IV ME, CV

USN | | | | | | | | | | |

10MAT41

Fourth Semester B.E. Degree Examination, June 2012

Engineering Mathematics - IV

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Using the Taylor's method, find the third order approximate solution at x = 0.4 of the problem $\frac{dy}{dx} = x^2y + 1$, with y(0) = 0. Consider terms upto fourth degree. **(06 Marks)**

b. Solve the differential equation $\frac{dy}{dx} = -xy^2$ under the initial condition y(0) = 2, by using the modified Euler's method, at the points x = 0.1 and x = 0.2. Take the step size h = 0.1 and carry out two modifications at each step. **(07 Marks)**

c. Given $\frac{dy}{dx} = xy + y^2$; y(0) = 1, y(0.1) = 1.1169, y(0.2) = 1.2773, y(0.3) = 1.5049, find y(0.4) correct to three decimal places, using the Milne's predictor-corrector method. Apply the corrector formula twice. **(07 Marks)**

2 a. Employing the Picard's method, obtain the second order approximate solution of the following problem at x = 0.2.

$$\frac{dy}{dx} = x + yz; \quad \frac{dz}{dx} = y + zx; \quad y(0) = 1, \quad z(0) = -1.$$ **(06 Marks)**

b. Using the Runge-Kutta method, solve the following differential equation at x = 0.1 under the given condition:

$$\frac{d^2y}{dx^2} = x^3\left(y + \frac{dy}{dx}\right), \quad y(0) = 1, \quad y'(0) = 0.5.$$

Take step length h = 0.1. **(07 Marks)**

c. Using the Milne's method, obtain an approximate solution at the point x = 0.4 of the problem $\frac{d^2y}{dx^2} + 3x\frac{dy}{dx} - 6y = 0$, y(0) = 1, y'(0) = 0.1. Given y(0.1) = 1.03995, y'(0.1) = 0.6955, y(0.2) = 1.138036, y'(0.2) = 1.258, y(0.3) = 1.29865, y'(0.3) = 1.873. **(07 Marks)**

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

b. If f(z) is a regular function of z, prove that $\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right)|f(z)|^2 = 4|f'(z)|^2$. **(07 Marks)**

c. If w = ϕ + iy represents the complex potential for an electric field and $y = x^2 - y^2 + \frac{x}{x^2 + y^2}$ determine the function ϕ. Also find the complex potential as a function of z. **(07 Marks)**

4 a. Discuss the transformation of $w = z + \frac{k^2}{z}$. **(06 Marks)**

b. Find the bilinear transformation that transforms the points $z_1 = i$, $z_2 = 1$, $z_3 = -1$ on to the points $w_1 = 1$, $w_2 = 0$, $w_3 = \infty$ respectively. **(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 $|z| = 3$, using Cauchy's integral formula. **(07 Marks)**

PART – B

5 a. Obtain the solution of $x^2y'' + xy' + (x^2 - n^2)y = 0$ in terms of $J_n(x)$ and $J_{-n}(x)$. **(06 Marks)**

b. Express $f(x) = x^4 + 3x^3 - x^2 + 5x - 2$ in terms of Legendre polynomials. **(07 Marks)**

c. Prove that $\int_{-1}^{+1} P_m(x) \cdot P_n(x) dx = \frac{2}{2n+1}$, $m = n$. **(07 Marks)**

6 a. From five positive and seven negative numbers, five numbers are chosen at random and multiplied. What is the probability that the product is a (i) negative number and (ii) positive number? **(06 Marks)**

b. If A and B are two events with $P(A) = \frac{1}{2}$, $P(B) = \frac{1}{3}$, $P(A \cap B) = \frac{1}{4}$, find $P(A/B)$, $P(B/A)$, $P(\overline{A}/\overline{B})$, $P(\overline{B}/\overline{A})$ and $P(A/\overline{B})$. **(07 Marks)**

c. In a certain college, 4% of boy students and 1% of girl students are taller than 1.8 m. Furthermore, 60% of the students are girls. If a student is selected at random and is found taller than 1.8 m, what is the probability that the student is a girl? **(07 Marks)**

