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06MAT41

Fourth Semester B.E. Degree Examination, Dec.09/Jan.10
Engineering Mathematics - IV

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Employ Taylor's series method to find an approximate solution correct to fourth decimal places for the following initial value problem at x = 0.1, $dy/dx = x - y^2$, y(0)=1. **(06 Marks)**

b. Using modified Euler's method to find y(0.1) given $dy/dx = x^2 + y$, y(0) = 1 by taking h=0.05. Perform two iterations in each step. **(07 Marks)**

c. If $dy/dx = 2e^x - y$, y(0) = 2, y(0.1) = 2.010, y(0.2) = 2.04 and y(0.3)=2.09 find y(0.4) correct to four decimal places. By using Milne's predictor-corrector method (Use corrector formula twice). **(07 Marks)**

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

b. Find the analytic function f(z) = u+iv whose real part is $e^{-x}(x\cos y + y\sin y)$. **(07 Marks)**

c. Find the bilinear transformation which maps the points Z=0, i, ∞ onto the points w = 1, -i, -1 respectively. Find the invariant points. **(07 Marks)**

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

b. Expand $f(z) = \frac{1}{(z-1)(z-2)}$ in terms of Laurent's series valid in the regions i) $|z-1| < 1$ ii) $|z-1| > 1$. **(07 Marks)**

c. Evaluate $\int_c \frac{\sin \pi z^2 + \cos \pi z^2}{(z-1)^2(z-2)}$ using Cauchy's Residues theorem 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. Solve Bessel's differential equation leading to $J_n(x)$. **(07 Marks)**

c. Express $x^4 + 3x^3 - x^2 + 5x - 2$ in terms of Legendre's polynomials. **(07 Marks)**

PART – B

5 a. The pressure and volume of a gas are related by the equation $PV^\nu = K$, where ν and K being constants. Fit this equation to the following set of observations. **(06 Marks)**

P (kg/cm²)	0.5	1.0	1.5	2.0	2.5	3.0
V (litre)	1.62	1.00	0.75	0.62	0.52	0.46

b. Find the correlation coefficient and the regression lines of y on x and x on y for the following data: **(07 Marks)**

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

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

Find i) k ii) $P(X \geq 5)$ iii) $P(3 < X \leq 6)$ **(06 Marks)**

b. The number of telephone lines busy at an instant of time is a binomial variate with probability 0.1 that a line is busy. If 10 lines are choosen at random, what is the probability that i) no line is busy ii) at least 5 lines are busy iii) at most 3 lines are busy. **(07 Marks)**

c. Obtain the mean and standard deviation of the normal distribution. **(07 Marks)**

7 a. Explain the following terms:
i) Null hypothesis
ii) Confidence limits
iii) Type I & Type II errors. **(06 Marks)**

b. A die was thrown 9000 times and a throw of 5 or 6 was obtained 3240 times. On the assumption of random throwing, do the data indicate that the die is biased? **(07 Marks)**

c. The nine items of a sample have the following values: 45, 47, 50, 52, 48, 47, 49, 53, 51. Does the mean of these differ significantly from the assumed mean of 47.5? (Given $t_{0.05}$ for 8 df = 2.31). **(07 Marks)**

8 a. The joint probability distribution of two random variables X and Y are given below.

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

Determine i) E(X) and E(Y) ii) E(XY) iii) COU (X,Y) **(06 Marks)**

b. Every year, a man trades his car for a new car. If he has a Maruti, he trades it for an Ambassador. If he has an Ambassador, he trades it for a Santro. However, if he has a Santro, he is just as likely to trade if for a new Santro as to trade if for Maruti or an Ambassador. In 2000, he bought his first car, which was Santro. Find the probability that he has
i) 2002 Santro ii) 2002 Maruti. **(07 Marks)**

c. Define stochastic matrix. Find the unique fixed probability vector for the regular stochastic matrix $A = \begin{bmatrix} 0 & 1 & 0 \\ 1/2 & 0 & 1/2 \\ 1/2 & 1/4 & 1/4 \end{bmatrix}$ **(07 Marks)**

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06ME42B

Fourth Semester BE Degree Examination, Dec.09-Jan.10
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks:100

Note: ***1. Missing data can be suitably assumed.***
2. Solve any FIVE questions choosing at least 2 from each part.

