CBCS SCHEME

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

18MAT41

Fourth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Complex Analysis, Probability and Statistical Methods

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 $w = f(z) = z + e^z$ is analytic and hence find $\frac{dw}{dz}$. **(06 Marks)**

b. Derive Cauchy's – Riemann equations in polar form. **(07 Marks)**

c. If $u = x^3 - 3xy^2 + 3x^2 - 3y^2 + 1$ then find analytic function $f(z) = u + iv$. **(07 Marks)**

OR

2 a. Show that the real and imaginary parts of an analytic function $f(z) = u + iv$ are harmonic. **(06 Marks)**

b. If $f(z)$ is an analytic function then show that

$$\left[\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right] |f(z)|^2 = 4|f'(z)|^2$$ **(07 Marks)**

c. If $u = \left(r + \frac{1}{r}\right)\cos\theta$ then find the corresponding analytic function $f(z) = u + iv$. **(07 Marks)**

Module-2

3 a. State and prove Cauchy's integral formula. **(06 Marks)**

b. Discuss the conformal transformation $w = f(z) = z^2$. **(07 Marks)**

c. Find the bilinear transformation which maps the points $z = 1, i, -1$ into the points $w = i, 0, -i$. **(07 Marks)**

OR

4 a. Evaluate $\int_C z^2\,dz$ along the curve made up of two line segments, one from $z = 0$ to $z = 3$ and another from $z = 3$ to $z = 3 + i$ **(06 Marks)**

b. Evaluate $\int_c \frac{e^{2z}}{(z+1)(z-2)}\,dz$, where c is the circle $|z| = 3$. **(07 Marks)**

c. Find the bilinear transformation which maps the points $z = -1, 0, 1$ into the points $w = 0, i, 3i$. **(07 Marks)**

Module-3

5 a. The probability distribution of a random variable X is given by the following table:

$X(= x_i)$	-3	-2	-1	0	1	2	3
P(X)	k	2k	3k	4k	3k	2k	k

Find (i) The value of k, (ii) $P(x \le 1)$, (iii) $P(-1 < x \le 2)$ **(06 Marks)**

b. The probability that a pen manufactured by a factory be defective is 1/10. If 12 such pens are manufactured, what is the probability that (i) Exactly 2 are defective (ii) Atleast 2 are defective (iii) None of them are defective. **(07 Marks)**

c. The length of telephone conversation in a booth has been an exponential distribution and found on an average to be 5 minutes. Find the probability that a random call made from this booth (i) Ends less than 5 minutes (ii) Between 5 and 10 minutes. **(07 Marks)**

OR

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

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

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

b. In a certain town the duration of a shower is exponentially distributed with mean 5 minutes what is the probability that a shower will last for (i) Ten minutes or more (ii) Less than Ten minutes (iii) Between 10 and 12 minutes. **(07 Marks)**

c. The marks of 1000 students in an examination follows a normal distribution with mean 70 and standard deviation 5. Find the number of students whose marks will be (i) less than 65, (ii) more than 75 (iii) 65 to 75. [$\phi(1) = 0.3413$] **(07 Marks)**

Module-4

7 a. Compute the rank correlation coefficient for the following data:

x	68	64	75	50	64	80	75	40	55	64
y	62	58	68	45	81	60	68	48	50	70

(06 Marks)

b. Find a best fitting straight line $y = ax + b$ for the data below:

x	1	3	4	6	8	9	11	14
y	1	2	4	4	5	7	8	9

(07 Marks)

c. Obtain the lines of regression and hence find the coefficient of correlation for the data below:

x	1	2	3	4	5	6	7
y	9	8	10	12	11	13	14

(07 Marks)

OR

8 a. If θ is the acute angle between the lines of regression then show that

$$\tan\theta = \frac{\sigma_x \sigma_y}{\sigma_x^2 + \sigma_y^2}\left[\frac{1 - r^2}{r}\right]$$