7 a. A random variable x has the density function $P(x) = \begin{cases} Kx^2, & 0 \le x \le 3 \\ 0, & \text{elsewhere} \end{cases}$. Evaluate K, and find: i) $P(x \le 1)$, (ii) $P(1 \le x \le 2)$, (iii) $P(x \le 2)$, iv) $P(x > 1)$, (v) $P(x > 2)$. **(06 Marks)**

b. Obtain the mean and standard deviation of binomial distribution. **(07 Marks)**

c. In an examination 7% of students score less than 35% marks and 89% of students score less than 60% marks. Find the mean and standard deviation if the marks are normally distributed. It is given that $P(0 < z < 1.2263) = 0.39$ and $P(0 < z < 1.4757) = 0.43$. **(07 Marks)**

8 a. A random sample of 400 items chosen from an infinite population is found to have a mean of 82 and a standard deviation of 18. Find the 95% confidence limits for the mean of the population from which the sample is drawn. **(06 Marks)**

b. In the past, a machine has produced washers having a thickness of 0.50 mm. To determine whether the machine is in proper working order, a sample of 10 washers is chosen for which the mean thickness is found as 0.53 mm with standard deviation 0.03 mm. Test the hypothesis that the machine is in proper working order, using a level of significance of (i) 0.05 and (ii) 0.01. **(07 Marks)**

c. Genetic theory states that children having one parent of blood type M and the other of blood type N will always be one of the three types M, MN, N and that the proportions of these types will on an average be 1 : 2 : 1. A report states that out of 300 children having one M parent and one N parent, 30% were found to be of type M, 45% of type MN and the remainder of type N. Test the theory by χ^2 (Chi square) test. **(07 Marks)**

* * * * *

USN | | | | | | | | | | |

10ME/AU/PM/TL42B

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

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. With a sketch, explain anyone type of material length standard. What are the disadvantages and advantages of material length standards? **(08 Marks)**

b. Using NPL method, derive equation for calibrating end standards from line standards. **(08 Marks)**

c. What are Airy points? Explain in detail. **(04 Marks)**

2 a. With the help of sketch, define the following Zero line, Basic size, Limits, Allowances, Deviation, Upper deviation, Lower deviation and Fundamental deviation. **(08 Marks)**

b. What is the difference between unilateral and bilateral tolerances? Which is the most suitable tolerance method and why? **(06 Marks)**

c. Determine the type of fit after deciding the fundamental deviations and tolerances in the following : Fit = 70 H_9/e_7 ; Diameter step 50 to 80 ;
Fundamental deviation for shaft = $-11D^{0.41}$ in micron ;
$IT_7 = 16i$ and $IT_9 = 40i$; $i = 0.45\sqrt[3]{D} + 0.001D$ in micron. **(06 Marks)**

3 a. Explain with neat sketch, the construction and working principle of LVDT. **(08 Marks)**

b. Describe the working of a vernier bevel protractor, with a neat sketch. **(06 Marks)**

c. Explain the principle of sine bar. **(06 Marks)**

4 a. Draw a neat sketch of a toolmakers microscope and explain briefly the construction and uses. **(08 Marks)**

b. Describe the 3 – wire method of measuring effective diameter of threads and derive the equation for the same. **(08 Marks)**

c. Illustrate the use of gear tooth caliper to measure tooth thickness. **(04 Marks)**

PART – B

5 a. Explain the three stages of generalized measuring method, using any one example. **(08 Marks)**

b. Explain the following, with respect to an instrument : i) Sensitivity ii) Threshold iii) Hysteresis and iv) Loading effect. **(08 Marks)**

c. What is the significance of measurement system? **(04 Marks)**

6 a. With an example, explain primary and secondary transducer. **(08 Marks)**

b. Explain with sketches, variable self – inductance (both single and two coils) transducers. **(06 Marks)**

c. Explain with sketches i) Photoelectric transducers ii) Photoconductive transducer. **(06 Marks)**

7 a. Explain hydraulic dynamometer, with a neat sketch. What are the advantages of hydraulic dynamometers over mechanical brakes? **(08 Marks)**

b. Explain with sketch, working of proving ring. **(08 Marks)**

c. What are the methods of force measurement? Give examples. **(04 Marks)**

8 a. Explain with neat sketch, the working principle of resistance thermometer. **(08 Marks)**

b. Explain using neat sketch, working principle of null balance type strain measurement. **(08 Marks)**

c. Explain law of intermediate temperature, with figure. **(04 Marks)**

*****

USN | | | | | | | | | | |

10ME/AU43

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

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Explain the following with reference to a combustion process:
i) Percent excess air ii) Enthalpy of formation
iii) Adiabatic flame temperature iv) Enthalpy of combustion. **(08 Marks)**

b. The products of combustion of an unknown hydrocarbon C_x H_y have the following composition as measured by an Orsat apparatus:
CO_2 = 8.0%, CO = 0.9%, O_2 = 8.8%, N_2 = 82.3%. Determine:
i) The composition of the fuel
ii) The air-fuel ratio
iii) The percent excess air used and
iv) Dew point temperature of the product if the total pressure of the product is 1.01325 bar. **(12 Marks)**

