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10MAT41

Fourth Semester B.E. Degree Examination, June/July 2016
Engineering Mathematics – IV

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting atleast TWO questions from each part.*
2. Use of statistical tables permitted.

PART – A

1 a. Using Taylor's series method, solve $y' = x + y^2$, $y(0) = 1$ at $x = 0.1, 0.2$, considering upto 4^{th} degree term. **(06 Marks)**

b. Using modified Euler's method, find an approximate value of y when x = 0.2 given that $\frac{dy}{dx} = x + y$ and y = 1 when x = 0. Take h = 0.1. Perform two iterations in each stage. **(07 Marks)**

c. Using Adams-Bashforth method, obtain the solution of $\frac{dy}{dx} = x - y^2$ at x = 0.8 given that y(0) = 0, y(0.2) = 0.0200, y(0.4) = 0.0795, y(0.6) = 0.1762. 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, $\frac{dy}{dx} = x + yz$, $\frac{dz}{dx} = y + zx$, $y(0) = 1$, $z(0) = -1$. **(06 Marks)**

b. Solve $\frac{dy}{dx} = 1 + xz$ and $\frac{dz}{dx} = -xy$ for x = 0.3 by applying Runge Kutta method given y(0) = 0 and z(0) = 1. Take h = 0.3. **(07 Marks)**

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

3 a. Define an analytic function and obtain Cauchy-Riemann equations in polar form. **(06 Marks)**

b. Show that $u = e^{2x}(x\cos 2y - y\sin 2y)$ is a harmonic function and determine the corresponding analytic function. **(07 Marks)**

c. 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)**

4 a. Evaluate using Cauchy's integral formula $\int_c \frac{\cos \pi z}{z^2 - 1} dz$ around a rectangle with vertices $2 \pm i, -2 \pm i$. **(06 Marks)**

b. Find the bilinear transformation which maps 1, i, -1 to 2, i, -2 respectively. Also find the fixed points of the transformation. **(07 Marks)**

c. Discuss the conformal transformation of $w = z^2$. **(07 Marks)**

PART – B

5 a. Reduce the differential equation:

$x^2\frac{d^2y}{dx^2}+x\frac{dy}{dx}+(k^2x^2-n^2)y=0$ into Bessel form and write the complete solution in terms of $\tau_n(x)$ and $\tau_{-n}(x)$. **(06 Marks)**

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

c. If α and β are the roots of $\tau_n(x)=0$ then prove that

$$\int_0^1 x\tau_n(\alpha x)\tau_n(\beta x)\,dx=\begin{cases}0, & \alpha\neq\beta\\ \frac{1}{2}[\tau_{n+1}(\alpha)]^2, & \alpha=\beta\end{cases}$$ **(07 Marks)**

6 a. The probability that sushil will solve a problem is 1/4 and the probability that Ram will solve it is 2/3. If sushil and Ram work independently, what is the probability that the problem will be solved by (i) both of them; (ii) at least one of them? **(06 Marks)**

b. A committee consists of 9 students two of which are from first year, three from second year and four from third year. Three students are to be removed at random. What is the chance that (i) the three students belong to different classes; (ii) two belong to the same class and third to the different class; (iii) the three belong to the same class? **(07 Marks)**

c. The contents of three urns are: 1 white, 2 red, 3 green balls, 2 white, 1 red, 1 green balls and 4 white, 5 red, 3 green balls. Two balls are drawn from an urn chosen at random. These are found to be one white and one green. Find the probability that the balls so drawn came from the third urn. **(07 Marks)**

7 a. The probability mass function of a variate X is

x	0	1	2	3	4	5	6
p(x)	k	3k	5k	7k	9k	11k	13k

i) Find k

ii) Find $p(x<4)$, $p(x\geq 5)$, $p(3<x\leq 6)$, $p(x>1)$

iii) Find the mean. **(06 Marks)**

b. Derive the mean and variance of Poisson distribution. **(07 Marks)**

c. The mean height of 500 students is 151cm and the standard deviation is 15cm. Assuming that the heights are normally distributed, find how many students heights i) lie between 120 and 155cm; ii) more than 155cm. [Given A(2.07) = 0.4808 and A (0.27) = 0.1064, where A(z) is the area under the standard normal curve from 0 to $z>0$]. **(07 Marks)**

