y^2}^1 \sin\left(\frac{\pi y}{\sqrt{x}}\right) dx dy$. 6
2. a) Change the order of integration and evaluate $\int_0^1 \int_{x-1}^{x+1} 3y + x dx dy$. 8
b) Evaluate $\int_0^1 \int_{y^2}^1 \int_0^{1-x} x + y dz dx dy$. 6
c) For the curve $\vec{r}(t) = a \cos t \vec{i} + a \sin t \vec{j} + b t \vec{k}$ $a \geq 0, b \geq 0$ and $a^2 + b^2 \neq 0$ find the curvature. 6
3. a) Find by double integration the volume of the solid generated by the revolution of the ellipse $x^2 + \frac{y^2}{4} = 1$ about the x-axis. 6
b) The velocity of a particle at time t is given by $\vec{v} = \sin 2t \vec{i} + 2 \cos 2t \vec{j} + t \vec{k}$ was at origin at $t = 0$. Find the position vector and acceleration of the particle for $t \geq 0$. Also find the times for which the position and acceleration are orthogonal. 7
c) Evaluate $\iiint 2x + z \, dx dy dz$ over the region $\{(x, y, z) / y^2 \leq x, x \leq 1, 0 \leq z \leq 1\}$. 7

P.T.O.





PART – B

4. a) In which direction is the rate of change of $f(x, y, z) = 2x^2 + 3z + y^2$ at $(1, -2, 2)$ maximum ? Find the magnitude of this maximum. 4
- b) Show that $\vec{F} = 4xy\hat{i} + (2x^2 + 4z)\hat{j} + 4y\hat{k}$ is irrotational and find its scalar Potential. 6
- c) Solve the following : 10
- i) $(x + y + 1)^2 \frac{dy}{dx} = 1$
- ii) $\frac{dy}{dx} - y \tan x = y^4 \sec x$
5. a) Use Stoke's theorem to evaluate the surface integral $\iint_S (\nabla \times \vec{F}) \cdot \hat{n} dS$ where $\vec{F} = (x^2y)\hat{i} + (2y + z)\hat{j} + y^2\hat{k}$ and \hat{n} is the unit outward normal vector to S, S being the surface of the region bounded by $x = 0, y = 0, x + 2y + z = 2$ excluding the surface in the xy plane. 8
- b) Prove for any scalar fields f and g 6
- i) $\text{div}(\text{grad } f) = \nabla^2 f$
- ii) $\text{grad}(fg) = f(\text{grad } g) + g(\text{grad } f)$
- c) Solve $x^2 \frac{d^2y}{dx^2} + 5x \frac{dy}{dx} + 4y = x \log_e x$. 6
6. a) Verify Green's Theorem in the plane for $\oint (2x + y^2)dx + (5 + xy)dy$ along the boundary of the region bounded by $y^2 = 4x$ and $y = 2x$. 10
- b) Solve : 10
- i) $(D^3 - D^2 - 6D)y = x^2 + 1$
- ii) $(D^2 + 5D + 6)y = \sinh(x)$.





PART – C

7. a) If $\vec{r}(t) = \vec{a}e^{2t} + \vec{b}e^{2t}$, then prove that $\frac{d^2\vec{r}}{dt^2} - 4\frac{d\vec{r}}{dt} + 4\vec{r} = 0$. Where \vec{a} and \vec{b} are constant vectors. 7
- b) If $f = x^2\vec{i} - 2xy\vec{j} + yz\vec{k}$, compute $\int_C \vec{f} \cdot d\vec{r}$ between (2, 1, 2) and (6, 9, 8) where C is the path with parametric equations $x = 2t$, $y = t^2$, $z = 3t - 1$. 7
- c) Solve $(1+x)\frac{dy}{dx} + 1 = 2e^{-y}$. 6
8. a) The curve $r = 2a\cos\theta$ is revolved about the X-axis. Use integration to find the surface area of the object generated. 7
- b) Find the volume of the region $\{(x, y, z)/x^2 + y^2 \leq z^2, x^2 + y^2 + z^2 \leq 4\}$. 7
- c) Solve $x^2 \frac{d^2y}{dx^2} - 2x \frac{dy}{dx} - 4y = x^2 + 2\log_e x$. 6

