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10MAT41

Fourth Semester B.E. Degree Examination, June/July 2017
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. Find $y(0.1)$ by using Taylor's series method, given that $y' = \sqrt{x^2 + y}$, $y(0) = 0.8$. Consider upto third order derivative terms. **(06 Marks)**

b. Given : $\frac{dy}{dx} = \frac{1}{1+x^2} - 2y^2$, $y(0) = 0$. Find $y(0.5)$, by taking $h = 0.25$, using Euler's modified method. **(07 Marks)**

c. If $y' = \frac{1}{x+y}$, $y(0) = 2.0000$, $y(0.2) = 2.0933$, $y(0.4) = 2.1755$, $y(0.6) = 2.2493$, find $y(0.8)$ by using Adams-Bash forth method. **(07 Marks)**

2 a. Using the Picard's method, obtain the 2nd order approximate solution of the problem at $x = 0.2$, $\frac{dy}{dx} = x + yz$; $\frac{dz}{dx} = y + zx$, $y(0) = 1$ and $z(0) = -1$. **(06 Marks)**

b. Using the R-K method, find the solution at $x = 0.1$ of an equation; $y'' - x^2y' - 2xy - 1 = 0$ with the conditions $y(0) = 1$, $y'(0) = 0$ and step size 0.1. **(07 Marks)**

c. Given that $y'' + xy = 0$, $y(0) = 1$, $y(0.1) = 1.0998$, $y(0.2) = 1.1987$, $y(0.3) = 1.2955$, $y'(0) = 1$, $y'(0.1) = 0.9946$, $y'(0.2) = 0.9773$, $y'(0.3) = 0.946$, find $y(0.4)$, using Milne's method. (Apply corrector formula only once). **(07 Marks)**

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

b. If $f(z) = u + iv$ is an analytic function, then prove that the family of curves; $u(x, y) = C_1$, $v(x, y) = C_2$, C_1 and C_2 being constants, interfect orthogonally. Is the converse true? Justify your answer. **(07 Marks)**

c. In a two dimensional fluid flow; if the velocity potential is $e^{-x}\cos y + xy$, find the stream function. **(07 Marks)**

4 a. Find the bilinear transformation which maps the points $z = 1, i, -1$ onto the points $w = i, 0, -i$. Also find the invariant points. **(06 Marks)**

b. Discuss the transformation, $w = z + \frac{K^2}{z}$, where $z \neq 0$, $K \neq 0$. **(07 Marks)**

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

PART – B

5 a. Obtain the series solution of Bessel's differential equation. **(07 Marks)**

b. Derive the Rodrigue's formula. **(07 Marks)**

c. Express the polynomial $2x^3 - x^2 - 3x + 2$ in terms of Legendre polynomials. **(06 Marks)**

6 a. 'A' can hit a target 3 times in 5 shots, 'B' 2 times in 5 shots and 'C' 3 times in 4 shots. They fire a volley. Find the probability that (i) 2 shots hit (ii) at least 2 shots hit. **(06 Marks)**

b. If A and B are events with $P(A) = \frac{1}{2}$, $P(A \cup B) = \frac{3}{4}$, $P(\overline{B}) = \frac{5}{8}$ find $P(A \cap B)$, $P(\overline{A} \cap \overline{B})$, $P(\overline{A} \cup \overline{B})$ and $P(\overline{A} \cap B)$. **(07 Marks)**

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

7 a. (i) Is the function defined as follows a density function? $f(x) = e^{-x}, x \geq 0$, $f(x) = 0$, $x < 0$.

(ii) If so, determine the probability that the variate having this density will fall in the interval (1, 2).

(iii) Also find the cumulative probability function F(2). **(06 Marks)**

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

c. The life of an electric bulb is normally distributed with mean life of 200 hours and S.D. of 60 hours. Out of 2500 bulbs, find the number of bulbs which are likely to last between 1900 and 2100 hours. Given that $P(0 < Z < 1.67) = 0.4525$. **(07 Marks)**

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

b. Two types of batteries are tested for their length of life and the following results are obtained:

Battery A : $n_1 = 10$, $\bar{x}_1 = 500$ hrs, $\sigma_1^2 = 100$

Battery B : $n_2 = 10$, $\bar{x}_2 = 560$ hrs, $\sigma_2^2 = 121$.