2 a. Derive an expression for efficiency of diesel cycle in terms of compression ratio, cut-off ratio and specific heats ratio. **(08 Marks)**

b. An air-standard limited pressure cycle has a compression ratio of 15 and compression begins at 0.1 MPa, 40 °C. The maximum pressure is limited to 6 MPa and the heat added is 1675 kJ/kg. Compute:
i) The heat supplied at constant volume per kg air
ii) The heat supplied at constant pressure
iii) The cycle efficiency
iv) The cut-off ratio and
v) m.e.p of the cycle. **(12 Marks)**

3 a. Explain the 'William's line method for calculating the frictional power in an IC Engine. **(04 Marks)**

b. A test on a two-stroke engine gave the following results at full load:
Speed = 350 rpm, Net brake load = 65 kg_f, m.e.p = 3 bar, Fuel consumption = 4 kg/h, Jacket cooling water flow rate = 500 kg/h, Jacket cooling water temperature rise = 20 °C, Air used per kg of fuel = 32 kg, Cylinder diameter = 22 cm, Stroke = 28 cm, Effective brake drum diameter = 1 m, CV of fuel = 43 MJ/kg, Cp_g = 1 kJ/kg, Exhaustgas temp = 400 °C, Room temperature = 20 °C.
Find the mechanical efficiency and also draw a heat balance sheet on minute and percentage basis. **(10 Marks)**

c. A 4-cylinder petrol engine has a rated output of 52 kW at 2000 rpm. A Morse test is carried out and the brake torque readings are 177, 170, 168 and 174 N-m respectively. For normal running at this speed, the BSFC is 0.25 kg/kW–h and C.V of fuel used is 42500 kJ/kg. Calculate the mechanical and brake thermal efficiency. **(06 Marks)**

4 a. Draw a schematic diagram and show the actual regenerative vapour power cycle. Also derive an expression for its efficiency. **(08 Marks)**

b. An ideal Rankine cycle with reheat is designed to operate according to the following specification:
Pressure at the inlet of HP turbine = 20 MPa.
Temperature of steam at the inlet of HP turbine = 550 °C.
Temperature of steam at the end of reheat = 550 °C.
Pressure of steam at the turbine exit = 15 kPa
Quality of steam at the turbine exit = 90%. Determine:
i) Reheat pressure ii) Temperature in the condenser
iii) Ratio of pump work to turbine and iv) Cycle thermal efficiency. **(12 Marks)**

PART – B

5 a. What are the advantages of multi-stage compression? **(04 Marks)**

b. Derive an expression for volumetric efficiency of a single stage reciprocating air compressor in terms of clearance factor (K), pressure ratio $\left(P_2/P_1\right)$ and index of compression (n). **(04 Marks)**

c. A single acting, two-stage air-compressor delivers air at 17 bar when the pressure and temperature of air at the end of suction are 1 bar and 303 k. The interstage pressure is 4 bar and there is perfect intercooling. If LP cylinder diameter is 23 cm and common stroke is 15 cm and speed of the compressor is 350 rpm. Determine:
i) Volumetric efficiency of LP stage compressor.
ii) Heat transfer in the inert cooler in kJ/min and
iii) Capacity of the motor required to drive the compressor if the mechanical efficiency is 85%.
Assume the clearance volume of LP compressor = 5% of stroke volume. The compression and expansion in both cylinders follow the law $PV^{1.25}$ = constant. **(12 Marks)**

6 a. What are the advantages of closed cycle gas turbine over the open cycle gas turbine plant? **(04 Marks)**

b. Write a short note on jet-propulsion. **(04 Marks)**

c. 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 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 Cp and γ to be same for both air and products of combustion. **(12 Marks)**

7 a. Sketch and explain the Ammonia-Water absorption refrigeration system. **(08 Marks)**

b. What are the desirable thermodynamics and thermo-physical properties of a good refrigerant? **(04 Marks)**

c. In an air-refrigeration plant working on a reversed Brayton cycle, air enters into the compressor at 1 bar and-15 °C, where it is compressed to a pressure of 5.5 bar. Air enters the expander at 15°C. Determine:
i) COP of the cycle and
ii) Mass flow rate of air into the compressor per minute for 1 ton of refrigeration.
Assume both compression and expansion process are isentropic. **(08 Marks)**