(06 Marks)

b. Find a best fitting second degree parabola of the form $y = ax^2 + bx + c$ for the data below:

x	1	2	3	4	5
y	10	12	13	16	19

(07 Marks)

c. Find the coefficient of correlation for the following data:

x	10	14	18	22	26	30
y	18	12	24	06	30	36

(07 Marks)

Module-5

9 a. The joint probability of discrete random variables X and Y is given below:

X \ Y	1	3	9
2	1/8	1/24	1/12
4	1/4	1/4	0
6	1/8	1/24	1/12

Determine (i) Marginal distribution of X and Y. (ii) Covariance and correlation of X and Y. **(06 Marks)**

b. A survey was conducted in a slum locality of 2000 families by selecting a sample of size 800, it was revealed that 180 families were illiterates. Find the probable limits of the illiterates families in the population of 2000 at 1% level of significance. **(07 Marks)**

c. A group of 10 boys fed at diet A and another group of 08 boys fed on another diet B for a period of 06 months record the following increase in weights in pounds.

Diet A	05	06	08	01	12	04	03	09	06	10
Diet B	02	03	06	08	10	01	02	08	-	-

Test whether diet A and B differ significantly regarding their effect on increase in weight. $[t_{0.05} = 2.12]$ **(07 Marks)**

OR

10 a. Explain the terms :
(i) Null hypothesis
(ii) Type-I and Type-II errors
(iii) Level of significance. **(06 Marks)**

b. A certain stimulus administered to each of the 12 patients resulted in the following change in blood pressure: 5, 2, 8, –1, 3, 0, 6, –2, 1, 5, 0, 4
Can it be concluded that the stimulus will increase the blood pressure? $[t_{0.05} = 2.201]$ **(07 Marks)**

c. A sample analysis of examination, result of 500 students was made, it was found that 220 students had failed, 170 had secured third class, 90 had secured second class, 20 had secured first class. Do these figures support the general examination result which is in the ratio 4 : 3 : 2 : 1 for the respective categories? $[\chi^2_{0.05} = 7.81]$. **(07 Marks)**

* * * * *

CBCS SCHEME

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

18MATDIP41

Fourth Semester B.E. Degree Examination, Dec.2024/Jan.2025
Additional Mathematics – II

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Find the rank of the matrix $\begin{pmatrix} 1 & 3 & -1 & 2 \\ 0 & 11 & -5 & 3 \\ 2 & -5 & 3 & 1 \\ 4 & 1 & 1 & 5 \end{pmatrix}$ by reducing to echelon form. **(06 Marks)**

b. Solve the system of equations by Gauss elimination method:
$x + y + z = 9$
$x - 2y + 3z = 8$
$2x + y - z = 3$ **(07 Marks)**

c. Find the eigen values and eigen vectors of the matrix $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$. **(07 Marks)**

OR

2 a. Find the rank of the following matrix by applying elementary row transformation
$\begin{bmatrix} 2 & 3 & -1 & -1 \\ 1 & -1 & -2 & -4 \\ 3 & 1 & 3 & -2 \\ 6 & 3 & 0 & -7 \end{bmatrix}$ **(06 Marks)**

b. Solve the following system of linear equations by Gauss elimination method:
$x + 2y + z = 3$, $2x + 3y + 3z = 10$, $3x - y + 2z = 13$ **(07 Marks)**

c. Find the eigen values and eigen vectors of the matrix $A = \begin{bmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 0 & 2 \end{bmatrix}$ **(07 Marks)**

Module-2

3 a. A function f(x) is given by the following table

x	0	1	2	3	4	5	6
f(x)	176	185	194	203	212	220	229

Obtain the value of f(x) at x = 0.6 by using appropriate interpolation formula. **(06 Marks)**

b. The equation $x^3 - 3x + 4 = 0$ has one real root between -2 and -3. Find the root to three places of decimals by using Regula-Falsi method. **(07 Marks)**

c. Using Simpson's 1/3rd rule, evaluate $\int_0^1 e^{-x^2}$ by dividing the interval (0, 1) into 10 sub intervals, (h = 0.1). **(07 Marks)**

