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BET-011

DIPLOMA IN CIVIL ENGINEERING (DCLE(G))/ DIPLOMA IN MECHANICAL ENGINEERING (DME) / DCLEVI / DMEVI / DELVI / DECVI / DCSVI / ACCLEVI / ACMEVI / ACELVI / ACECVI / ACCSVI

Term-End Examination

December, 2015

BET-011 : MATHEMATICS – I

Time : 2 hours *Maximum Marks : 70*

Note : *Question number 1 is* ***compulsory****. Attempt any* ***four*** *more questions out of the remaining questions. Use of scientific calculator is permitted. Assume any missing data, if required.*

1. Answer any ***seven*** of the following questions : *7×2=14*

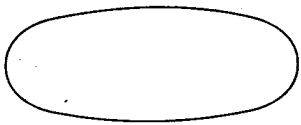
(a) Rationalise the denominator of $\frac{4}{3 \cdot \sqrt[4]{25}}$.

(b) Find the logarithm of 1728 to the base $2\sqrt{3}$.

(c) Discuss the nature of the roots of the equation $2x^2 - 3x + 5 = 0$.

(d) Which term of the A.P. { 7, 11, 15, 19, ... } is 111 ?

(e) What is the meaning of the following box in a flow chart ?



(f) Find the middle term (or terms) of $\left(a - \frac{1}{a}\right)^{12}$.

(g) If $\sin \alpha = x$ and $\tan \alpha = y$, prove that $\frac{1}{x^2} - \frac{1}{y^2} = 1$.

(h) A diameter of a circle has the extreme points (7, 9) and (–1, –3). What would be the co-ordinates of the centre ?

(i) Find the co-ordinates of vertices and eccentricity of the ellipse $9x^2 + 25y^2 = 225$.

(j) The position vectors of four points P, Q, R and S are a, b, $2a + 3b$ and $2a - 3b$ respectively. Express the vectors $\overrightarrow{PR}$ and $\overrightarrow{PQ}$ in terms of 'a' and 'b'.

2. (a) If α and β be the roots of the equation $2x^2 + x + 1 = 0$, find the equation whose roots are $\frac{\alpha^2}{\beta}$ and $\frac{\beta^2}{\alpha}$.

(b) If a, b and c are in G.P., show that $(a^2 + b^2)$, $(ab + bc)$ and $(b^2 + c^2)$ are also in G.P.

(c) Show that

$$\frac{1}{(\log_a bc + 1)} + \frac{1}{(\log_b ca + 1)} + \frac{1}{(\log_c ab + 1)} = 1.$$

5+5+4=14

3. (a) If $\sin A = 3/5$, find the values of $\sin 2A$, $\cos 2A$ and $\tan 2A$.

(b) Show that $\sec \alpha + \tan \alpha = \tan (\pi/4 + \alpha/2)$.

(c) Find the value of

$$\tan^{-1}\left(\frac{b-c}{1+bc}\right) + \tan^{-1}\left(\frac{c-a}{1+ca}\right) + \tan^{-1}\left(\frac{a-b}{1+ab}\right).$$

5+5+4=14

4. (a) Find the area of the quadrilateral whose vertices have co-ordinates (1, 1), (3, 4), (5, – 2) and (4, – 7).

(b) If the points (1, 2), (2, 4) and (t, 6) are collinear, find the value of t.

(c) Examine whether the straight lines $x - y + 4 = 0$, $2x + 3y - 6 = 0$ and $8x + 7y - 26 = 0$ are concurrent or not. *5+5+4=14*

5. (a) Find the equation of the circle passing through the points (4, 3) and (–2, 5) and having its centre on the line $2x - 3y = 4$.

(b) If the parabola $y^2 = 4ax$ passes through the point of intersection of $3x + y + 5 = 0$ and $x + 3y - 1 = 0$, find the co-ordinates of its focus.

(c) If the ellipses $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ and $\frac{x^2}{p^2} + \frac{y^2}{q^2} = 1$ have the same eccentricity, show that $aq = bp$. *5+5+4=14*

6. (a) Find the angle between the vectors

$\vec{a} = \vec{i} + 2\vec{j} + 2\vec{k}$ and

$\vec{b} = \vec{i} - 2\vec{j} + 2\vec{k}$.

(b) If $\vec{a} = 3\vec{i} - \vec{j} + 2\vec{k}$, $\vec{b} = 2\vec{i} + \vec{j} - \vec{k}$ and $\vec{c} = \vec{i} - 2\vec{j} + 2\vec{k}$, show that $(\vec{a} \times \vec{b}) \times \vec{c} \neq \vec{a} \times (\vec{b} \times \vec{c})$.

(c) If $\vec{a} = 2\vec{i} - \vec{j} + \vec{k}$, and $\vec{b} = 3\vec{i} + 4\vec{j} - \vec{k}$, prove that $\vec{a} \times \vec{b}$ represents a vector which is perpendicular to $\vec{a}$. *5+5+4=14*