8 a. Derive an expression for specific humidity of air-water vapour mixture. **(06 Marks)**

b. Sketch and explain the winter air-conditining showing the processes on a psychrometric chart. **(07 Marks)**

c. The dry and wet temperatures of atmospheric air at 101.325 KPa pressure are measured with a sling psychrometer and determined to be 25 °C and 15 °C respectively. Determine:
i) Dew point temperature ii) Specific humidity
iii) Relative humidity and iv) Enthalpy of moist air.
Use properties of table only, without using psychrometric chart. **(07 Marks)**

* * * * *

USN | | | | | | | | | | |

10ME/AU/IP/IM/MA/TL/PM44

Fourth Semester B.E. Degree Examination, June 2012
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 obtained on graphsheets or on answer book itself.***

PART – A

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

b. Sketch and explain the working of an elliptical trammel. Prove that it traces an ellipse. **(10 Marks)**

2 a. Explain with a neat sketch, crank and slotted lever quick return motion mechanism. **(08 Marks)**

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

c. Explain with a neat sketch, Geneva wheel mechanism. **(06 Marks)**

3 In the toggle mechanism shown in fig.Q3, the slider D is constrained to move on a horizontal path. The crank OA is rotating in the counter clockwise direction at a speed of 180 rpm. The dimensions of the various links are as follows : OA = 180mm , CB = 240mm, AB = 360mm and BD = 540mm. For the given configuration find ,

a. Velocity of the slider.
b. Angular velocity of the links AB, CB and BD.
c. Velocity of rubbing on the pins of diameter of 30mm at A and D.
d. Torque applied to the crank OA for a force of 2kN at D. **(20 Marks)**

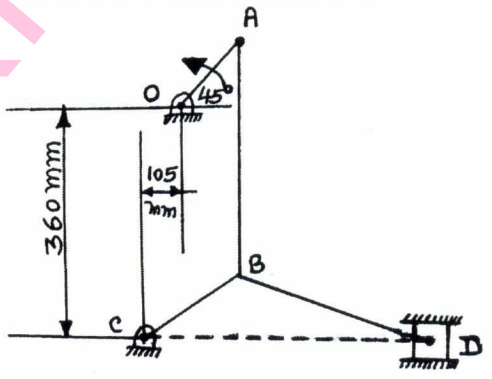

Fig.Q3

4 a. Explain the procedure for velocity and acceleration of the piston in a reciprocating engine mechanism. **(10 Marks)**

b. Explain how by means of Klein's construction the acceleration of a reciprocating engine is determined. **(10 Marks)**

PART - B

5 The crank of a reciprocating engine is 90mm long, the connecting rod is 360mm long and the crank rotates at 150rpm clockwise. Find the velocity and acceleration of the piston and the angular velocity and angular acceleration of the connecting rod when the angle which the crank makes with inner dead centre is 30^0. Solve the problem through complex algebra. **(20 Marks)**

6 a. Derive the expression for length of path of contact, length of arc of a contact and contact ratio for a pair of involute gears in contact. **(10 Marks)**

b. The following data relate to a pair of involute spur gear in mesh : Module = 6mm ; Number of teeth on wheel = 49 ; Number of teeth on pinion = 17 ; Addendum of pinion and gear wheel interms of module = 1 , find the number of pairs of teeth in contact? **(10 Marks)**

7 a. Sketch and explain different types of gear trains. **(06 Marks)**

b. Figure Q7(b), shows an Epicyclic gear train where the arm A the driver and annular gear D is the follower. The wheel D has 112 teeth and B has 48 teeth. B runs freely on pin P and D is separately driven. The arm A runs at 100 rpm and wheel D at 50 rpm in same direction. Find the speed of wheel B and C. **(14 Marks)**

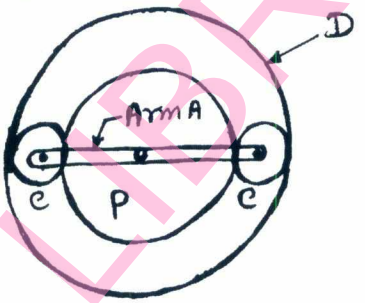

Fig.Q7(b)

