

CBCS SCHEME

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18MAT41

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024 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. State and prove Cauchy – Riemann equations in Cartesian form. (07 Marks)
b. Find the analytic function $f(z) = u + iv$, given that $u - v = e^x[\cos y - \sin y]$. (07 Marks)
c. If $y(z)$ is an analytic function, then show that :

$$\left\{ \frac{\partial}{\partial x} |f(z)| \right\}^2 + \left\{ \frac{\partial}{\partial y} |f(z)| \right\}^2 = |f'(z)|^2. \quad (06 \text{ Marks})$$

OR

- 2 a. Determine the analytic function $f(z)$, where imaginary part is $\left(\gamma - \frac{K^2}{\gamma} \right) \sin \theta$, $r \neq 0$. Hence find the real part of $f(z)$. (07 Marks)
b. Find the analytic function $f(z)$, whose real part is $u = \log \sqrt{x^2 + y^2}$. (07 Marks)
c. Show that $f(z) = z^n$ is analytic and hence find its derivative. (06 Marks)

Module-2

- 3 a. Discuss the transformation $w = z^2$. (07 Marks)
b. State and prove Cauchy's integral theorem. (07 Marks)
c. Evaluate : $\int_0^{(2+i)} (\bar{z})^2 dz$, along the real axis up to 2 and then vertically to $2 + i$. (06 Marks)

OR

- 4 a. Evaluate : $\int_c \frac{\sin \pi z^2 + \cos \pi z^2}{(z-1)(z-2)} dz$ where c is the circle $|z| = 3$. (07 Marks)
b. Find the bilinear transformation that maps the points $z = 1, i, -1$ onto $w = 0, 1, \infty$. (07 Marks)
c. Evaluate : $\int_{(1-i)}^{(2+i)} (2x + iy + 1) dz$ along the straight line joining the points $(1, -1)$ and $(2, 1)$. (06 Marks)

Module-3

- 5 a. A coin is tossed twice. If x represents the number of heads turning up, find the probability distribution of x . also find its mean and variance. (07 Marks)
b. If 2% of the fuses manufactured by a firm are defective. Find the probability that a box containing 200 fuses contains : i) no defective fuses ii) 3 or more defective fuses. (07 Marks)
c. In a normal distribution, 31% of the items are below 45 and 8% of the items are above 64. Find the mean and standard deviation of the distribution. Given that :
 $A(1.4) = 0.42$ and $A(0.5) = 0.1915$. (06 Marks)

OR

- 6 a. Find the constant K such that

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

is a probability density function. Also find :

- i) $P(1 \leq x \leq 2)$
- ii) $P(x \leq 2)$
- iii) $P(x > 1)$. (07 Marks)
- b. When a coin is tossed 4 items, find the probability of getting
- i) exactly one head
- ii) at most 3 heads
- iii) at least 2 heads. (07 Marks)
- c. If x is an exponential variate with mean 5. Evaluate :
- i) $P(0 < x < 5)$
- ii) $P(-\infty < x < 10)$
- iii) $P(x \leq 0)$ or $(x \geq 1)$. (06 Marks)

Module-4

- 7 a. Find the coefficient of correlation and the lines of regression for the following data :

x	1	2	3	4	5
y	2	5	3	8	7

(07 Marks)

- b. Fit a curve of the form
- $y = ax^b$
- for the data :

x	1	2	3	4	5
y	0.5	2	4.5	8	12.5

(07 Marks)

- c. If the equations of regression lines of two variables x and y are
- $x = 19.13 - 0.879y$
- and
- $y = 11.64 - 0.5x$
- . Find the correlation coefficient and the means of x and y. (06 Marks)

OR

- 8 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

(07 Marks)

- b. Fit a parabola
- $y = a + bx + cx^2$
- by the method of least squares to the following data :

x	1	2	3	4	5	6	7
y	2.3	5.2	9.7	16.5	29.4	35.5	54.4

(07 Marks)

- c. Compute the mean values of x and y and the coefficient correlation for the regression lines
- $2x + 3y + 1 = 0$
- and
- $x + 6y - 4 = 0$
- . (06 Marks)

