CBCS SCHEME

USN | | | | | | | | | | |

21MATME41

Fourth Semester B.E. Degree Examination, June/July 2024
Complex Analysis, Probability and Linear Programming

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Show that $w = f(z) = \log z$ $(z \neq 0)$ is analytic, using Cauchy – Riemann equation and find $\frac{dw}{dz}$ **(06 Marks)**

b. Derive Cauchy – Riemann equation in Cartesian form. **(07 Marks)**

c. Find the analytic function f(z) whose imaginary part is $e^x(x \sin y + y \cos y)$ **(07 Marks)**

OR

2 a. Show that $f(z) = \cosh z$ is analytic and hence find $f'(z)$. **(06 Marks)**

b. If f(z) is analytic function show that $\left(\frac{\partial}{\partial x}|f(z)|\right)^2 + \left(\frac{\partial}{\partial y}|f(z)|\right)^2 = |f'(z)|^2$ **(07 Marks)**

c. Find the analytic functions whose real part is $\frac{x^4 - y^4 - 2x}{x^2 + y^2}$. Hence determine V. **(07 Marks)**

Module-2

3 a. Discuss the transformation $w = e^z$. **(06 Marks)**

b. State and prove Cauchy's integral formula. **(07 Marks)**

c. Find the bilinear transformation which maps the points z = 1, i, –1 in to w = 2, i, –2. **(07 Marks)**

OR

4 a. Find the bilinear transformation which maps the points $z = \infty$, i, 0 into w = –1, –i, 1. **(06 Marks)**

b. Discuss the transformation $w = z + \frac{1}{z}$ **(07 Marks)**

c. Evaluate $\int_c \frac{\sin \pi z^2 + \cos \pi z^2}{(z-1)^2(z-2)} dz$, where C is the circle (i) $|z| = 3$, (ii) $|z| = \frac{1}{2}$ **(07 Marks)**

Module-3

5 a. The probability density function of a variate X is given by the following table.

x	0	1	2	3	4	5	6
P(x)	K	3K	5K	7K	9K	11K	13K

Find K. Also find $P(x \geq 5)$ and $P(3 < x \leq 6)$ **(06 Marks)**

b. Find the Mean and Variance of a Poisson distribution. **(07 Marks)**

c. The number of telephone lines busy at an instant of time is binomial variate with probability 0.1 that a line is busy if 10 lines are choosen at random, what is the probability that (i) no line is busy (ii) all lines are busy (iii) atleast one line is busy (iv) atmost 2 lines are busy. **(07 Marks)**

OR

6 a. The probability density function of a random variable X is

$$f(x) = \begin{cases} Kx^2, & 0 < x < 3 \\ 0, & \text{otherwise} \end{cases}$$

Find (i) the value of K, (ii) $P(1 < x < 2)$, (iii) $P(x \leq 1)$ **(06 Marks)**

b. Find the mean and variance of binomial distribution. **(07 Marks)**

c. The marks of 1000 students in an examination follows a normal distribution with mean 70 and standard deviations. Find the number of students whose marks will be
(i) Less than 65, (ii) More than 75 (iii) Between 65 and 75. **(07 Marks)**

Module-4

7 a. Using the Simplex method to solve the L.P.P.
Maximize $Z = 5x_1 + 7x_2$
Subject to constraint $x_1 + x_2 \leq 4$
$3x_1 - 8x_2 \leq 24$
$10x_1 + 7x_2 \leq 35$
and $x_1, x_2 \geq 0$ **(10 Marks)**

b. Use Big-M method to solve the L.P.P.
Maximize $Z = -2x_1 - x_2$
Subject to constraint $3x_1 + x_2 = 3$
$4x_1 + 3x_2 \geq 3$
$x_1 + 2x_2 \leq 4$
and $x_1, x_2 \geq 0$ **(10 Marks)**

OR

8 a. Define the following terms :
i) A linear Programming problems
ii) Basic solution
iii) Basic feasible solution
iv) Optional solution
v) Artificial variables of an LPP. **(10 Marks)**

b. Use Big-M method to solve the LPP.
Maximize $Z = x_1 + 2x_2 + 3x_3 - x_4$
Subject to constraints $x_1 + 2x_2 + 3x_3 = 15$
$2x_1 + x_2 + 5x_3 = 20$
$x_1 + 2x_2 + x_3 + x_4 = 10$
$x_1, x_2, x_3, x_4 \geq 0$ **(10 Marks)**

Module-5

9 a. Find the feasible solution to the following transportation problem using North West corner method.

