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10MAT41

Fourth Semester B.E. Degree Examination, December 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 series method, solve the initial value problem $\frac{dy}{dx} = x^2y - 1$, $y(0) = 1$ at the point $x = 0.1$ **(06 Marks)**

b. Employ the fourth order Runge-Kutta method to solve $\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$, $y(0) = 1$ at the points $x = 0.2$ and $x = 0.4$. Take $h = 0.2$. **(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 $y(0.4)$ 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, find the solution at $x = 0.1$ of the differential equation $\frac{d^2y}{dx^2} - x^2\frac{dy}{dx} - 2xy = 1$ under the conditions $y(0) = 1$, $y'(0) = 0$. 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 that $y(0.1) = 1.03995$, $y(0.2) = 1.138036$, $y(0.3) = 1.29865$, $y'(0.1) = 0.6955$, $y'(0.2) = 1.258$, $y'(0.3) = 1.873$. **(07 Marks)**

3 a. If $f(z) = u + iv$ is an analytic function, then prove that $\left(\frac{\partial}{\partial x}|f(z)|\right)^2 + \left(\frac{\partial}{\partial y}|f(z)|\right)^2 = |f'(z)|^2$. **(06 Marks)**

b. Find an analytic function whose imaginary part is $v = e^x\{(x^2 - y^2)\cos y - 2xy \sin y\}$. **(07 Marks)**

c. If $f(z) = u(r, \theta) + iv(r, \theta)$ is an analytic function, show that u and v satisfy the equation $\frac{\partial^2\varphi}{\partial r^2} + \frac{1}{r}\frac{\partial\varphi}{\partial r} + \frac{1}{r^2}\frac{\partial^2\varphi}{\partial\theta^2} = 0$. **(07 Marks)**

4 a. Find the bilinear transformation that maps the points 1, i, –1 onto the points i, 0, –i respectively. **(06 Marks)**

b. Discuss the transformation $W = e^z$. **(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 $|z| = 3$. **(07 Marks)**

PART – B

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

b. Obtain the series solution of Bessel's differential equation $x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + (x^2 - n^2)y = 0$ in the form $y = AJ_n(x) + BJ_{-n}(x)$. **(07 Marks)**

c. Derive Rodrique's formula $P_n(x) = \frac{1}{2^n n!}\frac{d^n}{dx^n}(x^2 - 1)^n$. **(07 Marks)**

6 a. State the axioms of probability. For any two events A and B, prove that $P(A \cup B) = P(A) + P(B) - P(A \cap B)$. **(06 Marks)**

b. A bag contains 10 white balls and 3 red balls while another bag contains 3 white balls and 5 red balls. Two balls are drawn at ransom from the first bag and put in the second bag and then a ball is drawn at random from the second bag. What is the probability that it is a white ball? **(07 Marks)**

c. In a bolt factory there are four machines A, B, C, D manufacturing respectively 20%, 15%, 25% 40% of the total production. Out of these 5%, 4%, 3% and 2% respectively are defective. A bolt is drawn at random from the production and is found to be defective. Find the probability that it was manufactured by A or D. **(07 Marks)**

7 a. The probability distribution of a finite random variable X is given by the following table:

x_i	-2	-1	0	1	2	3
$p(x_i)$	0.1	k	0.2	2k	0.3	k

Determine the value of k and find the mean, variance and standard deviation. **(06 Marks)**

b. The probability that a pen manufactured by a company will be defective is 0.1. If 12 such pens are selected, find the probability that (i) exactly 2 will be defective, (ii) at least 2 will be defective, (iii) none will be defective. **(07 Marks)**

c. In a normal distribution, 31% of the items are under 45 and 8% are over 64. Find the mean and standard deviation, given that A(0.5) = 0.19 and A(1.4) = 0.42, where A(z) is the area under the standard normal curve from 0 to z >0. **(07 Marks)**

8 a. A biased coin is tossed 500 times and head turns up 120 times. Find the 95% confidence limits for the proportion of heads turning up in infinitely many tosses. (Given that $z_c = 1.96$) **(06 Marks)**

b. A certain stimulus administered to each of 12 patients resulted in the following change in blood pressure:

5, 2, 8, -1, 3, 0, 6, -2, 1, 5, 0, 4 (in appropriate unit)

Can it be concluded that, on the whole, the stimulus will change the blood pressure. Use $t_{0.05}(11) = 2.201$. **(07 Marks)**

c. A die is thrown 60 times and the frequency distribution for the number appearing on the face x is given by the following table:

x	1	2	3	4	5	6
Frequency	15	6	4	7	11	17

Test the hypothesis that the die is unbiased.

