USN | | | | | | | | | | 　　　　　　　　　　　　　　　　　**10MAT41**

Fourth Semester B.E. Degree Examination, June/July 2015
Engineering Mathematics - IV

Time: 3 hrs.　　　　　　　　　　　　　　　　　　　　　　　Max. Marks:100

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

PART - A

1. a. Obtain y(0.2) using Picards method upto second iteration for the initial value problem
$$\frac{dy}{dx} = x^2 - 2y \quad y(0) = 1.$$
(06 Marks)

   b. Solve by Eulers modified method to obtain y(1.2) given $y' = \frac{y+x}{y-x}$ $y(1) = 2$. (07 Marks)

   c. Using Adam Bash forth method obtain y at x = 0.8 given (07 Marks)
$$\frac{dy}{dx} = x - y^2 \ , \quad y(0) = 0 \ , \quad y(0.2) = 0.02 \ , \quad y(0.4) = 0.0795 \text{ and } y(0.6) = 0.1762.$$

2. a. Solve by 4th order Runge Kutta method simultaneous equations given by
$$\frac{dx}{dt} = y - t \ , \quad \frac{dy}{dt} = x + t \text{ with } x = 1 = y \text{ at } t = 0 \ , \text{ obtain } y(0.1) \text{ and } x(0.1).$$
(06 Marks)

   b. Solve $\frac{d^2y}{dx^2} - x\left(\frac{dy}{dx}\right)^2 + y^2 = 0$, $y(0) = 1$, $y'(0) = 0$. Evaluate y(0.2) correct to four decimal places, using Runge Kutta method of fourth order. (07 Marks)

   c. Solve for x = 0.4 using Milnes predictor corrector formula for the differential equation y" + xy' + y = 0 with y(0) = 1 , y(0.1) = 0.995 , y(0.2) = 0.9802 and y(0.3) = 0.956. Also z(0) = 0 , z(0.1) = -0.0995 , z(0.2) = -0.196 , z(0.3) = -0.2863. (07 Marks)

3. a. Verify whether f(z) = sin2z is analytic, hence obtain the derivative. (06 Marks)

   b. Determine the analytic function f(z) whose imaginary part is $\frac{y}{x^2 + y^2}$. (07 Marks)

   c. Define a harmonic function. Prove that real and imaginary parts of an analytic function are harmonic. (07 Marks)

4. a. Under the mapping w = e^z, find the image of i) $1 \leq x \leq 2$ ii) $\frac{\pi}{3} < y < \frac{\pi}{2}$. (06 Marks)

   b. Find the bilinear transformation which maps the points 1, i, -1 from z plane to 2, i, -2 into w plane. Also find the fixed points. (07 Marks)

   c. State and prove Cauchy's integral formula. (07 Marks)

PART - B

5. a. Prove $J_n(x) = \frac{x}{2n} [J_{n-1}(x) + J_{n+1}(x)]$. (06 Marks)

   b. Prove $(n+1) P_n(x) = (2n+1) x P_n(x) - n P_{n-1}(x)$. (07 Marks)

   c. Explain the following in terms of Legendres polynomials.
$$x^4 + 3x^3 - x^2 + 5x - 2$$
(07 Marks)

6 a. A class has 10 boys and 6 girls. Three students are selected at random one after another. Find the probability that i) first and third are boys , second a girl   ii) first and second are of same sex and third is of opposite sex. **(06 Marks)**

    b. If $P(A) = 0.4$, $P(B/A) = 0.9$, $P(\overline{B}/\overline{A}) = 0.6$. Find $P(A/B)$, $P(A/\overline{B})$. **(07 Marks)**

    c. In a bolt factory machines A, B and C manufacture 20%, 35% and 45% of the total of their outputs 5%, 4% and 2% are defective. A bolt is drawn at random found to be defective. What is the probability that it is from machine B? **(07 Marks)**

