CBCS SCHEME

USN | | | | | | | | | | 17MAT41

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
Engineering Mathematics – IV

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Apply modified Euler's method to solve $\frac{dy}{dx} = x + y$, $y(0) = 1$. Compute $y(0.2)$ taking $h = 0.1$. **(07 Marks)**

b. Using fourth order Runge-Kutta method, find $y(0.2)$ for the equation $\frac{dy}{dx} = \frac{y-x}{y+x}$, $y(0) = 1$ taking $h = 0.2$. **(06 Marks)**

c. If $\frac{dy}{dx} = 2e^x - y$, $y(0) = 2$, $y(0.1) = 2.010$, $y(0.2) = 2.0679$, $y(0.3) = 2.090$, find $y(0.4)$ correct to four decimal places by using Milne's predictor and corrector method. **(07 Marks)**

OR

2 a. Use Taylor's series method to find $y(4.1)$ given that $\frac{dy}{dx} = \frac{1}{x^2 + y}$ and $y(4) = 4$. **(06 Marks)**

b. Solve $(y^2 - x^2)dx = (y^2 + x^2)dy$ in the range $0 \le x \le 0.4$ given that $y = 1$ at $x = 0$ initially by applying R-K method of fourth order. **(07 Marks)**

c. Apply Milne's method to compute $y(1.4)$ correct to four decimal places given $\frac{dy}{dx} = x^2 + \frac{y}{2}$ and following the data $y(1) = 2$, $y(1.1) = 2.2156$, $y(1.2) = 2.4649$, $y(1.3) = 2.7514$ **(07 Marks)**

Module-2

3 a. Given $y'' - xy' - y = 0$ with the initial condition $y(0) = 1$, $y'(0) = 0$. Compute $y(0.2)$ and $y'(0.2)$ using fourth order R-K method. **(07 Marks)**

b. If α and β are two distinct roots of $J_n(x) = 0$ then prove that

$$\int_0^1 xJ_n(\alpha x)J_n(\beta x)dx = 0 \text{ if } \alpha \ne \beta.$$ **(07 Marks)**

c. Express the polynomial $4x^3 - 2x^2 - 3x + 8$ interms of Legendre polynomials. **(06 Marks)**

OR

4 a. Applying Milne's predictor and corrector formulae to compute $y(0.8)$ given that y satisfies the equation $y'' = 2yy'$ using the following data :
$y(0) = 0$, $y(0.2) = 0.2027$, $y(0.4) = 0.4228$, $y(0.6) = 0.6841$, $y'(0) = 1$, $y'(0.2) = 1.041$, $y'(0.4) = 1.179$, $y'(0.6) = 1.468$. **(07 Marks)**

b. Prove that $J_{\frac{1}{2}}(x) = \sqrt{\frac{2}{\pi x}} \sin x$. **(06 Marks)**

c. Derive Rodrigue's formula, $P_n(x) = \frac{1}{2^n n!}\frac{d^n}{dx^n}\left[(x^2-1)^n\right]$. (07 Marks)

Module-3

5 a. Derive Cauchy-Riemann equation in the polar form. (07 Marks)

b. State and prove Cauchy's-Integral formula, $f(a) = \frac{1}{2\pi i}\int_C \frac{f(z)}{z-a}dz$. (06 Marks)

c. Find the bilinear transformation which map the points z = 1, i − 1 into w = i, 0, − i. (07 Marks)

OR

6 a. Find the analytic function f(z) whose real part is $\frac{\sin 2x}{\cosh 2y - \cos 2x}$. (06 Marks)

b. Using Cauchy's residue theorem, evaluate $\int_C \frac{z\cos z}{\left(z-\frac{\pi}{2}\right)^3}dz$ where C : $|z-1| = 1$. (07 Marks)

c. Discuss the transformation $\omega = e^z$. (07 Marks)

Module-4

7 a. If the mean and standard deviation of the number of correctly answered questions in a test given to 4096 students 2.5 and $\sqrt{1.875}$. Find an estimate of the number of candidates answering correctly,

(i) 8 or more questions
(ii) 2 or less
(iii) 5 questions (07 Marks)

b. Derive mean and standard deviations of binomial distributions. (06 Marks)

c. The joint probability distribution for two random variables X and Y is as follows :