8 a. The means of simple samples of sizes 1000 and 2000 are 67.5 and 68.0cm respectively. Can the samples be regarded as drawn from the same population of S.D 2.5cm [Given $z_{0.05}=1.96$]. **(06 Marks)**

b. A random sample of 10 boys had the following I.Q: 70, 120, 110, 101, 88, 83, 95, 98, 107, 100. Do these data support the assumption of a population mean I.Q of 100? [Given $t_{0.05}$ for 9d.f = 2.26]. **(07 Marks)**

c. The following table gives the number of aircraft accidents that occurred during the various days of the week. Find whether the accidents are uniformly distributed over the week.

Days :	Sun	Mon	Tue	Wed	Thur	Fri	Sat	Total
No. of accidents :	14	16	8	12	11	9	14	84

[Given $\psi^2_{0.05}$ 6d.f = 12.59] **(07 Marks)**

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10ME42A/AU42A

Fourth Semester B.E. Degree Examination, June/July 2016
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. Distinguish between BCC, FCC and HCP crystals with respect to structure, No. of atoms, Lattice constant, Co-ordination number and APF. **(08 Marks)**

b. What is Berger's vector? Explain its significance using edge dislocation. **(04 Marks)**

c. i) What is Diffusion? Explain the factors affecting diffusion. **(04 Marks)**

ii) The diffusivity of iron atoms in the BCC Fe lattice is 2.1×10^{-23} m^2/S at 400^0C and $4.0 \times 10^{-16} m^2/S$ at 800^0C. Calculate the activation energy in Joules per mole for diffusion of iron atoms in BCC Fe lattice in this temperature range. Take R = 2.3 × 8.314 J/mol – K. **(04 Marks)**

2 a. With the help of Stress – Strain diagram, explain any Four mechanical properties in plastic region. **(08 Marks)**

b. Derive an expression for true strain and convention strain. **(04 Marks)**

c. What is Plastic Deformation? With a neat sketch, explain the mechanism of Twinning. **(08 Marks)**

3 a. What is Fracture? Derive an expression for fracture strength of a real material based on Griffith's theory of brittle fracture. **(08 Marks)**

b. Briefly discuss the factors affecting creep. **(04 Marks)**

c. What is Fatigue? Briefly explain R.R Moore fatigue testing and plot S – N curves for mild steel and Aluminium alloy. **(08 Marks)**

4 a. i) What is Solidification? Derive an expression for critical radius of Nucleus and explain its importance. **(05 Marks)**

ii) Write in brief note on Cast Metal Structures. **(05 Marks)**

b. i) What are Solid Solutions? Briefly discuss Hume Ruthery Rules for the formation of substitutional solid solutions. **(05 Marks)**

ii) Explain the application of Gibb's phase rule for a Binary phase diagram. **(05 Marks)**

PART – B

5 a. What is a Phase Diagram? Explain its significance. **(04 Marks)**

b. The melting point of lead is 327^0C and that of tin is 232^0C, they form an Eutectic of 62% tin and 38% lead at 183^0C. At Eutectic temperature, maximum solubility of tin in lead is 19% and lead in tin is 3%. Assume their solid solubilities at 0^0C is 0%, liquidus solidus and solvus lines to be straight. Draw phase diagram to scale indicating all phase fields and explain the solidification of 30% tin and 70% lead alloy. **(08 Marks)**

c. Draw Iron – Cementite phase diagram showing all Phase fields, Critical temperature and Invariant reactions. **(08 Marks)**

