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06MAT41

Fourth Semester B.E. Degree Examination, Dec.08 / Jan.09
Engineering Mathematics - IV

Time: 3 hrs. Max. Marks:100

Note : ***Answer FIVE full questions choosing atleast two from each part.***

Part A

1 a. Find by Taylor's series method the value of y at $x = 0.1$ and $x = 0.2$ to five places of decimals from $\frac{dy}{dx} = x^2y - 1$, $y(0) = 1$ consider upto 4^{th} degree terms. **(06 Marks)**

b. Apply Runge-Kutta method to find an approximate value of y for $x = 0.2$ in steps of 0.1 of $\frac{dy}{dx} = x + y^2$, given that y = 1, when x = 0. **(07 Marks)**

c. Given $\frac{dy}{dx} = x^2(1+y)$ and y(1)=1, y(1.1)=1.233, y(1.2)=1.548, y(1.3)=1.979, evaluate y(1.4) by Adam's-Bashforth method. **(07 Marks)**

2 a. Derive Cauchy – Riemann equations in polar-form. **(06 Marks)**

b. Determine the analytic function, $f(z) = u + iv$, if

$$u - v = \frac{\cos x + \sin x - e^{-y}}{2(\cos x - \cosh y)}.$$ **(07 Marks)**

c. Discuss the transformation $w = e^z$. **(07 Marks)**

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

b. Find the Taylor's expansion of $f(z) = \frac{2z^3 + 1}{z^2 + z}$ about the point z = i. **(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 $|z| = 3$. **(07 Marks)**

4 a. Solve in series the equation $x\frac{d^2y}{dx^2} + \frac{dy}{dx} + xy = 0$. **(06 Marks)**

b. Reduce the differential equation $x\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + k^2xy = 0$ to Bessel's equation. **(07 Marks)**

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

Part B

5 a. Fit a second degree polynomial to the following data: **(06 Marks)**

x	1.0	1.5	2.0	2.5	3.0	3.5	4.0
y	1.1	1.3	1.6	2.0	2.7	3.4	4.1

b. The two regression equations of the variables x and y are
$x = 19.13 - 0.87y$ and $y = 11.64 - 0.50x$
Find i) mean of x's ii) mean of y's and iii) the correlation coefficient of x and y. **(07 Marks)**

c. State and prove Baye's theorem. **(07 Marks)**

6 a. The probability density function of a variate x is

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

i) Find k.

ii) Find $P(x<4)$, and $P(3<x\leq 6)$. **(06 Marks)**

b. Derive mean and variance for the Poisson distribution. **(07 Marks)**

c. In a test on 2000 electric bulbs, it was found that the life of a particular make, was normally distributed with an average life of 2040 hours and S.D. if 60 hours. Estimate the number of bulbs likely to burn for

i) More than 2150 hours

ii) Less than 1950 hours and

iii) More than 1920 hours, but less than 2160 hours. **(07 Marks)**

7 a. In a city A, 20% of a random sample of 900 school boys has a certain slight physical defect. In another city B, 18.5% of a random sample of 1600 school boys had the same defect. Is the difference between the proportions significant? **(06 Marks)**

b. A machinist is making engine parts with axle diameter of 0.7 inch. A random sample of 10 parts shows mean diameter 0.742 inch with a S.D. of 0.04 inch. On the basis of this sample, would you say that the axle is inferior? **(07 Marks)**

c. A set of five similar coins is tossed 320 times and the result is:

No. of heads	0	1	2	3	4	5
Frequency	6	27	72	112	71	32

Test the hypothesis that the data follow a binomial distribution. **(07 Marks)**

8 a. The joint distribution of two random variables x and y is given by the following table:

x \ y	2	3	4
1	0.06	0.15	0.09
2	0.14	0.35	0.21

Determine the marginal distribution of x and y. Also verify that x and y are stochastically independent. **(06 Marks)**

b. Find the fixed probability vector of the regular stochastic matrix,

$$\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ \frac{1}{2} & \frac{1}{2} & 0 \end{bmatrix}$$ **(07 Marks)**

c. Explain i) Transient state ii) Recurrent state iii) absorbing state of Markov chain. **(07 Marks)**