X \ Y	−3	2	4
1	0.1	0.2	0.2
2	0.3	0.1	0.1

Determine : (i) Marginal distribution of X and Y (ii) COV (X, Y) (iii) Correlations of X and Y. (07 Marks)

OR

8 a. Derive mean and standard deviations of Exponential distribution. (06 Marks)

b. X and Y are independent random variables. X takes values 2, 5, 7 with probability $\frac{1}{2}, \frac{1}{4}, \frac{1}{4}$ respectively. Y take values 3, 4, 5 with the probability $\frac{1}{3}, \frac{1}{3}, \frac{1}{3}$.

(i) Find the Joint probability distribution of X and Y.
(ii) Show that the covariance of X and Y.
(iii) Find the probability distribution of Z = X + Y (07 Marks)

c. In 800 families with 5 childrens each how many families would be expected to have, (i) 3 boys (ii) 5 girls (iii) either 2 or 3 boys (iv) atmost 2 girls by assuming probabilities for boys and girls to be equal. (07 Marks)

Module-5

9 a. A survey was conducted in a slum locality of 2000 families by selecting a sample size 800. It was revealed that 180 families were illiterates. Find the probable limits of the illiterate families in the population of 2000. **(07 Marks)**

b. Ten individuals are choosen at random from a population and their heights in inches are found to be 63, 63, 64, 65, 66, 69, 69, 70, 70, 71. Discuss the suggestion that the mean height of the population is 65 inches given that $t_{0.05} = 2.262$ for 9 d.f. **(07 Marks)**

c. Find the unique fixed probability vector for the regular stochastic matrix,

$$A = \begin{bmatrix} 0 & 1 & 0 \\ \frac{1}{6} & \frac{1}{2} & \frac{1}{3} \\ 0 & \frac{2}{3} & \frac{1}{3} \end{bmatrix}.$$

(06 Marks)

OR

10 a. Four coins are tossed 100 times and the following results were obtained. Fit a binomial distribution for the data and test the goodness of fit ($x^2_{0.05} = 9.49$ for 4 d.f) **(07 Marks)**

No. of heads	0	1	2	3	4
Frequency	5	29	36	25	5

b. The transition probability matrix of a Markov chain is given by,

$$P = \begin{bmatrix} \frac{1}{2} & 0 & \frac{1}{2} \\ 1 & 0 & 0 \\ \frac{1}{4} & \frac{1}{2} & \frac{1}{4} \end{bmatrix}$$

and the initial probability distribution is $P^{(0)} = \left(\frac{1}{2}, \frac{1}{2}, 0\right)$. Find $P_{13}^{(2)}$, $P_{23}^{(2)}$, $P^{(2)}$ and $P_1^{(2)}$.

(06 Marks)

c. A man's smoking habits are as follows. If he smokes filters cigarettes one week, he switches to non filter cigarettes the next week with probability 0.2. On the other hand if he smokes nonfilter cigarettes one week there is a probability of 0.7 that he will smoke non filter cigarettes the next week as well. In the long run how often does he smoke filter cigarettes? **(07 Marks)**

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CBCS SCHEME

USN

17MATDIP41

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
Additional Mathematics - II

Time: 3 hrs. Max. Marks: 100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Find the Rank of the Matrix $\begin{bmatrix} 2 & -1 & -3 & -1 \\ 1 & 2 & 3 & -1 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & -1 \end{bmatrix}$. (06 Marks)

b. Test for consistency and solve $x + y + z = 6$, $x - y + 2z = 5$, $3x + y + z = 8$. (07 Marks)

c. Solve the system of equations by Gauss Elimination Method $x + y + z = 9$, $x - 2y + 3z = 8$, $2x + y - z = 3$. (07 Marks)

OR

2 a. Find the Eigen values and Eigen vectors of the Matrix $\begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$. (06 Marks)

b. Verify Cayley – Hamilton theorem for the matrix $A = \begin{bmatrix} 1 & 4 \\ 2 & 3 \end{bmatrix}$ and find its inverse. (07 Marks)

c. Find the Rank of the Matrix $\begin{bmatrix} 1 & 2 & 3 & 2 \\ 2 & 3 & 5 & 1 \\ 1 & 3 & 4 & 5 \end{bmatrix}$. (07 Marks)

