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10MAT41

Fourth Semester B.E. Degree Examination, June/July 2014
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. Obtain a solution upto the third approximation of y for x = 0.2 by Picard's method, given that $\frac{dy}{dx} + y = e^x$; y(0) = 1. **(06 Marks)**

b. Apply Runge-Kutta method of order 4, to find an approximate value of y for x = 0.2 in steps of 0.1, if $\frac{dy}{dx} = x + y^2$ given that y = 1 when x = 0. **(07 Marks)**

c. Using Adams-Bashforth formulae, determine y(0.4) given the differential equation $\frac{dy}{dx} = \frac{1}{2}xy$ and the data, y(0) = 1, y(0.1) = 1.0025, y(0.2) = 1.0101, y(0.3) = 1.0228. Apply the corrector formula twice. **(07 Marks)**

2 a. Apply Picard's method to find the second approximation to the values of 'y' and 'z' given that $\frac{dy}{dx} = z$, $\frac{dz}{dx} = x^3(y + z)$, given y = 1, $z = \frac{1}{2}$ when x = 0. **(06 Marks)**

b. Using Runge-Kutta method, solve $\frac{d^2y}{dx^2} - x\left(\frac{dy}{dx}\right)^2 + y^2 = 0$ for x = 0.2 correct to four decimal places. Initial conditions are x = 0, y = 1, y′ = 0. **(07 Marks)**

c. Obtain the solution of the equation $\frac{2d^2y}{dx^2} = 4x + \frac{dy}{dx}$ at the point x = 1.4 by applying Milne's method given that y(1) = 2, y(1.1) = 2.2156, y(1.2) = 2.4649, y(1.3) = 2.7514, y′(1) = 2, y′(1.1) = 2.3178, y′(1.2) = 2.6725 and y′(1.3) = 3.0657. **(07 Marks)**

3 a. Define an analytic function in a region R and show that f(z) is constant, if f(z) is an analytic function with constant modulus. **(06 Marks)**

b. Prove that $u = x^2 - y^2$ and $v = \frac{y}{x^2 + y^2}$ are harmonic functions of (x, y) but are not harmonic conjugate. **(07 Marks)**

c. Determine the analytic function f(z) = u + iv, if $u - v = \frac{\cos x + \sin x - e^{-y}}{2(\cos x - \cosh y)}$ and f(π/2) = 0. **(07 Marks)**

4 a. Find the images of the circles |z| = 1 and |z| = 2 under the conformal transformation $w = z + \frac{1}{z}$ and sketch the region. **(06 Marks)**

b. Find the bilinear transformation that transforms the points 0, i, ∞ onto the points 1, –i, –1 respectively. **(07 Marks)**

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

PART – B

5 a. Obtain the solution of the equation $x^2\frac{d^2y}{dx^2}+x\frac{dy}{dx}+\left(x^2-\frac{1}{4}\right)y=0$. **(06 Marks)**

b. Obtain the series solution of Legendre's differential equation,

$$(1-x^2)\frac{d^2y}{dx^2}-2x\frac{dy}{dx}+n(n+1)y=0$$ **(07 Marks)**

c. State Rodrigue's formula for Legendre polynomials and obtain the expression for $P_4(x)$ from it. Verify the property of Legendre polynomials in respect of $P_4(x)$ and also find $\int_{-1}^{1}x^3P_4(x)dx$. **(07 Marks)**

6 a. Two fair dice are rolled. If the sum of the numbers obtained is 4, find the probability that the numbers obtained on both the dice are even. **(06 Marks)**

b. Given that $P(\overline{A}\cap\overline{B})=\frac{7}{12}$, $P(A\cap\overline{B})=\frac{1}{6}=P(\overline{A}\cap B)$. Prove that A and B are neither independent nor mutually disjoint. Also compute P(A/B) + P(B/A) and $P(\overline{A}/\overline{B})+P(\overline{B}/\overline{A})$. **(07 Marks)**

c. Three machines M_1, M_2 and M_3 produces identical items. Of their respective outputs 5%, 4% and 3% of items are faulty. On a certain day, M_1 has produced 25% of the total output, M_2 has produced 30% and M_3 the remainder. An item selected at random is found to be faulty. What are the chances that it was produced by the machine with the highest output? **(07 Marks)**

