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MATDIP401

Fourth Semester B.E. Degree Examination, June 2012
Advanced Mathematics - II

Time: 3 hrs. Max. Marks:100

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

1 a. Find the angles between any two diagonals of a cube. **(06 Marks)**

b. Find the equations of two planes, which bisect the angles between the planes $3x - 4y + 5z = 3$, $5x + 3y - 4z = 9$. **(07 Marks)**

c. Find the image of the point (1, 2, 3) in the line $\frac{x+1}{2} = \frac{y-3}{3} = -z$ **(07 Marks)**

2 a. Find the equation of the plane through the point (1, -1, 0) and perpendicular to the line $2x + 3y + 5z - 1 = 0 = 3x + y - z + 2$. **(06 Marks)**

b. Find the value of k such that the line $\frac{x}{k} = \frac{y-2}{2} = \frac{z+3}{3}$ and $\frac{x-2}{2} = \frac{y-6}{3} = \frac{z-3}{4}$ are coplanar. For this k find their point of intersection. **(07 Marks)**

c. Find the distance of the point (1, -2, 3) from the plane $x - y + z = 5$ measured parallel to the line $\frac{x}{2} = \frac{y}{3} = \frac{z}{-6}$. **(07 Marks)**

3 a. Show that the position vectors of the vertices of a triangle $\vec{a} = 3(\sqrt{3}\hat{i} - \hat{j})$, $\vec{b} = 6\hat{j}$, $\vec{c} = 3(\sqrt{3}\hat{i} + \hat{j})$ form an isosceles triangle. **(06 Marks)**

b. Find the unit normal to both the vectors $4\hat{i} - \hat{j} + 3\hat{k}$ and $-2\hat{i} + \hat{j} - 2\hat{k}$. Find also the sine of the angle between them. **(07 Marks)**

c. Prove that the position vectors of the points A, B, C and D represented by the vectors $-\hat{j} - \hat{k}$, $4\hat{i} + 5\hat{j} + \hat{k}$, $3\hat{i} + 9\hat{j} + 4\hat{k}$ and $-4\hat{i} + 4\hat{j} + 4\hat{k}$, respectively are coplanar. **(07 Marks)**

4 a. Find the value of λ so that the points A(-1, 4, -3), B(3, 2, -5), C(-3, 8, -5) and D(-3, λ, 1) may lie on one plane. **(06 Marks)**

b. If $\vec{a}, \vec{b}, \vec{c}$ are the position vectors of points A, B, C, prove that $(\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a})$ is a vector perpendicular to the plane of triangle ABC. **(07 Marks)**

c. Find a set of vectors reciprocal to the set $2\hat{i} + 3\hat{j} - \hat{k}$, $\hat{i} - \hat{j} - 2\hat{k}$, $\hat{i} + 2\hat{j} + 2\hat{k}$. **(07 Marks)**

5 a. Find the maximum directional derivative of $\log(x^2 + y^2 + z^2)$ at (1, 1, 1). **(06 Marks)**

b. Find the unit normal vector to the curve $\vec{r} = 4\sin t\hat{i} + 4\cos t\hat{j} + 3t\hat{k}$. **(07 Marks)**

c. Show that $\vec{F} = \frac{x\hat{i} + y\hat{j}}{x^2 + y^2}$ is both solenoidal and irrotational. **(07 Marks)**

6 a. Find the Laplace transforms of $\sin^2 3t$ and $\sqrt{t}$. **(06 Marks)**

b. Find L[f(t)], given that $f(t) = \begin{cases} t-1 & 0 < t < 2 \\ 3-t & t > 2 \end{cases}$. **(07 Marks)**

c. Find the Laplace transform of $e^{2t}\cos t + t\,e^{-t}\sin 2t$. **(07 Marks)**