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MATDIP401

Fourth Semester B.E. Degree Examination, Dec.08 / Jan.09
Advanced Mathematics II

Time: 3 hrs. Max. Marks:100

Note : ***Answer any FIVE full questions.***

1 a. Show that the lines whose direction cosines are given by the equations $l+m+n=0$, $al^2+bm^2+cn^2=0$ are perpendicular if a+b+c = 0. **(06 Marks)**

b. Show that the angle between any two diagonals of a cube is $\cos^{-1}\left(\frac{1}{3}\right)$. **(07 Marks)**

c. If P, Q, A, B are (1, 2, 3), (-2, 1, 3), (4, 4, 2), (2, 1, -4), find the projection of PQ on AB. **(07 Marks)**

2 a. Find the equation of the plane in the intercept form. **(06 Marks)**

b. Find the equation of the plane which passes through (3, -3, 1) and is perpendicular to the planes $7x+y+2z=6$ and $3x+5y-6z=8$. **(07 Marks)**

c. Show that the lines $\frac{x-5}{4}=\frac{y-7}{4}=\frac{z+3}{-5}$, $\frac{x-8}{7}=\frac{y-4}{1}=\frac{z-5}{3}$ are coplanar. Find their common point. **(07 Marks)**

3 a. Show that the four points whose position vectors are $3i-2j+4k$, $6i+3j+k$, $5i+7j+3k$ and $2i+2j+6k$ are coplanar. **(06 Marks)**

b. A particle moves along the curve $x=t^3+1$, $y=t^2$, $z=2t+5$ where t is the time. Find the components of its velocity and acceleration at t = 1 in the direction $2i+3j+6k$. **(07 Marks)**

c. If $\vec{A}=4i+3j+k$, $\vec{B}=2i-j+2k$ find a unit vector N perpendicular to vectors A and B. Such that A, B, N form a right-handed system. **(07 Marks)**

4 a. Find the angle between the tangents to the curve $\vec{r}=t^2i+2tj-t^3k$ at the point $t=\pm1$. **(06 Marks)**

b. Let $\vec{a}=i+j-k$, . $\vec{b}=i-j+k$, $\vec{c}=i-j-k$. Find the vector $\vec{a}\times\left(\vec{b}\times\vec{c}\right)$. **(07 Marks)**

c. Find a unit vector normal to the surface $x^2+3y^2+2z^2=6$ at (2, 0, 1). **(07 Marks)**

5 a. Find the directional derivative of $f(x,y,z)=xy^2+yz^3$ at the point (2, -1, 1) in the direction of i+2j+2k. **(06 Marks)**

b. Find i) $\operatorname{div}\left(3x^2i+5xy^2j+xyz^3k\right)$ at (1, 2, 3).

ii) $\operatorname{curl}\left[xyzi+3x^2yj+\left(xz^2-y^2z\right)k\right]$ **(07 Marks)**

c. Find the values of the constants a, b, c for which the vector $v=(x+y+az)i+(bx+3y-z)j+(3x+cy+z)k$ is irrotational. **(07 Marks)**

6 a. Find the Laplace transform of

$$f(t)=\begin{cases}e^t;0<t<1\\0;\ t>1\end{cases}.$$ **(05 Marks)**

b. Find $L\left\{e^{-3t}(2\cos5t-3\sin5t)\right\}$. **(05 Marks)**

c. Evaluate $L\left\{t\sin^2t\right\}$. **(05 Marks)**

d. Find $L\left\{\frac{1-e^t}{t}\right\}$. **(05 Marks)**

7 Find the inverse Laplace transform for the following:

a. $\frac{s^2-3s+4}{s^3}$. **(05 Marks)**

b. $\frac{s+2}{s^2-4s+13}$. **(05 Marks)**

c. $\frac{s^2+s-2}{s(s+3)(s-2)}$. **(05 Marks)**

d. $\log\left(\frac{s+a}{s+b}\right)$. **(05 Marks)**

8 a. Use Laplace transform method to solve,

$\frac{d^2x}{dt^2}-2\frac{dx}{dt}+x=e^t$ with $x=2$, $\frac{dx}{dt}=-1$ at $t=0$. **(10 Marks)**

b. Solve the following simultaneous equations using Laplace transform method,

$\frac{dx}{dt}-y=e^t$; $\frac{dy}{dt}+x=\sin t$; given $x(0)=1$, $y(0)=0$. **(10 Marks)**

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06ME42B

Fourth Semester B.E. Degree Examination, Dec 08 / Jan 09
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks:100

Note : ***1. Answer FIVE full questions, selecting atleast TWO questions from each part.***
2. Draw neat sketches, wherever necessary.