7 a. In a quiz contest of answering 'Yes' or 'No', what is the probability of guessing atleast 6 answers correctly out of 10 questions asked? Also find the probability of the same if there are 4 options for a correct answer. **(07 Marks)**

b. Define exponential distribution and obtain the mean and standard deviation of the exponential distribution. **(07 Marks)**

c. If X is a normal variate with mean 30 and standard deviation 5, find the probabilities that (i) $26 \le X \le 40$, (ii) $X \ge 45$, (iii) $|X - 30| > 5$. [Give that $\phi(0.8) = 0.2881$, $\phi(2.0) = 0.4772$, $\phi(3.0) = 0.4987$, $\phi(1.0) = 0.3413$] **(06 Marks)**

8 a. Certain tubes manufactured by a company have mean life time of 800 hrs and standard deviation of 60 hrs. Find the probability that a random sample of 16 tubes taken from the group will have a mean life time (i) between 790 hrs and 810 hrs, (ii) less than 785 hrs, (iii) more than 820 hrs. [$\phi(0.67) = 0.2486$, $\phi(1) = 0.3413$, $\phi(1.33) = 0.4082$]. **(06 Marks)**

b. A set of five similar coins is tossed 320 times and the result is:

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

Test the hypothesis that the data follow a binomial distribution. [Given that $\chi^2_{0.05}(5) = 11.07$] **(07 Marks)**

c. It is required to test whether the proportion of smokers among students is less than that among the lectures. Among 60 randomly picked students, 2 were smokers. Among 17 randomly picked lecturers, 5 were smokers. What would be your conclusion? **(07 Marks)**

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10ME/AU42A

Fourth Semester B.E. Degree Examination, June/July 2014
Material Science and Metallurgy

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Explain crystal imperfections with a neat sketch. **(06 Marks)**

b. Define diffusion. What are the factors affecting diffusion? **(08 Marks)**

c. Copper has F.C.C. structure and an atomic radius of 1.278°A. Calculate its density. Given mol. wt = 63.54 g/mole. **(06 Marks)**

2 a. Define the following:
i) Toughness; ii) Yield stress; iii) Proportional limit; iv) Resilience. **(08 Marks)**

b. Derive an expression for critically resolved shear stress in a crystal structure. **(08 Marks)**

c. Calculate the resolved shear stress of a limit cell in a nickel if a tensile stress of 13.7 MPa is applied. Given that angle between the axial force and slip direction is 45° and angle between axial force and normal to slip plane is 54°. **(04 Marks)**

3 a. Derive an expression for homogeneous nucleation with a suitable graph. **(10 Marks)**

b. Explain the following with a suitable sketches:
i) Substitutional solid solution.
ii) Interstitial solid solution. **(10 Marks)**

4 a. What are the factors affecting the fatigue life? **(06 Marks)**

b. Write a short note on the following: i) Ductile fracture; ii) Brittle fracture. **(08 Marks)**

c. Draw a creep curve and explain its various stages. **(06 Marks)**

PART – B

5 a. Explain the classification of cast irons in detail. **(10 Marks)**

b. Why is iron carbide diagram drawn until 6.67% carbon? **(06 Marks)**

c. Define Martensite, Cementite, Austenite and Ferrite. **(04 Marks)**

6 a. What are the objectives of heat treatment? **(06 Marks)**

b. Explain with a neat sketch of Jomony end quench test method. **(08 Marks)**

c. Explain inductive hardening with a neat sketch. **(06 Marks)**

7 a. What is merit by S.G. iron? Explain the structure composition and properties of S.G. iron. **(06 Marks)**

b. What are the factors affecting microstructure of cast iron? Explain. **(08 Marks)**

c. Explain the classification of engineering materials. **(06 Marks)**

8 a. Explain the classification of composite materials. **(08 Marks)**

b. What do you mean by ceramic matrix composites? **(06 Marks)**

c. List the advantages and disadvantages of composite materials. **(06 Marks)**

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10ME42B/AU42B/TL42

Fourth Semester B.E. Degree Examination, June/July 2014

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. Briefly explain: i) International prototype metre
ii) Reference standard
iii) Wringing phenomenon
iv) Significance of wavelength standard **(08 Marks)**