Module-5

- 9 a. The joint probability distribution of two random variables x and y is defined by the function $P(x, y) = \frac{1}{27}(2x + y)$, where x and y assume the values 0, 1, 2. Find the marginal distributions of x and y . Also compute $E(x)$ and $E(y)$. (07 Marks)
- b. Fit a Poisson distribution for the following data and test the goodness of fit. Given that $\chi^2_{0.05} = 9.49$ for degrees of freedom 4. (07 Marks)
- c. Write short notes on :
 i) Null hypothesis
 ii) Type – I and Type – II
 iii) Level of significance. (06 Marks)

OR

- 10 a. Joint probability distribution of two random variables is given by the following data :

y x	-3	2	4
1	0.1	0.2	0.2
3	0.3	0.1	0.1

- Find :
 i) Marginal distributions of x and y
 ii) $Cov(x, y)$
 iii) $P(x, y)$. (07 Marks)
- b. The following are the I-Q's of a randomly chosen sample of 10 boys.
 70, 120, 110, 101, 88, 83, 95, 98, 107, 100
 Does this data support the hypothesis that the population mean of I-Q's is 100 at 5% level of significance? Given $t_{0.05} = 2.26$. (07 Marks)
- c. A sample of 900 items is found to have the mean 3.4. Can it be reasonably regarded as a truly random sample from a large population with mean 3.25 and standard deviation 1.61 at 5% level of significance? Given $Z_{0.05} = 1.96$ (Two Tailed Test). (06 Marks)

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18MATDIP41

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024 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 $\begin{bmatrix} 1 & 2 & 3 & 2 \\ 2 & 3 & 5 & 1 \\ 1 & 3 & 4 & 5 \end{bmatrix}$. (06 Marks)
- b. Solve by using Gauss elimination method. Given $x + y + z = 9$, $2x + y - z = 0$ and $2x + 5y + 7z = 52$. (07 Marks)
- c. Find the eigen values and eigen vectors of the matrix $\begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$. (07 Marks)

OR

- 2 a. Find the rank of the matrix $\begin{bmatrix} 0 & 1 & -3 & -1 \\ 1 & 0 & 1 & 1 \\ 3 & 1 & 0 & 2 \\ 1 & 1 & -2 & 0 \end{bmatrix}$. (06 Marks)
- b. Find the eigen values and eigen vectors of the matrix $A = \begin{bmatrix} -19 & 7 \\ -42 & 16 \end{bmatrix}$. (07 Marks)
- c. Find the values of λ and μ so that the equations $x + y + z = 6$, $x + 2y + 3z = 10$ and $x + 2y + \lambda z = \mu$ have (i) no solution (ii) a unique solution (iii) an infinite number of solutions. (07 Marks)

Module-2

- 3 a. Using Newton Raphson method, find the real root of the equation $3x = \cos x + 1$, correct to four decimal places. Take $x = 0.6$ as the initial approximation. (06 Marks)
- b. Given $f(40) = 184$, $f(50) = 204$, $f(60) = 226$, $f(70) = 250$, $f(80) = 276$, $f(90) = 304$. Find $f(85)$ using Newton's backward difference interpolation formula. (07 Marks)
- c. Evaluate $\int_0^6 \frac{1}{1+x^2} dx$ by using Simpson's $\frac{1}{3}$ rule by considering 6 subintervals. (07 Marks)

OR

- 4 a. Using Regula Falsi method, find a real root of the equation $x \log_{10} x - 1.2 = 0$ which lies in (2, 3). Carryout 3 iterations. (06 Marks)
- b. Using the following data, find y when $x = 1$. Given,
- | | | | | | | | |
|---|-----|-----|------|------|------|------|------|
| x | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| y | 4.8 | 8.4 | 14.5 | 23.6 | 36.2 | 52.8 | 73.9 |
- Use Newton's forward interpolation formula. (07 Marks)

- c. Evaluate $\int_4^{5.2} \log x dx$ by using Weddle's rules taking 6 subintervals. (07 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.