PART – A

1 a. Explain with sketch "Wringing Phenomenon" with respect to slip gauges. **(10 Marks)**
b. A calibrated meter bar (end bar) has an actual length L = 1000.0003mm. It is to be used in the calibration of two bars A and B, each having a basic length of 500mm. When compared with the meter bar, $L_A + L_B$ was found shorter by 0.0002mm. When A and B are compared, it was found that the bar A was 0.0004m longer than bar B. Find the actual length of bar A and bar B. **(10 Marks)**

2 a. Explain the following : i) Tolerance build – up ii) Compound Tolerances. **(10 Marks)**
b. Explain the Taylor's principle of Guage design. **(10 Marks)**

3 a. What is Comparator? Explain any one type of mechanical comparator. **(07 Marks)**
b. Explain the uses of Angle gauges. **(03 Marks)**
c. Explain with sketch, how sine bar can be used to measure a taper angle. **(10 Marks)**

4 a. What is Auto Collimator? Explain with sketch the principle and working of an Auto Collimator. **(10 Marks)**
b. Explain 2 – wire and 3 – wire method of measuring pitch and effective diameter of screw threads. **(10 Marks)**

PART – B

5 a. Explain with block diagram, the generalized concept of a measuring system. **(10 Marks)**
b. Explain the terms with sketches : i) Linearity ii) Hysteresis. **(10 Marks)**

6 a. What are the inherent problems of the mechanical intermediate modifying devices? **(04 Marks)**
b. State the advantages of electrical signal conditioning elements. **(06 Marks)**
c. What is CRO? Explain with sketch the principle and working of Cathode Ray Oscilloscope. **(10 Marks)**

7 a. Explain with sketch any one device used for force measurement. **(10 Marks)**
b. Explain with sketch, the Bridgeman guage used for pressure measurement. **(10 Marks)**

8 a. What is Thermo couple? State the law of thermocouple. **(04 Marks)**
b. Explain Resistance Thermometer. **(06 Marks)**
c. Explain with sketch the "Grid Technique" used for strain measurement. **(10 Marks)**

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06ME43

Fourth Semester B.E. Degree Examination, Dec 08 / Jan 09
Applied Thermodynamics

Time: 3 hrs. Max. Marks:100

Note : ***1. Answer FIVE full questions, selecting atleast TWO questions from each part.***
2. Use of Thermodynamics Data handbook, Steam tables, Mollier chart, Psychrometric chart is permitted.

Part A

1 a. With a neat sketch, explain the analysis of exhaust gases by orsat apparatus. **(08 Marks)**

b. The volumetric composition of the dry products of combustion of an unknown hydro carbon fuel C_xH_y, gives CO_2 12.1%, O_2 3.8%, CO 0.90% and N_2 83.2%. Determine i) Chemical formula of the fuel ii) Air Fuel ratio iii) % of excess air. **(12 Marks)**

2 a. Compare Otto, Diesel and Dual cycles on the basis of same compression ratio and same maximum pressure. **(10 Marks)**

b. In an air standard diesel cycle, the compression ratio is 16. At the beginning of Isentropic compression, the temperature is 15^0C and pressure is 0.1 MPa. Heat is added until the temperature at the end of the constant pressure process is 1480°C. Calculate i) cut – off ratio ii) heat supplied per kg of air iii) cycle efficiency and iv) mean effective pressure. **(10 Marks)**

3 a. With neat sketches, explain Turbo Jet and Ram Jet propulsions. **(08 Marks)**

b. A gas turbine plant draws in air at 1.013 bar 10^0C and has a pressure ratio of 5.5. The maximum temperature in the cycle is limited to 750^0C. Compression is conducted in an uncooled rotory compressor having an isentropic efficiency of 82% and expansion takes place in a Turbine with an isentropic efficiency of 85%. A heat exchanger with an efficiency of 70% is fitted between the compressor outlet and combustion chamber. For an air flow of 40 kg/sec, find i) Overall efficiency of cycle ii) Turbine output iii) Air – fuel ratio if the calorific value of fuel used is 45.22 MJ/kg. **(12 Marks)**