(Given that $\chi^2_{0.05}(5) = 11.07$ and $\chi^2_{0.01}(5) = 15.09$) **(07 Marks)**

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10ME42B/AU42B/PM42/TL42

Fourth Semester B.E. Degree Examination, December 2012
Mechanical Measurement 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. Explain international prototype meter, with sketch. **(06 Marks)**

b. What are Airy points? Where are the airy points located on 600mm bar? **(04 Marks)**

c. Using a set of M112 slip gauges, build the following dimensions :
i) 49.3115 ii) 68.208 iii) 52.496 iv) 78.3665. **(10 Marks)**

2 a. Explain Indian Standard (IS919 – 1963) along with the concept of limit, size and tolerance, with the neat diagram. **(05 Marks)**

b. Compare the following :
i) Build – up tolerance and Compound tolerance ii) Interchangeability and selective assembly. **(05 Marks)**

c. State the Taylor's principle and design the gauges to measure the fit designated by $50E_4\ f_8$ which is produced by mass production. Given i) 50mm lies between 30 to 50mm
ii) $i = 0.45\sqrt[3]{D} + 0.001D$ iii) Fundamental deviation for hole is $11D^{0.41}$.
iv) Fundamental deviation for shaft is $-5.5D^{0.41}$.
v) Tolerance grade for IT4 and IT8 is "5i" and "25i".
Write the type of fit for $50E_4\ f_8$ and express the value in unilateral dimension. **(10 Marks)**

3 a. Explain the working of a sigma comparator, with a sketch. **(10 Marks)**

b. With a neat diagram, explain the principle of working of LVDT. **(06 Marks)**

c. Select the sizes of angle gauges required to build, the angle 570 34′ 9″, show the arrangement of gauges. **(04 Marks)**

4 a. With a neat sketch, explain the working principle of an auto collimeter. **(06 Marks)**

b. Define "effective diameter" and "best size wire". Derive an expression to determine the best size wire diameter. **(08 Marks)**

c. How do you measure the chord thickness of spur gear tooth using gear tooth vernier? Explain with a sketch. **(06 Marks)**

PART – B

5 a. Explain the concept of "generalized measurement system", with block diagram taking the working of bourdon pressure gauge as an example. **(08 Marks)**

b. Explain any three system response characteristics. **(06 Marks)**

c. Classify and sub classify errors. Explain briefly each type of error, with example and how it can be reduced. **(06 Marks)**

6 a. Sketch and explain the platform balance method of measuring force. **(06 Marks)**

b. With a neat sketch, explain the working of hydraulic dynamometer. **(06 Marks)**

c. Write a note on X – Y plotters. **(08 Marks)**

7 a. Explain the inherent problem present in mechanical intermediate modifying systems. **(06 Marks)**

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

c. What are electronic amplifiers? With a neat sketch, explain chopper amplifier. **(08 Marks)**

8 a. State and explain the laws of thermocouple. **(06 Marks)**

b. Explain the principle and working of unbonded and bonded electrical strain gauges. **(06 Marks)**

c. Write notes on any two of the following :

i) Gauge factor and cross sensitivity.

ii) Temperature compensation in resistance type strain gauges.

iii) Calibration of strain gauges.

iv) Wheat stone bridge arrangement for strain measurement. **(08 Marks)**

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10ME/AU42A

Fourth Semester B.E. Degree Examination, December 2012
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 atomic packing factor. Calculate the atomic packing factor for BCC. **(06 Marks)**

b. What is diffusion? Explain. Give the Fick's laws of diffusion and their conditions. **(08 Marks)**

c. Iron has an atomic radius of 0.124 nm, B.C.C. crystal structure and an atomic weight of 55.85 g/mol. Calculate the density. **(06 Marks)**

2 a. Define the following terms:
i) Proportional limit ii) Hardness iii) Resillience iv) Toughness **(08 Marks)**

b. Explain Brinell hardness and Rockwell hardness with sketch and equations. **(06 Marks)**

c. Explain how yield strength is determined for a material which does not exhibit a distinct yield point. **(06 Marks)**

3 a. Draw S-N diagram for steel and aluminium alloy and explain the salient features. **(06 Marks)**

b. Sketch creep curve and explain different stages of creep. **(06 Marks)**

c. Explain fatigue failures and give the methods of reducing fatigue failure. **(08 Marks)**