PART - A

1 a. A calibrated metre and bar has an actual length 1000.0006 mm. It is to be used in the calibration of two bars A and B each having a length of 500 mm. When compared with metre bar $\alpha A + \alpha B$ was found to be shorter by 0.0003 mm. In comparing A with B it was found that A was 0.0005 mm longer than B. Find the actual length of A and B. **(06 Marks)**

b. Explain "International prototype meter" with sketch. **(05 Marks)**

c. Build up a dimension of 69.2875 mm using M112 set slip gauges. **(05 Marks)**

d. Distinguish between "Line standards and end standards". **(04 Marks)**

2 a. Explain types of fits with sketches. **(06 Marks)**

b. Design 'Go' and 'NOGO' gauges to control the production of $90H_6e_7$.
90 mm lies in a step of 80 – 120 mm
FD for shaft $e = -11D^{0.14}$
$IT_6 = 10i$ $IT_7 = 16i$ $i = 0.45\sqrt[3]{D} + 0.001D$ **(14 Marks)**

3 a. List the important design principles of a comparator. **(06 Marks)**

b. With a neat sketch explain the working of Reed type comparator. **(08 Marks)**

c. Explain with a neat sketch induction type electrical comparator. **(06 Marks)**

4 a. Explain the two wire method to find the effective diameter of screw thread. **(06 Marks)**

b. With a neat sketch explain the gear pitch checking instrument. **(06 Marks)**

c. With neat sketches explain how would you measure the major and minor diameters of internal screw threads. **(08 Marks)**

PART – B

5 a. Explain the working "generalised measurement system" with block diagram taking the example of LVDT. **(06 Marks)**

b. Define the following terms
i) Accuracy ; ii) Sensitivity ; iii) Precision ; iv) Threshold. **(08 Marks)**

c. Classify the errors. Explain each type of error. **(06 Marks)**

6 a. Explain the working of "Cathode Ray Oscilloscope". **(06 Marks)**

b. List the various functions associated with intermediate modifying stage and briefly explain them. **(06 Marks)**

c. Explain with a neat sketch / circuit diagram.
i) Ballast circuit ii) Ionization transducer. **(08 Marks)**

7 a. Give the classification of dynamometers with brief working principle of each class. **(04 Marks)**

b. Explain with a neat sketch, the measurement of torque using proney brake dynamometer. **(08 Marks)**

c. Explain with a neat sketch McLeod gauge used for pressure measurement. **(08 Marks)**

8 a. Explain the working of a resistance thermometer. **(06 Marks)**

b. State the laws of thermocouple. **(04 Marks)**

c. Define i) Gauge factor ii) Cross Sensitivity. **(06 Marks)**

d. Sketch the arrangement and explain the method of mounting strain gauges to measure the bending strain. **(04 Marks)**

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06ME43

Fourth Semester B.E. Degree Examination, Dec.09-Jan.10
Applied Thermodynamics

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define the following :
i) Stoichimetric air ii) Enthalpy of combustion iii) Calorific value
iv) Adiabatic flame temperature v) Percentage excess air. **(10 Marks)**

b. The products of combustion of hydrocarbon fuel of unknown composition have the following composition as measured on dry basis : Co_2 = 80%, 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. **(10 Marks)**

2 a. Derive the expression for the air standard efficiency of a Diesel cycle with usual notations. State the assumptions made and represent the process on P-V and T-S diagrams. **(10 Marks)**

b. A petrol engine works on Otto cycle under ideal conditions. The initial pressure before the beginning of compression is 101Kpa at 340K. The pressure at the end of heat addition process is 2.5mpa. As per the details furnished by the manufacturer engine has stroke length twice the bore. Engine bore is 300mm and clearance volume is $4 \times 10^{-3} m^3$. Determine :
i) Compression ratio
ii) The air standard efficiency
iii) The mean effective pressure. **(10 Marks)**