7 a. Find the Laplace transform of $\int_0^t \cos 2(t-u)\cos 3u\,du$. **(06 Marks)**

b. Find the inverse Laplace transform of

i) $\frac{s+1}{s^2-s+1}$ ii) $\frac{1}{s(s^2+a^2)}$. **(14 Marks)**

8 a. Find the inverse Laplace transform by using convolution theorem of $\frac{1}{(s^2+a^2)^2}$. **(10 Marks)**

b. By applying Laplace transform, solve the differential equation $\frac{d^2y}{dt^2}+5\frac{dy}{dt}+6y=5e^{2t}$. Subject to the conditions $y(0)=2$, $y'(0)=1$. **(10 Marks)**

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06MAT41

Fourth Semester B.E. Degree Examination, June 2012
Engineering Mathematics – IV

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer FIVE full questions, selecting at least TWO questions from each part.***
2. Use of statistical tables is permitted.

PART – A

1 a. Employ Taylor's method to obtain approximate value of y at x = 0.1 and x = 0.2 for the differential equation $y' = x^2y - 1$, y(0) = 1 considering upto the fourth degree term. **(06 Marks)**

b. Using Runge-Kutta method of fourth order, solve : $\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$ with y(0) = 1 at x = 0.2, 0.4. **(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 Adams – Bashforth method. **(07 Marks)**

2 a. Obtain the Cauchy-Riemann equations in polar form. **(06 Marks)**

b. Verify that $v = e^x (x \sin y + y \cos y)$ is harmonic. Find u such that f(z) = u + iv is an analytic function. Also find f(z). **(07 Marks)**

c. Find the region in the W-plane bounded by the lines x = 1, y = 1, x + y = 1 under the transformation $W = Z^2$. Indicate the region with sketches. **(07 Marks)**

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

b. Find the Laurent's expansion for $f(z) = \frac{z^2}{(z-1)(z-3)}$ in the region i) $1 < |z| < 3$; ii) $|z-1| < 2$. **(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 $|z| = 3$, by Cauchy's residue theorem. **(07 Marks)**

4 a. Obtain the series solution of the equation $4xy'' + 2(1 - x)y' - y = 0$. **(06 Marks)**

b. Obtain the series solution of Legendre's differential equation $(1 - x^2)y'' - 2xy' + n(n + 1)y = 0$. **(07 Marks)**

c. Express $4x^3 - x^2 - 3x + 8$ interms of Legendre polynomial. **(07 Marks)**

PART – B

5 a. Fit a parabola of the form $y = a + bx + cx^2$ to the following data : **(06 Marks)**

x	0	1	2	3	4	5
y	1	3	7	13	21	31

b. Obtain the lines of regression and hence find the coefficient of correlation for the data : **(07 Marks)**

x	1	3	4	2	5	8	9	10	13	15
y	8	6	10	8	12	16	16	10	32	32

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

6 a. Find mean and standard deviation of the binomial distribution. **(06 Marks)**

b. The probability that an individual suffers a bad reaction from a certain injection is 0.001. Using Poisson distribution, determine the probability that out of 2000 individuals :

i) Exactly 3 and

ii) More than 2 will suffer a bad reaction. **(07 Marks)**

c. The weekly wages of workers in a company are normally distributed with mean of Rs.700/- and standard deviation of Rs.50. Find the probability that the weekly wage of a randomly chosen worker is i) between Rs.650 and Rs.750, and ii) more than Rs.750. **(07 Marks)**

7 a. The mean and standard deviation of marks scored by a sample of 100 students are 67.45 and 2.92. Find : i) 95% and ii) 99% confidence intervals for estimating the mean marks of the student population. **(06 Marks)**

b. Ten individuals are chosen at random from a population and their heights in inches are found to be 63, 63, 66, 67, 68, 69, 70, 70, 71, 71. Test the hypothesis that the mean height of the universe is 66 inches. ($t_{0.5} = 2.262$ for 9 d.f). **(07 Marks)**

c. Explain the following terms :

i) Null hypothesis

ii) Confidence limits

iii) Type I and type II errors. **(07 Marks)**

8 a. A fair coin is tossed thrice. The random variables x and y are defined as follows : x = 0 or 1 according as head or tail occurs on the first toss. y = number of heads.

i) Determine the marginal probability distribution of x and y.

ii) Determine the joint distribution of x and y.