8 The following data relate to a cam profile in which the roller follower moves with uniform acceleration and retardation motion during ascent and descent.
Minimum radius of cam = 25mm ; Roller radius = 8mm ; Lift = 32 mm ; Offset of follower axis = 12mm towards right ; Angle of ascent = 60^0 ; Angle of descent = 90^0 ; Angle of dwell between ascent and descent = 45^0 ; Speed of cam = 200 rpm clockwise.
Draw the profile of the cam. **(20 Marks)**

*****

USN | | | | | | | | | | |

10ME/AU/PM/TL45

Fourth Semester B.E. Degree Examination, June 2012
Manufacturing Process – II

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. With neat sketches, explain clearly the different types of chips by enumerating the conditions under which each variety of chip will be formed. **(09 Marks)**

b. Mild steel bars of 50 mm diameter are to be turned over a length of 160 mm with a depth of cut of 1.5 mm, feed of 0.2 mm/rev at 230 rpm by HSS tool. If the tool life equation is given by, $VT^{0.2}f^{0.3}d^{0.12} = 50$, determine how many components may be turned before regrinding of the tool. **(07 Marks)**

c. Write an explanatory note on flank wear. **(04 Marks)**

2 a. List and explain the essential properties of cutting tool materials. **(08 Marks)**

b. List the various functions of a cutting fluid in metal cutting. **(04 Marks)**

c. State the various methods of measuring the tool tip temperature and hence explain any one of them with neat sketch. **(08 Marks)**

3 a. Distinguish clearly between shaping and planing. **(04 Marks)**

b. Explain clearly the tail stock offset method of taper turning in a lathe. **(07 Marks)**

c. With a neat sketch, explain clearly the construction and working of a shaper. **(09 Marks)**

4 a. With a neat diagram, explain briefly the construction and working principle of upright drilling machine. State its relative merits and demerits. **(10 Marks)**

b. Explain briefly with suitable sketches the various operations to be performed on a drilling machine. **(10 Marks)**

PART – B

5 a. With the aid of suitable sketches, explain clearly the concepts of up milling and down milling. **(08 Marks)**

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

c. Differentiate between simple indexing and compound indexing. **(04 Marks)**

6 a. With neat sketch, explain clearly the construction and working principle of a surface grinding machine. **(10 Marks)**

b. Explain the following:
i) Types of abrasives used in grinding wheels.
ii) Dressing and truing of grinding wheels. **(10 Marks)**

7 a. Distinguish clearly between push broach and pull broach. **(04 Marks)**

b. What is honing? With a neat sketch, explain clearly the vertical honing machine. **(09 Marks)**

c. Explain with a neat sketch, the process of lapping. **(07 Marks)**

8 a. With a neat sketch, explain clearly the principle of working and construction of a Abrasive Water Jet Machining (AWJM). State the process parameters. **(10 Marks)**

b. Explain briefly the principle of EDM, with a neat sketch. List the various factors affecting the MRR in EDM process and explain any one of them. **(10 Marks)**

* * * * *

USN | | | | | | | | | | |

10ME/AU46B

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

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***
2. ***Missing data may be assumed suitably with proper reasoning.***

PART - A

1 a. Distinguish between the following :
i) Mass density and weight density
ii) Dynamic viscosity and kinematic viscosity.
iii) Ideal fluid and real fluid. **(06 Marks)**

b. Prove that an ideal gas undergoing an adiabatic process, the bulk modulus of elasticity (K) is γ time the pressure (P) where $\gamma = C_p/C_v$. **(04 Marks)**

c. Derive an expression for surface tension on a liquid jet. **(04 Marks)**

d. An oil film of thickness 1.5mm is used for lubrication between a square plate of size 0.9m × 0.9m and an inclined plane having an angle of inclination 20^0 with horizontal. The mass of the square plate is 40 kg and it slides down the plane with a uniform velocity of 0.2m/s. Find the dynamic viscosity of the oil. **(06 Marks)**

2 a. State and prove hydrostatic law. **(06 Marks)**

b. Find the pressure difference between A and B in kPa in meters of water for the fig.Q2(b). **(06 Marks)**