3 a. Derive an expression for the work output of a gas turbine in terms of pressure ratio and maximum and minimum temperatures T_3 and T_1. Hence show that the pressure ratio for maximum specific work output is given by $R_p = \left[\frac{T_3}{T_1}\right]^{\frac{\gamma}{2[\gamma-1]}}$. **(10 Marks)**

b. In an open cycle gas turbine plant air enters the compressor at 1 bar and 27°C.The pressure after compression is 4 bar. The isentropic efficiencies of the turbine and the compressor are 85% and 80% respectively. Air fuel ratio is 80:1. Calorific value of the fuel used is 42000 KJ/kg. Mass flow rate of air is 2.5 kg/S. Determine the power output from the plant and the cycle efficiency. Assume that 'Cp' and 'γ' to be same for both air and products of combustion. **(10 Marks)**

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

b. A steam power plant incorporates an ideal reheat cycle to improve the existing efficiency. Steam at 30 bar and 250°C is supplied at high pressure turbine inlet and expands till it is dry saturated at 3 bar. Now the steam is taken to a reheater and its temperature is again increased to 250°C by constant pressure reheating process. The reheated steam expands in the low pressure turbine to a condenser pressure of 0.04 bar. Determine the cycle efficiency. **(10 Marks)**

PART – B

5 a. Derive the expression for the work done for a single stage, single acting reciprocating compressor with clearance volume. **(06 Marks)**

b. Discuss applications of compressed air, and derive an expression for the volumetric efficiency of reciprocating air compressor. **(06 Marks)**

c. A two stage reciprocating compressor works between pressure limits of 1 bar and 8 bar and draws in air at 15°C at the rate of 467 lit/min. The compression in both the stages is isentropic and intercooling is perfect. Estimate the minimum power supplied. **(08 Marks)**

6 a. Write a brief note on properties of refrigerants. **(04 Marks)**

b. With a neat sketch, describe clearly the working of a Bell-Coleman cycle. **(06 Marks)**

c. A vapour compression refrigerator of 10 tonnes capacity using Freon-12 as the refrigerant has an evaporator temperature of – 10°C and a condenser temperature of 30°C. Assuming simple saturation cycle, determine :

i) Mass flow rate of refrigerant in kg/min
ii) Power input
iii) COP

Take $C_{pv} = 0.72 KJ/kgk$. **(10 Marks)**

7 a. Define the following clearly :

i) Dry bulb temperature ii) Wet bulb temperature iii) Specific humiity **(06 Marks)**

b. With a neat sketch, briefly describe a summer air-conditioning system. **(06 Marks)**

c. Atmospheric air at 101.325Kpa has 30°C DBT and 15°C DPT. Without using the psychrometric chart, using the property values from the tables, calculate :

i) Partial pressures of air and water vapour ii) Specific humidity
iii) Ralative humidity iv) Vapour density v) Enthalpy of moist air **(08 Marks)**

8 a. What do you understand by heat balance sheet? Enumerate the importance of the same. **(06 Marks)**

b. Describe the principle of conducting Morse test on IC engines. **(04 Marks)**

c. A 4-cylinder, 4 stroke SI engine 90mm bore and 90mm stroke was tested at constant speed. The fuel supply was fixed at 0.0008kg/sec and plug of 4 cylinders were successively short circuited without change of speed. The power measurement was as follows :
With all cylinders working 16.25 KW ; with number of 1 cylinder cut off 11.55 KW ; with number of 2 cylinder cut off 11.65 KW ; with number of 3 cylinder cut off 11.70 KW ; with number of 4 cylinder cut off 11.50 KW.
Find :

i) The indicated power
ii) Indicated and brake thermal efficiency, if the C.V. of fuel is 42500 KJ/kg.
iii) Relative thermal efficiency if the clearance volume is $65cm^3$. **(10 Marks)**

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06ME44

Fourth Semester B.E. Degree Examination, Dec.09/Jan.10
Kinematics of Machines

Time: 3 hrs. Max. Marks:100

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

PART – A

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

b. Differentiate between the following:
i) Higher pair and lower pair ii) Machine and structure. **(06 Marks)**

c. Find the degree of freedom of four bar chain and slider crank chain. **(04 Marks)**