Module-2

3 a. Solve $\frac{d^3y}{dx^3} + 6\frac{d^2y}{dx^2} + 11\frac{dy}{dx} + 6y = 0$. (06 Marks)

b. Solve $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 9y = 5e^{-2x}$. (07 Marks)

c. Solve $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 13y = \cos 2x$. (07 Marks)

OR

4 a. Solve $\frac{d^2y}{dx^2} + 4y = \sin^2 x$. (06 Marks)

b. Solve $(4D^4 - 4D^3 - 23D^2 + 12D + 36)\, y = 0$. (07 Marks)

c. Solve $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = x^2$. (07 Marks)

Module-3

5 a. Find the Laplace Transform of the function $\sin 5t \cos 2t$. (06 Marks)

b. Find the $L\left[\frac{\cos at - \cos bt}{t}\right]$. (07 Marks)

c. Find the Laplace Transform of the Periodic function defined by $f(t) = \frac{Kt}{T}$, $0 < t < T$, $f(t + T) = f(t)$. (07 Marks)

OR

6 a. Find Laplace Transform of $[(3t + 4)^3 + 5^t]$. (06 Marks)

b. Find $L[t \cos a t]$. (07 Marks)

c. Express the following function interms of Unit step function and hence find its Laplace Transform, where

$$f(t) = \begin{cases} t , & 0 < t < 4 \\ 5 , & t > 4 \end{cases}.$$ (07 Marks)

Module-4

7 a. i) Find $L^{-1}\left[\frac{s}{s^2 - 16}\right]$ ii) Find $L^{-1}\left[\frac{(s+2)^3}{s^6}\right]$. (06 Marks)

b. Find $L^{-1}\left[\frac{2s^2 + 5s - 4}{s(s-1)(s+2)}\right]$. (07 Marks)

c. Find $L^{-1}\left[\frac{2s - 1}{s^2 + 4s + 29}\right]$. (07 Marks)

OR

8 a. Find $L^{-1}\left[\frac{3}{s^2} + 2\frac{e^{-s}}{s^3} - 3\frac{e^{-2s}}{s}\right]$. (06 Marks)

b. Find $L^{-1}\left[\frac{3s + 2}{(s-2)(s+1)}\right]$. (07 Marks)

c. Solve by using Laplace Transform, $\frac{d^2y}{dt^2} + k^2y = 0$, given that $y(0) = 2$, $y'(0) = 0$. (07 Marks)

Module-5

9 a. State and prove Addition Theorem of probability $P(A \cup B) = P(A) + P(B) - P(A \cap B)$. (06 Marks)

b. The probability that an integrated circuit chip will have defective etching is 0.12. The probability that it will have a crack defect is 0.29 and the probability that it will have both defects is 0.07. What is the probability that a newly manufactured chip will have i) an etching of crack defect? ii) neither defect? (07 Marks)

c. If A and B are events with $P(A \cup B) = \frac{7}{8}$, $P(A \cap B) = \frac{1}{4}$, $P(A \cap \overline{B}) = \frac{1}{3}$. Find P(A) , P(B) and $P(\overline{A} \cap B)$. (07 Marks)

OR

10 a. State and prove Baye's Theorem. (06 Marks)

b. In a certain college 4% of Men students and 1% of Women students are taller than 1.8m. Further more 60% of the students are Women. If a student is selected at random and is found taller than 1.8m, what is the probability that the student is a Women? (07 Marks)

c. The probability that a communication system will have high fidelity is 0.81 and the probability that it will have high fidelity and high selectivity is 0.18. Find the probability that a system will have high selectivity, given it has high fidelity. (07 Marks)