OR

4 a. Find f(2.5) by using Newton's backward interpolation formula given that f(0) = 7.4720, f(1) = 7.5854, f(2) = 7.6922, f(3) = 7.8119, f(4) = 7.9252. **(06 Marks)**

b. Find the real root of the equation $xe^x - 2 = 0$, correct to three decimal places by using Newton Raphson method. **(07 Marks)**

c. Evaluate $\int_0^1 \frac{x\,dx}{1+x^2}$ by Weddle's rule taking seven ordinates. **(07 Marks)**

Module-3

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

b. Solve : $(D^2 + 7D + 12)y = \cosh x$ **(07 Marks)**

c. Solve : $\frac{d^2y}{dx^2} - 3\frac{dy}{dx} + 2y = \cos 2x$ **(07 Marks)**

OR

6 a. Solve : $(D^3 - 4D^2 + 5D - 2)y = 0$ **(06 Marks)**

b. Solve : $\frac{d^2y}{dx^2} - 4y = \cosh(2x - 1) + 3^x$ **(07 Marks)**

c. Solve : $(D^2 - 4D + 3)y = \sin 3x.\cos 2x$ **(07 Marks)**

Module-4

7 a. Form the partial differential equation by eliminating the arbitrary constants 'a' and 'b' $z = (x^2 + a)(y^2 + b)$ **(06 Marks)**

b. Form the partial differential equation by eliminating arbitrary functions "f" from $z = f\left(\frac{xy}{z}\right)$. **(07 Marks)**

c. Solve $\frac{\partial^2 z}{\partial x \partial y} = \sin x.\sin y$, given that $\frac{\partial z}{\partial y} = -2\sin y$ when x = 0 and z = 0 when y is an odd multiple of $\pi/2$. **(07 Marks)**

OR

8 a. Form the partial differential equation by eliminating arbitrary function 'f' from the function $f(xy + z^2, x + y + z) = 0$ **(06 Marks)**

b. Form partial differential equation by eliminating arbitrary functions 'f' and 'g' from the function $z = y\,f(x) + x\,g(y)$ **(07 Marks)**

c. Solve $\frac{\partial^2 z}{\partial x^2} + z = 0$, given that when x = 0, $z = e^y$ and $\frac{\partial z}{\partial x} = 1$. **(07 Marks)**

Module-5

9 a. A bag contains 8-white and 6-red balls. Find the probability of drawing two balls of the same colour. **(06 Marks)**

b. Three machines A, B, C produces 50%, 30%, 20% of the items in a factory. The percentage of defective outputs are 3, 4, 5. If an item is selected at random, what is the probability that it is defective? What is the probability that it is for A? **(07 Marks)**

c. A can hit a target 3-times in 5 shots, B – 2 times in 5 shots and C – 3 times in 4 shots. They fire a volley. What is the probability that i) two shots hit ii) atleast two shots hit? **(07 Marks)**

OR

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

b. State the axiomatic definition of probability. For any two arbitrary events A and B, prove that $P(A \cup B) = P(A) + P(B) - P(A \cap B)$. **(07 Marks)**

c. If A and B are two events with $P(A) = \frac{1}{2}$, $P(B) = \frac{1}{3}$, $P(A \cap B) = \frac{1}{4}$. Then find $P(A/B)$, $P(B/A)$, $P\left(\bar{A}/\bar{B}\right)$, $P\left(\bar{B}/\bar{A}\right)$ and $P\left(A/\bar{B}\right)$. **(07 Marks)**

* * * * *

CBCS SCHEME

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

18ME42

Fourth Semester B.E. Degree Examination, Dec.2024/Jan.2025
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 steam tables / Molar circuit / Psychrometric chart permitted.