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

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

2 a. What are the concepts of interchangeability and selective assembly? Which is advantageous? **(06 Marks)**

b. Briefly explain: i) Go-gauges, ii) NO-GO gauges, iii) Gauge tolerance and wear allowance. **(06 Marks)**

c. Determine the tolerance on the hole and shaft for a fit designated by 50H7g6; diameter step 50 to 80 mm; fundamental deviation for shaft = -2.5 $D^{0.34}$ in micron; IT6 = 10i and IT7 = 16i, $i = 0.45\sqrt[3]{D} + 0.001D$ in micron. State the actual maximum and minimum sizes of the hole and shaft and maximum and minimum clearances. **(08 Marks)**

3 a. What are comparators? How do they differ from measuring instruments? **(06 Marks)**

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

c. Explain with sketch, the construction and working of LVDT. **(08 Marks)**

4 a. What is the principle of interferometry? How is it adopted in optical interferometer? **(06 Marks)**

b. Derive an expression for the cherdal tooth thickness of gear. **(06 Marks)**

c. Explain 3-wire method of measuring effective diameter of screw thread. **(08 Marks)**

PART – B

5 a. What is the significance of measurement? **(04 Marks)**

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

c. Differentiate: i) Sensor and transducer ii) Primary and secondary transducer
iii) Accuracy and sensitivity iv) Error and correction **(08 Marks)**

6 a. What is the necessity of modifying devices? What are the advantages of electrical modifying devices? **(06 Marks)**

b. Explain with a neat sketch, ballast circuit diagram. **(06 Marks)**

c. With a block diagram, explain the working of an x-y plotter. **(08 Marks)**

7 a. Briefly explain how pressure can be measured with elastic transducer. **(06 Marks)**

b. What are the methods of force measurement? Give examples. **(06 Marks)**

c. Explain with a neat sketch proxy brake dynamometer. **(08 Marks)**

8 a. Explain the working principles of radiation pyrometer and thermocouple. **(08 Marks)**

b. Briefly explain: i) Strain gauge material; ii) Strain gauge factor; iii) Thermocouple material. **(12 Marks)**

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10ME/AU43

Fourth Semester B.E. Degree Examination, June/July 2014
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 thermodynamics data hand book permitted.

PART – A

1 a. Define:
i) Stoichiometric air
ii) Enthalpy of formation
iii) Enthalpy of reaction
iv) Adiabatic flame temperature. **(08 Marks)**

b. The products of combustion of an unknown hydrocarbon C_xH_y have the following composition as measured by an ORSAT apparatus: CO_2 = 8%, CO = 0.9%, O_2 = 8.8%, N_2 = 82.3%. Determine:
i) The composition of fuel.
ii) Air-fuel ratio.
iii) Percentage excess air. **(12 Marks)**

2 a. Derive an expression for mean effective pressure of an Otto cycle. **(08 Marks)**

b. An air-standard diesel cycle has an compression ratio of 14. The pressure at the beginning of compression stroke is 98.1 kPa and temperature is 27°C. The maximum temperature of the cycle is 2500°C. Determine: i) Temperature at all salient points; ii) Thermal efficiency; iii) Mean effective pressure. **(12 Marks)**

3 a. Explain 'Willan's line method' of determining the friction power of an IC engine. **(04 Marks)**

b. The following data were obtained on MORSE test of 4-cylinder four stroke SI engine coupled to a hydraulic dynamometer operating at constant speed of 1500rpm, brake load with all four cylinders firing = 296N, brake load with first cylinder not firing = 201N, brake load with second cylinder not firing = 206N, brake load with third cylinder not firing = 192N, brake load with fourth cylinder not firing = 200N. Brake power in kW is calculated using the equation BP = WN/42,300, where 'W' is brake load in Newton, N-speed of the engine in RPM. Calculate: i) Brake power; ii) Indicated power; iii) Mechanical efficiency. **(06 Marks)**

c. In a trial of a single cylinder two-stroke engine, the following observations were made: Compression ratio = 15, fuel consumption = 10.2 kg/hr, calorific value of the fuel = 43,890 kJ/kg, air consumption = 3.8 kg/min, speed = 1900 rpm, torque on brake drum = 186 N-m, quantity of cooling water used = 15.5 kg/min, temperature rise of cooling water = 36°C. Exhaust gas temperature = 410°C, room temperature = 20°C,
specific heat of exhaust gas = 1.17 kJ/kg-K. Calculate: i) Brake power; ii) BSFC; iii) Brake thermal efficiency; iv) Draw heat balance sheet. **(10 Marks)**