	D_1	D_2	D_3	D_4	
O_1	6	4	1	5	14
O_2	8	9	2	7	16
O_3	4	3	6	2	5
	6	10	15	4	

(10 Marks)

b. The processing time in hours for the Jobs when allocated to the different machines are indicated below. Assign the machines for the Jobs so that the total processing time is minimum.

		Machines				
		M_1	M_2	M_3	M_4	M_5
Jobs	J_1	9	22	58	11	19
	J_2	43	78	72	50	63
	J_3	41	28	91	37	45
	J_4	74	42	27	49	39
	J_5	36	11	57	22	25

(10 Marks)

OR

10 a. Solve the following transportation problem by least cost method.

5	4	3	6
4	7	6	8
2	5	8	12
8	6	7	4
8	10	12	

(10 Marks)

b. Four jobs are to be done on four different machines. The cost (in rupees) of producing i^{th} Job on the J^{th} machine is given below.

		Machines			
	J\ M	M_1	M_2	M_3	M_4
Jobs	J_1	15	11	13	15
	J_2	17	12	12	13
	J_3	14	15	10	14
	J_4	16	13	11	17

Assign the Jobs to different machines so as to minimize the total cost. **(10 Marks)**

* * * * *

CBCS SCHEME

USN | | | | | | | | | | |

21ME42

Fourth Semester B.E. Degree Examination, June/July 2024
Machining Science and Jigs & Fixtures

Time: 3 hrs. Max. Marks: 100

Note: *1. Answer any FIVE full questions, choosing ONE full question from each module.*
2. write a neat sketch wherever necessary.
3. Missing data, if any, may be suitably assumed.

Module-1

1 a. With a line at diagram explain the construction and working of an engine lathe. **(08 Marks)**

b. List the various operations that can be performed in a lathe and explain any two methods of taper turning process. **(06 Marks)**

c. Explain the different operations that can be performed on a drilling machine. **(06 Marks)**

OR

2 a. Differentiate between drilling machine and milling machine. **(06 Marks)**

b. Differentiate between up milling and down milling process. **(06 Marks)**

c. With a neat sketch explain construction of CNC milling machine. **(08 Marks)**

Module-2

3 a. Differentiate between orthogonal and oblique cutting process. **(04 Marks)**

b. With usual notations prove that, where Q is shear angle r – chip thickness ratio and α rake angle. **(06 Marks)**

c. In an orthogonal cutting the following observations were made :

Pipe diameter	100mm
Pipe thickness	0.3mm
Cutting speed	200m/min
Feed	0.26mm/rev
Cutting force	1000N
Feed force	600N
Chip thickness	0.3mm
Contact length	1mm
Power consumed	2KW

Back rake angle = 10° (negative) = –10°.
Calculate the shear strain and shear energy. **(10 Marks)**

OR

4 a. With the help of merchant circle diagram desire an expansion for co-effcient of friction and show that $\mu = \left[\frac{F_c \tan\alpha F_T}{F_c - F_r \tan\alpha}\right]$. **(06 Marks)**

b. Explain the different zones of heat generation and the parameters influencing in heat generation in metal cutting. **(06 Marks)**

c. What is cutting fluid? What are requirements of ideal cutting fluid and list–factors for selection of cutting fluid? **(08 Marks)**

Module-3

5 a. What is tool wear and explain different types of tool wear with a neat sketch. **(08 Marks)**

b. What is tool life and explain Taylor's tool life equation. **(04 Marks)**

c. A 50mm dia M S Rod is turned at 300rpm. The tool failure occurs in 10 mins the speed was changed to 200 rpm and the tool failure occurred offer 50 mins. Calculate the cutting speed to obtain the fool life of 30 mins. **(08 Marks)**

OR

6 a. Explain the variables affecting tool life. **(06 Marks)**

b. Explain any two of the following finishing process :
   i) Honing
   ii) Capping
   iii) Power coating **(08 Marks)**

c. What is machinability index?
   i) Explain
   ii) Galvanizing. **(06 Marks)**

Module-4

7 a. Explain the process parameters in abrasive jet machining process that affect surface finish of machined surface and MRR. **(06 Marks)**

b. Explain the later beam machining with a neat sketch. **(07 Marks)**

c. Explain electron bean machining process with its advantage, limitations and applications. **(07 Marks)**

OR

8 a. With a neat sketch explain the electro chemical machining and discuss about tool design in ECM. **(06 Marks)**

b. Explain the principle of EDM electric discharge machining. What are the functions and dielectric fluid in EDM process? Mention advantages and limitations of EDM process. **(08 Marks)**

c. Explain the following process with a neat sketch :
   i) Ultrasonic assisted electric discharge machining (UAEDM)
   ii) Electro discharge grinding. **(06 Marks)**