Module-1

1 a. Obtain an expression for the mean effector pressure for an engine operation based on air standard Otto cycle. **(08 Marks)**

b. The volume of air at the beginning of compression in a single cylinder engine operated on dual cycle is 0.0168 m^3. The maximum pressure in the cycle is limited to 60 bar. The pressure and temperature of the air at the beginning of the cycle are 1 bar and 27°C. Heat is added during constant pressure process upto 3% of the stroke. Assuming cylinder diameter as 25 cm and stroke as 30 cm find the following :

(i) Work done per cycle
(ii) Air standard efficiency of the cycle.
(iii) Power developed if the number of working cycles are 200 per minute. **(12 Marks)**

OR

2 a. Describe the phenomenon of detoxation or knocking in S.I. Engine. How can it be controlled? **(06 Marks)**

b. The following observations were made during a trial of a single cylinder four stroke gas engine having cylinder diameter of 18 cm and stroke of 24 cm.

Duration of trial = 30 min; Total N = 9000; Total number of explosion=4200;
1 m.c.p = 5 bar ; Net load = 390 N ;
Effective diameter of brake wheel = 1 m ;
Calorific value of gaseous fuel at NTP = 19 MJ/m^3 ;
Total fuel used at NTP = 2.4 m^3 ; Total air used = 36 m^3 ;
Pressure of air = 720 mm of mercury ; Density of air at NTP = 1.29 kg/m^3 ;
Temperature of air =17°C ; Temperature of exhaust gases = 350°C ;
Sp.Heat of exhaust gases = 1 kJ/kgK ; Room temperature = 17°C ;
Cooling water circulated = 80 kg ; Rise in temperature of cooling water=30°C

Draw up a heat balance sheet and estimate the mechanical and indicated thermal efficiencies of the engine take R = 287 kJ/kgK. **(14 Marks)**

Module-2

3 a. Sketch the flow diagram and corresponding temperature entropy diagram of a gas turbine plant having 2 stage compression with intercooling, a regenerator and a 2 stage expansion with reheating in between the stages. Mark the state points clearly on both the diagrams. (Also description is necessary) **(06 Marks)**

b. In an open cycle gas turbine plant air enters the compressor at 1 bar and 27°C. The pressure of air after compression is 4 bar. The isentropic efficiency of the turbine and compressor are 85% and 80% respectively. Air fuel ratio is 80 : 1. Calorific value of fuel used is 42000 KJ/kg. Mass flow rate of air is 2.5 kg/sec. Determine the power output from the plant and the cycle efficiency. Assume that C_P and V to be same for both air and products of combustion. **(14 Marks)**

OR

4 a. Explain briefly the methods used to increase the thermal efficiency and work output of a gas turbine power plant. **(08 Marks)**

b. In a gas turbine plant, the air at 10°C and 1 bar is compressed to 4 bar with compression efficiency of 80%. The air is heated in the regenerator and combustion chamber till the temperature is raised to 700°C and during the process, the pressure falls by 0.14 bar. The air is then expanded in the turbine and passes to regenerator which has 75% effectiveness and causes a pressure drop of 0.14 bar. If the isentropic efficiency of the turbine is 85%, determine the thermal efficiency of the plant. **(12 Marks)**

Module-3

5 a. Explain with the help of TS diagrams the effect of varying the boiler pressure and condenser pressure on the performance of a simple Rankine cycle. **(10 Marks)**

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

OR

6 a. Why is Carnot cycle not practicable for steam power plant? Explain briefly. **(06 Marks)**

b. Steam at 30 bar and 350°C is supplied to a steam turbine in a practical regenerative cycle and the steam is bled at 4 bar. The bled steam comes out as dry saturated steam and heats the feed water in an open type feed water, heater to its saturated liquid state. Rest of the steam in the turbine expands to a condenser pressure of 0.1 bar. Assuming the turbine efficiency to be same before and after bleeding determine,