4 a. With a schematic diagram, explain the working of reheat vapour power cycle and deduce an expression for cycle efficiency. **(08 Marks)**

b. Steam at 20 bar, 360°C is expanded in steam turbine to 0.08bar. It then enters a condenser, where it is condensed to saturated liquid water. The pump feeds back the water into the boiler.

i) Assuming ideal process, find per kg of steam, the net work and cycle efficiency.

ii) If the turbine and pump each have 80% efficiency. Find percentage reduction in net work and cycle efficiency. **(12 Marks)**

PART – B

5 a. Derive an expression for minimum work required by a two stage air compressor with perfect inter cooling between stages. **(10 Marks)**

b. A single stage, double acting air compressor, required to deliver $14m^3$ of air per minute measured at 1.013 bar and 15°C. The delivery pressure is 7 bar and speed is 300rpm. Take the clearance volume as 5% of swept volume with the compression and expansion index $\eta = 1.3$. Calculate: i) the swept volume of cylinder; ii) delivery temperature; iii) indicated power. **(10 Marks)**

6 a. Explain the different methods of improving the efficiency of Brayton cycle. **(08 Marks)**

b. A gas turbine unit receives air at 1 bar and 300K and compress it adiabatically to 6.2 bar. The compressor efficiency is 88%. The fuel has a heating value of 44186 kJ/kg and fuel-air ratio is 0.017 kg/kg of air. The turbine efficiency is 90%. Calculate the work of turbine and compressor per kg of air compressed and thermal efficiency. For products of combustion, $C_p = 1.147$ kJ/kg-k and $\gamma = 1.333$. **(12 Marks)**

7 a. Derive an expression for COP of air refrigeration system working on Bell Colemann cycle. **(05 Marks)**

b. What are the desirable properties of good refrigerants? **(03 Marks)**

c. An air refrigeration plant is to be designed according to the following specifications. Pressure of the air at compressor inlet = 101 kPa, pressure at compressor exit = 404 kPa. Pressure loss in cold chamber = 3kPa, pressure loss in intercooler = 12 kPa, temperature of air at compressor inlet = -6°C, temperature of air at turbine inlet = 27°C, isentropic efficiency of compressor = 85%, isentropic efficiency of turbine = 85%. Determine: i) COP of cycle; ii) Power required to produce 1 ton of refrigeration; iii) Air circulation rate per ton of refrigeration. **(12 Marks)**

8 a. Define: i) Specific humidity; ii) Relative humidity; iii) Degree of saturation. **(06 Marks)**

b. With a neat sketch, describe the working of summer air conditioning system for hot and dry weather. **(06 Marks)**

c. Moist air at 35°C has a dew point of 15°C. Calculate its relative humidity, specific humidity and enthalpy. **(08 Marks)**

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10ME/AU/TL44

Fourth Semester B.E. Degree Examination, June / July 2014
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 graph sheets 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 mechanism. **(06 Marks)**

3 A single slider crank mechanism shown in fig. Q3 has the crank CB = 100mm and connecting rod BA = 300mm, with center of gravity G 100mm from B. The crank shaft has a speed of 75 rad/sec and an angular acceleration of 1200 rad/sec^2. Find

a. The velocity of 'G' and the angular velocity of AB.

b. The acceleration of 'G" and the angular acceleration of AB. **(20 Marks)**

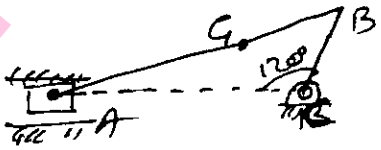

Fig.Q3

4 a. State and prove Kennedy's theorem. **(06 Marks)**

b. Explain the analysis of velocity and acceleration of a piston in a single slider mechanism using Klein's construction. **(06 Marks)**

c. For a pin jointed four bar mechanism having the following dimensions. Fixed link AD = 4m, Driving link AB = 1.5m , Driven link CD = 2.5m , Connecting rod BC = 3m and angle BAD = 60^0, Link AB rotates at 25rpm. Determine using instantaneous centre method.
i) Angular velocity of link CD and ii) Angular velocity of link BC. **(08 Marks)**