4 a. Explain with T-S diagrams, limitations of Carnot cycle and how we can overcome the same in Rankine cycle. **(08 Marks)**

b. The net power out put of an Ideal Regenerative – Reheat steam cycle is 80 MW. Steam enters the HP turbine at 80 bar, 500^0C and expands till it becomes saturated vapour. Some of the steam then goes to an open feed water heater and the balance is reheated to 400^0C, after which it expands in the LP turbine to 0.07 bar. Compute i) The reheat pressure ii) Steam flow rate to HP turbine iii) Cycle efficiency. **(12 Marks)**

Part B

5 a. Show that the optimum intermediate pressure of a two stage reciprocating air compressor for minimum work is the Geometric mean of the suction and discharge pressures. **(10 Marks)**

b. A single acting Air compressor has a bore and stroke of 12cms and 15cms. The speed is 1200 rpm. It compresses CO_2 gas from a pressure of 120 KPa, 20^0C to a temperature of 215^0C. Assume polytropic compression with n = 1.3, no clearance and volumetric efficiency of 100% . Calculate i) pressure ratio ii) indicate power iii) Shaft power if the mechanical efficiency is 80% iv) mass flow rate. If a second stage of equal pressure ratio were added, calculate the overall pressure ratio and bore of second stage if the same stroke was maintained. **(10 Marks)**

6 a, Derive an expression for COP of an Air Refrigeration system. **(08 Marks)**

b. A refrigerating unit takes air from a cold chamber at 5^0C and compresses it from 1 bar to 6.5 bar. The index of compression is 1.25. The compressed air is cooled to a temperature, which is 10^0C above the ambient temperature of 30^0C before being expanded isentropically in an expander. Neglecting the clearance volume of the compressor and expander find the COP and the amount of air circulated in m^3/minute, if 2000 kg of ice is to be formed per day at 0^0C from water at 25^0C. What is the tonnage of the unit? **(12 Marks)**

7 a. Define the following : i) DBT ii) Dew point temperature iii) Specific humidity iv) Relative humidity. **(08 Marks)**

b. It is required to design an A/C for the following condition :
Outdoor condition : 32^0C DBT and 65% RH ; Indoor conditions : 25^0C DBT and 60% RH
Amount of air circulated : 250m^3/min ; Coil dew temperature : 13^0C.
If the required condition is achieved first by cooling and dehumidifying and then by heating, calculate i) Cooling coil capacity and its by pass factor ii) Heating coil capacity and its surface temperature if its by pass factor is 0.3 iii) Mass of water vapour removed per hour. **(12 Marks)**

8 a. Explain any three methods to measure indicate power of an IC engine in laboratory. **(06 Marks)**

b. The following observations were recorded in a test of 1 hour duration on a single cylinder 4-stroke oil engine.
Bore = 220 mm, Stroke = 300mm, Fuel used = 4 kgs, Calorific value of fuel used = 42000 kJ/kg, Shaft speed = 300 rpm, Number of explosions per minute = 148, M.E.P = 5 bar, Load on brake drum = 60 kg's , Spring balance reading = 30N, Diameter of Brake drum = 1.4m , Quantity of cooling water Circulated = 500 kgs, Increase in Temperature of cooling water = 20^0C, Air Fuel ratio = 16 , Exhaust gas temperature = 410^0C , Specific heat of exhaust gases = 1.1 kJ/kg K , Ambient air temperature = 30^0C.
Determine IP, BP, Mechanical efficiency, Brake thermal efficiency, Specific fuel consumption. Draw the heat balance sheet in kJ/min. **(14 Marks)**

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06ME44

Fourth Semester B.E. Degree Examination, Dec.08 / Jan.09
Kinematics of Machines

Time: 3 hrs. Max. Marks:100

Note : ***Answer any FIVE questions selecting at least two from each part.***

Part A

1 a. Define with suitable examples :
   i) Structure
   ii) Machine
   iii) Mechanism
   iv) Higher pair **(08 Marks)**

   b. Sketch and explain the following:
   i) Beam engine
   ii) Gnome engine.
   iii) Elliptical trammel. **(12 Marks)**