6 With neat sketches, explain the following :
   a. TTT – Diagram. **(05 Marks)**
   b. Normalizing heat treatment. **(05 Marks)**
   c. Flame hardening. **(05 Marks)**
   d. Age – hardening of Aℓ - Cu Alloys. **(05 Marks)**

7 Briefly explain the structure, properties, composition and applications of the following :
   a. Types of CAST IRONS. **(10 Marks)**
   b. Alloys of copper (any four). **(10 Marks)**

8 a. What are Composites? Mention any four advantages and applications of composites. **(06 Marks)**
   b. With a neat sketch, explain the fabrication of FRP's by any one method of open mould processes. **(06 Marks)**
   c. With a neat sketch, explain the production of MMC's by Stir casting technique. **(08 Marks)**

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10ME42B/AU42B

Fourth Semester B.E. Degree Examination, June/July 2016

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. List the objectives of metrology. **(05 Marks)**

b. Explain the wringing phenomena of slip gauges with neat figure. **(05 Marks)**

c. List the slips to be wrung together to produce an overall dimension of 92.357 mm using two protection slips of 2.500 mm size. **(10 Marks)**

2 a. What are the various types of fits used for the purpose of assembly of machine parts? Explain each with neat figure. **(10 Marks)**

b. With neat figure, explain: i) Plug gauges, ii) Ring gauges, iii) Snap gauges. **(10 Marks)**

3 a. How the comparators are classified? **(05 Marks)**

b. Describe with a neat sketch construction and working of LVDT. **(10 Marks)**

c. Select the sizes of angle gauges required to build (i) 37°9′18″ and show the combination. **(05 Marks)**

4 a. Explain the principle of autocollimator with neat figure. **(10 Marks)**

b. Describe the 3-wire method of measuring effective diameter of threads. Give the setup for the above. **(10 Marks)**

PART – B

5 a. Explain the generalized measurement system with block diagram. Give examples. **(10 Marks)**

b. Explain with sketch the construction and working of an electronic transducer. **(10 Marks)**

6 a. Describe in detail a ballast circuit. **(10 Marks)**

b. What are X-Y plotters? With a block diagram, explain its working. **(10 Marks)**

7 a. With the help of neat sketch, explain the working principle of prony brake dynamometer. **(10 Marks)**

b. Explain the working of McLeod gauge with neat sketch. **(10 Marks)**

8 a. With figure describe the construction and working principle of optical pyrometer. **(10 Marks)**

b. Describe the strain measurement by neat figure. **(10 Marks)**

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10ME/AU43

Fourth Semester B.E. Degree Examination, June/July 2016
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 Thermodynamics Data Hand book permitted.***

PART – A

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

b. Methane (CH_4) is burned with atmospheric air. The analysis of the products of combustion on a dry basis is as follows: CO_2 – 10% O_2 – 2.37% CO – 0.53% and N_2 – 87.10%. Calculate the air fuel ratio and the percent theoretical air and determine the combustion equation. **(10 Marks)**

2 a. Explain the method of findings friction power using
i) Morse test ii) Motoring test of an engine. **(08 Marks)**

b. In a test of 4-cylinders, 4-stoke petrol engine of 75mm bore and 100mm stroke. The following results were obtained at full throttle at a constant speed and with a fixed setting of the fuel supply at 0.082 kg/min. BP with all the 4 – cylinders working = 15.24kW. B.P with cylinder No.1 cutoff = 10.45kW, BP with cylinder
No.2 cutoff = 10.33 kW, BP with cylinder
No.3 cutoff = 10.23kW, BP with cylinder
No.4 cutoff = 10.45kW.
Determine :
i) The indicated power
ii) The indicated thermal efficiency, if CV of the fuel = 44mJ/kg.
iii) Relative efficiency based on IP is clearance volume in each cylinder = 115CC.
(12 Marks)