PART - B

5 a. The crank of an engine is 20cm long and the connecting rod length to crank radius is 4. Determine the acceleration of the piston when the crank has turned through 45^0 from the inner dead center position and moving towards the other center at 240rpm, counter clock wise direction using complex algebra analysis. **(16 Marks)**

b. Explain in brief Loop closure equation. **(04 Marks)**

6 a. Derive an equation to determine the length of path of contact by a pair of mating spur gear. **(08 Marks)**

b. Two 20^0 involute spur gears have a module of 10mm and addendum of one module. The number of teeth on pinion is 13 and on the spur gear is 52. Does interference occur? If it occurs to what value should the pressure angle be changed to eliminate the interference? **(12 Marks)**

7 a. Explain with a neat sketch the "sun and planet wheel". **(04 Marks)**

b. In an epicyclic gear train, an arm carries two gears A & B having 36 & 45 teeth respectively. If the arm rotates at 150rpm in the anti clock wise direction about the center of gear 'A' which is fixed, determine the speed of the gear B. If the gear A instead of being fixed makes 300rpm in the clock wise direction what will be the speed of gear 'B'. **(16 Marks)**

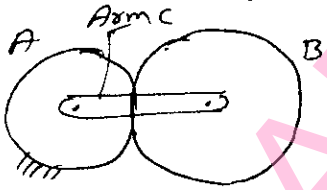

Fig.Q7(b)

8 Construct the profile of a cam to suit the following specification :
Cam shaft diameter = 40mm
Least radius of cam = 25mm
Diameter of roller = 25mm
Angle of lift = 120^0
Angle of fall = 150^0
Lift of the follower = 40mm
No. of pauses are two of equal interval between motion. During the lift the motion is SHM. During the fall motion is UARM. The speed of cam shaft is uniform. The line of stroke is centre of the cam. **(20 Marks)**

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10ME/AU45

Fourth Semester B.E. Degree Examination, June/July 2014

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 suitable sketches, explain different types of chips produced during machining. **(07 Marks)**

b. Discuss the causes for tool failure. **(07 Marks)**

c. In an orthogonal cutting the following observations were made:

Feed = 0.25 mm/rev
Chip thickness = 0.8 mm
Depth of cut = 2 mm
Length of chip-tool contact = 0.5 mm
Working rake angle = 0°
Cutting force = F_c = 1800 N
Axial thrust = 900 N

Determine:

i) The mean angle of friction of tool face.
ii) The mean shear strength of the work material.
iii) The maximum frictional stress on tool face. **(06 Marks)**

2 a. Draw the sketches showing sources of heat and heat distribution to various elements during metal cutting. **(10 Marks)**

b. Discuss the effect of temperature on hardness for different cutting tool materials. **(06 Marks)**

c. List and explain the characteristic features of a good cutting tool material. **(04 Marks)**

3 a. What are the difference between a capstan lathe and a turret lathe? **(06 Marks)**

b. Find the time required for taking a complete cut on a plate 600 mm length × 300 mm width if the cutting speed is 9 m/min. The return time to cutting time ratio is 1:4 and the feed is 3 mm. the clearance at each end is 75 mm. **(06 Marks)**

c. List out the differences between shaper and planer. **(08 Marks)**

4 a. With suitable sketches, explain the following operations using drilling machine:

i) Trepanning
ii) Tapping
iii) Boring
iv) Reaming **(12 Marks)**

b. Define x, y and z axes on a NC drill machine. **(04 Marks)**

c. Explain point-to-point positioning control system of tools in NC system. **(04 Marks)**

PART – B

5 a. With suitable sketches, explain the following milling machine operations:

i) Form milling
ii) Gang milling **(08 Marks)**

b. Draw the neat sketch showing all the elements of plain milling cutter and label all parts. **(06 Marks)**

c. Name various work holding devices used in milling machine and indicate their uses. **(06 Marks)**

