S J P N Trust's

HirasugarInstitute of Technology, Nidasoshi.

Inculcating Values, Promoting Prosperity

Approved by AICTE, Recognized by Govt. of Karnataka and Affiliated to VTU Belagavi.

E&E Engg. Dept.
Exam.
Internal Assessment
Odd Sem(2017-18)

SECOND INTERNAL ASSESSMENT

Sem: III
Date: 17-10-2017

Sub: EMT
Time: 3.00PM – 4.00PM

Sub. Code: 15EC36
Max. Marks: 25

Note: Answer two full questions, draw sketches wherever necessary.

Q. No		Discription of Question	Marks	CO
1	a	State and prove Guass law	6	CO206.2
	b	A charge is uniformly distributed over spherical surface of radius a, determine electric field intensity everywhere due to it.	6	
OR				
2	a	Let $\bar{D} = 5r^2\,\bar{a_r}$; $D < r < 0.08m$ $= 0.1/r^2\,\bar{a_r}$; when $r > 0.08m$ i)Find the charge density for $r = 0.06m$ ii) Find the charge density for $r = 0.1m$	6	CO206.2
	b	State and prove guass divergence theorem	6	
3	a	Find the total charge in a volume defined by a parallelopipe with $1 \le x \le 2$, $2 \le y \le 3$ and $3 \le z \le 4$, if $\bar{D} = 4x\,\bar{a_x} + 3y^2\,\bar{a_y} + 2z^3\,\bar{a_z}$ C/m3 .	6	CO206.2
	b	Evaluate both the sides of divergence theorem for the closed surface enclosed by $r = 2$, $z = 0$ and 5 given $\bar{D} = 30\,e^{-r}\,\bar{a_r} - 2z\,\bar{a_z}$.	7	
OR				
4	a	Show that work done is independent of the path selected when 2C of charge is moved from B (1,0,1) to A (0.8, 0.6, 1) in $\bar{E} = y\bar{a_x} + x\,\bar{a_y} + 2\bar{a_z}$; over the paths i)when $x^2 + y^2 = 1$ and $z = 1$ ii) over the straight line path	6	CO206.3
	b	A 15nC point charge is at the origin in free space. Calculate V1 if, P is located at (-2, 3, -1) and i) V =0 at (6, 5, 4) ii) V =0 at infinity.	7	

PO1, PO-1 - PO3, PO6 - PO8, PO12 -

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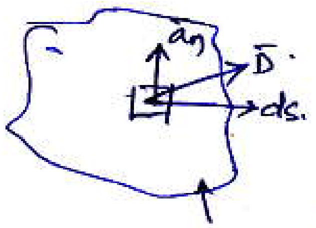
II - IA SCHEME OF EVALUATION

Sem : 3	Subject : EMT	Sub Code : 15EC36	Date : 17/10/17

Q. No.	Bit	Description	Marks	Mapped CO's
1.	a	The electric flux passing through any closed surface is equal to the charge enclosed by that surface.	1	
		$Q = \int dQ = \oint_{surf} \bar{D}.\bar{ds}$	2	
		 Consider a point charge		
		 $Q = \oint \bar{D}.ds$ $= \oint_{surf} \bar{D}.\bar{ds}_r$	3	CO 206.2
		$= \frac{Q}{4\pi r^2} \cdot 4\pi r^2$.		
		$\psi = Q = \oint_{surf} \bar{D}.ds$		
	b.	$\bar{D} = 5r^2 \bar{a}_r$. $\longrightarrow$ Spherical Co-ordinate system		
		$\rho_v = \nabla.\bar{D} = \frac{1}{r^2}\frac{\partial}{\partial r} r^2 D_r + \frac{1}{r\sin\theta}\frac{\partial(\sin\theta D_\theta)}{\partial\theta} + \frac{1}{r\sin\theta}\frac{\partial}{\partial\phi} D_\phi$	1	
		$r = 0.06$.		
		$\therefore$ i) $\nabla.\bar{D} = \rho_v = \frac{1}{r^2}\frac{\partial}{\partial r} r^2 5r^2$		
		$= \frac{1}{r^2}\frac{\partial}{\partial r} 5r^4 = \frac{20}{r^2} r^3 = 20r.$	3	
		$\rho_{v \cdot r=0.06} = 20 \times 0.06 = 1.2 C/m^3$.		CO206.2
		ii) when, $r = 0.1$ $\bar{D} = 0.1/r^2$		
		$\therefore \nabla.\bar{D} = \rho_v = \frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2 \frac{0.1}{r^2}\right) = 0$,	2.	
		$\rho_{v_{0.1m}} = 0 C/m^3$.		
2.	a.	Derivation of $\bar{E}$ when $r > a$, $r = a$, & $r < a$ for a spherical shell.		