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CBCS SCHEME

USN | | | | | | | | | | | **17ME42**

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
Kinematics of Machinery

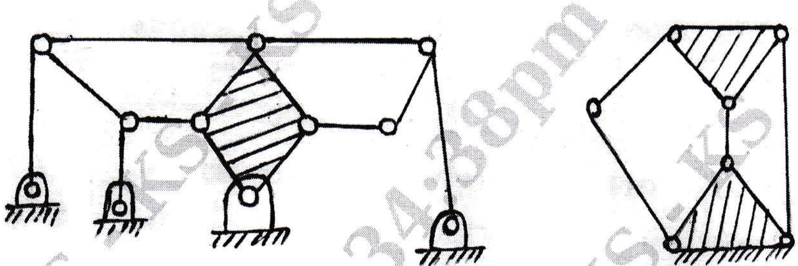
Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define the following:
i) Kinematic chain
ii) Mechanism
iii) Structure
iv) Inversion
v) Machine. **(10 Marks)**

b. Define 'degree of freedom' and find degree of freedom for the chains shown in Fig.Q.1(b). **(10 Marks)**



(i) (ii)

Fig.Q.1(b)

OR

2 a. Obtain condition for correct steering for a four wheeled vehicle. **(10 Marks)**

b. Prove that the Peaucellier's mechanism can be used to draw exact straight line motion. **(10 Marks)**

Module-2

3 A four bar mechanism ABCD pin jointed at the ends. AD is fixed link which is 180mm long. The links AB, BC and CD are 90mm, 120mm and 120mm long respectively. At certain instant, the link AB makes an angle of 60° with the link AD. If the link AB rotates at a uniform speed of 100rpm clock wise determine angular velocity and angular acceleration of links BC and CD by graphical method. **(20 Marks)**

OR

4 a. State and prove Kennedy's theorem. **(06 Marks)**

b. Determine the velocity and acceleration of the Piston by Klein construction to the following specifications. Stroke = 300mm, Ratio of length of connecting rod to crank length = 4, speed of the engine = 300rpm, position of crank = 45° with inner dead centre. **(14 Marks)**

Module-3

5 Using complex algebra derive expression for velocity and acceleration of the piston and angular acceleration of connecting rod for a reciprocating engine mechanism. Use these expressions to find the above quantities, if the crank length is 50mm, connecting rod is 200mm, crank speed is constant at 3000rpm and crank angle is 30°. **(20 Marks)**

OR

6 a. Derive Freudenstein's equation for four bar mechanism. **(12 Marks)**

b. Explain function generation for four bar mechanism. **(08 Marks)**

Module-4

7 a. Derive an expression for minimum number of teeth necessary for a pinion to avoid interference. **(12 Marks)**

b. When a pinion having 17 teeth drives a gear having 49 teeth. The profile of the gear is involute with pressure angle 20°. Module 6mm and addendum on pinion and gear wheel equal to one module. Calculate: i) Length of path of contact ii) Contact ratio. **(08 Marks)**

OR

8 An epicyclic gear train consists of a sun wheel (S), a stationary internal gear (E) and three identical planet wheels (P) carried on a star shaped carrier (C). The size of different toothed wheels are such that the planet carrier (C) rotates at $1/5^{th}$ of the speed of the sun wheel. The minimum number of teeth on any wheel is 16. The driving torque on the sun wheel is 100N-m. Determine: i) Number of teeth on P and E ii) Torque required to keep the internal gear stationary. **(20 Marks)**

Module-5

9 A cam rotating clockwise at uniform speed of 300rpm operates a reciprocating follower through a roller 1.5cm diameter. The follower motion is defined as below:

i) Outward during 150° with UARM
ii) Dwell for next 30°
iii) Return during next 120° with SHM
iv) Dwell for the remaining period.

Stroke of the follower is 3cm. Minimum radius of the cam is 3cm. Draw the cam profile follower axis passes through cam axis. Also find the maximum velocity and acceleration during the raise and return of the follower. **(20 Marks)**

OR

10 a. Explain with neat sketch in brief 'radial cam' and 'cylindrical cam'. **(06 Marks)**

b. Obtain expressions for displacement, velocity and acceleration for a flat forced follower is contact with circular flank of a cam. **(14 Marks)**

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CBCS SCHEME

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17ME43

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
Applied Thermodynamics

Time: 3 hrs.