6	a.	What are the differences of grinding machine over shaping machine?	**(05 Marks)**
	b.	List and explain different abrasive materials used in grinding wheel.	**(05 Marks)**
	c.	How a grinding wheel is marked? Describe Indian standard marking system.	**(05 Marks)**
	d.	Briefly explain the constructional features of grinding machine.	**(05 Marks)**
7	a.	What is broach? How broaches are classified?	**(05 Marks)**
	b.	What are the limitations of broaching process?	**(05 Marks)**
	c.	Briefly explain the following surface finishing operations: i) Buffing ii) Polishing	**(10 Marks)**
8	a.	With suitable sketch, explain Abrasive jet machining.	**(05 Marks)**
	b.	Discuss the effect of cutting parameters in USM.	**(05 Marks)**
	c.	What are the advantages and disadvantages of ECM?	**(05 Marks)**
	d.	List the essential requirements of a dielectric fluid used in EDM.	**(05 Marks)**

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10ME/AU46B

Fourth Semester B.E. Degree Examination, June/July 2014

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. Define the following fluid properties and state their units:
i) Specific weight ii) Viscosity
iii) Surface tension iv) Specific volume **(06 Marks)**

b. Classify the various types of fluids with the help of a diagram and briefly explain them. **(05 Marks)**

c. An oil film of thickness 1.5 mm is used for lubrication between a square plate of size 0.9 m × 0.9 m and an inclined plane having an angle of inclination 20° with the horizontal. The weight of the square plate is 392.4 N and it slides down the plane with a uniform velocity of 0.2 m/s. Find the dynamic viscosity of oil. **(09 Marks)**

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

b. The measurements of pressure at the base and top of a mountain are 74 cm and 60 cm of mercury respectively. Calculate the height of the mountain if air has a mass density of 1.22 kg/m^3. **(06 Marks)**

c. Derive expressions for total pressure and centre of pressure for a plane surface immersed vertically in a static mass of fluid. **(08 Marks)**

3 a. Define the terms buoyancy, centre of buoyancy, meta-centre and meta-centric height. **(06 Marks)**

b. A block of wood of specific gravity 0.8 floats in water. Determine the meta-centric height of block if its size is 3 m long, 2 m wide and 1 m height. State whether equilibrium is stable or unstable. **(08 Marks)**

c. Derive continuity equation in Cartesian coordinates. **(06 Marks)**

4 a. Derive Euler's equation of motion for ideal fluids and hence deduce Bernoulli's equation of motion. State the assumptions made. **(10 Marks)**

b. A pipe line carrying oil of specific gravity 0.8 changes in diameter from 300 mm at position (1) to 600 mm in diameter at position(2), which is 5 m at a higher level. If the pressure at position (1) and (2) are 100 kN/m^2 and 60 kN/m^2 respectively and discharge is 300 ℓps, determine (i) loss of head and (ii) direction of flow. **(10 Marks)**

PART – B

5 a. Derive an expression for discharge through a venturi-meter. **(08 Marks)**

b. State Buckingham's π theorem. **(04 Marks)**

c. The frictional torque 'T' of a disc of diameter 'D' rotating at a speed of 'N' in a fluid of viscosity 'μ' and density 'ρ' in a turbulent flow is given by $T = D^2N^2\rho\phi\left[\frac{M}{D^2N\rho}\right]$. Prove this relation using Buckingham's π theorem. **(08 Marks)**

6 a. Derive Darcy's relation for a turbulent flow through a circular pipe. **(10 Marks)**

b. Find the diameter of a pipe of length 2000 m when the rate of flow of water through the pipe is 200 ℓps and head lost due to friction is 4 m. Take the value of 'C' = 50 in Chezy's formula. **(10 Marks)**

7 a. Prove that the ratio of maximum velocity to average velocity in a viscous flow of fluid through a circular pipe is 2.0. **(10 Marks)**

b. Lubricating oil of specific gravity 0.85 and dynamic viscosity 0.1 N-s/m^2 is pumped through a 3 cm diameter pipe. If the pressure drop per metre length of the pipe is 15 kPa, determine:

i) The mass flow rate of oil in kg/min.

ii) The shear stress at the pipe wall.

iii) Reynolds number of the flow and

iv) The power required per 40 m length of the pipe to maintain the flow. **(10 Marks)**