Module-3

- 5 a. Solve $(D^3 + 3D^2 + 3D + 1)y = 0$. (06 Marks)
 b. Solve $(D^2 + 7D + 12)y = \cosh x$. (07 Marks)
 c. Solve $(D^2 - 4D + 4)y = \cos 2x$. (07 Marks)

OR

- 6 a. Solve $(4D^4 - 8D^3 - 7D^2 + 11D + 6)y = 0$. (06 Marks)
 b. Solve $(D^2 - 6D + 9)y = 6e^{3x}$. (07 Marks)
 c. Solve $(D^2 - 5D + 6)y = \sin 3x$. (07 Marks)

Module-4

- 7 a. Form the partial differential equation by eliminating arbitrary functions from $z = y^2 + 2f\left(\frac{1}{x} + \log y\right)$. (06 Marks)
 b. Form the PDE by eliminating arbitrary constants a and b from the relation $(x - a)^2 + (y - b)^2 + z^2 = k^2$. (07 Marks)
 c. Solve $\frac{\partial^2 z}{\partial x^2} = a^2 z$, given that when $x = 0$, $z = 0$ and $\frac{\partial z}{\partial x} = a \sin y$. (07 Marks)

OR

- 8 a. Form a partial differential equation by eliminating the arbitrary function from $\phi(x + y + z, x^2 + y^2 + z^2) = 0$. (06 Marks)
 b. Form a partial differential equation by eliminating arbitrary function from $z = f(x + ct) + g(x - ct)$. (07 Marks)
 c. Solve $\frac{\partial^2 z}{\partial x \partial y} = \sin x \sin y$ by direct integration. Given that $\frac{\partial z}{\partial y} = -2 \sin y$ when $x = 0$ and $z = 0$ when y is an odd multiple of $\frac{\pi}{2}$. (07 Marks)

Module-5

- 9 a. Given $P(A) = \frac{1}{4}$, $P(B) = \frac{1}{3}$ and $P(A \cup B) = \frac{1}{2}$. Find $P(A/B)$, $P(B/A)$, $P(A \cap \bar{B})$ and $P(A/\bar{B})$. (06 Marks)
 b. The probability that three students A, B, C, solve a problem is $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$ respectively. If the problem is simultaneously assigned to all of them, what is the probability that the problem is solved? (07 Marks)
 c. State and prove Baye's theorem. (07 Marks)

OR

- 10 a. If A and B are independent events, show that \bar{A} and \bar{B} are also independent. (06 Marks)
 b. The probability that a team wins a match is $\frac{3}{5}$. If this team plays 3 matches in a tournament, what is the probability that the team wins (i) atleast one match (ii) all matches. (07 Marks)
 c. An office has 4 secretaries handling respectively 20%, 60% and 15% and 5% of the files of all government reports. The probability that they misfile such reports is respectively 0.05, 0.1 and 0.05. Find the probability that a misfiled report can be blamed on first secretary? (07 Marks)

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18ME42

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024 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 thermodynamic data handbook is permitted.*

Module-1

- 1 a. With a neat P-V and T-S diagrams for a diesel cycle, derive an expression for air-standard efficiency in terms of compression ratio and cut-off ratio. (10 Marks)
b. The compression ratio of a diesel cycle is 14 and cut off ratio is 2.2. At the beginning of the cycle, air is at 0.98 bar and 100°C. Find : (i) Temperature and pressure at salient points (ii) Air standard efficiency (iii) Mean effective pressure. Represent with neat sketches of P-V and T-S. (10 Marks)

OR

- 2 a. Explain with neat diagram combustion in CI engine. (10 Marks)
b. A six cylinder four stroke IC engine is designed to develop 60 KW power at an average pressure of 7 bar. The bore and stroke of the engine is 70 mm and 100 mm respectively. If the engine speed is 3700 rpm, find the average misfires/min and actual power developed. (10 Marks)