(i) The turbine efficiency.
(ii) Steam quality at inlet to the condenser.
(iii) Mass flow rate of bled steam per unit mass flow rate at turbine inlet.
(iv) Cycle efficiency. **(14 Marks)**

Module-4

7 a. With the help of a neat sketch, elucidate the working of a vapour compression refrigeration system with the help of TS and hs diagram. Obtain the expression for the C.O.P. and capacity of refrigeration system. **(08 Marks)**

b. In a Bell-Colemann cycle, environment temperature is 302 K and the refrigerant temperature is 282 K. The pressure in the refrigerator is 1 bar and that in the cooler is 8 bar, Find the following :

(i) Maximum pressure and temperature in the cycle.
(ii) Refrigerant effect and heat rejected per kg of air.
(iii) Net work required per kg of air
(iv) Compressor and expander swept volume per kg of air
(v) C.O.P of the cycle.
(vi) η_e (relative efficiency)

Assume compression and expansion follow the Law $PV^{1.35} = C$. **(12 Marks)**

OR

8 a. Define the following terms with respect to air conditioning :
(i) Dry bulb temperature
(ii) Wet bulb temperature
(iii) Dew point temperature
(iv) Specific humidity
(v) Relative humidity **(10 Marks)**

b. The sling psychrometer in a laboratory test recorded the following readings:
(i) Dry bulb temperature = 35 °C
(ii) Wet bulb temperature = 25 °C
Calculate the following :
(i) Specific humidity (ii) Relative humidity
(iii) Vapour density in air. (iv) Dew point temperature
(v) Enthalpy of mixture per kg dry air.
Take atmospheric pressure = 1.0132 bar. **(10 Marks)**

Module-5

9 a. Define the following with respect to a reciprocating air compressor,
(i) Isothermal efficiency
(ii) Adiabatic efficiency
(iii) Mechanical efficiency
(iv) Overall efficiency
(v) Volumetric efficiency **(10 Marks)**

b. The following data refer to a single stage air compressor :
Atmospheric conditions = 1 bar and 25 °C
Receiver pressure = 10 bar,
Cylinder diameter = 12 cm,
Stroke to Bore ratio is unity,
Clearance volume is $\frac{1}{25}^{th}$ of the stroke volume.
Index for both the compression and expansion = 1.25,
Mechanical efficiency = 80%, if the receiver capacity is 600 liters and it takes 8 minutes to fill the receiver till its pressure is 10 bar starting from 1 bar, determine
(i) Actual volumetric efficiency.
(ii) Mass of air compressed per second
(iii) Speed of compressor
(iv) Power input.
Assume that receiver temperature to remain at 25 °C throughout the filling process.
(10 Marks)

OR

10 a. What are the disadvantages of a single stage compressor? Obtain an expression for optimum pressure ratio in case of a 2 stage reciprocating air compressor with perfect inter cooling. Also derive an expression for minimum work for the same. **(10 Marks)**

b. A single acting two stage air compressor with complete inter cooling delivers 6 kg/min of air at 15 bars pressure. Assuming an intake state of 1 bar and 15 °C and that of compression and expansion processes are polytropic with n = 1.3. Calculate the power required and isothermal efficiency if the speed is 410 rpm. Assuming the clearance volume of L.P. and H.P. cylinders to be 4% and 5% of the respective cylinder swept volumes, calculate the swept and clearance volumes for the cylinder. **(10 Marks)**

* * * * *

CBCS SCHEME

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

18ME43

Fourth Semester B.E. Degree Examination, Dec.2024/Jan.2025
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 with SI units :
i) weight density ii) kinematic viscosity iii) capillarity iv) Bulk modulus. **(08 Marks)**

b. What is the effect of pressure and temperature on mass density? **(04 Marks)**

c. A cubical block of 200 mm edge and weight 196 N is allowed to slide down an inclined plane 20° to horizontal on which there is thin film of oil of viscosity 2.156×10^{-3} Pa-See. What terminal velocity will be attained by the block. It the film thickness is estimated to be 0.025 mm. **(08 Marks)**