8 a. The experiments were conducted in a wind tunnel with a wind speed of 50 km/hr on a flat plate of size 2 m long and 1 m wide. The density of air is 1.15 kg/m^3. The coefficients of lift and drag are 0.75 and 0.15 respectively. Determine:

i) Lift force

ii) Drag force

iii) The resultant force

iv) Direction of resultant force

v) Power exerted by air on plate. **(10 Marks)**

b. Briefly explain, what is meant by boundary layer and hence define,

i) Displacement thickness

ii) Momentum thickness **(06 Marks)**

c. Define Mach number and derive an expression for the same. **(04 Marks)**

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MATDIP401

Fourth Semester B.E. Degree Examination, June / July 2014
Advanced Mathematics – II

Time: 3 hrs. Max. Marks:100

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

1 a. Define direction cosine and direction ratio of a line. Hence show that $l^2 + m^2 + n^2 = 1$. **(06 Marks)**

b. For any cube show that angle between any two diagonals is $\cos^{-1}\left(\frac{1}{3}\right)$. **(07 Marks)**

c. Define plane. Derive equation of plane in general form. **(07 Marks)**

2 a. Find equation of plane passing through A(-1, 1, 1), B(1, -1, 1) and perpendicular to plane $x + 2y + 2z - 5 = 0$ **(06 Marks)**

b. Show that the line $\frac{x-4}{2} = \frac{y-2}{3} = \frac{z-3}{10}$ is parallel to plane $2x + 2y - z = 6$. Find distance between them. **(07 Marks)**

c. Show that lines $\frac{x-5}{4} = \frac{y-7}{4} = \frac{z+3}{-5}$ and $\frac{x-8}{7} = \frac{y-4}{1} = \frac{z-5}{3}$ are coplanar. Find point of intersection. **(07 Marks)**

3 a. Find sine and cosine of angle between the vectors $4i + 3j + k$, $2i - j + 2k$. **(06 Marks)**

b. Show that points (4, 5, -1), (0, -1, -1), (3, 9, 4), (-4, 4, 4) are coplanar using vector method. **(07 Marks)**

c. Prove that $\left[\vec{a}+\vec{b}, \vec{b}+\vec{c}, \vec{c}+\vec{a}\right] = 2\left[\vec{a}, \vec{b}, \vec{c}\right]$. **(07 Marks)**

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

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

c. Show that $\text{grad}\left(\frac{1}{r}\right) = -\frac{\vec{r}}{r^2}$. **(07 Marks)**

5 a. For any scalar function ϕ show that $\text{curl}(\text{grad}\phi) = 0$. **(06 Marks)**

b. If $\vec{F} = \text{grad}\phi$, $\phi = x^2+y^2+z^2+xyz$, find $\nabla \cdot \left(\vec{F}\right)$ and $\nabla \times \left(\vec{F}\right)$ at (1, 1, 1). **(07 Marks)**

c. Find a, b, c so that $\vec{F} = (x + y + az)i + (x + cy + 2z)j + (x + 2y - z)k$ is irrotational. Find scalar function. **(07 Marks)**

6 a. Find Laplace Transform if t^n and hence find $L\left(t^{\frac{1}{2}}\right)$. **(06 Marks)**

b. Find $L\left[e^{2t}\cos 3t + e^{-t}\sin 2t + t\sin t\right]$. **(07 Marks)**

c. Find $L\left[\frac{e^{t}(\cos 3t - \cos t)}{t}\right]$. **(07 Marks)**

7 a. Find $L[\sin t \ \sin 2t \ \sin 3t]$. **(06 Marks)**

b. Find $L[f(t)]$ where $f(t) = \begin{cases} 1 & 0 < t \le 1 \\ t & 1 < t \le 2 \\ t^2 & t > 2 \end{cases}$. **(07 Marks)**

c. Find $L^{-1}\left\{\log\sqrt{\frac{s+a}{s-b}}\right\}$. **(07 Marks)**

8 a. Find $L^{-1}\left\{\frac{2s^2 - 6s + 5}{s^3 - 6s^2 + 11s - 6}\right\}$. **(10 Marks)**

b. Solve by Laplace transformation, $\frac{d^2y}{dt^2} + 7\frac{dy}{dt} + 10y = 4e^{-3t}$, given $y(0) = 0, y'(0) = -1$. **(10 Marks)**

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