2 a. Sketch the crank and slotted lever mechanism. Indicate the strokes. **(06 Marks)**

   b. Sketch and explain Geneva wheel mechanism. **(07 Marks)**

   c. Sketch Ackremann steering mechanism and obtain condition for correct steering. **(07 Marks)**

3 A double slider crank mechanism is shown in figure Q3. The crank OA rotates at a constant angular velocity of 10 rad/sec. The links OA, AB and AC are 100 mm, 200mm and 200 mm long respectively. By drawing the velocity and acceleration polygons determine:
   a. Velocity and acceleration of each slider.
   b. Angular velocity and angular acceleration of each connecting rod. **(20 Marks)**

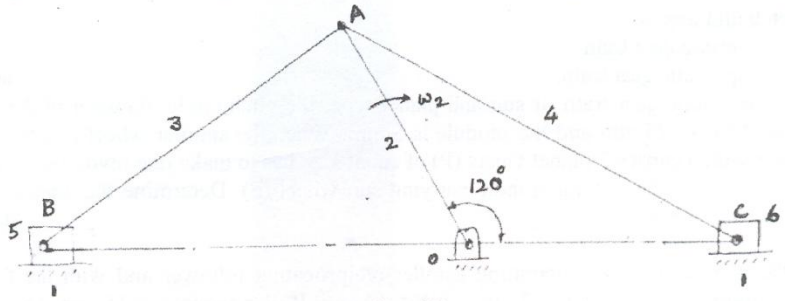

Fig. Q3

4 a. Locate all the instantaneous centers for a
   i) Four bar mechanism.
   ii) Slider crank mechanism. **(10 Marks)**

   b. Determine the velocity and acceleration of the piston by Kleins construction for a steam engine to the following specifications:
   Stroke of piston = 600 mm
   Ratio of length of connecting rod to crank length = 5
   Speed of engine = 450 rpm clockwise.
   Position of crank = 45° with inner dead centre. **(10 Marks)**

Part B

5 a. Obtain loop closure equation for a 4-bar mechanism. **(04 Marks)**

b. Develop equations for the angular velocities and angular accelerations for the links 3 and 4 as shown in figure Q5 (b) using complex algebra method. **(16 Marks)**

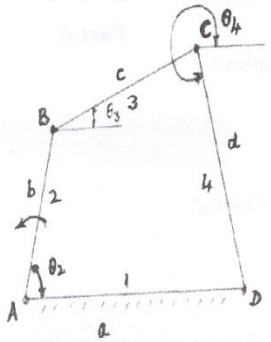

Fig. Q5 (b)

6 a. Compare cycloidal and involute gear tooth profile. **(05 Marks)**

b. What is meant by interference? Mention various methods of avoiding interference in gears. **(05 Marks)**

c. Two gear wheels have respectively 28 and 45 teeth and a standard addendum of one module. The pressure angle is 20° and the module of 6 mm Determine : i) length of path of contact. ii) contact ratio. **(10 Marks)**

7 a. Sketch and explain:

i) Simple gear train.

ii) Epicyclic gear train. **(06 Marks)**

b. In an epicyclic gear train of sun and planet type, the pitch circle diameter of the Annular wheel (A) is 425 mm and the module is 5 mm. When the annular wheel is stationary, the spider which carries 3 planet Gears (P) of equal size has to make one revolution for every 6 revolutions of the driving spindle carrying sun wheel (S). Determine the number of teeth on all the wheels. **(14 Marks)**

8 Draw the profile of a cam operating a roller reciprocating follower and with the following data: Minimum radius of cam = 25 mm, Lift = 30 mm; Roller diameter = 15 mm. The cam lifts the follower for 120° with SHM followed by a dwell period of 30°, then the follower lowers down during 150° of the cam rotation with UARM followed by a dwell period. The cam rotates at a uniform speed of 150 rpm (CW direction). The axis of the follower passes through the axis of the cam shaft. Calculate the maximum velocity and acceleration of the follower during the descent period. **(20 Marks)**

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06ME45

Fourth Semester B.E. Degree Examination, Dec.08 / Jan.09
Manufacturing Process II