Module-2

- 3 a. With neat P-V and T-S diagrams, explain the process of Brayton cycle and derive an expression for efficiency of ideal gas turbine. (10 Marks)
b. Air enters compressor of an open cycle constant pressure gas turbine at a pressure of 1 bar and temperature of 20°C. The pressure of air after compression is 4 bar. The isentropic efficiencies of the compressor and turbine are 80% and 85% respectively. The air fuel ratio used is 90:1. The air flow rate is 3 kg/s. Find : (i) Power developed (ii) Thermal efficiency of the cycle. (10 Marks)

OR

- 4 a. Analyze Ram pressure ratio with respect to Mach number of a Ram jet engine for sea level conditions. (10 Marks)
b. A jet propulsion unit with turbo jet engine propelling with a forward speed of 1100 km/h produces 14 kN of thrust and uses 2400 kg of air per minute. Find:
(i) The relative exit jet velocity (ii) The thrust power
(iii) The propulsive power (iv) The propulsive efficiency (10 Marks)

Module-3

- 5 a. With a schematic diagram and T-S diagram, briefly explain the working of regenerative vapor cycle with open feed water heaters. Derive the thermal efficiency expression for the same. (10 Marks)
b. A reheat cycle operating between 30 bar and 0.04 bar pressure. The temperature of steam supplied from boiler is 450°C. The first stage of expansion taken place till the steam is dry saturated and then reheated to 450°C and then expanded in second stage. Determine:
i) Reheat pressure ii) Quality of exhaust steam
iii) Ideal cycle efficiency iv) Steam rate (10 Marks)

OR

- 6 a. With neat diagram, explain the effects of pressure and temperature on Rankine cycle performance. (12 Marks)
- b. In a boiler house steam from a steam generator enters a turbine at 20 bar and expands to condenser pressure of 0.2 bar. Determine the Rankine cycle efficiency neglecting pump work.
- (i) When steam is 85% dry at turbine inlet.
- (ii) When steam is saturated at turbine inlet.
- (iii) When steam is superheated at turbine inlet by 37.6°C (08 Marks)

Module-4

- 7 a. Analyse vapour compression refrigeration cycle for, (i) Heat rejected (ii) COP (iii) Compressor displacement (iv) Power consumption per TR (10 Marks)
- b. An air refrigeration plant is to be designed according to following specifications:
 Pressure at compressor inlet = 101 kPa
 Pressure of air at compressor exit = 404 kPa
 Temperature of air at compressor inlet = -6°C
 Temperature of air at turbine inlet = 27°C
 Isentropic efficiency of compressor = 85%
 Isentropic efficiency of turbine = 85%
 Determine:
- (i) COP of the cycle
 (ii) Power required to produce 1 ton of refrigeration
 (iii) Air circulation rate per ton of refrigeration. (10 Marks)

OR

- 8 a. Explain the following with definition:
 (i) Specific humidity
 (ii) Degree of saturation
 (iii) Dalton's law of partial pressures (10 Marks)
- b. Atmospheric air at 40°C and 40% RH is to be cooled to a state of saturated air at 10°C by dehumidification. The mass flow rate of air entering the dehumidifier is 0.8 kg/s. Neglecting the pressure drop, determine: (i) Mass of water removed (ii) Quantity of heat removed. (10 Marks)

Module-5

- 9 a. Obtain an expression for work done by a reciprocating compressor with and without clearance volume. (10 Marks)
- b. Find the power required to compress and deliver 2 kg of air per minute from 1 bar and 20°C to a delivery pressure of 7 bar when the compression is carried out in:
 (i) Single stage compressor
 (ii) Two stage compressor
 The compression of air follows the law $PV^{1.4} = C$. Neglect clearance and assume ideal conditions for intercooler. Take $R = 0.287 \text{ kJ/kg.K}$. (10 Marks)

OR

- 10 a. Why turbine nozzles are made divergent after the throat? (10 Marks)
- b. Steam at a pressure of 6.85 bar and 0.9 dry expands through a nozzle having a throat area of 4.65 cm^2 . The back pressure is 1.03 bar. Determine:
 (i) Mass of steam flowing per minute
 (ii) The diameter of mouth of the nozzle for maximum discharge
 (iii) The final velocity of the steam (10 Marks)