7 a. A random variable x has the following distribution :

x :	-2	-1	0	1	2	3	4
P(x) :	0.1	0.1	k	0.1	2k	k	k

      Find k, mean and S.D of the distribution. **(06 Marks)**

    b. The probability that a bomb dropped hits the target is 0.2. Find the probability that out of 6 bombs dropped i) exactly 2 will hit the target   ii) atleast 3 will hit the target. **(07 Marks)**

    c. Find the mean and variance of the exponential distribution. **(07 Marks)**

8 a. A die is tossed 960 times and 5 appear 184 times. Is the die biased? **(06 Marks)**

    b. Nine items have values 45, 47, 50, 52, 48, 47, 49, 53, 51. Does the mean of these differ significantly from assumed of mean of 47.5. ($\gamma = 8$, $t_{0.05} = 2.31$). **(07 Marks)**

    c. A set of 5 similar coins tossed 320 times gives following table.

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

      Test the hypothesis that data follows binomial distribution (Given $\gamma = 5$, $\chi^2_{0.05} = 11.07$) **(07 Marks)**

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Fourth Semester B.E. Degree Examination, June/July 2015
Material Science and Metallurgy

Time: 3 hrs.　　　　　　　　　　　　　　　　　　　　　　Max. Marks:100

Note: 1. *Answer any FIVE full questions, selecting*
atleast TWO questions from each part.
2. *Use of Handbook / Charts / Tables etc are not required.*

PART - A

1 a. What do you mean by co-ordination number? With a neat figure, write co-ordinations number for HCP structures. **(04 Marks)**
 b. What is Crystal Imperfections? With a neat sketches, explain line defects and surface defects. **(12 Marks)**
 c. Explain briefly, Factors affecting diffusion. **(04 Marks)**

2 a. Differentiate between i) Engg. Stress of True stress　　ii) Engg. Strain and True strain. Derive the relation between Engg. Strain and True Strain. **(08 Marks)**
 b. Explain with neat sketches, plastic deformation by i) Slip and ii) Twinning. **(08 Marks)**
 c. Draw the stress – strain curve for a ductile material and explain the important points on the curve. **(04 Marks)**

3 a. What do you mean by Type – I, Type – II, and Type – III fractures? Explain with neat sketches. **(06 Marks)**
 b. What is Creep? Explain creep curve, with neat sketch. **(08 Marks)**
 c. Explain with neat sketches, Typical fatigue stress cycles (Fatigue Loading). **(06 Marks)**

4 a. Explain with neat sketch, the mechanism of solidification. **(05 Marks)**
 b. What is Homogeneous Nucleation? With a neat sketch, derive the relation for free energy charge, Δfe. **(10 Marks)**
 c. Explain Hume – Rothary Rules for formation of solid solutions. **(05 Marks)**

PART - B

5 a. Explain briefly the construction of phase diagram using cooling curve, with a neat sketch. **(05 Marks)**
 b. Name the different types of phase diagrams. Explain with a neat sketch solid solution phase diagram (Complete solubility). **(10 Marks)**
 c. Draw the Iron - Carbon Equilibrium diagram and label all the phases. **(05 Marks)**

6 a. What do you mean by T - T – T curves? Explain with neat sketches, the construction of TTT curves for plain carbon steel. **(10 Marks)**
 b. Explain with neat sketch, Pack carburizing. **(05 Marks)**
 c. Explain with neat sketch, Flame Hardening. **(05 Marks)**

7 a. Explain the Composition, Properties and Applications of i) Gray cast iron ii) Malleable cast iron. **(10 Marks)**
 b. Explain the Composition, Properties and Application of
 i) Aluminum - Copper Alloys ii) Aluminum - Zinc Alloys. **(10 Marks)**

8 a. Define the Composite material. Explain the different types of Matrix Materials and Types of Reinforcements. **(10 Marks)**
 b. Explain with a neat sketch, the 'Pultrusion' process for producing FRP's. **(06 Marks)**
 c. Give the Advantages and Applications of composites. **(04 Marks)**