Time: 3 hrs. Max. Marks:100

Note : ***Answer FIVE questions, choosing at least two questions from Part A and two questions from Part B.***

Part A

1 a. Derive an expression for shear plane angle, with respect to orthogonal cutting. **(08 Marks)**

b. In an orthogonal cutting process, the following data were observed:
t = depth of cut = 0.25 mm ; F_h = Horizontal force = 1135 N ;
F_V = Force component normal to F_h = 110 N ; chip thickness ratio = r_ϵ = 0.47 ;
α = Rake angle = 20° ; b = Width of cut = 4 mm ; V = Cutting velocity = 30 m/min
Determine the friction angle, shear plane angle, resultant cutting force and power. **(12 Marks)**

2 a. Discuss the salient features of the following cutting tool materials:
i) CBN. Ii) Ceramics. iii) Cemented carbides. **(12 Marks)**

b. Explain the three zones of heat generation in metal cutting. **(08 Marks)**

3 a. Distinguish between Saddle type turret lathe and Ram type turret lathe. **(04 Marks)**

b. Explain the difference between side hung type cross slide and reach over type of cross slide. **(06 Marks)**

c. With a neat sketch explain hydraulic shaper mechanism. **(10 Marks)**

4 a. Draw a neat sketch of a drill bit and explain its nomenclature. **(08 Marks)**

b. With simple sketches explain the following processes:
i) Reaming.
ii) Trepanning. **(08 Marks)**

c. Find the time required for drilling a 18 mm hole in a work piece having thickness of 50 mm. Assume cutting speed of 12 meters / minute and feed 0.2 mm/revolution. Neglect the length of approach. **(04 Marks)**

Part B

5 a. With a neat sketch explain the working of a universal dividing head. **(08 Marks)**

b. Explain the various steps involved in differential indexing. **(06 Marks)**

c. Show the calculation for indexing 87 divisions in a milling machine by compound indexing. The following index plates are available. **(06 Marks)**

Plate No. 1	15	16	17	18	19	20
Plate No. 2	21	23	27	29	31	33
Plate No. 3	37	39	41	43	47	49

6 With respect to grinding process, differentiate between:
a. Glazing and loading.
b. Plunge cut and traverse grinding.
c. In feed and through feed.
d. Cylindrical grinding and centreless grinding.
e. Dressing and truing of grinding wheel. **(20 Marks)**

7 a. With a neat sketch explain honing process. **(10 Marks)**

b. With a neat sketch explain lapping process. **(10 Marks)**

8 Explain with neat sketches, principal, need, equipment, operation, advantages and disadvantages of the following non-traditional machining processes:
a. Electrochemical machining.
b. Water jet machining. **(20 Marks)**

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06ME46B

Fourth Semester B.E. Degree Examination, Dec 08 / Jan 09
Fluid Mechanics

Time: 3 hrs. Max. Marks:100

Note : ***Answer FIVE full questions, selecting atleast TWO questions from each part.***

PART - A

1 a. Differentiate between : i) Newtonian and Non-Newtonian fluids. ii) Ideal and Real fluids. iii) Dynamic and Kinematic viscosity of fluids. iv) Vapour pressure and cavitation. **(08 Marks)**

b. Derive an expression for capillary rise in water. **(04 Marks)**

c. A cubical block of sides 1m and weighing 350N slides down an inclined plane with a uniform velocity of 1.5 m/s. The inclined plane is laid on a slope of 5 vertical to 12 horizontal and has an oil film of 1.0mm thickness. Calculate the dynamic viscosity of oil. **(08 Marks)**

2 a. Prove that the centre of pressure lies below the centre of gravity of a vertically immersed plane surface in a static fluid. **(08 Marks)**

b. An inverted U – tube manometer is connected to two horizontal pipes A and B through which water is flowing. The vertical distance between the axes of these pipes is 30cm. When an oil (S = 0.8) is used as a gauge fluid, the vertical height of water columns in the two limbs of the inverted manometer (when measured from the respective centre lines of the pipes) are found to be same and equal to 35cm. Determine the difference of pressure between the pipes. Pipe B is lying below the pipe A. **(08 Marks)**

c. A metallic body floats at the interface of mercury (S = 13.6) and water such that 30% of its volume is submerged in mercury and remaining in water. Estimate the density of the metal. **(04 Marks)**