2 a. Explain the Whitworth quick return motion mechanism, with a neat sketch. **(08 Marks)**

b. Explain the pantograph mechanism, with a neat sketch. State its applications. **(06 Marks)**

c. Explain Peaucellier's exact straight line mechanism, with a line diagram. **(06 Marks)**

3 For the mechanism shown in Fig.3, the crank OA rotates at 20 rpm anticlockwise and gives motion to the sliding blocks B and D. The dimensions of various links are OA = 300mm; AB = 1200 mm; BC = 450mm and CD = 450mm.

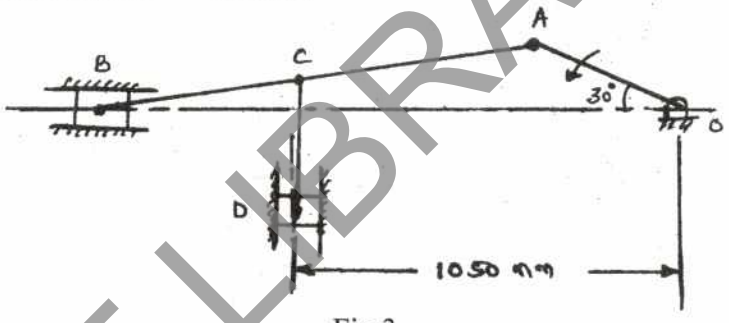

Fig.3

For the given configuration, determine:
i) Velocity of sliding at B and D ii) Angular velocity of CD iii) Linear acceleration of D. **(20 Marks)**

4 a. Locate all the instantaneous centres for a mechanism of a wrapping machine as shown in Fig.4(a). The dimension of the mechanism are O_1P = 80mm; PR = 650mm; QR = 200mm; O_3R= 180mm, O_2T = 350mm; O_2S = 175mm and QS = 125mm. Also find velocity of point Q. **(12 Marks)**

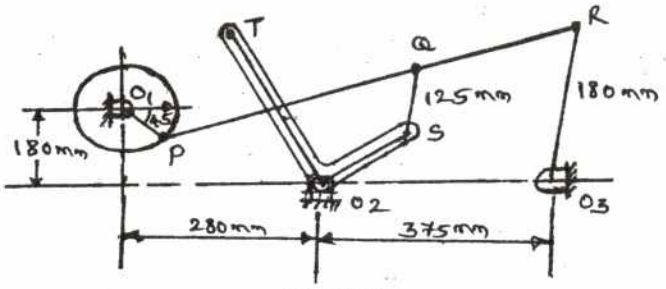

Fig.4(a)

b. The crank and connecting rod of a reciprocating engine are 200mm and 700mm respectively. The crank rotates in clockwise direction at 120 rad/s. Find with the help of Klien's construction. Velocity and acceleration of piston at the instant when the crank is at 30° to I.D.C. **(08 Marks)**

PART – B

5 For an offset slider crank mechanism, write the loop closure equation and determine the expression for

i) connecting rod angle and output displacement
ii) Angular velocity of connecting rod.
iii) Angular acceleration of connecting rod. **(20 Marks)**

6 a. Derive the expression for length of path of contact and arc of contact for a pair of involute gears in contact. **(08 Marks)**

b. What is interference in Involute gears? How it can be avoided. **(04 Marks)**

c. A pinion having 30 teeth drives a gear having 80 teeth. The profile of gears is involute with 20° pressure angle; 12mm module and 10 mm addendum. Find length of path of contact and length of arc of contact. **(08 Marks)**

7 a. Explain different types of gear trains with neat sketches. **(08 Marks)**

b. An epicyclic gear train consists of three gears 1, 2 and 3 as shown in Fig.7(b), the internal gear 1 has 72 teeth and gear 3 has 32 teeth. The gear 2 meshes with both gears 1 and 3 and is carried on arm A which rotates about centre O_2 at 20 rpm. If the gear 1 is fixed, determine the speed of gears 2 and 3. **(12 Marks)**