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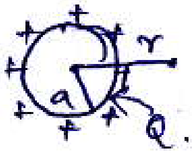
AY: 2017-1 8 (Odd)

- IA SCHEME OF EVALUATION

Sem : 3	Subject : EMT	Sub Code : 15EC36	Date : 17/10/17

Q. No.	Bit	Description	Marks	Mapped CO's
Q.2	a.			

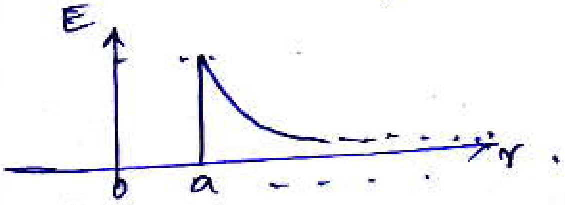
$r > a$. $\bar{E} = \dfrac{Q}{4\pi\varepsilon r^2}\,\bar{a}_r$.



$= \dfrac{\rho_s 4\pi a^2}{4\pi\varepsilon r^2}\,\bar{a}_r$. — 2+1

$r = a$, $\bar{E} = \dfrac{Q}{4\pi\varepsilon r^2}\,\bar{a}_r$. — 1 — CO202.2

$r < a$. $\oint \bar{D}.\bar{ds} = Q = 0$.
$\Rightarrow \bar{E} = 0$. — 1



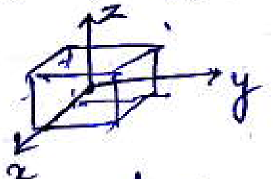
Q.2 b. Gauss divergence theorem → statement — 1

W.k. Gauss law.

$Q = \oint \bar{D}.\bar{ds}$

When applied to the differential volume.

$D_0 = D_{x0}\bar{a}_x + D_{y0}\bar{a}_y + D_{z0}\bar{a}_z$.



$\oint \bar{D}.\bar{ds} = \int \bar{D}_y \bar{ds} + \int \bar{D}.\bar{ds} + \cdots$ — 2 — CO 202.2

$\lim\limits_{\Delta v \to 0} \dfrac{\oint D.ds}{\Delta V} = \dfrac{\partial D_x}{\partial x} + \dfrac{\partial D_y}{\partial y} + \dfrac{\partial D_z}{\partial z}$. — 1

$\therefore \nabla.\bar{D} = \lim\limits_{\Delta V \to 0} \dfrac{\oint D.ds}{\Delta V} = \lim\limits_{\Delta V \to 0} \dfrac{Q}{\Delta V}$.

flux passing through a small closed surface per unit volume as volume shrinks to zero. — 1

$\lim\limits_{\Delta V \to 0} \dfrac{Q}{\Delta V} = \rho_V$. $\nabla.\bar{D} = \rho_V$

$\Rightarrow \oint \bar{D}.\bar{ds} = \int_{vol} \rho_V dv' = \int_{vol} \nabla.\bar{D}\, dv$. — 1