Find students 't' and test whether there is a significant difference in the two means. ($t_{0.05} = 2.10$ and $t_{0.01} = 2.88$). **(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% are found to be of type M, 45% of type MN and the remainder of type N. Test the theory by ψ^2 (chi-square) test. **(07 Marks)**

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10ME/AU42A

Fourth Semester B.E. Degree Examination, June/July 2017
Material Science and Metallurgy

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define coordination number. Also work-out the APF for FCC unit cell. **(08 Marks)**
b. Write note on crystal imperfections. **(04 Marks)**
c. Discuss diffusion process and laws of diffusion. **(08 Marks)**

2 a. Explain with stress-strain diagram the behavior of ductile metal under static tension till fracture. **(06 Marks)**
b. Discuss Johnson's offset method for finding yield stress. **(04 Marks)**
c. Distinguish between slip and twinning. **(04 Marks)**
d. A test bar of 6mm dia is subjected to tensile load of 600N and reduced to 5mm dia through plastic deformation. Calculate – i) Engg. Stress ii) Engg. Strain iii) True stress iv) True strain. **(06 Marks)**

3 a. Define fracture. Illustrate stages of ductile metal fracture in tensile loading. **(07 Marks)**
b. Explain creep curve with stages of creep. **(06 Marks)**
c. Illustrate fatigue testing arrangement. Also draw S-N curve for ferrous and non-ferrous materials. **(07 Marks)**

4 a. Discuss homogeneous and heterogeneous nucleation. **(05 Marks)**
b. Sketch and explain crystal growth and cast metal structure. **(05 Marks)**
c. List and briefly explain "Hume-Rothazy rules'. **(05 Marks)**
d. State Gibbs phase rule and explain each term. **(05 Marks)**

PART – B

5 a. With neat figure explain lever rule. **(06 Marks)**
b. Draw Iron – Carbon equilibrium diagram and discuss the salient features. **(10 Marks)**
c. Briefly write about invariant reactions. **(04 Marks)**

6 a. Briefly explain TTT curves with figure. **(05 Marks)**
b. List and explain various heat treatment processes. **(10 Marks)**
c. Define hardenability and how it is determined. **(05 Marks)**

7 a. Compare the properties and composition of grey cast iron and malleable iron. **(08 Marks)**
b. Briefly discuss SG iron and steel properties. **(06 Marks)**
c. Classify the various brasses with their use. **(06 Marks)**

8 a. Define composite materials and list the classification. **(06 Marks)**
b. Discuss the fundamentals of production of FRP's and MMC's. **(08 Marks)**
c. List the advantages and application of composites. **(06 Marks)**

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10ME/AU42B

Fourth Semester B.E. Degree Examination, June/July 2017
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 metrology. State the objectives of metrology. **(06 Marks)**

b. With the help of a neat sketch, explain "international prototype meter". **(06 Marks)**

c. Distinguish between line standard and end standard. **(04 Marks)**

d. Write a note on slip gauges and explain wringing phenomenon. **(04 Marks)**

2 a. Define the following geometrical tolerances:
i) Straightness ii) Circularity iii) Cilyndricity **(06 Marks)**

b. In brief, explain the concept of "Universal Interchangeability" and "selective assembly". **(06 Marks)**

c. Determine the dimensions to be provided for a shaft and hole of 90 mm size H8/e9 type fit. Size 90 mm falls in diameter step of 80 – 100 value of tolerance for IT8 and IT9 grades are 25i and 40i respectively. Value of fundamental deviation for 'e' type shaft is $-11\ D^{0.41}$. State the type of fit. **(08 Marks)**

3 a. Define a comparator and state the uses of comparator. **(04 Marks)**

b. With a neat sketch, explain the principle of sigma comparator. **(08 Marks)**

c. With the help of a neat sketch, explain the working principle of "zeiss ultra optimeter". **(08 Marks)**