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Fourth Semester B.E. Degree Examination, Dec.2023/Jan.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. Define the following terms with S.I. units:
- i) Specific volume
 - ii) Relative density, S
 - iii) Kinematic viscosity
 - iv) Compressibility, C
 - v) Shear stress. (10 Marks)
- b. Dynamic viscosity of oil used for lubrication between a shaft and sleeve is 6 poise. Shaft diameter is 0.4m and rotates at 190rpm. Determine the power lost in the bearing for a sleeve length of 90mm. Thickness of oil film is 1.2mm. Determine the shear stress. (10 Marks)

OR

- 2 a. Define capillary rise. Derive an expression for capillary rise of water in a tube of diameter d. (06 Marks)
- b. Define and derive an expression for the Pascal law of static fluid. (06 Marks)
- c. A circular plate 3.0m diameter is immersed in water such that its greatest and least depth below the free surface are 4.0m and 1.5m respectively. Determine total force on the plate and its location. (08 Marks)

Module-2

- 3 a. Define Metacentre and centre of Buoyance. Explain conditions of equilibrium for floating bodies. (08 Marks)
- b. A cylindrical buoy is 2m in diameter, 2.5m long and weighs 2.2 metric tones. Density of sea water is 1025kg/m^3 . Check the condition of cylinder for floating. (12 Marks)

OR

- 4 a. Obtain an expression for (3) three dimensional continuity equation in Cartesian co-ordinates. (08 Marks)
- b. Differentiate between:
- i) Steady flow and unsteady flow.
 - ii) Rotation and Irrotational flow.
 - iii) Viscous and Turbulent flow. (06 Marks)
- c. The stream function for a flow is given by $\psi = 2xy$. Determine the velocity at a point P(2, 3) and find velocity potential function. (06 Marks)

Module-3

- 5 a. Derive Bernoulli's equation for fluid flow and state the assumptions. (08 Marks)
- b. With neat sketch, explain working of the venturimeter fitted in a pipeline. (06 Marks)
- c. Determine the velocity and discharge of oil flow in a pipe, when the difference of mercury level in a differential u-Tube manometer connected to Pitot-tube is 100mm. Assume coefficient of pitot-tube is 0.98 and special gravity of oil is 0.80, diameter 200mm. (06 Marks)

OR

- 6 a. For viscous flow through a circular pipe derive Hagen-Poiseuille equation. (10 Marks)
 b. For a pipeflow, due to sudden enlargement of diameter of pipe from 240mm to 480mm, kinetic head increases by 10mm. Determine the rate of water flow in lit/sec. (10 Marks)

Module-4

- 7 a. Explain following terms:
 i) Boundary layer
 ii) Displacement thickness
 iii) Momentum thickness
 iv) Lift, drag. (10 Marks)
 b. A man descends to the ground from an aeroplane with the help of a parachute which is hemispherical having a diameter of 4.0m against the resistance of air with a uniform velocity of 25m/sec. Find the weight of the man if the weight of parachute is 9.81N. Assume $C_D = 0.6$ and density of air is 1.25kg/m^3 . (10 Marks)

OR

- 8 a. List four Non-Dimensional Numbers used in model similitude and obtain relations for the numbers. (10 Marks)
 b. The frictional torque T of a disc of diameter D rotating at a speed ' N ' in a fluid of viscosity ' M ' and density ' ρ ' in a turbulent flow is given by $T = \rho N^2 D^5 f\left(\frac{u\ell}{\rho ND^2}\right)$. Use dimensional analysis method. (10 Marks)

Module-5

- 9 a. Derive relation for velocity of sound in compressible fluid flow at adiabatic conditions. (10 Marks)
 b. Explain the terms:
 i) Subsonic flow ii) Supersonic flow. (05 Marks)
 c. A projectile travels in air of pressure 10.104N/cm^2 at 10°C with speed of 1500km/hour . Determine Mach number and Mach angle. Assume $K = 1.4$, $R = 287\text{J/kg K}$. (05 Marks)

OR

- 10 a. Obtain an expression for stagnation pressure in compressible fluid flow. (10 Marks)
 b. Explain the necessity of CFD and list the applications of CFD. (10 Marks)