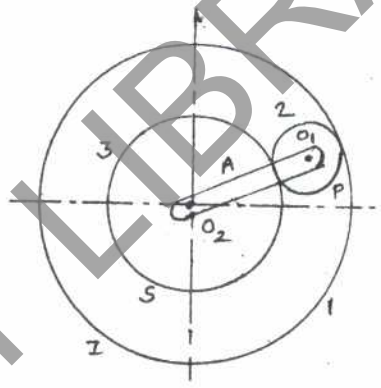

Fig.7(b)

8 Draw the profile of a cam operating a roller reciprocating follower and with following data:
Minimum radius of cam = 25 mm, Lift = 30mm, 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 cam rotation with uniform acceleration and deceleration followed by dwell period. If the cam rotates at uniform speed of 150 rpm, calculate maximum velocity and acceleration of the follower during the decent period. **(20 Marks)**

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06ME45

Fourth Semester B.E. Degree Examination, Dec.09/Jan.10
Manufacturing Process - II

me: 3 hrs. Max. Marks:100

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

PART – A

1. a. Give the differences between orthogonal cutting and oblique cutting with neat sketches. (06 Marks)
   b. Briefly describe the factors affecting tool life. (08 Marks)
   c. Why the tool fails during cutting? Explain, giving reasons, tool wear. (06 Marks)

2. a. Briefly explain the desirable properties and purpose of cutting fluids. (08 Marks)
   b. What are the desirable properties or characteristics of an ideal cutting tool material? Briefly explain cemented carbide tool material. (06 Marks)
   c. List the various methods of measuring chip-tool interface temperature. Explain briefly tool work thermocouple method of measuring it. (06 Marks)

3. a. Differentiate between a capstan and a turret lathe. (04 Marks)
   b. Draw the tool layout for producing a hexagonal headed bolt on a capstan lathe from a hexagonal bar stock. (08 Marks)
   c. With the help of a neat sketch, explain whitworth quick return mechanism of a shaper. (08 Marks)

4. a. Explain universal radial arm drilling machine, with a neat sketch. (06 Marks)
   b. With simple sketches, explain the following drilling machine operations: (08 Marks)
      i) Tapping ii) Trepaning.
   c. Explain the following twist drill nomenclature: Flutes, flank, face, land, lips, body clearance, with a neat sketch. (06 Marks)

PART – B

5. a. Differentiate between the following in a milling machine : (10 Marks)
      i) Up milling and down milling ii) Face milling and end milling.
   b. What is indexing? Name different methods of indexing. Briefly explain compound indexing method. (10 Marks)

6. a. Briefly explain external cylindrical centreless grinding with a neat sketch. Mention the advantages of same over centre type girding. (08 Marks)
   b. Explain the following grinding wheel parameters. (06 Marks)
      i) Grit ii) Grade iii) Structure.
   c. Explain the factors to be considered for selection of grinding wheels. (06 Marks)

7. a. Briefly explain the honing process with a neat sketch. State its advantages and disadvantages. (10 Marks)
   b. With a neat sketch, explain the lapping process. State its advantages and disadvantages. (10 Marks)

8. a. Differentiate between conventional and unconventional machining process. (05 Marks)
   b. Explain, with neat sketch, plasma arc machining. Give its merits and demerits. (10 Marks)
   c. List the advantages, disadvantages and applications of abrasive jet machining. (05 Marks)

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06ME46B

Fourth Semester B.E. Degree Examination, Dec.09-Jan.10
Fluid Mechanics

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Distinguish between :
   i) Mass density and specific weight
   ii) Newtonian and non-Newtonian fluid
   iii) Absolute and Kinematic viscosity. **(06 Marks)**

b. An oil film of thickness 2mm is used for lubrication between a square plate of size 0.9m x 0.9m on an inclined plane having an angle of inclination 30°. The weight of the square plate is 350N and it slides down the plane with a uniform velocity of 0.3m/sec. Find the viscosity of the oil in poise. **(06 Marks)**

c. Establish a relationship among absolute, gauge and atmospheric pressures with a simple sketch. **(03 Marks)**

d. A U-tube manometer containing mercury is connected to a pipe in which water is flowing. Water lend in the limb connected to pipe is 0.5m below centre of the pipe and the free surface mercury in the other limb (open to atmosphere) is 0.8m below the centre of the pipe, Calculate the pressure of water in the pipe. **(05 Marks)**