Module-5

9 a. Differentiate between Jigs and fixtures. **(04 Marks)**

b. Explain the factors to be considered for design of Jibs of fixtures. **(06 Marks)**

c. With a sketch explain leaf drill. **(10 Marks)**

OR

10 With a sketch explain any two of the following fixtures in detail :

a. Turning fixture

b. Milling fixture

c. Welding fixture

d. Fixtures for indexing. **(20 Marks)**

* * * * *

CBCS SCHEME

USN | | | | | | | | | | |

21ME43

Fourth Semester B.E. Degree Examination, June/July 2024
Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Derive an expression for Total hydrostatic pressure and centre of pressure from free liquid surface of a vertical plane surface submerged in water. **(08 Marks)**

b. A stream function is given by, $\psi = 3x^2t + 4xy + 2t$, find the velocity field and determine its magnitude and direction at a point defined by the position vector, $r = 1i + 2j + 3k$ when time $t = 5$. **(06 Marks)**

c. Prove that a stream line and potential lines are orthogonal. **(06 Marks)**

OR

2 a. Derive continuity equation for a 3-dimensional steady incompressible fluid flow in Cartesian coordinates with usual notations, also mention the assumptions made. **(12 Marks)**

b. A differential manometer is connected at two points A and B. The pressure at A is 1 Bar while pressure at B is 1.8 Bar. The pipe A carries fluid of specific gravity 1.5, while pipe B carries fluid of specific gravity 0.9. Determine the deflection in the level of Mercury in manometer. If the centre of Pipe A is 3 meter above centre of pipe B. While the level of mercury in Pipe B is 2 meter below centre of pipe B. Also show the diagrammatic representation of differential manometer as per the above data. **(08 Marks)**

Module-2

3 a. Derive an expression for Euler's momentum equation and deduce Bernoulli's equation, state the assumptions made. **(10 Marks)**

b. A $30cm \times 15cm$ venturimeter is provided in a vertical pipe line carrying oil of specific gravity 0.9. The flow being upwards. The difference in elevation of the throat section and entrance section of the Venturimeter is 30 cm. If the pressure difference between the entrance section and the throat section is 0.35 bar, determine the actual discharge of oil in litres per minute and the differential U-tube mercury manometer gauge deflection in millimeters of mercury. **(10 Marks)**

OR

4 a. With a neat sketch, explain the parts of a venturimeter and derive an expression for theoretical discharge with usual notations. List its advantages and limitations. **(10 Marks)**

b. The water is flowing through a pipe having diameters 20 cm and 10 cm at section 1 and section 2 respectively. The rate of flow through pipe is 35 litres per second. The section 1 is 6 m above datum and section 2 is 4 m above datum. If the pressure at section 1 is 40 N/cm^2, find the intensity of pressure at 2. Also determine the percentage drop in discharge if a 10% loss of difference in velocity head is considered for the same pressure difference. **(10 Marks)**

Module-3

5 a. Derive an expression to prove drop in pressure in a flow of viscous fluid through a circular pipe. $P_1 - P_2 = \frac{32\mu\bar{u}L}{D^2}$. **(12 Marks)**

b. The two fixed parallel plates kept at 80 mm apart have laminar flow of oil between them with a maximum velocity of 1.5 m/s, taking dynamic viscosity of oil to be 19.62 poise. Calculate

(i) The discharge per meter width.
(ii) The shear stress at the plates wall.
(iii) The pressure difference between two points 25 meter apart.
(iv) The velocity and fluid at a distance of 20 mm from plate. **(08 Marks)**

OR

6 a. Derive an expression for loss of head due to friction, "Darcy Weisback equation". **(10 Marks)**

b. Three pipes of diameter 300 mm, 200 mm and 400 mm having lengths of 450 meter, 225 meter and 315 meter respectively are connected in series between two tanks. The water flows from tank 1 to tank 2 through pipes as per the above given order, determine the rate of flow of water. If surface level of tank 2 is to be maintained 18 meters below the surface level of tank 1. Assume the co-efficient of friction of all the pipes as 0.0075. **(10 Marks)**

Module-4

7 a. Define the following and write their mathematical expressions :