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Fourth Semester B.E. Degree Examination, June/July 2015
Mechanical Measurements and Metrology

Time: 3 hrs.   Max. Marks:100

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

PART – A

1. a. Give the definition and objectives of metrology. **(06 Marks)**
   b. Explain line standard and end standard with examples. **(06 Marks)**
   c. The slip gauge set M38 consists of the following :

Range (mm)	Steps (mm)	Pieces
1.005	-	1
1.01 – 1.09	0.01	9
1.1 – 1.9	0.1	9
1.0 – 9.0	1.0	9
10.0 – 100.0	10.0	10

   List the slip gauges to build the following : i) 29.875mm ii) 15.09mm iii) 101.345mm. **(08 Marks)**

2. a. What are Limit, Fit and tolerance? **(06 Marks)**
   b. Explain hole basis system and shaft basis system. **(06 Marks)**
   c. Determine the dimensions of the shaft and hole for a fit $30H_8d_{10}$ and sketch the fit, given the following data :

   i) Diameter 30 falls in the dia range $18 - 30$, upper deviation for "d" shaft is $- 16D^{0.44}$.

   ii) $i = 0.45D^{1/3} + 0.001D$. Tolerance for IT8 = 25i , Tolerance for IT10 = 64i. **(08 Marks)**

3. a. Sketch and explain sigma comparator. **(08 Marks)**
   b. Explain with a neat sketch the construction and working principle of solex pneumatic comparator. **(06 Marks)**
   c. Give the systematic way of building angle gauges to set an angle of 33^0, 16' , 42", using a standard set of 13 pieces. Also sketch the combination of angle gauges used. **(06 Marks)**

4. a. Explain the principle of interferometry with the aid of sketch. **(06 Marks)**
   b. How do you find effective diameter of a screw thread using two – wire method? **(06 Marks)**
   c. With a sketch, explain the construction of a tool maker's microscope. What are its applications? **(08 Marks)**

PART – B

5. a. Explain with examples various stages of a generalized measurement system. **(08 Marks)**
   b. Define : Sensitivity, Hysterisis, Repeatability. **(06 Marks)**
   c. Give advantages and disadvantages of Electrical transducers. **(06 Marks)**

6. a. With a block diagram, explain telemetry. **(06 Marks)**
   b. With a neat sketch, explain the working principle of a CRO. **(08 Marks)**
   c. What are X – Y plotters? With a block diagram, explain its working. **(06 Marks)**

7 a. With a neat sketch, describe the Pirani gauge used for pressure measurement. **(08 Marks)**
   b. With a neat sketch, explain the working principle of prony brake dynamometer. **(06 Marks)**
   c. Describe with a neat sketch, the analytical balance. **(06 Marks)**

8 a. Sketch and explain the working principle of optical pyrometer. **(08 Marks)**
   b. Describe the steps to be taken for the preparation of specimen and mounting of strain gauges. **(06 Marks)**
   c. What is a Thermocouple? State the laws of thermocouple. **(06 Marks)**

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USN ☐☐☐☐☐☐☐☐☐☐ **10ME/AU43**

Fourth Semester B.E. Degree Examination, June/July 2015
Applied Thermodynamics

Time: 3 hrs. Max. Marks:100

Note: 1. *Answer any FIVE full questions, selecting*
atleast TWO questions from each part.
2. *Use of Thermodynamic Data handbook is permitted.*

PART - A

1 a. Explain the following : i) A – F Ratio   ii) Calorific value of fuels   iii) Adiabatic flame temperature   iv) Internal energy of combustion   v) Combustion efficiency.
(10 Marks)

   b. Coal with the following mass analysis is burnt with 100% excess air, C = 74% , H_2 = 4.3% , S = 2.7% , N_2 = 1.5% , H_2O = 5.5% , O_2 = 5% , ash = 7%. Find the moles of gases produced, if 100kg of fuel is burnt.
(10 Marks)