OR

2 a. Define the following :
i) Atmospheric pressure ii) Vacuum pressure iii) Absolute pressure. **(06 Marks)**

b. Derive an expression for the hydrostatic force exerted on a plane surface immersed vertically in a liquid and to locate centere of pressure. **(08 Marks)**

c. Find intensity of pressure required to suck fruit juice by a straw through a height of 200 mm from a vessel in absolute scale. Take relative density of fruit juice as 1.20. **(06 Marks)**

Module-2

3 a. Explain the following terms :
i) Buoyancy ii) Centere of buoyancy iii) Meta centre iv) Meta centric height **(06 Marks)**

b. A rectangular pontoon is 5 m long, 3 m wide and 1.2 m high. The depth of immersion of the pontoon is 0.8 m in seawater. If the centre of gravity is 0.6 m above the bottom of the pontoon. Determine the metacentric height. The density of sea water = 1025 Kg/m^3. **(08 Marks)**

c. Explain the conditions of equilibrium of submerged and floating bodies. **(06 Marks)**

OR

4 a. Explain the following :
i) Study and unstudy flows
ii) Uniform and nonuniform flows
iii) Laminar and turbulent flows
iv) Compressible in incompressible flows. **(08 Marks)**

b. Derive continuity equation for 3D, flow for Cartesian coordinate system. **(08 Marks)**

c. Calculate the unknown velocity component so that the following velocity components represent a possible case of incompressible flow
$u = 2x^2$, $v = xyz$, $w = ?$ **(04 Marks)**

Module-3

5 a. Derive Euler's equation of motion along a stream line, Also derive Bernoulli's equation from Euler's equation of motion and list the assumptions made for deriving Bernoulli's equations. **(10 Marks)**

b. A 50 mm diameter tube gradually expands to 100 mm diameter in a length of 10 m. If the tube makes an angle of 20° in the upward direction with the horizontal. Determine the pressure at the exist. If the tube carries a discharge of 3.125 liters/sec and the inlet pressure is $60kN/m^2$, when
i) When there is no loss of energy
ii) Loss of energy is 0.2 m, flow being upwards. **(10 Marks)**

OR

6 a. Derive Darcy-Weisbach relation for fluid flow through a pipe. **(04 Marks)**

b. Differentiate between venturimeter and orifice meter. **(08 Marks)**

c. Prove that the ratio of maximum velocity to average velocity for Laminar Flow between two stationary parallel plates is 1.5. **(08 Marks)**

Module-4

7 a. Explain the terms :
i) Lift ii) Drag iii) Displacement thickness iv) Momentum thickness. **(10 Marks)**

b. A flat plate 1.5 m × 1.5 m moves at 50 kM/hr in stationary air of density $1.15 Kg/m^3$. If the coefficient of drag and life are 0.15 and 0.75 respectively. Determine :
i) The life force
ii) The drag force
iii) The resultant force
iv) The power required to keep the plate in motion. **(06 Marks)**

c. Write a short note on boundary layer separation method to control it. **(04 Marks)**

OR

8 a. What is fundamental quantities and derived quantities with respect to dimensional analysis. **(04 Marks)**

b. Explain the following :
i) Geometric similarity ii) Kinematic similarity iii) Dynamic similarity **(06 Marks)**

c. Using Buckingham's π theorem show that discharge of a centrifugal pump is given by $Q = ND^3\phi\left[\frac{gH}{N^2D^2}, \frac{\mu}{ND^2\rho}\right]$. **(10 Marks)**

Module-5

9 a. Derive an expression for velocity of sound in terms of bulk modulus. **(08 Marks)**

b. Define the following :
i) Mach number ii) Sub sonic flow iii) Sonic flow iv) Super Sonic flow. **(06 Marks)**

c. An aeroplane is flying at on height of 15 km , where the temperature is -50°C. The speed of the plane is corresponding to M = 2.0 (Mach number). Assuming K = 1.4 and R = 287 J/Kg° K. Find the speed of the plane. **(06 Marks)**