iii) Determine E(x), E(y), E(xy).

iv) Determine σ_x, σ_y. **(06 Marks)**

b. Define Stochastic matrix. Show that the matrix P is a regular Stochastic matrix and also find its unique fixed probability vector.

$$P = \begin{bmatrix} 0.5 & 0.25 & 0.25 \\ 0.5 & 0 & 0.5 \\ 0 & 1 & 0 \end{bmatrix}$$ **(07 Marks)**

c. A software engineer goes to his office everyday by motor bike or by car. He never goes by bike on two consecutive days. But if he goes by car on a day then he is equally likely to go by car or by bike the next day. Find the transition probability matrix of the Markov chain. If car is used on the first day of the week, find the probability that after 4 days

i) Bike is used

ii) Car is used. **(07 Marks)**

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06ME42B

Fourth Semester B.E. Degree Examination, June 2012
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define metre in terms of wavelength standards and discuss the important features of wavelength standards. **(04 Marks)**

b. Describe with neat sketches:
i) Imperial yard standard.
ii) International prototype meter. **(08 Marks)**

c. Using M112 set of slip gauges, build the following dimensions:
i) 49.3115 ii) 68.208 **(08 Marks)**

2 a. With the help of neat sketch, differentiate the following:
i) Allowance and tolerance.
ii) Maximum material limit and minimum material limit.
iii) Clearance fit and interference fit. **(06 Marks)**

b. Explain 'hole' based and 'shaft' based limit of fits. **(08 Marks)**

c. Determine the actual dimensions to be provided for a shaft and hole of 90 mm size for H_8d_9 type clearance fit. Size 90 mm falls in diameter steps of 80 and 100. Value of tolerance unit $i = 0.45(\sqrt[3]{D}) + 0.001D$. Value of tolerance for IT8 and IT9 grades are 25i and 40i respectively. Value of fundamental deviation for 'd' type shaft is - $16D^{0.44}$. **(06 Marks)**

3 a. Give a brief note on essential characteristics of a good comparator. **(06 Marks)**

b. Sketch and explain the working of Johanson's Mikrokator. **(08 Marks)**

c. What is the maximum angle for which the sine bar can be set without sacrificing accuracy? Justify your answer. **(06 Marks)**

4 a. Explain the principle of 'interferometry'. **(04 Marks)**

b. Explain the 3 wire method of measuring effective diameter of a screw thread, with the help of a suitable sketch. **(10 Marks)**

c. Explain the procedure to measure gear thickness using gear tooth Vernier Caliper. **(06 Marks)**

PART – B

5 a. What are the causes of error in measurement? Give the detailed classification of errors. **(10 Marks)**

b. Define the following terms:
i) Hysteresis ii) Calibration iii) Repeatability iv) Threshold **(06 Marks)**

c. With reference to transducers discuss the significance of following terms:
i) Transfer efficiency ii) Sensitivity **(04 Marks)**

6 a. With neat sketch, explain ballast circuit. **(08 Marks)**

b. With a block diagram, explain the functioning of telemetering transmitting and receiving system. **(06 Marks)**

c. With block diagram, explain the working of x-y plotters. **(06 Marks)**

7 a. Explain briefly proving ring. **(06 Marks)**

b. With neat sketch, explain the working principle of Mcleod gauge. **(06 Marks)**

c. Sketch and explain the procedure for torque measurement using prony brake dynamometer. **(08 Marks)**

8 a. With the aid of a neat sketch explain how strain in a machine element subject to tensile load can be measured using electrical resistance strain gauges. Use a compensation gauge also. **(10 Marks)**

b. Explain the working of optical pyrometer and its application. **(06 Marks)**

c. Write a brief note on "mounting of strain gauges". **(04 Marks)**

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06ME43

Fourth Semester B.E. Degree Examination, June 2012
Applied Thermodynamics

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer FIVE full questions, selecting at least TWO questions from each part.***
2. Use of thermodynamics data handbook is permitted.