2 a. With the help of T – S and P – V diagrams, derive an expression for m.e.p of otto cycle in terms of compression ratio, pressure ratio, showing all the processes involved.   **(10 Marks)**

   b. The compression ratio of a Diesel engine working on an ideal diesel cycle is 16. The temperature of air at the beginning of compression is 300K and the temperature of air at the end of expansion is 900K. Determine i) Cut – off ratio   ii) Expansion ratio   iv) Cycle efficiency.
(10 Marks)

3 a. Explain the following in detail : i) Morse test method   ii) Willan's Line method.
(08 Marks)

   b. A test on a 2S IC engine gave the following results at full load. Speed = 350 rpm ; Net brake load = 650N ; Indicated m.e.p = 3 bar ; Fuel consumption = 1.1×10^{-3} kg/S ; Jacket cooling water flow rate = 0.138kg/s ; Jacket water temperature at inlet = 20^0C ; Jacket water temperature at outlet = 40^0C ;   Room temperature = 20^0C ;   Exhaust gas temperature = 400^0C ; Air used per kg of fuel = 32kg ;   Cylinder diameter = 22cms ; Brake drum circumference = 314cms ; Calorific value of fuel = 43 MJ/kg ; Specific heat of exhaust gases = 1kJ/kg.K. Determine i) Mechanical efficiency   ii) Brake mean effective pressure. Draw the heat balance sheet including heat equivalent of BP, heat loss due to friction, heat carried away by cooling water, heat carried away by exhaust gases and unaccounted heat loss.
(12 Marks)

4 a. With a superimposed T – S diagram, compare Carnot and Rankine vapour cycles operating between the same boiler and condenser temperatures.   **(08 Marks)**

   b. In a Rankine cycle, the steam inlet to turbine is saturated at a pressure of 35 bar and the exhaust pressure is 0.2bar. Calculate i) Turbine work   ii) Pump work   iii) Rankine efficiency   iv) Condenser heat flow   v) Dryness fraction at the end of expansion. Assume the mass flow rate of steam as 9.5kg/sec.
(12 Marks)

PART - B

5 a. Define the following with respect to a compressor :
   i)   Isothermal efficiency   ii)   Adiabatic efficiency   iii)   Mechanical efficiency
   iv) Overall efficiency   v)   Volumetric efficiency.
(10 Marks)

b. An air compressor takes in air at 1 bar and 20^0C and compresses the same according to the law $PV^{1.2}$ = C. It is then delivered to a receiver at a constant pressure of 10 bar. Determine
  i) Temperature at the end of compression ii) Work done and heat transferred during compression, per kg of air. R = 0.287 kJ/kg.K. **(10 Marks)**

6 a. With neat sketches, explain the working of the following :
  i) Turbojet engine ii) Liquid propulsion rocket. **(10 Marks)**
  b. A gas turbine plant works between the temperature limits of 300K and 1000K and a pressure of 1 bar and 16 bar. The compression is carried out in two stages with perfect inter cooling inbetween. Calculate the net power of the plant, per kg of air circulation :
  Cp = 1 kJ / kg.K ; γ = 1.4 for air. **(10 Marks)**

7 a. Define the following : i) Refrigerating effect ii) Ton of refrigeration iii) Ice making capacity iv) Relative Cop. **(04 Marks)**
  b. Give four comparisons between vapour compression refrigeration and vapour absorption refrigeration. **(04 Marks)**
  c. A vapour compression refrigeration of 10 tonnes capacity using Freon – 12 as the refrigerant has an evaporator temperature of -10^0C and a condenser temperature of 30^0C. Assuming simple saturation cycle, determine i) Mass flow rate of refrigerant in kg/min ii) Power input iii) Cop. Cpv = 0.72 kJ/kg.K.
  (Obtain properties of Freon – 12 From Data Handbook). **(12 Marks)**

