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BME-001

B.Tech. MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING)

Term-End Examination

01065

December, 2014

BME-001 : ENGINEERING MATHEMATICS-I

Time : 3 hours *Maximum Marks : 70*

Note : *All questions are **compulsory**. Use of calculators is allowed.*

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1. Answer any ***five*** of the following : *5×4=20*

(a) Solve the differential equation

$(2x + 3y - 6)\, dy = (6x - 2y - 7)\, dx.$

(b) Find the area of regions bounded by the curve $x^2 = 4y$ and the line $x = 4y - 2$.

(c) Calculate :

(i) $\int \frac{2x}{1 + x^2} dx$

(ii) $\int \sin^3 x \cos^2 x \, dx$

(d) Find the maximum and minimum of $f(x) = x^2 - x$ with the help of first derivative test.

(e) Find where the tangent is parallel to the x-axis for the curve $y^3 = x^2 (2 - x)$.

(f) Find the value of b for which the function

$$f(x) = \begin{cases} x^3 + 1, & \text{when } x < 2 \\ bx + \dfrac{2}{x}, & \text{when } x \geq 2 \end{cases}$$

is continuous at $x = 2$.

2. Answer any ***four*** of the following : *4×5=20*

(a) Using Green's theorem, evaluate the integral $\oint_C (-y\,dx + x\,dy)$, where C is the circumference of the circle $x^2 + y^2 = 1$.

(b) Find the divergence of the vector

$$A = x^2y\,\hat{i} + 2yz\,\hat{k} - 2xz\,\hat{j}$$

(c) Solve the vector field defined by

$$F = 2xyz^3\,\hat{i} + x^2z^3\,\hat{j} + 3x^2yz^2\,\hat{k}$$

is irrotational. Find a scalar potential μ such that $F = \text{grad}\,\mu$.

(d) Find a unit vector normal to the surface

$x^2y = 2xz = 4$ at point $(2, -2, 3)$.

(e) Find the work done in moving a particle once round the circle $x^2 + y^2 = 9$ in the XOY plane if the field of force, is given by

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

(f) Find the directional derivative of

$x^2 + y^2 + 4xyz$ at $(1, -2, 2)$ in the direction of $2\hat{i} - 2\hat{j} + \hat{k}$.

3. Answer any ***five*** of the following : *5×3=15*

(a) Solve the equations by Cramer's Rule :

$$x + y + z = 6$$
$$x - y + z = 2$$
$$2x + y - z = 1$$

(b) Verify Cayley – Hamilton theorem for the matrix A, and find its inverse

$$A = \begin{bmatrix} 7 & 2 \\ -6 & -1 \end{bmatrix}.$$

(c) Find the product of the eigenvalue of

$$\begin{bmatrix} 7 & 2 & 2 \\ -6 & -1 & 2 \\ 6 & 2 & -1 \end{bmatrix}.$$

(d) For what value of a and b, is the following system of equations consistent :

$$x + y + z = 6$$

$$2x + 5y + az = b$$

$$x + 2y + 3z = 14$$

(e) Find the inverse of the matrix

$$A = \begin{bmatrix} 1 & 2 & -2 \\ -1 & 3 & 0 \\ 0 & -2 & 1 \end{bmatrix}$$

by using Elementary row transformation.

(f) Use the Gauss elimination method to solve the following system of linear equations :

$$x + 2y + z = 19$$

$$x + y + z = 10$$

$$x + 2y = 14$$

(g) Identify whether the set is linearly independent or not :

$$S = \{(2, 2, 2), (3, 1, 1), (1, 3, 3)\}$$

4. Answer any ***three*** of the following : *3×5=15*

(a) A speaks the truth in 70% cases and B speaks the truth in 80% cases. What is the probability that they will say the same thing while describing a single event ?

(b) The chances that doctor A will diagnose a disease X is 60%. The chances that a patient will die by this treatment after correct diagnosis is 40% and the chances of death by wrong diagnosis is 70%. A patient of doctor A who has disease X, died. What are the chances that this disease was diagnosed correctly ?

(c) A problem of Statistics is given to three students A, B and C whose chances of solving it are $\frac{1}{2}, \frac{1}{3}$ and $\frac{1}{4}$ respectively. What is the probability that the problem will be solved ?

(d) If the variance of the Poisson distribution is 2, find the probabilities for r = 1, 2, 3, 4 from the recurrence of the Poisson distribution. Also find $P(r \geq 3)$.

(e) A factory manufacturing televisions has four units A, B, C and D. The units A, B, C and D manufacture 15%, 20%, 30% and 35% of the total output respectively. It was found that out of their output 1%, 2%, 2% and 3% are defective. A television is chosen at random from the total output and found to be defective. What is the probability that it came from unit D ?