PART – A

1 a. Define the following :
i) Enthalpy of reaction ii) Heat of formation
iii) Higher calorific value iv) Enthalpy of formation. **(08 Marks)**

b. Find the stoichiometric air for the combustion of gaseous propane (C_3H_8) on mass basis and molar basis. **(04 Marks)**

c. The products of combustion of hydrocarbon fuel of unknown composition have the following composition as measured on dry basis.
CO_2 – 8.0%, CO–0.9%, O_2 – 8.8%, N_2 – 82.3%
Calculate :
i) Air fuel ratio
ii) Composition of fuel on mass basis
iii) The percentage of theoretical air on mass basis. **(08 Marks)**

2 a. With the help of superimposed P–V and T–S diagrams compare, the efficiencies of air standard Otto cycle and diesel cycles for same state of air before compression and same maximum pressure and temperature in both the cycles. **(08 Marks)**

b. The compression ratio for a single cylinder engine operating on dual cycle in 8. The max pressure in the cycle is limited to 55 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 the diameter as 25 cm and stroke as 30 cm, find the following :
i) The work done per cycle
ii) The air–standard efficiency of the cycle
iii) The power developed if number of working cycles are 200/ min. **(12 Marks)**

3 a. What are the methods used for improvement of thermal efficiency of simple open cycle constant pressure gas turbine plant? Explain any one in detail. **(10 Marks)**

b. In a jet propulsion cycle, air enters the compressor at 1 bar and 15°C. The pressure leaving the compressor is 5 bar and the max. temperature is 900°C. The air expands in the turbine to such a pressure that the turbine work is just equal to the compressor work. On leaving the turbine, the air expands in a reversible adiabatic process in a nozzle to 1 bar. Calculate the velocity of air leaving the nozzle.
Take Cp = 1.0035 and $\gamma = 1.4$ for compressor and expansion processes. **(10 Marks)**

4 a. Sketch the flow diagram and corresponding temperature entropy diagram of the reheat vapor cycle and derive an expression for the reheat cycle efficiency. What are the advantages gained by reheating the steam in between stages? **(10 Marks)**

b. A vapour power plant is working on closed feed water heater regenerative rankine cycle. Boiler pressure = 70 bar and 400°C ; condense pressure = 0.1 bar ; steam is bled from the turbine at 10 bar. Bled stream and feed water leaves the closed feed water heater as saturated liquid. Calculate the thermal efficiency of Rankine cycle. **(10 Marks)**

PART – B

5 a. Derive the condition for minimum work input to a two stage compressor with perfect inter cooling between stages. Also derive an expression for the ideal intermediate pressure for the same. **(10 Marks)**

b. A two stage compressor delivers 2 m^3 free air per minute. The temperature and pressure of air at the suction are 27°C and 1 bar. The pressure at delivery is 50 bar. The clearance is 5% of the stroke in L.P cylinder as well as in H.P cylinder. Assume perfect intercooling between the two stages. Find the minimum power required to run the compressor at 200 rpm. Also find the diameters and strokes assuming the strokes of both cylinders are equal to the diameter of LP cylinder. What is the ratio of cylinder volumes? Law of compression and re–expansion in both cylinders is $PV^{1.35}$ = constant. Also assume that the ambient air condition is same such as suction condition. **(10 Marks)**

6 a. Explain with the aid of T-S diagram and P-H diagram, the effect of superheat and sub cooling on the vapour compression refrigeration cycle. **(06 Marks)**

b. What are the desirable properties of refrigerants? **(04 Marks)**

c. An air refrigerator working on Bell-Colemann cycle takes air from cold chamber at 1 bar and –5°C and compresses to 6 bar following the law $PV^{1.25}$ = C. The compressed air is cooled to 37°C in the cooler before entering into the expander. The expansion in isentropic. Determine,

i) C.O.P. of the cycle.

ii) Mass of air circulated per minute if 500 kg of ice is produced per day at 0°C when water is supplied at 20°C.

iii) Refrigeration capacity of the plant in tons.