Max. Marks: 100

Note: 1. *Answer any FIVE full questions, choosing ONE full question from each module.*
2. *Use of Thermodynamics data hand book and Mollier chart is permitted.*

Module-1

1 a. State the assumptions made in the air standard cycles. Derive the expression for the air standard efficiency of Otto cycle. **(10 Marks)**

b. The compression ratio of a Diesel cycle is 14 and the cut-off ratio is 2.2. At the beginning of cycle, air is at 0.98 bar and 100°C. Find the temperature and pressure at all salient points and also Air Standard efficiency. **(10 Marks)**

OR

2 a. Explain briefly with T-S diagram for the following Gas Turbine cycle :
(i) Regeneration (ii) Intercooling (iii) Reheating. **(10 Marks)**

b. Air enters the compressor of an ideal air standard Brayton cycle at 100 KPa, 300 K with a volumetric flow rate of 6 m^3/s. The compressor pressure ratio is 10. The turbine inlet temperature is 1500 K. Determine :
(i) Thermal efficiency (ii) Work ratio (iii) Power developed. **(10 Marks)**

Module-2

3 a. With T-S diagram and schematic diagram explain the working of ideal regenerative Rankine cycle. **(10 Marks)**

b. In a Rankine cycle, the steam at inlet to turbine is saturated at a pressure of 35 bar and the exhaust pressure is 0.2 bar. Calculate :
(i) Pump work (ii) Turbine work (iii) Rankine efficiency (iv) Condenser heat flow.
Assume mass flow rate = 9.5 kg/s. **(10 Marks)**

OR

4 a. Sketch the flow diagram and T-S diagram of a reheat Rankine cycle. Briefly explain the working principle and derive the cycle efficiency for reheat Rankine cycle. **(10 Marks)**

b. Steam enters the turbine of a steam power plant operating an Rankine cycle at 10 bar and 300°C. The condenser pressure is 0.1 bar. Steam leaving the turbine is 90% dry. Calculate the adiabatic efficiency of the turbine and also cycle efficiency. Neglecting pump work. **(10 Marks)**

Module-3

5 a. Explain the following with reference to combustion process:
(i) Percent excess air (ii) Enthalpy of formation
(iii) Enthalpy of combustion (iv) Internal energy of combustion. **(10 Marks)**

b. Calculate the air-fuel ratio for burning of propane (C_3H_8) with 130% theoretical air. **(10 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

OR

6 a. Explain briefly the combustion process in spart ingnition (SI) and Compression Ignition (CI) engines. **(10 Marks)**

b. The following observations are taken during a trial on four stroke Diesel Engine :

Cylinder diameter = 25 cm, Stroke = 40 cm
Speed = 250 rpm, Brake load = 70 kg,
Brake drum diameter = 2 m, Mean effective pressure = 6 bar,
Diesel oil consumption = 0.1 m^3/min, Specific gravity of fuel = 0.78,
Calorific value of fuel = 43900 kJ/kg

Determine :
(i) IP (ii) BP (iii) FP
(iv) Mechanical efficiency (v) Brake thermal efficiency. **(10 Marks)**

Module-4

7 a. Derive an expression for COP of an air refrigeration system working on Bell-Coleman cycle. **(10 Marks)**

b. A vapour compression plant uses R-12 and is to develop 5 tonnes of refrigeration. The condenser and evaporator temperature are to be 40°C and $-10^\circ C$ respectively.

Determine : (i) The refrigerant flow rate in kg/s
(ii) The volume flow rate handled by the compressor in m^3/s
(iii) The compressor discharge temperature
(iv) Pressure ratio. **(10 Marks)**

OR

8 a. Define the following :
(i) Dry bulb temperature (ii) Dew point temperature.
(iii) Relative humidity (iv) Specific humidity
(v) Degree of saturation **(10 Marks)**

b. A sling psychrometer reads 40°C DBT and 28°C WBT, Calculate the following :
(i) Specific humidity (ii) Relative humidity
(iii) Dew point temperature (iv) Enthalpy of mixture / kg of dry air. **(10 Marks)**