4 a. With a neat sketch, explain the working principle of an 'autocollimator'. **(08 Marks)**

b. With the help of a sketch, define the following:
i) Major diameter ii) Minor diameter
iii) Effective or pitch diameter iv) Depth of thread **(06 Marks)**

c. Sketch and explain gear tooth verneir. **(06 Marks)**

PART – B

5 a. With the help of a block diagram, explain the "generalized measurement system". **(08 Marks)**

b. Define the following (with sketches wherever necessary):
i) Accuracy ii) Precision iii) Sensitivity iv) Repeatability **(08 Marks)**

c. What are the sources of errors in measurement? **(04 Marks)**

6 a. Explain the inherent problems present in the mechanical intermediate modifying devices. **(06 Marks)**

b. Explain the working principle of a 'cathode ray oscilloscope' (with sketch). **(08 Marks)**

c. What is a Ballast circuit? Explain with a neat sketch. **(06 Marks)**

7 a. With the help of a neat sketch, explain the working of a hydraulic dynamometer. **(08 Marks)**

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

c. Sketch and explain the measurement of force using proving ring. **(04 Marks)**

8 a. Explain: i) Cross sensitivity and (ii) Temperature compensation. **(06 Marks)**

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

c. Explain, how a strain gauge is calibrated. **(04 Marks)**

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

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10ME/AU43

Fourth Semester B.E. Degree Examination, June/July 2017
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 thermodynamic data hand book, charts and tables permitted.***

PART – A

1 a. Define the following:
(i) Combustion (ii) Stoichiometric air (iii) Enthalpy of combustion (iv) Enthalpy of formation (v) Adiabatic flame temperature. **(10 Marks)**

b. Butane is burned with air and volumetric analysis of the combustion products on dry basis yield following composition:

Gas	CO_2	CO	O_2	N_2
%	7.8	1.1	8.2	82.9

Determine percentage of theoretical air used. **(10 Marks)**

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

b. An engine of 250 mm bore and 375 mm stroke works on Otto cycle. The clearance volume is 0.00263 m^3. The initial pressure and temperature are 1 bar and 50°C. If the maximum pressure is limited to 25 bar. Find the following:
(i) The air standard efficiency.
(ii) The mean effective pressure for the cycle.
Assume the ideal condition. **(10 Marks)**

3 a. Write elaborate note on heat balance sheet and Morse test on IC engine. **(10 Marks)**

b. A 4 cylinder petrol engine has an 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 specific fuel consumption is 0.364 kg/kWhr. The calorific value of fuel is 44200 kJ/kg. Calculate (i) Mechanical efficiency (ii) Brake thermal efficiency of the engine. **(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. State the advantages. **(10 Marks)**

b. A steam power plant operates on a theoretical reheat cycle. Steam at boiler at 150 bar, 550°C expands through the high pressure turbine. It is reheated at a constant pressure of 40 bar to 550°C and expands through the low pressure turbine to a condenser at 0.1 bar. Draw T-S and h-S diagram find (i) Quality of steam at exhaust (ii) Cycle efficiency (iii) Steam rate in kg/kWhr. **(10 Marks)**

PART – B

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

b. An air compressor takes in air at 1 bar and 20°C and compresses it according to law $PV^{1.2} = C$. It is then delivered to a receiver at a constant pressure of 10 bar R = 0.287 kJ/kg K. Determine

(i) Temperature at the end of compression.
(ii) Work done /kg of air.
(iii) Heat transferred during Compression/kg of air. **(10 Marks)**

6 a. Explain any two methods to improve the thermal efficiency of simple gas turbine with neat sketch and T-Q diagram. **(06 Marks)**

b. Write a note on turbojet propulsion. **(04 Marks)**

c. A gas turbine unit has a pressure ratio of 6 : 1 and maximum cycle temperature of 610°C. The isentropic efficiencies of the compressor and turbine are 0.80 and 0.82 respectively. Calculate the power output in kilo watts of an electric generator geared to the turbine when the air enters the compressor at 15°C at the rate of 16 kg/sec. Take C_P = 1.005 kJ/kgK and δ = 1.4 for compression process, C_P = 1.11 kJ/kgK and δ = 1.333 for the expansion process. **(10 Marks)**