3 a. Derive an expression for thermal efficiency of Dual cycle with PV and TS diagrams. **(10 Marks)**

b. An engine operates on air standard diesel cycle. The pressure and temperatures at the beginning of compression are 100KPa and 27°. The compression ratio is 18. The heat added per kg of air is 1850kJ. Determine maximum pressure, Maximum temperature, thermal efficiency, network done and mean effective pressure of the cycle. Assume $\gamma = 1.4$ and $C_p = 1.005$ kJ/kg K. **(10 Marks)**

4 a. With T-S and schematic diagrams explain regenerative cycle with open feed water heater. **(10 Marks)**

b. A 40MW steam power plant working on Rankine cycle operates between boiler pressure of 4MPa and condenser pressure of 10KPa. The steam leaves the boiler and enters the turbine at 400°C. the isentropic efficiency of the steam turbine is 85% determine:
i) The cycle efficiency ii) The quality of exhaust steam from turbine
iii) Steam flow rate in kg/hr. consider pump work. **(10 Marks)**

PART – B

5 a. Derive expression for the intermediate pressure which gives minimum power in a two stage compressor with perfect inter cooling. **(08 Marks)**

b. A single cylinder, double acting air compressor is required to deliver $100 m^3/min$ of air at a mean piston speed of 500m/min measured at 1bar and 15°C. The air is delivered at 7 bar. Assume a clearance volume of $\frac{1}{15}^{th}$ of swept volume per stroke. Find volumetric efficiency speed, bore, stroke for the following two cases.

i) If ambient and suction conditions are same

ii) If ambient and suction conditions are different.

Assume, Ambient pressure = 1.0bar,

Ambient temperature = 15°C, Suction pressure = 0.98 bar. Suction temperature = 30°C

$\frac{L}{D} = 1.25$ **(10 Marks)**

c. Write the uses of compressed air. **(02 Marks)**

6 a. Derive an expression for optimum pressure ratio which gives maximum specific work output in gas turbine considering machine efficiency. **(06 Marks)**

b. Explain the working of a ramjet engine with the help of a sketch. What are its advantages, disadvantages and applications? **(10 Marks)**

c. Explain with neat sketch any one method to improve thermal efficiency of Gas Turbine cycle. **(04 Marks)**

7 a. A refrigerating unit takes air from a cold chamber at 5°C and compresses it from 1bar to 6.5bar. The index of compression is 1.25. The compressed air is cooled to a temperature which is 10°C above the ambient temperature of 30°C before being expanded isentropically in an expander. Neglecting the clearance volume of compressor and expander. Find the COP and the amount of air circulated in m^3/min. If 2000kg of ice is to be formed per day at 0°C from water at 25°C, what the tonnage of the unit? **(12 Marks)**

b. Draw neat PV and TS diagram for reversed Brayton cycle. **(02 Marks)**

c. Show that COP reversed Brayton cycle = $\frac{1}{\left[R_P^{\frac{\gamma-1}{\gamma}} - 1\right]}$

Where R_p = pressure ratio

$\gamma = \frac{C_P}{C_V}$, remains same during expansion and compression process. **(06 Marks)**

8 a. With a neat sketch, briefly describe a summer air conditioning system. **(08 Marks)**

b. Define the following: i) DBT ii) Specific humidity iii) Relative humidity. **(06 Marks)**

c. Show the following processes on Psychrometric chart.

i) Sensible heating and cooling

ii) Cooling and dehumidification

iii) Adiabatic mixing of two streams

iv) Heating and humidification. **(06 Marks)**

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10ME/AU44

Fourth Semester B.E. Degree Examination, June/July 2016
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. Define the following:
   i) Kinematic chain
   ii) Mechanism
   iii) Structure
   iv) Inversion
   v) Degree of freedom. **(10 Marks)**

   b. Describe with neat figures two inversions of double slider-crank chain. **(10 Marks)**

2 a. With neat sketch, explain crank and slotted lever quick return mechanism. **(07 Marks)**

   b. Explain the pantograph mechanism, with a neat sketch. State its applications. **(07 Marks)**

   c. Draw a line diagram and explain peancellier's straight line mechanism. **(06 Marks)**