Module-5

9 a. Show that for perfect intercooling, stage pressure ratio remains the same in multistage air compressor and hence prove that $Z = \left[\frac{P_{X-1}}{P_1}\right]^{\frac{1}{X}}$. where Z = stage pressure ratio, P_1 = Initial pressure, X = Number of stages. **(10 Marks)**

b. In a two-stage reciprocating air compressor 1.5 kg/min of air is compressed from 1 bar to 25 bar and the index of compression is 1.2. If the work of compression is minimum and the air is cooled in the intercooler so that its temperature is brought back to initial temperature of 15°C. Determine :
(i) Heat rejected during compression. (ii) Heat rejected in the intercooler.
(iii) Power.
Take for air C_P = 1 KJ/kgK and C_V = 0.714 KJ/KgK **(10 Marks)**

OR

10 a. Define critical pressure ratio for the nozzle of the steam turbine. Obtain analytically its value in terms of the index of expansion. **(10 Marks)**

b. Steam is allowed to expand in a set of nozzles from 10 bar and 200°C to final pressure of 5 bar what type of nozzle is it. Neglecting the initial velocity of steam, calculate the minimum area of the nozzle required to allow a flow of 3 kg/s under the given conditions. Assume that expansion of steam to be Isentropic. **(10 Marks)**

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CBCS SCHEME

USN | | | | | | | | | | | 17ME44

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
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. Define the following properties of fluid with their units:
(i) Mass density (ii) Specific gravity (iii) Dynamic viscosity **(06 Marks)**

b. State and prove the Pascal's law. **(06 Marks)**

c. The dynamic viscosity of an oil, used for lubrication between a shaft and sleeve is 5 poise. The shaft is of 0.5 m diameter and rotates at 200 rpm. Calculate the power lost in the bearing for a sleeve length of 100 mm. The thickness of oil film is 1 mm. **(08 Marks)**

OR

2 a. Define the following terms: (i) Buoyancy (ii) Metacentre **(02 Marks)**

b. Derive an expression for total pressure force and depth of centre of pressure for a vertical plane surface submerged in water. **(10 Marks)**

c. A solid cylinder of diameter has a height of 3m. Find the metacentric height, when it is floating in water with its axis vertical. The specific gravity of cylinder is 0.6. **(08 Marks)**

Module-2

3 a. Establish the relationship between stream function and velocity potential function. **(04 Marks)**

b. Derive an expression for continuity equation in Cartesian coordinates for three dimensions. **(08 Marks)**

c. The velocity potential function (ϕ) is given by an expression $\phi = -\frac{xy^3}{3} - x^2 + \frac{x^3y}{3} + y^2$. Calculate the velocity components in x and y directions. Check the possibility of such a flow. **(08 Marks)**

OR

4 a. Derive Euler's equation of motion for a steady flow and deduce Bernoulli's equation and state the assumptions made for such a derivation. **(10 Marks)**

b. Give the relative merits and demerits of orifice meter with respect to venturimeter. **(04 Marks)**

c. A horizontal venturimeter with inlet diameter 20 cm and throat diameter 10 cm is used to measure the flow of water. The pressure at inlet is 17.658 N/cm^2 and the vacuum pressure at the throat is 30 cm of mercury. Find the discharge of water through venturimeter. Take $C_d = 0.98$. **(06 Marks)**

Module-3

5 a. Define Reynold's number. What is its significance? **(04 Marks)**

b. Derive an expression for Hagen-Poiseuille formula for viscous flow of fluid. **(08 Marks)**

c. A fluid of viscosity 0.7 NS/m^2 and specific gravity 1.3 is flowing through a circular pipe of diameter 100 mm. The maximum shear stress at the pipe wall is given as 196.2 N/m^2. Calculate: (i) Pressure gradient (ii) Average velocity (iii) Reynold's number of the flow. **(08 Marks)**

OR

6 a. Derive Darcy-Weisbach equation to determine the loss of head due to friction in pipes. **(08 Marks)**

b. Differentiate between major losses and minor losses in pipe flow. **(04 Marks)**

c. An oil of specific gravity 0.9 and viscosity 0.06 poise is flowing through a pipe of diameter 200 mm at the rate of 60 litres/s. Calculate:
(i) Head lost due to friction for a 500 m length of pipe
(ii) Power required to maintain this flow **(08 Marks)**