8 a. Derive an expression for the following :
  i) Specific humidity (w) ii) Degree of saturation (μ). **(08 Marks)**
  b. The dry and wet bulb temperatures of atmospheric air at 1 atm pressure are measured with a sling psychrometer and found to be 25^0C and 15^0C respectively. Determine
  i) Specific humidity ii) Relative humidity iii) Enthalpy of air.
  Use the table to find property values. Do not use psychrometric chart. **(12 Marks)**

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USN ☐☐☐☐☐☐☐☐☐☐ **10ME/AU44**

Fourth Semester B.E. Degree Examination, June/July 2015
## Kinematics of Machines

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting*
atleast TWO questions from each part.
2. Graphical solutions may be done on graph sheets
*or in answer book itself.*

PART – A

1 a. With a neat sketch define the following:
   i) Kinematic link
   ii) Kinematic pair
   iii) Kinematic chain
   iv) Kinematic mechanism
   v) Machine. **(10 Marks)**
   b. Define inversion of a kinematic chain. With the help of a neat sketch explain inversions of single slider crank chain. **(10 Marks)**

2 a. With the help of a neat sketch, explain the working principle of crank and slotted lever mechanism. **(10 Marks)**
   b. List various straight line generating mechanisms. With the help of a neat sketch along with proof, explain how a peaucellier mechanism generates a straight line. **(10 Marks)**

3 PQRS is a four bar m/sm with link PS fixed as shown in Fig.Q.3(a). The lengths of the links are; PQ = 62.5 mm, QR = 175 mm, RS = 112.5 mm, PS = 200 mm. The crank PQ rotates at 10 rad/s clockwise. Draw the velocity and acceleration diagrams when angle QPS = 60° and Q and R lie on the same side of PS. Find angular velocity and angular acceleration of links QR and RS. **(20 Marks)**

Fig.Q.3
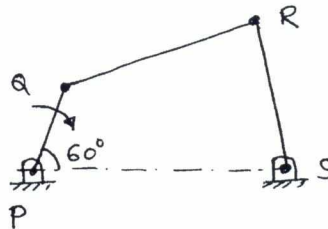
4 a. Locate all the instantaneous centres of the mechanism shown in Fig.Q.4(a). Determine the angular velocity of link AB and velocity of slider. Crank OB rotates CW at 150 rpm. **(10 Marks)**

Fig.Q.4(a)
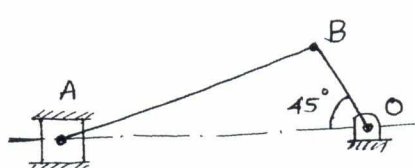
AB = 600 mm
OB = 150 mm

   b. State Kennedy's theorem and state the properties of instantaneous centres (any two). **(04 Marks)**
   c. With the help of a sketch, explain: i) Fixed instantaneous centre ; ii) Permanent instantaneous centre and iii) Neither fixed nor permanent instantaneous centres. **(06 Marks)**

1 of 2

PART – B

5. The crank and connecting rod of a reciprocating engine are 300mm and 1500mm in length respectively. The crank rotates at 180 rpm in the clockwise direction. Determine the velocity and acceleration of the piston when the crank is 40° from IDC. Also determine the position of the crank for zero acceleration of the piston. Use complex algebra method. **(20 Marks)**

6. a. Compare involute and cycloidal tooth profiles of a gear. **(04 Marks)**
   b. What is interference with respect to involute gears? State the methods to avoid interference. **(06 Marks)**
   c. A pinion of 32 involute teeth and 4 mm module drives a rack. The pressure angle is 20°. The addendum of both pinion and rack is the same. Determine the maximum permissible value of addendum to avoid interference. Also find the number of pairs of teeth in contact. **(10 Marks)**