4 a. Explain the mechanism of solidification and homogeneous and heterogeneous nucleation. **(06 Marks)**

b. State and explain Hume-Rothery's rules for solid solution. **(05 Marks)**

c. Differentiate between interstitial and substitutional solid solutions. **(04 Marks)**

d. State and explain with example the Gibb's phase rule. **(05 Marks)**

PART – B

5 a. Draw neatly Iron-carbon diagram and label all the parts. **(08 Marks)**

b. With the help of above diagram, explain cooling of steel with 0.9% carbon showing the micro-structure at different stages. **(06 Marks)**

c. Draw TTT diagram for eutectoid steel and explain the microstructures obtained at various cooling rates. **(06 Marks)**

6 a. What is heat treatment? Classify the various types of heat treatments. **(08 Marks)**

b. What is meant by carburizing of steels? Explain various types of carburizing. **(08 Marks)**

c. Differentiate between annealing and normalizing. **(04 Marks)**

7 a. Explain different types of cast irons with microstructure. **(08 Marks)**

b. Discuss the composition and uses of α-brasses and bronzes. **(06 Marks)**

c. Write short note on Aluminium alloys. **(06 Marks)**

8 a. Differentiate between a composite and alloy. **(02 Marks)**

b. Classify the composites based on reinforcement and matrix materials. **(06 Marks)**

c. Explain with sketches any two methods of production of FRP's. **(06 Marks)**

d. Explain with sketches any two methods of production of MMC's. **(06 Marks)**

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10ME/AU43

Fourth Semester B.E. Degree Examination, December 2012
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 book is permitted.

PART – A

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

b. A sample of fuel has the following percentage composition by weight:
Carbon = 83%, Hydrogen = 11%, Oxygen = 3%, Nitrogen = 2%, Ash = 1%
i) Determine the stoichiometric air fuel ratio by mass.
ii) If 20% excess air is supplied, find the percentage composition of dry flue gases by volume. **(10 Marks)**

2 a. Derive an expression for air-standard efficiency of limited pressure cycle. **(10 Marks)**

b. The pressures on the compression curve of a diesel engine are at $1/8^{th}$ stroke 1.4 bar and at $7/8^{th}$ stroke 14 bar. Estimate the compression ratio. Calculate the air standard efficiency and mean effective pressure of the engine if the cut-off occurs at $1/15^{th}$ of the stroke. Assume initially air is at 1 bar and 27°C. **(10 Marks)**

3 a. List out the methods used for measuring friction power of an IC engine. Explain motoring test. **(05 Marks)**

b. Explain Morse test. **(05 Marks)**

c. During a trial of 60 minutes on a single cylinder oil engine having cylinder dia 300 mm, stroke 450 mm and working on two-stroke cycle, the following observations were made:

Total fuel used = 9.6 litres
Calorific value of fuel = 45000 kJ/kg
Total number of revolutions = 12624
Gross mean effective pressure = 7.24 bar
Pumping mean effective pressure = 0.34 bar
Net load on brake = 3150 Newton
Diameter of brake drum = 1.78 m
Diameter of rope = 40 mm
Cooling water circulated = 545 litres
Cooling water temperature rise = 25°C
Specific gravity of oil = 0.8
Heat carried away by the exhaust gases = 15% total heat supplied.

Determine IP, BP and mechanical efficiency. Draw up the heat balance sheet on minute basis. **(10 Marks)**

4 a. With a schematic diagram, explain the working of reheat vapour power cycle and deduce an expression for cycle efficiency. **(10 Marks)**

b. A turbine is supplied with steam at a pressure of 32 bar and a temperature of 410°C. The steam then expands isentropically to a pressure of 0.08 bar. Find the dryness fraction at the end of expansion and thermal efficiency of the cycle.
If the steam is reheated at 5.5 bar to a temperature of 400°C and then expanded isentropically to a pressure of 0.08 bar, what will be the dryness fraction and thermal efficiency of the cycle? **(10 Marks)**

PART – B

5 a. Show that for a multistage compressor $Z = \left(\frac{P_{x+1}}{P_1}\right)^{1/x}$ where Z = stage pressure ratio, x = number of stages, $\frac{P_{x+1}}{P_1}$ = overall pressure ratio. **(08 Marks)**

b. What are the advantages of multistage compressor? **(04 Marks)**

c. Air at standard atmospheric conditions is compressed and delivered to a receiver of 0.4 m diameter and 1 m long until a final pressure of 10 atm is reached. Assuming ideal conditions with no valve pressure drops, compute the power needed to drive the compressor for (i) isothermal compression, (ii) polytropic compression with n = 1.32.