Module-4

7 a. Find: (i) Displacement thickness (ii) Momentum thickness for the velocity distribution in the boundary layer given by $\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$. **(08 Marks)**

b. Define the following terms: (i) Lift force (ii) Drag force **(04 Marks)**

c. A man weighing 90 kgf descends to the ground from an aeroplane with the help of parachute against the resistance of air. The velocity with which the parachute, which is hemispherical in shape, comes down is 20 m/s. Find the diameter of parachute. Assume $C_D = 0.5$ and density of air = 1.25 kg/m^3. **(08 Marks)**

OR

8 a. Define the term similitude. Explain the following with reference to similitude:
(i) Geometric similarity
(ii) Kinematic similarity
(iii) Dynamic similarity **(08 Marks)**

b. Explain the term dimensionally homogeneous equation. **(02 Marks)**

c. The resisting force R of a supersonic plane during flight can be considered as dependent upon the length of aircraft ℓ, velocity V, air viscosity μ, air density ρ and bulk modulus of air K. Express the functional relationship between these variables and the resisting force R. **(10 Marks)**

Module-5

9 a. Define the following terms: (i) Mach number (ii) Mach angle **(04 Marks)**

b. Derive an expression for velocity of sound in terms of bulk modulus and density. **(08 Marks)**

c. An airplane is flying at an altitude of 15 km where the temperature is −50°C. The speed of the plane corresponds to mach number of 1.6. Assume $\gamma = 1.4$ and R = 287 J/kgK for air. Find the speed of the plane and mach angle α. **(08 Marks)**

OR

10 a. Define the following terms: (i) Subsonic flow (ii) Supersonic flow **(04 Marks)**

b. Enumerate the engineering applications of CFD, bringing the advantages and limitations. **(08 Marks)**

c. Define the following terms and write the relevant equations for the same:
(i) Stagnation pressure (ii) Stagnation temperature **(08 Marks)**

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CBCS SCHEME

USN [| | | | | | | | |]

17ME46B/17MEB406

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
Mechanical Measurement and Metrology

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. What is metrology? What are the objectives of metrology? **(07 Marks)**
b. With a neat sketch, explain the working of sine center. **(08 Marks)**
c. Define Line and End standard. **(05 Marks)**

OR

2 a. Define wave length standard. What are the advantages of wavelength standard? **(05 Marks)**
b. Explain with a neat sketch Wringing of Slip Gauges. **(07 Marks)**
c. With a neat sketch, explain the working of Auto collimator. **(08 Marks)**

Module-2

3 a. With a neat sketch, explain Hole basis system and shaft basis system. **(08 Marks)**
b. Explain with a neat sketch working of LVDT. **(07 Marks)**
c. Define comparators. What is the need of a comparator? **(05 Marks)**

OR

4 a. State and explain Taylor's principle of Gauge Design. **(05 Marks)**
b. With a neat sketch, explain the working of Zeiss ultra optimeter. **(08 Marks)**
c. With a neat sketch, explain Dial Indicator. What are the advantages? **(07 Marks)**

Module-3

5 a. Explain with a neat sketch Tools Maker's Microscope. **(10 Marks)**
b. With a neat sketch, explain coordinate measuring machine. **(10 Marks)**

OR

6 a. Derive an expression for Best Wire size for screw thread measurement. **(10 Marks)**
b. Explain with neat sketch, Gear Tooth Terminology. **(10 Marks)**

Module-4

7 a. Explain Generalized Measurement System with a block diagram. **(08 Marks)**
b. Classify different types of Errors. **(06 Marks)**
c. Define : i) Accuracy ii) Hysteresis ii) Threshold. **(06 Marks)**

OR

8 a. With a neat sketch, explain Cathode Ray Oscilloscope. **(10 Marks)**
b. Explain with a neat sketch Piezoelectric Transducer with its advantages, disadvantages and application. **(10 Marks)**

Module-5

9 a. With a neat sketch, explain McLeod Gauge. **(10 Marks)**
b. Define Thermocouple. Explain Laws of Thermocouple. **(10 Marks)**

OR

10 a. Explain with neat sketch, Rope Brake Dynamometer. **(10 Marks)**
b. With a neat sketch, explain optical Pyrometer. **(10 Marks)**

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