2014

M.Sc. Part–I Examination

APPLIED MATHEMATICS WITH OCEANOLOGY AND COMPUTER PROGRAMMING

PAPER—V

Full Marks : 100

Time : 5 Hours

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Illustrate the answers wherever necessary.

Write the answer to questions of each group in Separate answer booklet.

Group—A

(*Principles of Mechanics*)

Marks : 50

Answer *Q. No. 6* and any *three* questions from the rest.

1. (a) Derive the Euler's equation of motion of a perfect-fluid. Hence obtain the Bernoulli equation in its most general form.

(b) The stain tensor at a point is given by :

$$e_{vj} = \begin{pmatrix} a & b & 0 \\ b & -a & 0 \\ 0 & 0 & 0 \end{pmatrix}$$

Find principal directions and corresponding direction ratios of principal stains. 8

2. (a) Derive the equation of energy for a perfect fluid. 8

(b) If the equation charaterizing the deformation are given by :

$$x_1 = X_1 + \epsilon X_2$$
$$x_2 = X_2 - \epsilon X_1 + \epsilon X_3$$
$$x_3 = X_3 - \epsilon X_2$$

Determine the Lagrangian and Eulerian finite stain tensor.

3. (a) Define source and sink. Two sources, each of strength m, are placed at the points (–a, 0) and (a, 0) and a sink of strength 2m is placed at the origin. Show that the stream lines are curves

$$\left(x^2 + y^2\right)^2 = a^2\left(x^2 - y^2 + \lambda xy\right)$$

where λ is a parameter. Also find the final speed at any point. 2+6

(b) Define the isotopic linearly elastic body. Find the constitutive equation of such body. 8

4. (a) The stress matrix at a point $P(x_i)$ in a material is given by :

$$\left(T_{ij}\right) = \begin{pmatrix} x_1x_3 & x_3^2 & 0 \\ x_3^2 & 0 & -x_2 \\ 0 & -x_2 & 0 \end{pmatrix}$$

Find the stress vector at the point Q(1, 0, –1) on the surface $x_1 = x_1 = x_2^2 + x_3^2$. 4

(b) Show that the difference of the values of a two-dimensional stream function at two points represents the flux of a fluid across any curve joining the points. 4

(c) Define stress Quadric. Prove that the normal stress across any plane through the centre of stress quadric is equal to the inverse of the square of the central radius vector of the quadric normal to the plane. 8

5. (a) Prove that :

$$\frac{x_1^2}{a_1^2} f_1(t) + \frac{x_2^2}{a_2^2} f_2(t) + \frac{x_3^2}{a_3^2} f_3(t) = 1$$

is a possible form of the boundary surface of a liquid provided that $f_1(t)\, f_2(t)\, f_3(t)$ = constant. 8

(b) The necessary and sufficient condition for an irrational motion in an incompressible homogeneous fluid the circulation along any closed circuit is zero. 8

6. (a) Differentiate between stream line and path line. 2

Or

(b) Show that for two dimensional motion there exist a stream function ψ such that equation of stream line is given by ψ = constant. 2

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Group—B

[Marks : 50]

Answer *three* questions, *one* from each group.
Write at least *one* program in C and *one* program in FORTRAN.

Problem : 39 marks ; Lab. Note Book and Viva : 11 marks

Question are to be selected by lottery.

Group — A

1. Write a program to find a real root of an equation by bisection method.
2. Write a program to find a real root of an equation by iteration method.
3. Write a program to find a real root of an equation by regula-falsi method.
4. Write a program to find a real root of an equation by Newton-Raphson's method.

5. Write a program to find all real roots of a system of linear equations by Gauss-Elimination method.
6. Write a program to find all real roots of a system of linear equations by Guass-Seidal method.
7. Write a program to form a difference table from the table of X and Y values.
8. Write a program to find a value of a function by Lagrange interpolation technique.
9. Write a program to find a value of a function by Newton forward interpolation technique.
10. Write a program to find a value of a function by Newton Backward Interpolation Technique.
11. Write a program to find the value of integration by Trapezoidal rule.
12. Write a program to find the value of integration by Simpson's $\frac{1}{3}$ rule.
13. Write a program to find the value of integration by Weddeles rule.
14. Write a program to find the value of a given point from solving the differential equation by Euler's method.
15. Write a program to find the value of a given point from solving the differential equation by Modified Euler's method.

16. Write a program to find the value of a given point from solving the differential equation by Runge-Kutta Fourth Order method.

17. Write a program to find the largest eigenvalue and the corresponding eigenvector by power method.

Group — B

18. Write a program to form a frequency table for a distribution.

19. Write a program to find mean and standard deviation for discrete distribution.

20. Write a program to find median and mode for discrete distribution.

21. Write a program to find moments for any order for discrete distribution.

22. Write a program to calculate the mean for the group frequency distribution.

23. Write a program to calculate median and mode for the group frequency distribution.

24. Write a program to find out a correlation coefficient for a set of points (x_i, y_i).

25. Write a program to fitting a straight line through a set of points (x_i, y_i).

26. Write a program to search a number from a list of numbers by linear search technique.

27. Write a program to search a number from a sorted list of numbers by binary search technique.

28. Write a program to sort a list of numbers by bubble sort technique.

29. Write a program to sort a list of numbers by insertion sort technique.

30. Write a program to sort a list of numbers by selection sort technique.

Group — C

31. Write a program to find a number of occurrences of a letter in a given string.

32. Write a program to check whether a string is palindrome or not.

33. Write a program to rewrite a name with surname first, allowed by comma and initials first and middle name.

34. Write a program to reverse a string.

35. Write a program to sort a list of names in alphabetic order.

36. Write a program to search a given word in a given string.

37. Write a program to count the characters, words and line in a text.

38. Write a program to generate some random numbers.

39. Write a program to generate all prime numbers between two specified numbers.

40. Write a program to generate first some Fibonacci numbers.

41. Write a program to generate PASCALS triangle.

42. Write a program to check a number for a palindrome.

43. Write a program to convert the upper case to lower case and vice versa.

44. Write a program to find the roots of a quadratic equation.

45. Write a program to product of two matrices.

46. Write a program to count the number of vowels, consonants and space in a line.

47. Write a program to find the product of two polynomials.