3 a. Prove that the equipotential lines and the stream lines are always intersect orthogonally. **(06 Marks)**

b. Given the velocity field, $V = 5x^3 i - 15x^2 yj$, obtain the equation of the streamlines. For the above given velocity field, check for the continuity and irrotationality. **(08 Marks)**

c. The velocity potential function is given by the expression, $\phi = -\frac{xy^3}{3} - x^2 + \frac{x^3 y}{3} + y^2$.

i) Find the velocity components in x and y directions.

ii) Show that ϕ represents a possible case of flow. **(06 Marks)**

4 a. What do you mean by : i) Geometric similarity ii) Kinematic similarity iii) Dynamic similarity iv) Dimensional homogeneity. **(04 Marks)**

b. The thrust (T) of a propeller is assumed to depend on the axial velocity of the fluid (V), the density (ρ) and viscosity (μ) of fluid, the rotational speed (N) rpm, and the diameter of the propeller (D). Find the relationship for T by using dimensional analysis. **(10 Marks)**

c. A model of an air duct operating with water produces a pressure drop of $10kN/m^2$ over 10m length. If the scale ratio is 1/50, $\rho_W = 1000\ kg/m^3$, $\rho_a = 1.2\ kg/m^3$, and $\mu_W = 0.001\ P_a$-s, $\mu_a = 0.00002\ P_a$–s, estimate the corresponding pressure drop in a 20m long air duct. **(06 Marks)**

PART - B

5 a. Derive Euler's equation of motion along a stream line and hence obtain the Bernoulli's equation for incompressible fluids. **(06 Marks)**

b. Using the Euler's equation of motion, derive the Bernoulli's equation for a compressible fluid under going i) Isothermal process and ii) Adiabatic process. **(06 Marks)**

c. A conical tube is fixed vertically with its small end upwards. Velocity of flow down the tube is 4.5m/s at the upper end and 1.5m/s at the lower end. Tube is 1.5m long and the pressure at the upper end is 24.3 kPa (ab). Loss in the tube expressed as head is $0.3(V_1 - V_2)^2/_{2g}$, where V_1 and V_2 are the velocities of fluid (S = 0.8) flow at the upper and lower ends respectively. What is the pressure head at the lower end? **(08 Marks)**

6 a. Derive an expression for the actual discharge through orifice meter. **(08 Marks)**

b. Water is to be supplied to a town of 4 lakhs inhabitants. The reservoir is 6.4 km away from the town and the loss of head due to friction is measured as 15m. Calculate the size of the supply main if each inhabitant consumes 180 litres of water per day and half of the daily supply is pumped is 8 hour. Take the coefficient of friction for the pipe, f = 0.0075. **(06 Marks)**

c. A venturimeter is to be installed in a 180mm pipeline horizontally at a section where the pressure is 110 kPa (gauge). If the maximum flow rate of water in the pipe is $0.15m^3/s$, find the least diameter of the throat so that the pressure at the throat does not fall below 80 kPa (vacuum). Assume that 4% of the differential head is lost between inlet and the throat. **(06 Marks)**

7 a. Derive Hagen Poiseuille equation for a laminar flow in a circular tube. **(10 Marks)**

b. Water at 15^0C flows between two large parallel plates at a distance of 1.6mm apart. Determine i) the maximum velocity ii) pressure drop per unit length and iii) shear stress at the walls of the plates if the average velocity is 0.2 m/s. The viscosity of water at 15^0C is given as 0.01 poise. **(10 Marks)**

8 a. We know that the velocity of sound wave is the square root of the ratio of change of pressure to the change of density of a fluid. Using this definition, derive the expressions for a velocity of sound in a compressible fluid when it undergoes a process i) Isothermal and ii) Reversible adiabatic. **(06 Marks)**

b. Define the following and write their equations :
   i) Drag
   ii) Lift
   iii) Displacement thickness
   iv) Momentum thickness. **(06 Marks)**

c. A man descends to the ground from an aeroplane with the help of a parachute which is hemispherical having a diameter of 4m against the resistance of air with a uniform velocity of 25m/s. Find the weight of the man if the weight of parachute is 9.81N. Take $C_D = 0.6$ and density of air = $1.25kg/m^3$. **(08 Marks)**

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