3 A four bar chain ABCD has a fixed link AD = 1 m. The driving crank AB = 0.3 m. The follower link CD = 0.6 m and the connecting link BC = 1.2 m. Find the velocity and acceleration of point 'P' midway between B and C, when the angle BAD = 135° and AB rotates clock wise at a speed of 300rpm with an angular acceleration of 20 rad/sec^2 in CCW direction. **(20 Marks)**

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

   b. In a reciprocating engine, the length of crank is 250mm and length of connecting rod is 1000mm. The crank rotates at an uniform speed of 300rpm in clockwise direction and the crank is inclined at 30° with inner dead centre. The centre of gravity of the connecting rod is 400mm away from the crank end. By Klein's construction determine: i) Velocity and acceleration of piston; ii) Angular velocity and angular acceleration of connecting rod and iii) Velocity and acceleration at the centre of gravity of the connecting rod. **(15 Marks)**

PART – B

5 In a reciprocating engine length of crank is 250mm and length of connecting rod is 1000mm. The crank rotates at a uniform speed at 300rpm CW Crank is at 30° from IDC. Determine:
   i) Velocity of piston and angular velocity of connecting rod.
   ii) Acceleration of piston and angular acceleration of connecting rod by complex algebra method from first principal. **(20 Marks)**

6 a. State and prove law of gearing. **(06 Marks)**

   b. Derive an expression for path of contact. **(06 Marks)**

   c. A pair of spur gears has 16 teeth and 18 teeth, a module 12.5mm, an addendum 12.5mm and a pressure angle 14.5°. Prove that the gears have interference. Determine the minimum number of teeth and the velocity ratio to avoid interference. **(08 Marks)**

7 a. Explain epicyclic gear train with neat figure. **(05 Marks)**

b. An epicyclic gear train consists of a sun wheel (S), a stationary internal gear (E) and three identical planet wheels (P) carried on a star shaped planet carrier (C). The size of different toothed wheels are such that the planet carrier C rotates at 1/5 of the speed of the sun wheel. The minimum number of teeth on any wheel is 16. The driving torque on the sun wheel is 100Nm. Determine:

i) Number of teeth an different wheels of train.

ii) Torque necessary to keep the internal gear stationary. **(15 Marks)**

8 Draw the profile of a cam operating a roller reciprocating follower with the following data: minimum radius of cam = 25mm; lift = 30mm; roller diameter = 15mm. The cam lifts the follower for 120° with SHM followed by a dwell period of 30°. Then the follower lowers down during 150° of the cam rotation with uniform acceleration and deceleration followed by a dwell period. If the cam rotates at a uniform speed of 150rpm. Calculate the maximum velocity and acceleration of the follower during descent period. **(20 Marks)**

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10ME/AU45

Fourth Semester B.E. Degree Examination, June/July 2016
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 sketch, give nomenclature of a single-point-cutting-tool. **(07 Marks)**

b. List various factors affecting tool life. Explain any two of them. **(06 Marks)**

c. In an orthogonal cutting the following observations were made:
(i) Feed = 0.25 mm/rev (ii) Chip thickness = 0.8 mm (iii) Depth of cut = 2 mm
(iv) Length of chip-tool contact = 0.5 mm (v) Working rake angle = 0°
(vi) Cutting force = 1800 N (vii) Axial thrust, F_t = 900 N
Determine :
- The mean angle of friction on tool face.
- The mean shear strength of the work material.
- The maximum frictional stress on tool face. **(07 Marks)**

2 a. Explain the three zones of heat generation in metal cutting. **(06 Marks)**

b. Briefly explain the desirable properties and purposes of cutting fluids. **(08 Marks)**

c. List the various methods of chip-tool interface temperature. Explain briefly tool work thermocouple method of measuring it. **(06 Marks)**