2 a. Define the terms :
   i) Total pressure ii) Centre of pressure **(04 Marks)**

b. An annular plate 3m external diameter and 1.5m internal diameter is immersed in water with its greatest and least depths below water surface at 3.6m and 1.2m respectively. Determine the total pressure and the position of centre of pressure on one face of the plate. **(08 Marks)**

c. A solid cylinder 15cm diameter and 60cm long consists of two parts made of different materials. The first part at the base is 1.2cm long and of specific gravity 5. The other part of the cylinder is made of the material having specific gravity 0.6. State if it can float vertically in water. **(08 Marks)**

3 a. Distinguish between :
   i) Steady and un-steady flow
   ii) Uniform and non-uniform flow
   iii) Laminar and turbulent flow. **(06 Marks)**

b. Derive an expression for continuity equation for a three dimensional flow. **(08 Marks)**

c. If for a two dimensional potential flow, the velocity potential is given by $\phi = 4x(3y-4)$, determine the velocity at the point (2, 3). Determine also the value of stream function ψ at the point (2, 3). **(06 Marks)**

4 a. State Buckingham's π theorem. Why this theorem is considered superior over the Rayleigh's method for dimensional analysis? **(05 Marks)**

b. Assuming that the rate of discharge Q of a centrifugal pump is dependent upon the mass density ρ of fluid, pump speed N(rpm), the diameter of the impellor D, the pressure P and the viscosity of the fluid μ. Show using the Buckingham's theorm that, the discharge can be represented by

$$Q = ND^3 f\left[\left(\frac{gH}{N^2D^2}\right),\left(\frac{\mu}{\rho ND^2}\right)\right]$$ **(10 Marks)**

c. What is meant by geometric, kinematic and dynamic similarities? **(05 Marks)**

PART – B

5 a. Define Euler's equation of motion. Deduce Bernoulli's equation from the same. **(08 Marks)**

b. A pipe line carrying oil of specific gravity 0.8 changes in diameter from 300mm at position A to 500mm diameter at position B which is 5m at a higher level. If the pressure at A and B are $20N/cm^2$ and $15N/cm^2$ respectively and discharge is 150 litres/sec, determine the loss of head and direction of flow. **(06 Marks)**

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

6 a. What are the energy losses that occur in pipes? Derive an expression for loss of head due to friction in pipes. **(08 Marks)**

b. A pipe of dia 30cm and length 1000m connects two reservoirs having difference of water levels as 15m. Determine the discharge through the pipe. If an additional pipe of diameter 30cm and length 600m is attached to the last 600m length, find the increase in discharge. Take $f = 0.02$ and neglect minor losses. **(08 Marks)**

c. Write a note on Hydraulic gradient and total energy lines. **(04 Marks)**

7 a. Sketch the velocity and shear stress distribution across the section of the pipe for viscous flow through it. **(04 Marks)**

b. Derive Hagen-Poiseuille equation with usual notations. **(08 Marks)**

c. An oil of viscosity $0.1Ns/m^2$ and relative density 0.9 is flowing through a circular pipe of diameter 50mm and length 300m. The rate of flow of fluid through the pipe is 3.5 litres/sec. Find the pressure drop in a length of 300m and also the shear stress at the pipe wall. **(08 Marks**

8 a. Define the terms :

i) Boundary layer ii) Boundary layer thickness iii) Drag
iv) Life v) Momentum thickness. **(10 Marks)**

b. Define the terms : sub sonic flow, sonic flow and supersonic flow. **(06 Marks)**

c. An aeroplane is flying at a height of 15km where the temperature is $-50^\circ C$. The speed of the plane is corresponding to M = 2.0. Assuming K = 1.4 and R = 287J/kgK, find the speed of the plane. **(04 Marks)**