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

b. With the neat sketch, explain working of vapour compression refrigeration system and draw T-S and H-S diagram for the same. **(06 Marks)**

c. A refrigeration system operates on the reversed Carnot cycle. The higher temperature of the refrigerant in the system is 50°C and the lower temperature is -10°C. The capacity is to be 10 tonnes. Neglect all losses.
Determine : (i) C.O.P (ii) Heat rejected from the system per hr. (iii) Power required. **(10 Marks)**

8 a. Define the following: (i) Dry bulb temperature (ii) Wet bulb temperature (iii) Specific humidity (iv) Relative humidity. **(06 Marks)**

b. With neat sketch, briefly describe summer air conditioning system. **(04 Marks)**

c. The atmospheric conditions are 20°C and specific humidity of 0.00095 kg/kg of air. Calculate the following:

(i) Partial pressure of vapour
(ii) Relative humidity
(iii) Dew point temperature. **(10 Marks)**

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10ME/AU44

Fourth Semester B.E. Degree Examination, June/July 2017
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. What is an inversion? Give the inversions of double slider crank chain. Explain any one with neat sketch. **(10 Marks)**

b. Distinguish between: i) Lower pair and higher pair ii) Completely constrained and successfully constrained motion. **(10 Marks)**

2 a. Sketch and explain Geneva wheel and Ackermann steering mechanism. **(10 Marks)**

b. Same different quick return mechanisms and explain any one with neat sketch. Why the names quick return mechanism? **(10 Marks)**

3 a. What are centripetal and tangential acceleration components? **(04 Marks)**

b. A four bar mechanism has a fixed link AD = 1m driving crank AB = 0.3m, follower link CD = 0.6m and the connecting link is 1.2m. The crank rotates at a speed of 300 rpm clockwise with an angular acceleration of 200 r/sec^2 in anticlockwise direction. When the angle made by the crank with a fixed link is 135° in anticlockwise direction, determine,

i) Angular velocity of the link BC and CD
ii) Angular acceleration of the link BC and CD
iii) Acceleration of B and C. **(16 Marks)**

4 a. State and prove Kennedy's theorem. **(05 Marks)**

b. The length of the crank and connecting rod of a reciprocating engine are 200mm and 800mm respectively. The crank is rotating at a uniform speed of 480 rpm. Using Klein's construction. Find :

i) acceleration of piston
ii) acceleration of the middle point of the connecting rod and
iii) angular acceleration of the connecting rod when the crank has turned through 45° from the inner dead center. **(15 Marks)**

PART – B

5 The slider crank of an internal combustion engine has a crank of 150mm length and a connecting rod of 600mm length. The crank rotates at a constant speed of 300rpm counter clockwise. Determine the position, velocity and acceleration of the slider when the crank angle is 45° from the inner dead center position by complex algebra. **(20 Marks)**

6 a. What is interference? Explain the methods of avoiding it. **(08 Marks)**

b. Two gear wheels mesh externally are to give a velocity ratio of 3. Involutes teeth arc of 6mm module and 20° pressure angle. The standard addendum is one module and the pinion rotates at 400 rpm. Find number of teeth on each wheel, so that the interference is just avoided, length of path of contact, maximum velocity of sliding between the teeth, arc of contact and contact ratio. **(12 Marks)**

7 a. Name different types of gear trains. Give a note on gear train used in lathe head stock. **(06 Marks)**

b. The Fig Q7 (b) shows an epicyclic gear train where the arm A is the driver and annular gear D is the follower. The wheel D has 112 teeth and B has 48 teeth, B runs freely on P and D is separately driven. The arm A runs at 100rpm and the wheel D at 50rpm in same direction, find the torque on B if A receives 7.5kW. **(14 Marks)**

8 A cam with 25mm as minimum radius is rotating clockwise at uniform speed of 100rpm and has to give the motion to a knife edge follower as mentioned below.

i) Follower to move outwards through 25mm during 120° of cam rotation.
ii) Follower to dwell for next 60° of cam rotation
iii) Follower to return to original position by next 90° of cam rotation
iv) Follower to dwell for rest of cam rotation.