Neglect the clearances in compressor and expander. Take $\gamma = 1.4$ and $C_P = 1$ kJ/kg for air Latent heat of ice = 335 kJ/kg , C_p (water) = 4.1868 kJ/kg. **(10 Marks)**

7 a. What do you understand by dry bulb, wet bulb and dew point temperatures? **(06 Marks)**

b. Define the terms:

i) Specific humidity ii) Relative humidity **(04 Marks)**

c. 40 m^3 of air per minute at 31°C DBT and 18.5°C WBT is passed over the cooling coil whose surface temperature is 4.4°C. The coil cooling capacity is 3.56 tonnes of refrigeration under the given condition of air. Determine the DBT of the air leaving the cooling coil and bypass factor. **(10 Marks)**

8 a. What do you understand by heat balance sheet? Enumerate the importance of the same. **(05 Marks)**

b. Describe the principle of conducting Morse test on IC engines. What is the important precaution to be taken while conducting this test? **(05 Marks)**

c. A test on single cylinder, 4 stroke oil engine, having bore 180mm and stroke 360mm gave the following results:

Speed 290 rpm; brake torque 392 Nm; indicated mean effective pressure 7.2 bar; oil consumption 3.5 kg/hour; cooling water flow 270kg/hour; cooling water temperature rise 36°C; air fuel ratio by weight 25; exhaust gas temperature 415°C; barometric pressure 1.013 bar; room temperature 21°C. The fuel has calorific value of 45,200 kJ/kg and contains 15% of hydrogen by weight. Calculate

i) The indicated thermal efficiency ii) The volumetric efficiency based on the atmospheric conditions. Draw a heat balance sheet in terms of kJ/min.

Take R = 0.287 kJ/kg K, C_p for dry exhaust gases = 1.0035 kJ/kg K and C_{Ps} for super heated steam = 2.093 kJ/kg K. **(10 Marks)**

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06ME44

Fourth Semester B.E. Degree Examination, June 201
Kinematics of Machines

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define following; (i) Mechanism; (ii) Structure; (iii) Kinematic pair; (iv) Degree of freedom; (v) Inversions . **(10 Marks)**

b. Differentiate; (i)Machine and structure; (ii) Higher pair and lower pair; (iii) Unconstrained and completely constrained motion; (iv) Closed and unclosed pairs. **(08 Marks)**

c. Determine the mobility of four bar linkage. **(02 Marks)**

2 a. With neat sketch explain crank and slotted lever quick return mechanism. **(06 Marks)**

b. Draw a line diagram and explain Peaucellier's straight line mechanism. **(06 Marks)**

c. Draw and explain; (i)Ratchet and pawl mechanism; (ii) Geneva mechanism. **(08 Marks)**

3 A double slider is shown in fig.Q3. The crank OA rotates at constant angular velocity of 10 rad/sec. The links OA, AB and AC are 100 mm, 200 mm and 200 mm long respectively. Draw velocity and acceleration polygons and determine; (i) Velocity and acceleration of each slider; (ii) Angular velocity and angular acceleration of each connecting rod. **(20 Marks)**

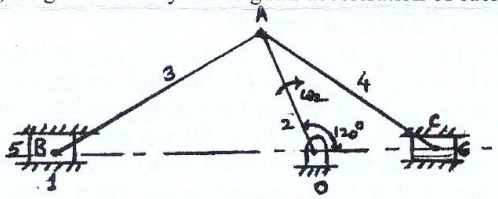

Fig.Q.3

4 a. Locate all the instantaneous centres of slider crank mechanism as shown in fig.Q4(a). The length of crank OB and connecting rod AB are 100 mm and 400 mm respectively. If the crank rotates clockwise with an angular velocity of 10 rad/sec, find; (i) Velocity of slider A; (ii) Angular velocity of connecting rod AB. **(12 Marks)**

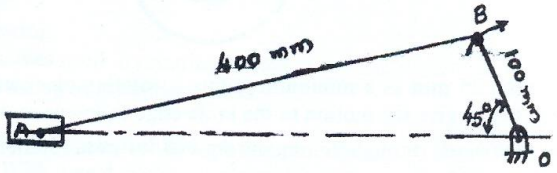

Fig.Q.4(a)

b. The crank of a reciprocating engine is 200 mm long and connecting rod is 700 mm, The crank rotates at 120 rad/sec. Find the velocity and acceleration of piston using Klein's construction, when crank is at 30° from inner dead center. Also find angular velocity and angular acceleration of connecting rod. **(08 Marks)**