Assume that the receiver temperature is maintained atmospheric throughout and filling takes place in 5 min. atmospheric temperature is 25°C. Also calculate isothermal efficiency of the compressor. **(08 Marks)**

6 a. With a neat block diagram and T-S diagram, explain how inter-cooling increases thermal efficiency of gas turbine plant. **(06 Marks)**

b. With a neat sketch, explain the working of Ram Jet. **(04 Marks)**

c. In a gas turbine plant working on Brayton cycle with a regenerator of 75% effectiveness, the air at the inlet to the compressor is at 0.1 MPa, 30°C, the pressure ratio is 6 and the maximum cycle temperature is 900°C. If the turbine and compressor have each an efficiency of 80%, find the percentage increase in the cycle efficiency due to regeneration. **(10 Marks)**

7 a. With a neat schematic diagram, explain the working of steam jet refrigeration. **(10 Marks)**

b. A Freon-12 refrigerator producing a cooling effect of 20 kJ/s operates on a vapour compression cycle with pressure limits of 1.509 bar and 9.607 bar. The vapour leaves the evaporator dry saturated and there is no under-cooling. Determine the power required by the machine. If the compressor operates at 300 rpm and has a clearance volume of 3% of stroke volume, determine the piston displacement of the compressor. Assume volumetric efficiency of compressor as 88%.

Properties of Freon – 12:

Temperature °C	P bar	V_g m^3/kg	h_f kJ/kg	h_g kJ/kg	s_f kJ/kgK	s_g kJ/kgK	c_p kJ/kgK
-20	1.509	0.1088	17.8	178.61	0.073	0.7082	--
40	9.607	--	74.53	203.05	0.2716	0.683	0.747

(10 Marks)

8 a. With a neat schematic diagram, explain the working of winter air conditioning system. Represent the processes on psychrometric chart. **(10 Marks)**

b. For a hall to be air conditioned, the following conditions are given:

Out door condition = 40°C DBT, 20°C WBT

Required comfort condition = 20°C DBT, 60% RH

Seating capacity of the hall = 1500

Amount of outdoor air supplied = 0.3 m^3/min/person

If the required condition is achieved first by adiabatic humidification and then by cooling, estimate: i) capacity of the cooling coil in TOR, ii) capacity of the humidifier in kg/h, iii) condition of air after adiabatic humidification. **(10 Marks)**

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10ME/AU/PM/TL44

Fourth Semester B.E. Degree Examination, December 2012
Kinematics of Machines

Time: 3 hrs. Max. Marks:100

Note: *1. Answer FIVE full questions, selecting at least TWO questions from each part.*
2. Graphical solution may be obtained either on graph sheet or on the answer book itself.

PART – A

1 a. Differentiate between:
i) Degree of freedom and mobility of mechanism.
ii) Kinematic chain and kinematic pair. **(08 Marks)**

b. Explain with a neat sketch, the single slider mechanism and its three inversions. **(12 Marks)**

2 a. Define 'Exact straight line motion'. Prove that a point on the Peaucellier's mechanism traces an exact straight line. **(10 Marks)**

b. Define 'Quick return motion' in a mechanism and using a neat sketch explain the drag link mechanism. **(10 Marks)**

3 In the mechanism shown in Fig.Q3, the slider 'C' is moving to the right with a velocity of 1 m/sec and an acceleration of 2.5 m/sec^2. The dimension of the various links are AB = 3 m, inclined at 45° with the vertical and BC = 1.5 m inclined at 45° with the horizontal. Determine
i) The magnitude of vertical and horizontal component of the acceleration of the points 'B' and
ii) The angular acceleration of links AB and BC. **(20 Marks)**

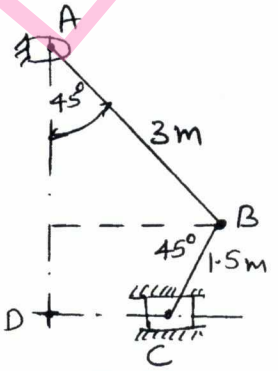

Fig.Q3

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 is 60°. Link AB rotates at 25 rpm. Determine using instantaneous centre method i) Angular velocity of link 'CD' and ii) Angular velocity of link BC. **(08 Marks)**