The displacement of the follower takes place with uniform acceleration and retardation on both outward and return strokes. Draw the cam profile when follower axis passes through the axis of cam. Determine the maximum velocity and acceleration during outstroke and return stroke. **(20 Marks)**

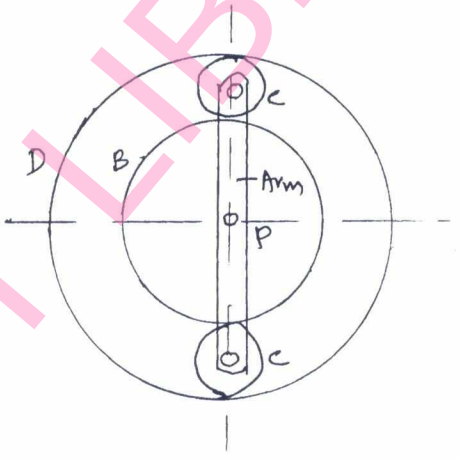

Fig Q8

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10ME/AU45

Fourth Semester B.E. Degree Examination, June/July 2017
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. Give the nomenclature of single point cutting tool. **(05 Marks)**
b. Briefly explain the types of chips. **(08 Marks)**
c. What are the effects of cutting tool parameters on tool life **(07 Marks)**

2 a. Discuss the properties of following cutting tool materials:
(i) CBN (ii) Cemented carbides (iii) HSS **(10 Marks)**
b. Explain with a neat sketch how tool tip temperature is measured. **(10 Marks)**

3 a. Differentiate between capstan and turret lathe. **(06 Marks)**
b. Draw the tool layout to produce a hexagonal headed bolt on capstan lathe. **(07 Marks)**
c. With a neat sketch, explain the quick return mechanism of a shaper. **(07 Marks)**

4 a. Explain universal radial arm drilling machine with sketch. **(08 Marks)**
b. With a neat sketch explain the nomenclature of a drill bit. **(06 Marks)**
c. Briefly explain the principle of operation of CNC machines. **(06 Marks)**

PART – B

5 a. Differentiate between :
(i) Upmilling and down milling.
(ii) Face milling and end milling. **(10 Marks)**
b. What is indexing? List the different methods of indexing. Explain compound indexing. **(10 Marks)**

6 a. Briefly explain cylindrical centreless grinding process, with a neat sketch. Mention advantages of it over centre type grinding. **(08 Marks)**
b. Explain :
(i) GRIT (ii) GRADE (iii) Structure **(06 Marks)**
c. What are the factors considered while selecting grinding wheel? **(06 Marks)**

7 a. Sketch and explain Honing process and state its advantages. **(07 Marks)**
b. Explain the principle of broaching machine. **(07 Marks)**
c. Briefly explain :
(i) Super finishing process. (ii) Polishing (iii) Buffing operation. **(06 Marks)**

8 a. Differentiate between conventional and non-conventional machining process. **(06 Marks)**
b. Explain principle, equipment and operation of
(i) Laser Beam machining (LBM) (ii) Electron Discharge machining (EDM). **(14 Marks)**

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10ME/AU46B

Fourth Semester B.E. Degree Examination, June/July 2017
Fluid Mechanics

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Differentiate between :
   (i) Weight density and mass density.
   (ii) Steady flow and unsteady flow.
   (iii) Gas and Vapour **(06 Marks)**

b. A cube of 0.25 m sides and mass 28 kg slides down a plane inclined at 2 V: 3 H covered by a thin film of oil of viscosity 2.2×10^{-3} pa-sec. If the thickness of the film is 0.02 mm determine the steady state velocity of the block. **(06 Marks)**

c. A vertical cylinder of diameter 180 mm rotates concentrically inside another cylinder of 181.2 mm. Both the cylinders are 300 mm high. The space between the cylinders is filled with a liquid whose viscosity is unknown. Determine the viscosity of liquid if a torque of 20 N-m is required to rotate the inner cylinder at 120 rpm. **(08 Marks)**