PART – B

5 A four bar mechanism is shown in fig.Q5. The crank O_2A rotates at 100 rpm clockwise and an angular acceleration of 12 rad/sec^2 clockwise at an instant when crank makes an angle of 60° with horizontal. Determine the angular velocities and angular accelerations of links 3 & 4 by Raven's method. Also find the velocity and acceleration of point C by assuming AC is parallel to 0_20_4. **(20 Marks)**

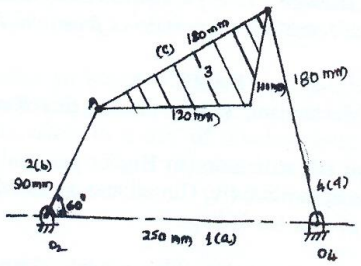

Fig.Q.5

6 a. State and prove law of gearing. **(06 Marks)**

b. Derive an expression for path of contact. **(06 Marks)**

c. Two 20° involute spur gears mesh externally and give a velocity ratio of 3. Module is 3 mm and addendum is equal to 1.1 module .If the pinion rotates at 120 rpm determine ; (i) The minimum number of teeth on each wheel to avoid interference; (ii) The number of pairs of teeth in contact. **(08 Marks)**

7 a. Explain compound and reverted gear train. **(06 Marks)**

b. In an epicyclical gear train as shown in fig.Q7(b), the pitch diameter of internally toothed ring D is to be as nearly as possible 228 mm and the module is 4 mm. When the ring is stationery, the spider A which carries three planet wheels C of equal size is to make one revolution for every five revolutions of the driving spindle carrying sun wheel B. Determine the number of teeth for all wheels and exact pitch circle diameter of the ring D using tabular method. If the torque of 30 Nm is applied on sun wheel B, what torque will be required to keep the ring stationery? **(14 Marks)**

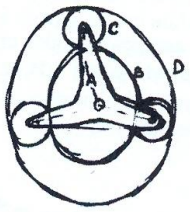

Fig.Q.7(b)

8 A cam with 25 mm as a minimum radius is rotating clockwise at a uniform speed of 100 rpm and has to give the motion to the knife edge follower as defined below ; (i) The follower to move outwards through 25 mm during 120° of cam rotation; (ii) Follower to dwell for the next 60° of cam rotating; (iii) Follower to return to its starting position during next 90° of cam rotation; (iv) Follower to dwell for rest of the cam rotating. The displacement of follower takes place with uniform and equal acceration and retardation both outward and return stroke. Draw the cam profile when follower axis is offset to right side by 10 mm from the axis of cam. Determine the maximum velocity and acceleration during outward and return stroke. **(20 Marks)**

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06ME46B

Fourth Semester B.E. Degree Examination, June 2012
Fluid Mechanics

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting atleast TWO questions each from Part – A and Part - B.***

PART – A

1 a. Define the following terms and mention their S.I. units :
i) Specific gravity ii) Kinematic viscosity iii) Surface tension iv) Capillarity. **(06 Marks)**

b. The space between two square flat parallel plates is filled with oil. Each side of the plate is 60cm. The thickness of the oil film is 12.5mm. The upper plate, which moves at 2.5 meter per sec requires a force of 98.1N to maintain the speed. Determine : i) the dynamic viscosity of the oil in poise ii) the kinematic viscosity of the oil in stokes if the specific gravity of the oil is 0.95. **(06 Marks)**

c. Derive an expression for the force exerted on a submerged vertical plane surface by the static liquid and locate the position of centre of pressure. **(08 Marks)**

2 a. State and prove hydrostatic law. **(04 Marks)**

b. Explain the term meta – centric height and derive an expression for the meta – centric height of a floating body. **(08 Marks)**

c. A block of wood of specific gravity 0.7 floats in water. Determine the meta – centric height of the block if its size is - 2m × 1m × 0.8m. **(08 Marks)**