OR

10 a. Derive an expression for stagnation temperature. **(06 Marks)**

b. Write a note on oblique and normal shocks. **(04 Marks)**

c. Define; computational fluid dynamics (CFD) also mention their applications and limitations. **(10 Marks)**

* * * * *

CBCS SCHEME

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

18ME44

Fourth Semester B.E. Degree Examination, Dec.2024/Jan.2025
Kinematics of Machines

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 with an example : i) Kinematic pair ii) Kinematic chain iii) Mechanism iv) Degree of freedom. **(08 Marks)**

b. Sketch and explain the following mechanisms :
i) Oscillating cylinder mechanism ii) Scotch yoke mechanism. **(12 Marks)**

OR

2 a. What is quick return motion mechanism? Sketch and explain crank and slotted lever mechanism. **(08 Marks)**

b. With neat sketches, explain the following mechanisms :
i) Ratchet and Pawl mechanism ii) Pantograph. **(12 Marks)**

Module-2

3 a. With a simple sketch, explain Corioli's component of acceleration. **(06 Marks)**

b. In a four bar mechanism ABCD. The link AD is fixed and crank AB rotates at 100 rpm clockwise. The link AB make 60° with fixed link AD. The lengths of link AB , BC ,CD and AD are 90, 120, 120 and 180 mm respectively. Determine angular velocity of link BC and CD by relative velocity method. **(14 Marks)**

OR

4 a. What is Instantaneous centre? Explain the types of instantaneous centres. **(08 Marks)**

b. The crank of an engine mechanism is 200 mm long and ratio of connecting rod to crank is 4. The crank speed is 240 rpm clockwise. When the crank has turned through 45° from inner dead centre determine the following using instantaneous centre method.
i) Angular velocity of connecting rod ii) Velocity of the slider. **(12 Marks)**

Module-3

5 a. What is Loop closure? Explain loop closure equation for Four bar mechanism. **(06 Marks)**

b. In a slider crank mechanism the crank and connecting rods are 150 mm and 600 mm long respectively. The crank rotates at uniform speed of 100 rpm clockwise. When the crank makes 30° with 1DC. Find
i) Angular velocity and angular acceleration at the connecting rod.
ii) Velocity and acceleration of the slider.
Use Complex algebra method. **(14 Marks)**

OR

6 a. Derive Freudenstein's equation for slider crank mechanism. **(08 Marks)**

b. Design a four bar mechanisms when the motions of the input and output links are governed by a function $y = 2x^2$ and x varies from 2 to 4 with an interval of 1. Assume θ to vary from 40° to 120° and ϕ from 60° to 132°. **(12 Marks)**

Module-4

7 Draw the profile of the cam with 30 mm minimum radius is rotating clockwise and has to give motion to the knife edge follower with follower axis offset to the right by 10 mm. The cam lifts the follower for 120° of cam rotation with SHM , followed by a dwell period of 60°. Then the follower returns to starting position through 90° with UARM and then dwells for the remaining period. Stroke = 300 mm. **(20 Marks)**

OR

8 The following data relate to a cam profile which operates a reciprocating inline roller follower.
Minimum radius of the cam = 30 mm
Roller diameter = 15 mm
Stroke of the follower = 30 mm
The follower moves outward during 150° with UARM.
Dwell for next 30°
Return during next 120° with SHM. Dwells for the rest of the rotation.
Draw the cam profile if the cam rotates in clockwise. **(20 Marks)**

Module-5

9 a. What is Interference in gears? Explain in brief the methods to avoid interference. **(08 Marks)**

b. Two spur gears have 24 and 30 teeth of module 10 mm. The standard addendum is 1 module and pressure angle is 20°. Determine
i) Length of path of contact ii) Length of arc of contact iii) Contact Ratio. **(12 Marks)**