PART – B

5 The crank of an engine is 200 mm long and the ratio of connecting rod length to crank radius is 4. Determine the acceleration of the piston when the crank has turned through 45° from the inner dead centre position and moving at 240 rpm by complex algebra method. **(20 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 mating spur gears have 30 and 40 involute teeth of module 12 mm and 20° obliquity. The addendum on each wheel is to be made of such a length that the link of contact on each side of pitch point has half the maximum possible length. Determine the addendum height for each gear wheel and length of line of contact. **(12 Marks)**

7 In an epicyclic gear train, the internal gears A, B and the compound gears C - D rotates independently about a common axis O. The gears E and F rotates on pins fixed to the arm 'G' which turns independently about the axis 'O'. E gears with A and C, F gears with B and D. All gears have the same module. The number of teeth on gears C, D, E and F are 28, 26, 18 and 18 respectively.

i) Sketch the arrangement.
ii) If 'G' makes 100 rpm clockwise and gear 'A' is fixed, find speed of gear 'B'.
iii) If 'G' makes 100 rpm clockwise and gear 'A' makes 10 rpm C.C.W. find the speed of gear 'B'. **(20 Marks)**

8 A roller follower cam with a roller diameter of 10 mm is rotating clockwise. The lift of the cam is 30 mm and the axis of the follower is offset to the right by a distance of 5 mm. The follower completes the lift with SHM during 120° of cam rotation. The dwell at lift is 60° of cam rotation. First half of the fall takes place with constant velocity and second half with UARM during 120° of cam rotation. The rest is the dwell at fall. Draw the cam profile. **(20 Marks)**

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10ME/AU/TL45

Fourth Semester B.E. Degree Examination, December 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. Write short notes on the following:
i) Rake angles; ii) Orthogonal and oblique cutting; iii) Tool signature with example. **(16 Marks)**

b. During orthogonal machining with a rake angle of 10^{o} and uncut thickness of 0.125mm. The average thickness of chip is 0.43mm. Evaluate cutting ratio and shear angle. **(04 Marks)**

2 a. What do you understand by i) 18 – 4 – 1 HSS; ii) 6 – 6 – 4 – 2 HSS. **(04 Marks)**

b. With neat sketch, explain various heat generation zones during metal cutting along with heat distribution curve. **(10 Marks)**

c. With the help of neat sketch, explain Tool-Work thermocouple technique to measure tool-tip temperature. **(06 Marks)**

3 a. With necessary sketches, explain various stages involved to produce hexagonal bolt using turret. **(08 Marks)**

b. Explain with neat sketch open and cross belt drive mechanism of a planer. **(08 Marks)**

c. A shaper makes 36 complete strokes/min and the stroke length is 30 cm. The shaper has a cutting stroke to return stroke ratio of 3:2. Determine the cutting speed in m/min. **(04 Marks)**

4 a. With a neat sketch, explain in detail the nomenclature of twist drill. **(08 Marks)**

b. Explain with neat sketch, the working principle of radial drilling machine. **(08 Marks)**

c. Give the advantages and disadvantages of CNC machines. **(04 Marks)**

PART – B

5 a. Explain following milling operations with relevant sketches:
i) Form milling; ii) Gang milling; iii) Straddle milling. **(10 Marks)**

b. Differentiate upmilling and down milling with sketches. **(05 Marks)**

c. With the help of crank mechanism explain simple indexing. **(05 Marks)**

6 a. Mention various bonding processes and explain vitrified and retinoid bonding process. **(08 Marks)**

b. Write short notes on the following:
i) Grade; ii) Marketing systems for grinding wheel; iii) Structure. **(12 Marks)**

7 a. With the help of neat sketch explain pull broach. **(10 Marks)**

b. Mention in detail the advantages of honing and lapping process along with the uses of the processes. **(10 Marks)**

8 a. Explain laser beam machining process with relevant sketches of formation of laser beam and energy level diagram. **(10 Marks)**

b. Explain in detail with respect to AJM element influence on AJM process. **(10 Marks)**

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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)**