Course Coordinator — Module Coordinator — HOD

- IA SCHEME OF EVALUATION

Sem : 3 | Subject : EMT | Sub Code : 15EC36 | Date : 17/10/17

Q. No.	Bit	Description	Marks	Mapped CO's
3	a.	$\bar{D} = 4x\bar{a}_x + 3y^2\bar{a}_y + 2z^3\bar{a}_z$ C/m³. $\oint \bar{D}.\bar{ds} = \int_f + \int_b + \int_l + \int_r + \int_t + \int_b$. $\int_f \bar{D}.\bar{ds}_x = \int_y\int_z 4x\,dydz = 4x\|_{x=2} = 8$ for front $\int_b \bar{D}.-\bar{ds}_x = -\int_y\int_z 4x\,dydz = -4x\|_{x=1} = -4\times1 = 4$ for back $\int_l \bar{D}.\bar{ds}_y = -\int 3y^2 dxdz = -3y^2 x.z = -3y^2\|^3_2 = 3\times 9 = 27$ $\cancel{3}=12$ $\int_r \bar{D}.\bar{ds} = \int 3(y^2 dxdz) = 3(9) = 27$ $\int_t \bar{D}.\bar{ds}_z = \int 2z^3 dxdy = 2z^3\|_{z=4} = 2\times4^3 = 128$ $\int_b \bar{D}.\bar{ds}_z = -\int 2z^3 dxdy = -2z^3\|_{z=3} = -2\cdot3^3 = -54$ $= 8-4+27-12+128-54 = 93C$	6	CO206.2
	b.	$\bar{D} = 30e^{-r}\bar{a}_r - 2\bar{a}_z$ $\oint \bar{D}.\bar{ds} = \int_r \bar{D}.\bar{ds} + \int_\phi \bar{D}.\bar{ds} + \int_z D_z\bar{a}_z$ $\int_r \bar{D}.\bar{ds}_r = \int_{surf.} 30e^{-r} r\,d\phi dz = 255.10C$ $\int_z \bar{D}.\bar{ds}_z = -\int 2z\, r dr d\phi = -40\pi = -125.68$ ($z=5$) $\int_z \bar{D}.\bar{ds}_z = \int 2z\, r dr d\phi = +8z\pi = 0$ ($z=0$) $\therefore \oint \bar{D}.\bar{ds} = 255.10 - 125.68 - 0 = 129.42 \to 3.$ $\int_{vol} \nabla.\bar{D}dv = \nabla.\bar{D} = \frac{1}{r}\frac{\partial}{\partial r} rD_r + \frac{1}{r}\frac{\partial D_\phi}{\partial\phi} + \frac{\partial D_z}{\partial z}$. +1 $= +30e^{-r}/r - 30e^{-r} - 2$. $\int_{vol} \nabla.\bar{D}dv = \int_{vol} (30e^{-r} - 30e^{-r}r - 2r)drd\phi dz$ $= -129.42 \to 3.$	7M.	CO206.2

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Q. No.	Bit	Description	Marks	Mapped CO's

4 a.

$\bar{E} = y\bar{a}_x + x\bar{a}_y + 2\bar{a}_z$;

$W = -Q\int_B^A \bar{E}\cdot d\bar{l} = -2\int_B ydx + xdy + 2dz$

i) $x^2+y^2=1 \Rightarrow x=\sqrt{1-y^2}$; $y=\sqrt{1-x^2}$

$W = -2\int_{1,0,1}^{0.8,0.6,1} \sqrt{1-x^2}dx + \sqrt{1-y^2}dy + 2dz$ (x = 1)

$= -2\{0.48 + 0.927 + 0 - 1.57\}$ — 3 — CO206

$= -0.96$ J.

ii) When st. line path $y - y_1 = \frac{y_2-y_1}{x_2-x_1}(x-x_1)$

$y - 0 = \frac{0.6-0}{-1+0.8}(x-1) \rightarrow y = \frac{0.6}{-0.2}(x-1)$

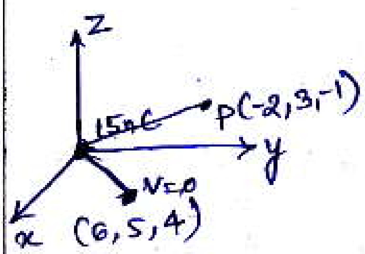
$y = -3x + 3$

$dy = -3dx$

$W = -2\int \bar{E}\cdot d\bar{l} = -2\left\{\int_1^{0.8}(-3x+3)dx + \int_1^{0.8} x(-3)dx + \int_1^1 2dz\right\}$

$= -2[-0.18] = -0.96$ J.

b.



i) V_p at $(-2,3,-1)$

$V_p = \frac{Q}{4\pi\varepsilon r} + C = \frac{15\times10^{-9}}{4\pi\varepsilon\times\sqrt{14}} + C$

$= 36.00$ V. — CO206.3

$\therefore V_B = \frac{Q}{4\pi\varepsilon\sqrt{77}} + C = \frac{15\times10^{-9}\times8.98\times10^{9}}{\sqrt{77}} + C$.

As $V_B = 0$,

$0 = 15.3 + C$ — 4

$\Rightarrow C = -15.3$ — +1

$\Rightarrow V_p = 36.00 - 15.3 = 20.67$ V

ii) $V = 0$ at ∞, $V_A = \frac{Q}{4\pi\varepsilon\sqrt{14}} = 36.00$ V — 2