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MATDIP401

Fourth Semester B.E. Degree Examination, Dec.09/Jan.10
Advanced Mathematics – II

Time: 3 hrs. Max. Marks:100

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

1 a. If (l, m, n) be the direction cosines of a line then prove that $l^2 + m^2 + n^2 = 1$. **(06 Marks)**

b. Find the value of K if the angle between the lines with direction ratios -2, 1, -1 and 1, -K, -1 is $\frac{2\pi}{3}$. **(07 Marks)**

c. Find the projection of the line segment AB on CD, where A = (3, 4, 5), B = (4, 6, 3), C = (-1, 2, 4), D = (1, 0, 5) **(07 Marks)**

2 a. Find the angle between the planes x-y+2z = 9 and 2x+y+z = 7. **(06 Marks)**

b. Find the equation of the plane passing through the line of intersection of the planes $x + 2y - 3z - 1 = 0$ and $3x - y + 4z - 5 = 0$ and perpendicular to the plane $3x - y - 3z + 4 = 0$. **(07 Marks)**

c. Find the point of intersection of the lines, $\frac{x-4}{1} = \frac{y+3}{-4} = \frac{z+1}{7}$ and $\frac{x-1}{2} = \frac{y+1}{-3} = \frac{z+10}{8}$. **(07 Marks)**

3 a. If $\vec{A} = 2i - 3j - k$ and $\vec{B} = i + 4j - 2k$, find $(\vec{A}+\vec{B}) \times (\vec{A}-\vec{B})$. **(06 Marks)**

b. For any three vectors $\vec{a}$, $\vec{b}$, $\vec{c}$, prove that $(\vec{a} \times \vec{b}) \times \vec{c} = (\vec{a} \cdot \vec{c})\vec{b} - (\vec{b} \cdot \vec{c})\vec{a}$ **(07 Marks)**

c. Prove that the four points $4i + 5j + k$, -(j+k), (3i+9j+4k) and 4(-i+j+k) are coplanar. **(07 Marks)**

4 a. A particle moves along the curve $x = 1 - t^3$, $y = 1 + t^2$ and $z = 2t - 5$ where t is the time. Find the velocity and acceleration at t = 1. **(06 Marks)**

b. Find the unit vector normal to the surface $x^2y - 2xz + 2y^2z^4 = 10$ at (2, 1, -1). **(07 Marks)**

c. Find the angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$ at the point (2, -1, 2). **(07 Marks)**

5 a. If $\vec{F} = (3x^2y - z)i + (xz^3 + y^4)j - 2x^3z^2k$ find grad(div $\vec{F}$) at (2, -1, 0). **(06 Marks)**

b. Find curl(curl $\vec{A}$) given that $\vec{A} = xyi + y^2zj + z^2yk$. **(07 Marks)**

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

6 a. Find the Laplace transform of $f(t) = \begin{cases} t, & 0 < t < 4 \\ 5, & t > 4 \end{cases}$. **(05 Marks)**

b. Find $L(t^n)$ where n is a positive integer. **(05 Marks)**

c. Find $L[t \cos at]$. **(05 Marks)**

d. Find $L\left[\frac{\cos at - \cos bt}{t}\right]$. **(05 Marks)**

7 Find the inverse Laplace transform for the following:

a. $\frac{(s+2)^3}{s^6}$ **(05 Marks)**

b. $\frac{2s-1}{s^2+4s+29}$ **(05 Marks)**

c. $\frac{2s^2+5s-4}{s^3+s^2-2s}$ **(05 Marks)**

d. $\log\left(1-\frac{a^2}{s^2}\right)$ **(05 Marks)**

8 a. Use Laplace transform method to solve, $\frac{d^2y}{dt^2}+4\frac{dy}{dt}+4y=e^{-t}$; $y(0)=0$, $y'(0)=0$ **(10 Marks)**

b. Find the inverse Laplace transformation of $\frac{s^2}{(s-2)^3}$ **(10 Marks)**

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