2 a. State and prove Pascal's law. **(06 Marks)**

b. Derive an expression for centre of pressure on a vertically plane submerged body. **(06 Marks)**

c. The diameters of a small piston and a large piston of a hydraulic jack are 3 cm and 10 cm respectively. A force of 80 N is applied on the small piston. Find the load lifted by the large piston when
   (i) The pistons are at the same level.
   (ii) Small piston is 40 cm above the large piston.
   Take density of liquid in the jack as 1000 kg/m^3. **(08 Marks)**

3 a. Derive an expression for continuity equation in 3D-flow and deduce it to 2D flow. **(10 Marks)**

b. A wooden cylinder of specific gravity 0.6 and circular in cross section is required to float in oil of specific gravity 0.9. Find the L/D ratio for the cylinder to float with its longitudinal axis vertical in oil, where L is the height of cylinder and 'D' is its diameter. **(10 Marks)**

4 a. Obtain an expression for Euler's equation of motion along a stream line and deduce it to Bernouli's equation. **(08 Marks)**

b. A pump has tapering pipe running full of water. The pipe is placed vertically with the diameters at the base and top being 1.2 m and 0.6 m respectively. The pressure at the upper end is 240 mm of mercury (vaccum), while the pressure at the lower end is 15 kN/m^2. Assume the head loss to be 20% of difference in velocity head. Calculate the discharge. The flow is vertically upwards and difference of elevation is 3.9 m. **(12 Marks)**

PART – B

5 a. Using Buckingham's π theorem, for a screw propeller. The relation between thrust 'F', torque 'T', diameter 'D', speed of travel 'U' , speed of rotation 'N', Density 'ρ' and viscosity 'μ' may be put in the form $F = \rho D^2 U^2 \phi \left[\frac{\rho D^3 U^2}{T}, \frac{DN}{U}, \frac{\rho UD}{\mu}\right]$. **(10 Marks)**

b. A venturimeter with a throat diameter 10 cm and Area ratio '4' is provided in a vertical pipe line carrying oil of specific gravity 0.9. The difference in elevation of throat section and entrance section of the venturimeter is 30 cm. The differential U tube mercury manometer shows a gauge deflection of 25 cm, calculate

(i) Discharge of oil.

(ii) The pressure difference between entrance section and throat section. Take $C_d = 0.98$. **(10 Marks)**

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

b. A horizontal pipe line 40 m long is connected to a water tank at one end and discharges freely into the atmosphere at the other end for the first 25 m of its length from the tank, the pipe is 150 mm diameter and its diameter is suddenly enlarged to 300 mm. The height of water level in the tank is 8 m above the centre of the pipe. Considering all losses of head which occur, determine the rate of flow, take f = 0.01 for both sections of pipe. **(10 Marks)**

7 a. Starting from first principles, show that for laminar flow between fixed parallel plates, the mean velocity is two-thirds of maximum velocity. **(10 Marks)**

b. The oil of specific gravity 0.82 is pumped through a horizontal pipe line 150 mm in diameter and 3 km long at the rate of 0.015 m^3/sec. The pump has an efficiency of 68% and requires 7.5 kW to pump the oil.

(i) What is dynamic viscosity of oil?

(ii) Is the flow is laminar? **(10 Marks)**

8 a. Explain the following:

(i) Stream line body (ii) Bluff body (iii) Mach number

(iv) Mach angle (v) Boundary layer thickness **(10 Marks)**

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

c. Experiments were conducted in a wind tunnel with a wind speed of 50 km/hour on a flat plate of size 2 m long and 1 m wide. The density of air is 1.15 kg/m^3. The co-efficients of lift and drag are 0.75 and 0.15 respectively. Determine

(i) Drag force.

(ii) Lift force.