3 a. Differentiate between Capstan and Turret Lathe. **(04 Marks)**

b. Explain with a neat sketch Crank and slotted link type of Quick return mechanism of a shaper. **(08 Marks)**

c. Sketch planning machine and indicating major parts. **(08 Marks)**

4 a. Draw neat sketch of a radial drilling machine and indicating parts. **(06 Marks)**

b. Briefly explain absolute co-ordinates system and incremental co-ordinate system used in CNC. **(08 Marks)**

c. With simple sketches, explain the following processes: (i) Counter sinking (ii) Trepanning (iii) Reaming. **(06 Marks)**

PART – B

5 a. Draw a neat sketch of horizontal milling machine and indicating parts. **(08 Marks)**

b. What is indexing? Name different methods of indexing. Briefly explain compound indexing method. **(08 Marks)**

c. Differentiate between up milling and down milling. **(04 Marks)**

6 a. Explain the factors to be considered for selection of grinding wheels. **(06 Marks)**

b. Briefly explain external cylindrical centreless grinding with a neat sketch. Mention the advantages of same over centre-type grinding. **(08 Marks)**

c. Explain the following grinding wheel parameters: (i) GRIT (ii) Grade (iii) Structure. **(06 Marks)**

7 a. Explain briefly the Honing process with a neat sketch. State its advantages and disadvantages. **(10 Marks)**

b. Explain with a neat sketch the Lapping process. State its advantages and disadvantages. **(10 Marks)**

8 a. With a neat sketch, explain the electric discharge machining. **(08 Marks)**

b. With a schematic diagram, explain the ultrasonic machining process. **(08 Marks)**

c. Differentiate between non-conventional machining process and conventional machining processes. **(04 Marks)**

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10ME/AU46B

Fourth Semester B.E. Degree Examination, June/July 2016
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. Explain the following fluid properties with relevant equations:
(i) Bulk modulus (ii) Capillarity (iii) Kinematic viscosity (iv) Surface tension. **(08 Marks)**

b. What is cavitation? Explain the importance of cavitation in the study of fluid mechanics. **(04 Marks)**

c. A square plate of side 1 m and weight 350 N slides down an inclined plane with a uniform velocity of 2 m/s. The inclined plane is laid on a slope of 6 : 8 and has an oil film of 1 mm thickness. Calculate the viscosity of oil. **(08 Marks)**

2 a. Explain the terms: (i) Total pressure (ii) Centre of pressure (iii) Pressure at a point. **(06 Marks)**

b. A simple U-tube manometer containing mercury is connected to a pipe in which a fluid of sp.gr. 0.8 and having vacuum pressure is flowing. The other end of the manometer is open to atmosphere. Find the vacuum pressure in pipe, if the difference of mercury level in the two limbs is 40 cm and the height of fluid in the left from the centre of pipe is 15 cm below. **(04 Marks)**

c. A circular plate of 3.0 m diameter with a concentric circular hole of diameter 1.5 m is immersed in water in such a way that its greatest and least depth below the free surface are 4 m and 1.5 m respectively. Determine the total pressure on one face of the plate and position of the centre of pressure. **(10 Marks)**

3 a. A metallic body floats at the interface of mercury and water in such a way that 30% of its volume is submerged in mercury and 70% in water. Find the density of the metallic body. **(05 Marks)**

b. A wooden block of size $3m \times 2m \times 1m$ and of specific gravity 0.8 floats in water. Determine its meta centric height. **(05 Marks)**

c. A fluid flow is given by $V = 10x^3 i - 8x^3 yj$. Find the shear strain rate and state whether the flow is rotational or irrotational. **(05 Marks)**

d. The velocity potential is given by $\phi = x(2y-1)$. Calculate the value of stream function at a point (1, 2). **(05 Marks)**