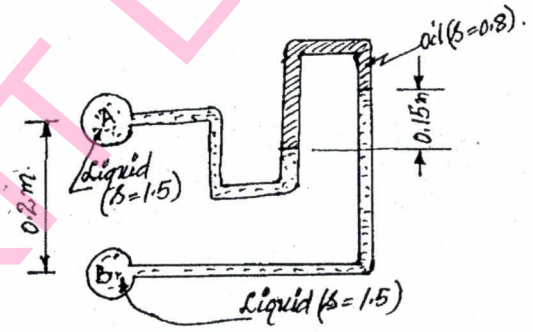

Fig.Q2(b)

c. A circular plate of 4.5m diameter is submerged in water with its greatest and least depths below the water surface being 3m and 1.5m respectively. Find i) the total pressure on the front face of the plate and ii) the position of centre of pressure. **(08 Marks)**

3 a. A hollow wooden cylinder (s = 0.6) has an outer diameter of 0.6m and an inner diameter of 0.3m. It is required to float in an oil of sp.gr. 0.9. Calculate i) the maximum length (height) of the cylinder so that it shall be stable when floating with its axis vertical ii) the depth to which it will sink. **(08 Marks)**

b. Distinguish between : i) Steady flow and uniform flow ii) Rotational flow and irrotational flow. **(04 Marks)**

c. In a two – dimensional flow field for an incompressible fluid, the velocity components are :
$u = y^3/3 + 2x - x^2y$ and $v = xy^2 - 2y - x^3/3$
i) Check for the continuity ii) Find an expression for the stream function. **(08 Marks)**

4 a. Derive Euler's equation of motion along a stream line. Also derive Bernoulli's equation from Euler's equation of motion and list the assumptions made for deriving Bernoulli's equation. **(10 Marks)**

b. A conical tube is fixed vertically with its smaller end upwards and it forms a part of pipe line. The velocity at the smaller end is 4.5m/s and at the large end is 1.5m/s. Length of the conical tube is 1.5m. The pressure at the upper end is equivalent to a head of 10m of water.

i) Neglecting the frictional loss, determine the pressure at the lower end of the tube.

ii) If head loss in the tube is $0.3\ (v_1 - v_2)^2/2g$, where v_1 and v_2 are the velocities at smaller and larger end respectively, determine the pressure at the larger end assuming flow downward. **(10 Marks)**

PART - B

5 a. Derive an expression for discharge through V – notch. **(06 Marks)**

b. A horizontal venturimeter with inlet diameter 20cm and throat diameter 10cm is used to measure the flow of water. The pressure at inlet is 147 kPa and vacuum pressure at the throat is 40cm of mercury. Find the discharge of water through venturimeter. Take $C_d = 0.98$. **(06 Marks)**

c. The shear stress (τ) in a pipe flow depends upon the diameter of the pipe (D), velocity (v) of the fluid, mass density (ρ) and dynamic visocity (μ) of the fluid and height of roughness of projection (k). Using dimensional analysis, obtain the relation for shear stress in a non – dimensional form. **(08 Marks)**

6 a. Derive Chezy's equation for loss of head due to friction in pipes. **(06 Marks)**

b. Water is to be supplied to the inhabitants of a college campus through a supply main. The following data is given :
Distance of the reservoir from the campus = 3km, Number of inhabitants = 4000, Consumption of water per day of each inhabitant = 180 litres, Loss of head due to friction = 18m, Coefficient of friction for the pipe, f = 0.007. If half of the daily supply is pumped in 8 hours, determine the size of the supply main. **(06 Marks)**

c. Three pipes of diameters 300mm, 200mm and 400mm, and length 450m, 255m and 315m respectively are connected in series. The difference in water surface levels in two tanks is 18m. Determine the rate of flow of water if co-efficient of frictions are 0.0075, 0.0078 and 0.0072 respectively. Neglect the minor losses. Also find the equivalent diameters of the pipe if the equivalent coefficient of friction is 0.0075. **(08 Marks)**

7 a. Show that the average velocity is equal to the half of the maximum velocity in a laminar flow through pipe. **(10 Marks)**

b. Determine i) the pressure gradient ii) the shear stress at the two horizontal plates iii) discharge per meter width for laminar flow of oil with a maximum velocity of 2m/s between two plates which are 150mm apart. Given $\mu = 2.5$ Pa-s. **(10 Marks)**

8 a. Differentiate between : i) Pressure drag and friction drag ii) Stream line body and bluff body iii) Lift and drag. **(08 Marks)**

b. Find the displacement thickness and momentum thickness for the velocity distribution in the boundary layer given by :

$$\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2.$$ **(08 Marks)**

c. Find the velocity of the bullet fired in standard air if the Mach angle is 30^0, Assume temperature of air as 15^0C. **(04 Marks)**

*****

USN | | | | | | | | | | |

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)**

*****