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18ME44

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024 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. What is quick return motion? Explain with neat sketch crank and slotted lever mechanism. (10 Marks)
- b. Draw a neat sketch of peaucellier's mechanism. Explain with proof how the tracing point describes a straight line path. (10 Marks)

OR

- 2 a. Define the following:
 - i) Link ii) Kinematic chain iii) Degree of freedom iv) Inversion. (08 Marks)
- b. Explain with a neat sketch:
 - i) Beam engine mechanism
 - ii) Geneva wheel mechanism
 - iii) Toggle mechanism. (12 Marks)

Module-2

- 3 For a four bar mechanism shown in Fig.Q.3 determine the acceleration of C and angular acceleration of link 3 when crank 2 rotates at 20 radians per second. (20 Marks)

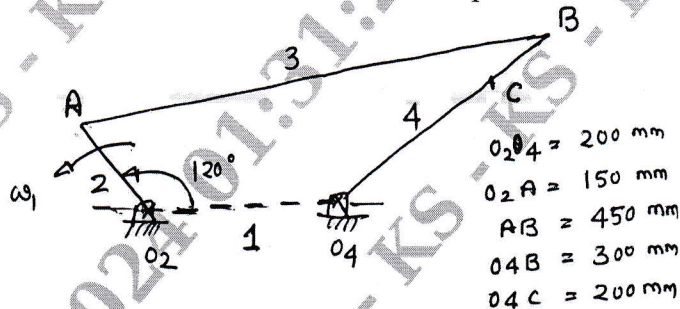


Fig.Q.3

OR

- 4 a. Define velocity of rubbing and spherical motion. (04 Marks)
- b. State and prove Kennedy's theorem. (06 Marks)
- c. In a slider crank mechanism shown in Fig.Q.4(c) the crank OA = 300mm and connecting rod AB = 1200mm. The crank OA is turned 30° from inner dead centre. Locate all the instantaneous centres. If the crank rotates at 15rad/sec clockwise find i) Velocity of slider B ii) Angular velocity of connecting rod AB. (10 Marks)

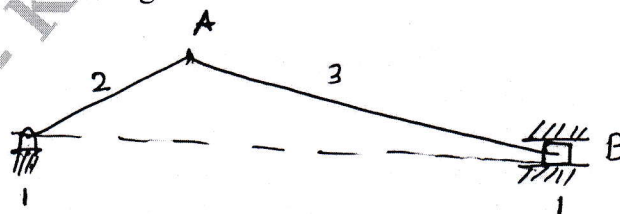


Fig.Q.4(c)

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-3

- 5 The crank of an engine is 200mm long and the ratio of connecting rod length to crank radius is 4. Determine the acceleration of piston when the crank has turned through 45° from the inner dead centre position and moving towards centre at 240rpm (CCW) direction by complex Algebra analysis. (20 Marks)

OR

- 6 a. Derive the expression for Freudensteion's equation for four bar mechanism. (15 Marks)
b. Explain function generation for four bar mechanism. (05 Marks)

Module-4

- 7 Draw the cam profile for cam with roller reciprocating follower. The axis of follower passes through the axis of cam. Particulars of cam and follower are the following:
Roller diameter = 20mm
Minimum radius of cam = 25mm
Total lift = 30mm
The cam has to lift the follower with SHM during 180° of cam rotation. Then allow the follower to drop suddenly half way and further return with uniform velocity during the remaining 180° of cam rotation. The cam rotates in anticlockwise direction. (20 Marks)

OR

- 8 A vertical spindle supplied with a plane horizontal face at its lower end is actuated by a cam keyed to a uniformly rotating shaft. The spindle is raised through a distance of 30mm in one fourth, remains at rest in $1/4$ is lowered in $1/3$ and remains at rest for the remainder of a complete revolution. Draw the profile assuming the least radius of cam profile as 25mm and that the spindle moves with uniform acceleration and retardation on both during ascent and descent. However during descent deceleration period is half the acceleration period. The axis of spindle passes through cam axis the cam rotates in anticlockwise direction. (20 Marks)