(i) Drag force. (ii) Lift force
(iii) Displacement thickness (iv) Momentum thickness
(v) Energy thickness **(10 Marks)**

b. The pressure drop in an aeroplane model of size $\frac{1}{10}$ of its prototype is 100 N/cm^2. The model is tested in water. Find the corresponding pressure drop in the prototype. Take the density of air as 1.1 kg/m^3 and the viscosity of water as 0.01 poise, while the viscosity of air is 0.00018 Poise. **(06 Marks)**

c. Define similitude and its types. **(04 Marks)**

OR

8 a. The power generated by a Turbo machine P depends on the following, discharge Q, specific input energy gH density fluid ρ, dynamic viscosity μ, Diameter of Rotor D, Speed of the Rotor N. Prove that $P = \rho N^3 D^5 \left(\frac{gH}{N^2D^2}, \frac{\theta}{ND^3}, \frac{\rho VD}{\mu} \right)$, using Buckingham π theorem. **(12 Marks)**

b. A Kite weighing 20 N and having an area of 1 m^2, makes an angle of 7° to the horizontal when flying in a wind of 36 km/hr. If pull on the string attached to the kite is 49 Neutons and it is inclined to the horizontal at 45°, calculate the lift and drag coefficients take density of air = 1.2 kg/m^3. **(08 Marks)**

Module-5

9 a. Derive an expression for velocity of sound in a compressible fluid when the compression is,

(i) Adiabatic in nature. (ii) Isothermal process
(iii) In terms of Bulk Modulus (K),

If velocity of sound $C = \sqrt{\frac{dP}{d\rho}}$, where P is pressure ρ is density. **(10 Marks)**

b. A projectile is travelling in air having pressure of 10 N/cm^2 at $10^\circ C$ at a speed of 1500 km/hour, find the Mach number and the Mach angle. Take adiabatic index $\gamma = 1.4$ and gas constant of air R = 287 J/kgK. **(04 Marks)**

c. With the help of neat sketch, explain propagation of disturbance for supersonic flow and define the following :
   (i) Mach angle (ii) Zone of action (iii) Zone of silence **(06 Marks)**

OR

10 a. Write short notes on, computational fluid dynamics as a tool to solve fluid flow and heat flow problems, its necessity, limitations and applications. **(08 Marks)**

b. Derive an expression for the following stagnation properties in terms of Mach number :
   (i) Stagnation pressure (P_O)
   (ii) Stagnation temperature (T_O)
   (iii) Stagnation Density (ρ_O)

   Assume compressible fluid flowing post a body under Adiabaitic condition. **(12 Marks)**

* * * * *

CBCS SCHEME

USN | | | | | | | | | | |

21ME44

Fourth Semester B.E. Degree Examination, June/July 2024
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define the following terms:
(i) Stress (ii) Strain (iii) Young's modulus
(iv) Poisson's ratio (v) Hooke's law **(05 Marks)**

b. Derive an expression for the total elongation of a tapered circular bar cross section of diameter 'D' and 'd' subjected to an axial load 'p'. **(05 Marks)**

c. A bar of 800 mm length is attached rigidly at A and B as shown in Fig.Q1(c). Determine reaction at both ends and stress in each portion. Bar diameter is 25 mm and Young's modulus E = 200 MPa.

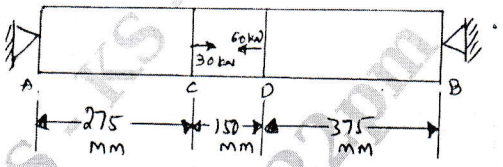

Fig.Q1(c) **(10 Marks)**

OR

2 a. A steel rail is 12.6 m long and is laid at a temperature of 24°C. The maximum temperature is expected to raise to 44°C.
(i) Estimate the minimum gap between the rails to be left so that temperature stress do not develop.
(ii) If the stress developed is 20 N/mm^2, what is the gap left between the rails?
Take E = 2×10^5 N/mm^2 and $\alpha = 12 \times 10^{-6}$/°C **(10 Marks)**

b. Derive a relation between modulus of elasticity and modulus of rigidity. **(10 Marks)**

Module-2

3 a. Derive the expression for normal stress and tangential stress or a plane inclined at θ to the vertical axis in a biaxial stress system with shear stress. **(08 Marks)**

b. State of stress at a point in a strained material is as shown in Fig.Q3(b). Determine:
(i) Direction of principal plane and magnitude of principal stresses
(ii) Maximum shear stress and its directions
(iii) Sketch and indicate above planes.