(iii) Resultant force. **(06 Marks)**

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MATDIP401

Fourth Semester B.E. Degree Examination, June/July 2017
Advanced Mathematics – II

Time: 3 hrs. Max. Marks:100

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

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

b. Find the angle between two lines whose direction cosines are given by $\ell + 3m + 5n = 0$ and $2mn - 6n\ell - 5\ell m = 0$. **(07 Marks)**

c. Find the coordinates of the foot of the perpendicular from A(1, 1, 1) to the line joining the points B(1, 4, 6) and C(5, 4, 4). **(07 Marks)**

2 a. Find the equation of the plane through (2, -1, 6) and (1, -2, 4) and perpendicular to the plane $x - 2y - 2z + 9 = 0$. **(06 Marks)**

b. Find the equation of a straight line through (7, 2, -3) and perpendicular to each of the lines. $\frac{x-1}{3} = \frac{y-3}{4} = \frac{z-4}{5}$ and $\frac{x+2}{4} = \frac{y-3}{5} = \frac{z-4}{6}$. **(07 Marks)**

c. Find the angle between the planes $x - y + z - 6 = 0$ and $2x + 3y + z + 5 = 0$. **(07 Marks)**

3 a. If $\vec{a}$, $\vec{b}$ and $\vec{c}$ are any three vectors then prove that $\vec{a} \times \left(\vec{b} \times \vec{c}\right) = \left(\vec{a} \cdot \vec{c}\right)\vec{b} - \left(\vec{a} \cdot \vec{b}\right)\vec{c}$ **(06 Marks)**

b. If $\vec{A} = 4i + 3j + k$, $\vec{B} = 2i - j + 2k$ find a unit vector N perpendicular to the vectors $\vec{A}$ and $\vec{B}$ also show that $\vec{A}$ is not perpendicular to $\vec{B}$. **(07 Marks)**

c. 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) lie on the same plane. **(07 Marks)**

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

b. Find the angle between tangents to the curve $x = t^2 + 1$, $y = 4t - 3$, $z = 2t^2 - 6t$ at $t = 1$ and $t = 2$. **(07 Marks)**

c. Find the directional derivative of $x^2yz + 4xz^2$ at (1, -2, -1) in the direction of $2i - j - 2k$. **(07 Marks)**

5 a. Prove that $\text{div}(\text{curl}\,\vec{A}) = 0$. **(06 Marks)**

b. Find the divergence and curl of the vector.

$\vec{F} = (xyz + y^2z)i + (3x^2y + y^2z)j + (xz^2 - y^2z)k$ **(07 Marks)**

c. Find the constants a, b, c so that the vector,

$\vec{F} = (x + 2y + az)i + (bx - 3y - z)j + (4x + cy + 2z)k$ is irrotational. **(07 Marks)**

6 Find :

a. $L[\sin 5t \sin 3t]$ **(05 Marks)**

b. $L[te^{8t} \cos 2t]$ **(05 Marks)**

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

d. $L\left[\int_0^t e^{2t} \frac{\sin at}{t} dt\right]$ **(05 Marks)**

7 a. Find $L^{-1}\left[\frac{2s-1}{s^2+2s+17}\right]$. **(05 Marks)**

b. Find $L^{-1}\left[\frac{s+1}{(s-1)^2(s+2)}\right]$. **(05 Marks)**

c. Find $L^{-1}\left[\cot^{-1}\left(\frac{s}{a}\right)\right]$. **(05 Marks)**

d. Using convolution theorem evaluate $L^{-1}\left[\frac{s}{(s+2)(s^2+9)}\right]$. **(05 Marks)**

8 a. Using Laplace transforms, solve $\frac{d^2y}{dt^2} + 2\frac{dy}{dt} - 3y = \sin t$ given $y(0) = y'(0) = 0$. **(10 Marks)**

b. Using Laplace transforms, solve $\frac{dx}{dt} + y = \sin t$, $\frac{dy}{dt} + x = \cos t$, given x = 2, y = 0 when $t = 0$. **(10 Marks)**

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