7. a. Sketch and explain: i) Compound gear train   ii) Epicyclic gear train. **(06 Marks)**
   b. In the epicyclic gear train shown in Fig.Q.7(b) the compound wheels 'A' and 'B' as well as internal wheel 'C' and 'D' rotate independently about the axis '0'. The wheels 'E' and 'F' rotate on the pins fixed to arm 'a'. All the wheels are of the same module. The number of teeth on the wheels are $T_A = 52$, $T_B = 56$, $T_E = T_F = 36$. Determine the speed of C if ;
      i) The wheel D fixed and arm 'a' rotates at 200 rpm in the clockwise.
      ii) The wheel D rotates at 20 rpm counter clockwise and the arm 'a' rotates at 200rpm clockwise. **(14 Marks)**

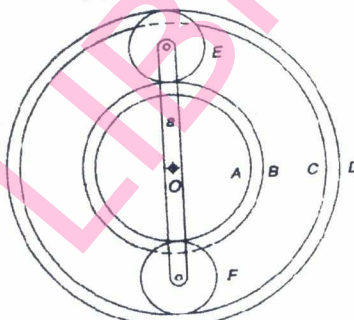

Fig.Q.7(b)

8. a. Sketch the following:
      i) Disc cam with translating follower.
      ii) Wedge cam with translating follower.
      iii) Cylindrical cam with oscillating follower. **(06 Marks)**
   b. Draw the profile of a cam operating a knife edge follower having a lift of 30 mm. The cam raises the follower with simple harmonic motion for 150° of the rotation followed by a period of dwell for 60°. The follower descends for the next 100° rotation of the cam with uniform velocity, again followed by a dwell period. The cam rotates at a uniform speed of 120 rpm and has a least radius of 20 mm. What will be the maximum velocity and acceleration of the follower during the lift and the return? **(14 Marks)**

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10ME/AU45

Fourth Semester B.E. Degree Examination, June/July 2015
Manufacturing Process – II

Time: 3 hrs.

Max. Marks:100

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

PART – A

1 a. Explain the various elements of a single point cutting tool, with the help of a neat sketch.
(08 Marks)

b. With the help of neat sketches, explain the different types of chips that are formed during metal cutting.
(06 Marks)

c. The following data refer to an orthogonal cutting process. Chip thickness 0.62mm, feed 0.2mm, rake angle 15°. Calculate chip reduction coefficient and shear angle.
(06 Marks)

2 a. Clearly explain the different factors that are to be considered during the selection of a cutting tool material.
(12 Marks)

b. Explain with neat sketch measurement of tool tip temperature.
(08 Marks)

3 a. With the help of a neat sketch, explain the constructional feature of a capstan lathe.
(06 Marks)

b. With a neat sketch, explain hydraulic driving mechanism of a shaper.
(08 Marks)

c. Sketch and explain the open and cross belt driving mechanism of a planer.
(06 Marks)

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

b. With a neat sketch, explain the working of gang drilling machine.
(06 Marks)

c. Explain with sketches the following operations in a drilling machine:
i) Spot facing   ii) Tre panning.
(06 Marks)

PART – B

5 a. With a neat sketch explain horizontal milling machine.
(08 Marks)

b. Show the calculations for setting dividing head to mill 87 divisions on a shaper wheel blank by compound indexing.
(06 Marks)

c. Sketch and explain the slab milling and gang milling operations.
(06 Marks)

6 a. What do you mean by grit, grade and structure of grinding wheel?
(06 Marks)

b. With the help of a block diagram, explain the working of a center type cylindrical grinding machine.
(08 Marks)

c. Write a short note on selection of grinding wheel.
(06 Marks)

7 a. With the help of neat sketches, discuss the working of continuous surface broaching machine.
(10 Marks)

b. Sketch and explain the process of lapping on a lapping machine.
(10 Marks)

8 a. Explain with neat sketch principle and advantages of electro chemical machining process.
(10 Marks)

b. Explain with neat sketch principle and applications of ultrasonic machining process.
(10 Marks)

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10ME46B/10AU46B

Fourth Semester B.E. Degree Examination, June/July 2015
Fluid Mechanics

Time: 3 hrs.