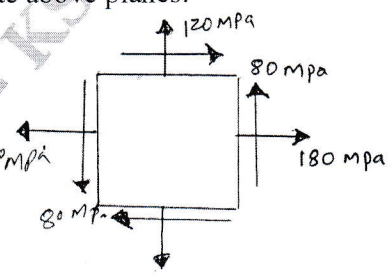

Fig.Q3(b) **(12 Marks)**

OR

4 The state of stress at a point in a strained material is shown in Fig.Q4. Determine:
(i) Direction of principal plane and magnitude of principal stress.
(ii) Direction of maximum shear stress and its magnitude
(iii) Draw Mohr's circle to verify the results obtained analytically

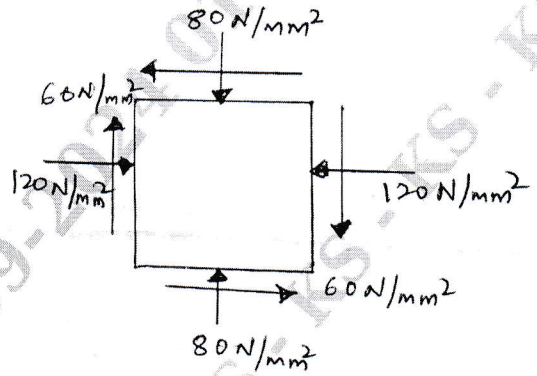

Fig.Q4 **(20 Marks)**

Module-3

5 a. A cantilever of length 2m carries an uniform distributed load of 1 kN/m run over a length of 1.5 m from the free end. Draw the shear force and bending moment diagram for the cantilever beam. **(06 Marks)**

b. Draw the BMD and SFD for the overhanging beam shown in Fig.Q5(b). Find also point of contraflexure with corresponding value of bending moment.

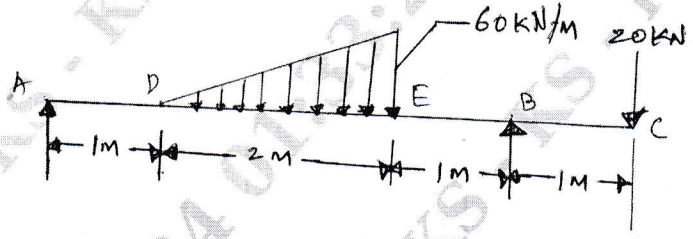

Fig.Q5(b) **(14 Marks)**

OR

6 a. Prove the relation $\frac{M}{I}=\frac{\sigma}{Y}=\frac{E}{R}$ with usual notations. **(10 Marks)**

b. Fig.Q6(b) shows the cross-section of a beam which is subjected to a shear force of 20 kN. Draw shear stress distribution across depth marking values at salient points.

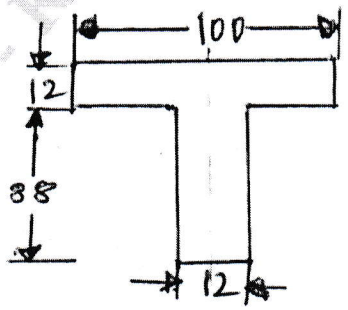

Fig.Q6(b) All dimension are in mm **(10 Marks)**

Module-4

7 a. Derive an expression for deflection, slope and maximum deflection of simply supported beam of span 'L' subjected to a concentrated load W at its mid span using differential equation for deflection. **(10 Marks)**

b. A simply supported beam of 6m span is subjected to a point load of 18 kN at 4 m from left support. Calculate:

(i) The position and the value of maximum deflection

(ii) Slope at mid-span

Assume E = 200 GPa and I = 15×10^6 mm^4. **(10 Marks)**

OR

8 a. Derive the torsional equation for a circular shaft with usual notations. State the assumptions made. **(10 Marks)**

b. A shaft is required to transmit 245 KW power at 240 rpm. The maximum torque may be 1.5 times the mean torque. The shear stress in the shaft should not exceed 40 N/mm^2 and the twist 1° per metre length. Determine the diameter required if shaft is hollow with external diameter twice the internal diameter. Take modulus of rigidity, G = 80 kN/mm^2. **(10 Marks)**

Module-5

9 a. A thick cylinder of outside diameter 300 mm and internal diameter 200 mm is subjected to an internal fluid pressure of 14 N/mm^2. Determine the maximum hoop stress developed in the cross section. Sketch the variation of hoop stress across the thickness of the cylinder. **(10 Marks)**

b. What is strain energy? Explain in brief. **(05 Marks)**

c. Obtain an expression for strain energy due to shear stress. **(05 Marks)**

OR

10 a. State the assumptions made while deriving Euler's column formula. Also derive Euler's expression of buckling for column with both ends hinged. **(10 Marks)**

b. A hollow cast from iron whose outside diameter is 200 mm and has a thickness of 20 mm is 4.5 m long and is fixed at both ends. Calculate the safe load by Rankine's formulae with factor of safety 2.5. Find the ratio of Euler's to Rankine's loads. Assume E = 1×10^5 N/mm^2, Rankine's constant = 1/1600 for both ends pinned and f_c = 550 N/mm^2. **(10 Marks)**

* * * * *