3 a. Obtain an expression for continuity equation for a three dimensional unsteady compressible flow. Deduce the same for steady and incompressible flow. **(10 Marks)**

b. Find the acceleration and the vorticity components at a point (1, 1, 1) for the following flow field. $U = 2x^2 + 2y$; $V = -2xy + 3y^2 + 3yz$; $W = \frac{-3}{2}z^2 + 2xz - 9y^2z$. **(06 Marks)**

c. Does a stream function ψ exist for a flow field described by $\overline{V} = 2y\hat{i} - 2x\hat{j}$? If so determine the stream function ψ. **(04 Marks)**

4 a. What do you mean by repeating variables? How are the repeating variables selected for dimensional analysis? **(04 Marks)**

b. State Buckingham's π theorem and explain dimensional homogeneity. **(04 Marks)**

c. An agitator of diameter D requires power P to rotate at a constant speed N in a liquid of density ρ and viscosity μ.
i) Show with the help of Buckingham 's π theorem that $P = \rho N^3 D5\ \phi\ (\rho ND^2/\mu)$
ii) An agitator of 225mm diameter rotating at 23rps in water requires a driving torque of 1.1Nm. Calculate the corresponding speed and the torque required to drive a similar agitator of 675mm diameter rotating in air.
($\mu air = 1.86 \times 10^{-5}$ Pas , $\mu water = 1.01 \times 10^{-3}$ Pas, $\rho air = 1.2$ kg/m^3, $\rho water = 1000$kg/m^3) **(12 Marks)**

PART – B

5 a. Name the different forces present in a fluid flow. For the Euler's equation of motion, which forces are taken into consideration? **(02 Marks)**

b. State Bernoulli's theorem for steady flow of an in compressible fluid. Derive an expression for Bernoulli's theorem from first principles and state the assumptions made for such a derivation. **(10 Marks)**

c. A 30cm × 15cm venturimeter is provided in a vertical pipe line carrying oil of specific gravity 0.9, the flow being upwards. The difference in elevation of the throat section and entrance section of the venturimeter is 30cm. The differential U - tube mercury manometer shows a gauge deflection of 25cm. Calculate : i) the discharge of oil and ii) the pressure difference between the entrance section and the throat section. Take the co-efficient of meter as 0.98 and specific gravity of mercury as 13.6. **(08 Marks)**

6 a. What is a pitot – tube? How will you determine the velocity at any point with the help of a pitot – tube? **(04 Marks)**

b. Derive Darcy's formula to calculate the frictional factor in a pipe. **(08 Marks)**

c. Find the diameter of a pipe of length 2000m when the rate of flow of water through the pipe is 200 litres/sec and the head loss due to friction is 4m. Take the value of C = 50 in Chezy's formula. **(04 Marks)**

d. Explain the terms hydraulic gradient line and total energy line. **(04 Marks)**

7 a. Describe Reynold's experiment to demonstrate laminar and turbulent flows. **(06 Marks)**

b. Derive an expression for the velocity distribution for viscous flow through a circular pipe. Also sketch the velocity distribution and shear stress distribution across a section of the pipe. **(08 Marks)**

c. Determine i) the pressure gradient ii) the shear stress at the two horizontal parallel plates and iii) the discharge per meter width for the laminar flow of oil with a maximum velocity of 2 m/s between two horizontal parallel fixed plates which are 100mm apart. Given $\mu = 2.4525\ Ns/m^2$. **(06 Marks)**

8 a. Define the following :
i) Stream lined body ii) Boundary layer iii) Bluff body iv) Lift and drag. **(08 Marks)**

b. Calculate the diameter of a parachute to be used for dropping an object of mass 100 kg so that the maximum terminal velocity of dropping is 5m/s. The drag co-efficient for the parachute, which may be treated as hemispherical is 1.3. The density of air is $1.216 kg/m^3$. **(06 Marks)**

c. Find the energy thickness for the velocity distribution in the boundary layer given by

$$\frac{V}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2.$$ **(06 Marks)**

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