Max. Marks:100

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

PART – A

1 a. Define the following terms and mention their SI units:
    i)   Weight density
    ii) Specific gravity
    iii) Absolute viscosity
    iv) Capillarity.   **(08 Marks)**
   b. Whether viscosity of fluids varies with temperature? If yes, give reason. **(04 Marks)**
   c. The velocity distribution of flow over a plate is parabolic with vertex 30cm from the plane, where the velocity is 180 cm/s. If the viscosity of the fluid of 0.9 N-s/m^2 find the velocity gradient and shear stresses at distances of 0, 15 cm and 30cm from the plane. **(08 Marks)**

2 a. Obtain the total pressure and the centre of pressure on an inclined plane surface immersed in a fluid. **(10 Marks)**
   b. Establish a relationship among absolute, gauge and atmospheric pressure with a sketch. **(04 Marks)**
   c. Two bulbs B and C of equal dimensions and connected with an inverted U-tube with vertical limbs. The bulbs B and C contain water and the monometric liquid is oil of S.G.0.8. The centre of the bulb B is 25 cm above the center of bulb C. The surface of separation of water and oil in the left limb of U-tube to which B is fixed is at a height of 20cm from the centre of bulb B and the surface separation of water and oil in the right limb to which C is fixed is at 50cm from the center of bulb C. Find the pressure difference between B and C. Sketch the arrangements. **(06 Marks)**

3 a. Define the following with example:
    i)   Rotational flow
    ii) Irrotational flow
    iii) Laminar flow
    iv) Turbulent flow
    v)   Non-uniform flow.   **(10 Marks)**
   b. A wooden block of specific gravity 0.75 floats in water. If the size of the block is 1m × 0.5m × 0.4m. Find its metacentric height. **(10 Marks)**

4 a. Derive an expression for Bernoulli's equation from the first principles and also mention the assumptions made. **(10 Marks)**
   b. A pipe line is carrying an oil of specific gravity 0.87, the diameter of the pipe changes from 200 mm at section A to 500 mm at section B which is 4 m higher than A. If the pressure at A and B is 100 kPa and 60 kPa respectively and if the discharge is 200 kg/sec. Determine:
    i) Loss of head   ii) Flow direction.   **(10 Marks)**

PART – B

5 a. Derive an expression for discharge through orifice meter. **(10 Marks)**

   b. The pressure difference ΔP in a pipe of diameter D and length ℓ due to turbulent flow depends on the velocity V. Viscosity μ. Density ρ and surface roughness K. Using Buckingham's π-theorem. Obtain an expression for ΔP. **(10 Marks)**

6 a. Derive Darcy's equation for head losses due to friction in a circular pipe. **(10 Marks)**

   b. The diameter of a horizontal pipe which is 300mm is suddenly enlarged to 600 mm. The rate of flow of water through this pipe is 0.4 m³/s. If the intensity of pressure in the smaller pipe is 125 kPa. Determine:
   i)   Loss of head, due to sudden enlargement
   ii)   Intensity of pressure in the larger pipe   and
   iii) Power lost due to enlargement. **(10 Marks)**

7 a. Derive Hagen-Poiseuille equation for viscous flow through a circular pipe. **(10 Marks)**

   b. A pipe 240 in diameter and 10km long is laid at a slope of 1 in 80. An oil of specific gravity 0.85 and absolute viscosity 1.5 poise is pumped up at the rate of 20 LPS. Find the head lost due to friction and the power required to pump the oil. **(10 Marks)**

8 a. Define the following:
   i)   Drag
   ii)   Lift
   iii) Momentum thickness
   iv)   Mach number
   v)   Mach cone. **(10 Marks)**

   b. On a flat plate of 2m length and 1m width, experiments were conducted in a wind tunnel with a wind speed of 50 km/h, the plate is kept at such an angle that the coefficient of drag and lift are 0.18 and 0.9 respectively. Determine:
   i)   Drag force
   ii)   Lift force
   iii) Resultant force
   iv)   Power exerted by the air stream on the plate
         Take density of air = 1.15 kg/m³. **(10 Marks)**