Module-5

- 9 a. Explain interference in gears. Discuss the methods of avoiding interference in gear drives. (10 Marks)
b. A pair of gears 40 and 30 teeth respectively are of 25° involute form addendum = 5mm module = 2.5mm if the smaller wheel is the driver and rotates at 1500rpm find the velocity of sliding at the point of engagement, at pitch point and the point of dis engagement, length of path of contact and length of arc of contact. (10 Marks)

OR

- 10 a. What do you mean by epicyclic gear train and also find the train value by algebraic method. (04 Marks)
b. In an epicyclic gear train the internal wheels A, B and the compound wheel C and D rotate independently about the axis "O". The wheels E and F rotate on a pin fixed to the arm G. E gears with A and C and F gears with B and D. All the wheels have same pitch and the number of teeth on E and F are 18, C = 28, D = 26.
i) Sketch the arrangement ii) Number of teeth on A and B iii) If arm G makes 150rpm CW and A is fixed find speed of B iv) If arm G makes 150rpm CW and wheel A makes 15rpm CCW find speed of B. (16 Marks)

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18ME46B/18MEB406

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024 Mechanical Measurements 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. Define Metrology. What are the objectives of metrology? (08 Marks)
b. Define material standard and wave length standard. Explain subdivision standards. (06 Marks)
c. List and draw the slip gauges to be wrong together to produce an overall dimension of :
i) 92.3565 ii) 62.306. Using M112 slip gauge set. (06 Marks)

OR

- 2 a. With a neat sketch, explain the working principle of sine bar. (06 Marks)
b. With a neat sketch, explain the working of autocollimator. (06 Marks)
c. Four length bars A, B, C, D of approximately 250mm each are to be calibrated with a calibrated standard meter bar which is 0.0008mm less than a meter. It is also found that, bar B is 0.0002mm longer than bar A, bar C is 0.0004mm longer than A, and bar D is 0.0001mm shorter than bar A the length of all four bars put together is 0.0003mm longer than the calibrated standard meter. Determine the actual dimensions of each bar. (08 Marks)

Module-2

- 3 a. Describe in detail the need of hole basis system and shaft basis system with sketches. (10 Marks)
b. Determine the dimensions of the shaft and hole for a 28H₈g₆ and sketch the fit. Diameter 28 falls in the diameter range of 18-30mm. Fundamental deviation for 'd' shaft is $-2.5D^{0.34}$,
 $IT_8 = 25i$, $IT_6 = 10i$, $I = 0.45\sqrt[3]{D} + 0.001D$ microns. (10 Marks)

OR

- 4 a. Give classification of comparators and explain with neat sketch Johansson Mikrokaktor. (10 Marks)
b. With a neat sketch, explain the construction and principle of solex pneumatic comparator. (10 Marks)

Module-3

- 5 a. With a neat sketch, explain the various terms used in the screw thread. (10 Marks)
b. With the help of neat sketch, explain the method of determining the chordal thickness of a gear tooth using gear tooth vernier calliper. (10 Marks)

OR

- 6 a. Derive an expression to find the effective diameter of screwthread using two-wire method. (10 Marks)
b. Sketch and explain composite error testing of spur gears. (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.

Module-4

- 7 a. Describe the generalized measurement system with a block diagram. (10 Marks)
b. Distinguish between :
i) Primary and Secondary transducer
ii) Active and Passive transducer. (10 Marks)

OR

- 8 a. Sketch and explain any one type of electrical transducer. Give advantages of electrical transducers. (10 Marks)
b. Describe the Cathode ray oscilloscope with a neat sketch. (10 Marks)

Module-5

- 9 a. With a neat sketch, explain the working principle of Prony brake dynamometer. What are its limitations? (10 Marks)
b. Sketch and explain the working of Pirani thermal conductivity gauge. Give advantages of Pirani thermal conductivity gauges. (10 Marks)

OR

- 10 a. Define strain gauge. With a neat sketch, explain wheat stone bridge circuit. (10 Marks)
b. Explain the construction and working principle of optical pyrometer. (10 Marks)

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