OR

10 a. Sketch and explain i) Simple gear train ii) Reverted gear train. **(06 Marks)**

b. An epicyclic gear train consists of three gears A, B and C as shown in Fig. Q1(b). The internal gear A has 72 teeth and gear C has 32 teeth. The gear B meshes with both gear A and C and is carried on an arm F, which rotates about the centre of gear A and C at 20 rpm. If the gear A is fixed determine the speed of gears B and C using Tabular column method. **(14 Marks)**

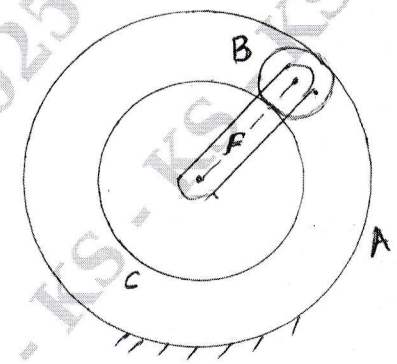

Fig. Q10(b)

* * * * *

CBCS SCHEME

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

18ME46B

Fourth Semester B.E. Degree Examination, Dec.2024/Jan.2025
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. Explain the objectives of metrology. **(06 Marks)**

b. With neat sketches, explain material standards. **(08 Marks)**

c. Explain adjustable slip gauge. How is it different form regular slip gauge? **(06 Marks)**

OR

2 a. Explain the working principle of autocollimeter with a neat sketch. **(08 Marks)**

b. Three 100 mm end bars are measured on a level comparator by first wringing them together and comparing with a 300 mm bar. There was an error of 0.03 mm and three bars together have total error of 0.064 mm less than the standard bar. Bar A is 0.02 mm longer than bar B and 0.025 mm longer than bar C. Determine the actual dimensions of all the end bars. **(08 Marks)**

c. List the range and number of pieces available in a standard set of M112 slip gauge. **(04 Marks)**

Module-2

3 a. Discuss unilateral and bilateral tolerance. **(04 Marks)**

b. With a neat sketch, explain hole basis and shaft basis system. **(08 Marks)**

c. A shaft of 35 ± 0.004 mm is to be checked by GO-NOGO gauge. Design the required dimension for gauge. Also, draw the diametric representation. **(08 Marks)**

OR

4 a. Sketch and explain Johnson Mikrokator. **(06 Marks)**

b. List the characteristics and applications of comparators. **(08 Marks)**

c. Give the classification of comparators. Explain any one in detail. **(06 Marks)**

Module-3

5 a. Explain the method of measurement of pitch diameter. **(10 Marks)**

b. With a neat sketch, explain the construction and working of toolmaker's microscope. **(10 Marks)**

OR

6 a. Sketch and explain the various types of standard tooth profile of a gear. **(10 Marks)**

b. Write short notes on base tangent method. **(05 Marks)**

c. Discuss the errors produced in manufacturing of gears. **(05 Marks)**

Module-4

7 a. Explain generalized measurement system with block diagram. **(06 Marks)**

b. Define the following terms:

i) Accuracy
ii) Precision
iii) Sensitivity
iv) Loading effect
v) Hysteresis. **(10 Marks)**

c. Explain the working principle of strain gauge. **(04 Marks)**

OR

8 a. With a neat sketch, explain the construction and working of cathode ray oscilloscope. **(10 Marks)**

b. Explain electrical intermediate modifying device. **(05 Marks)**

c. Write short notes on terminating devices. **(05 Marks)**

Module-5

9 a. List force measuring devices. Explain any one in detail. **(08 Marks)**

b. Explain the working of McLeod gauge. **(06 Marks)**

c. Briefly explain the types of dynameters. **(06 Marks)**

OR

10 a. Explain the laws of thermocouple. **(08 Marks)**

b. List the devices used for strain measurement. Explain any one in detail. **(08 Marks)**

c. Explain the method of preparation and mounting of strain gauges. **(04 Marks)**

* * * * *