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MATDIP401

Fourth Semester B.E. Degree Examination, June/July 2015
Advanced Mathematics - II

Time: 3 hrs.   Max. Marks:100

Note: *Answer any FIVE full questions.*

1 a. Find the angle between 2 diagonals of a cube.   **(06 Marks)**
   b. If A(0 9 6), B(1 2 3) , C(7 - 25) are vertices of a triangle. Find the coordinates of the foot of the perpendicular drawn from A to BC.   **(07 Marks)**
   c. Find the equation of the plane in the Intercept form $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$.   **(07 Marks)**

2 a. Find the equation of the plane passing through the three points (2, 3, 4) , (-3, 5, 1) (4, -1, 2).   **(06 Marks)**
   b. Find the equation of the plane through the points (1, 2, -1) and perpendicular to the planes $x + y - 2z = 5$ and $3x - y + 4z = 12$.   **(07 Marks)**
   c. Find the equation of the plane through the points (-1, 2, 0) and containing the plane $2x + 3y + 5z -1 = 0$ and $3x + y - z + 2 = 0$.   **(07 Marks)**

3 a. Find the unit vector parallel to the sum of the vector $\vec{A} = 2i + 4j - 5k$ and $\vec{B} = i + 2j + 3k$.   **(06 Marks)**
   b. Determine λ such that $\vec{A} = i + j + k$, $\vec{B} = 2i - 4k$. $\vec{C} = i + \lambda j + 3k$ are coplanar.   **(07 Marks)**
   c. Prove that $(\vec{a} \times \vec{b}) \times \vec{c} = (\vec{a}.\vec{c})\vec{b} - (\vec{b}.\vec{c})\vec{a}$.   **(07 Marks)**

4
   a. Prove that $\frac{d}{dt}[\vec{F}.\vec{G}] = \vec{F}.\frac{d\vec{G}}{dt} + \frac{d\vec{F}}{dt}.\vec{G}$.   **(06 Marks)**
   b. Find the velocity and acceleration for the curve $\vec{r} = (1-t^3) i + (1+t^2)j + (2t - 5)k$ at $t = 1$ and also find their magnitude.   **(07 Marks)**
   c. If $\frac{d\vec{a}}{dt} = \vec{w} \times \vec{a}$ and $\frac{d\vec{b}}{dt} = \vec{w} \times \vec{b}$ then show that $\frac{d}{dt}[\vec{a} \times \vec{b}] = \vec{w} \times (\vec{a} \times \vec{b})$.   **(07 Marks)**

5 a. Find the directional derivative of $\phi = x^2yz + 4xz^2$ at (1, -2, -1) along $2i - j - 2k$.   **(06 Marks)**
   b. If $\vec{F} = (x + y + 1) i + j - (x + y)k$. Find $\vec{F}.curl\vec{F}$.   **(07 Marks)**
   c. Show that $\nabla.(\nabla \times \vec{A}) = 0$.   **(07 Marks)**

6 a. Find L f(t) given that $f(t) = \begin{cases} t ; & 0 < t < 4 \\ 5 ; & t > 4 \end{cases}$ **(05 Marks)**

   b. Find i) $L[e^{3t} \sin5t \sin3t]$ ii) $L[t^5 \cosh3t]$ iii) $L[t^3 e^{-3t}]$.   **(15 Marks)**

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

   b. Find i) $L^{-1}\left[\frac{4s+5}{(s-1)^2(s+2)}\right]$ ii) $L^{-1}\left[\frac{4s+15}{16s^2-25}\right]$ iii) $L^{-1}\left[\frac{s}{s^2-6s+9}\right]$.   **(15 Marks)**

8   a. Using Laplace transform solve :
$$\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 3y = e^t \quad ; \quad y(0) = 0 \quad y'(0) = 1.$$ **(10 Marks)**

   b. Solve using Laplace transformation method
$$y'' + 2y' - 3y = \sin t, \quad y(0) = y'(0) = 0.$$ **(10 Marks)**

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