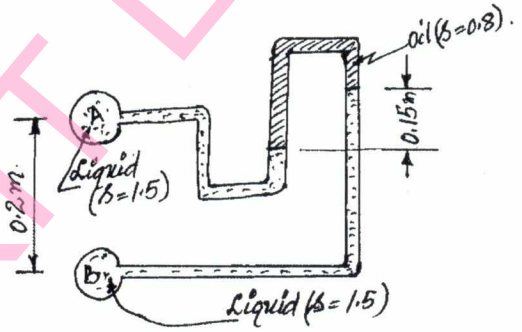

Fig.Q2(b)

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)**

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MATDIP401

Fourth Semester B.E. Degree Examination, December 2012

Advanced Mathematics – II

Time: 3 hrs. Max. Marks:100

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

1 a. Prove that the angle between two lines whose direction cosines are (ℓ_1, m_1, n_1) and (ℓ_2, m_2, n_2) is $\cos\theta = \ell_1\ell_2 + m_1m_2 + n_1n_2$. **(06 Marks)**

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

c. Find the angle between any two diagonals of cube. **(07 Marks)**

2 a. Find the equation of the plane passing through the points (3, 1, 2) and (3, 4, 4) and perpendicular to $5x + y + 4z = 0$. **(06 Marks)**

b. Show that the points (0, -1, 0), (2, 1, -1), (1, 1, 1) and (3, 3, 0) are coplanar. **(07 Marks)**

c. Find the equation of the plane through the points (1, 0, -1), (3, 2, 2) and parallel to the line $\frac{x-1}{1} = \frac{1-y}{2} = \frac{z-2}{3}$. **(07 Marks)**

3 a. Find the value of λ such that the vectors $\lambda i + j + 2k$, $2i - 3j + 4k$ and $i + 2j - k$ are coplanar. **(06 Marks)**

b. If $\vec{a} = 4i + 2j - k$, $\vec{b} = 2i - j$ and $\vec{c} = j - 3k$, find (i) $(\vec{a}\times\vec{b}).(\vec{b}\times\vec{c})$, (ii) $(\vec{a}\times\vec{b})\times(\vec{b}\times\vec{c})$. **(07 Marks)**

c. Find the cosine and sine of the angle between the vectors $2i - j + 3k$ and $i - 2j + 2k$. **(07 Marks)**

4 a. Find the components of velocity and acceleration at t = 2 on the curve, $\vec{r} = (t^2 + 1)i + (4t - 3)j + (2t^2 - 6t)k$ in the direction of $i + 2j + 2k$. **(06 Marks)**

b. Find the angle between the tangents to the curve $\vec{r} = \left\{t - \frac{t^3}{3}\right\}i + t^2j + \left\{t + \frac{t^3}{3}\right\}k$ at $t = \pm 3$. **(07 Marks)**

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

5 a. If $\vec{F} = \nabla(xy^3z^2)$, find div $\vec{F}$ and curl $\vec{F}$ at the point (1, -1, 1). **(06 Marks)**

b. Show that $\vec{F} = (y + z)i + (z + x)j + (x + y)k$ is irrotational. Also find a scalar function ϕ such that $\vec{F} = \nabla\phi$. **(07 Marks)**

c. Prove that $\nabla^2(\log r) = \frac{1}{r^2}$ where $\vec{r} = xi + yj + zk$ and $r = |\vec{r}|$. **(07 Marks)**

6 a. Find Laplace transform of $(2t + 3)^2$. **(05 Marks)**

b. Find Laplace transform of $e^{2t}\cos 3t$. **(05 Marks)**

c. Find $L\left\{\frac{\cos 2t - \cos 3t}{t}\right\}$. **(05 Marks)**

d. Using Laplace transform, evaluate $\int_0^\infty e^{-2t} t \cos t \, dt$. **(05 Marks)**

7 a. Find inverse Laplace transform of $\frac{s}{s^2 + 4s + 13}$. **(06 Marks)**

b. Find $L^{-1}\left\{\frac{1}{(s^2 + 3s + 2)(s + 3)}\right\}$. **(07 Marks)**

c. Find $L^{-1}\left\{\log\left(\frac{s^2 + 1}{s^2 + s}\right)\right\}$. **(07 Marks)**

8 a. Solve the differential equation $y'' + 4y' + 3y = e^{-t}$ with $y(0) = 1$ and $y'(0) = 1$ by using Laplace transforms. **(10 Marks)**

b. Solve by using Laplace transforms $\frac{dx}{dt} - 2y = \cos 2t$, $\frac{dy}{dt} + 2x = \sin 2t$ with $x = 1$, $y = 0$ at $t = 0$. **(10 Marks)**

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