4 a. State Bernoulli's theorem for fluid flow. Derive an expression for Bernoulli's equation from first principle. Also state the assumption made for such a derivation. **(10 Marks)**

b. A pipeline carrying oil of specific gravity 0.8 changes in diameter from 300 mm at a position A to 500 mm to a position B which is 5 m at a higher level. If the pressures at A and B are 1.962 bar and 1.491 bar respectively, and the discharge is 150 litres/s, determine the loss of head during the fluid flow. Also state the direction of the fluid flow. **(10 Marks)**

PART – B

5 a. When do you prefer orifice meter over a venturimeter? Why? **(02 Marks)**

b. An oil of specific gravity 0.9 is flowing in a venturimeter of size $20cm \times 10cm$. The oil mercury differential manometer shows a reading of 20 cm. Calculate the flow rate of oil through the horizontal venturimeter. Take discharge coefficient of venturimeter as 0.98. **(06 Marks)**

c. A rectangular channel 2 m wide has a discharge of 0.25 m^3/s, which is measured by a right-angled V-notch weir. Find the position of the apex of the notch from the bed of the channel if maximum depth of water is not to exceed 1.3 m. Take $C_d = 0.62$. **(04 Marks)**

d. Show by Buckingham's π-theorem that the frictional torque T of a disc of diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a flow is given by, $T = D^5N^2\rho\phi\left[\frac{\mu}{D^2N\rho}\right]$. **(08 Marks)**

6 a. Explain the terms HGL and TEL in case of flow through pipes. **(04 Marks)**

b. List out the various frictional and minor losses occurring in a flow through pipes. Also write down the expressions for the loss of head in each of the above cases. **(06 Marks)**

c. 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. Determine the rate of flow considering all losses of head which occur. Take $f = 0.01$ for both sections of the pipe. **(10 Marks)**

7 a. Explain the terms the critical Reynold's number, velocity gradient and pressure gradient with respect to a viscous flow. **(06 Marks)**

b. Derive an expression for the velocity distribution for Hagen-Poiseuille flow occurring in a circular pipe. Hence prove that the maximum velocity is twice the average velocity of the flow. **(10 Marks)**

c. Determine (i) the pressure gradient (ii) the shear stress at the two horizontal parallel plates for the laminar flow of oil with a maximum velocity of 1.5 m/s between two horizontal parallel fixed plates which are 80 mm apart. Take the viscosity of oil as 1.962 NS/m^2. **(04 Marks)**

8 a. Explain the terms : (i) Boundary layer thickness (ii) Displacement thickness (iii) Momentum thickness (iv) Energy thickness. **(06 Marks)**

b. A flat plate $2m \times 2m$ moves at 40 km/hr in stationary air of density 1.25 kg/m^3. If the coefficient of drag and lift are 0.2 and 0.8 respectively, find (i) the lift force (ii) the drag force (iii) the resultant force and (iv) the power required to keep the plate in motion. **(04 Marks)**

c. Obtain an expression for velocity of the sound wave in a compressible fluid in terms of change of pressure and change of density. **(06 Marks)**

d. Calculate the Mach number and Mach angle at a point on a jet propelled aircraft which is flying at 900 km/hour at sea level where air temperature is 15°C. Take K = 1.4 and R = 287 J/kgK. **(04 Marks)**

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MATDIP401

Fourth Semester B.E. Degree Examination, June/July 2016
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. **(07 Marks)**

b. Prove that the general equation of first degree in x, y, z represents a plane. **(07 Marks)**

c. Find the angle between the lines,

$$\frac{x-1}{1}=\frac{y-5}{0}=\frac{z+1}{5} \text{ and } \frac{x+3}{3}=\frac{y}{5}=\frac{z-5}{2}.$$ **(06 Marks)**

2 a. Prove that the lines,

$$\frac{x-5}{3}=\frac{y-1}{1}=\frac{z-5}{-2} \text{ and } \frac{x+3}{1}=\frac{y-5}{3}=\frac{z}{5}$$ are perpendicular. **(07 Marks)**

b. Find the shortest distance between the lines.

$$\frac{x-8}{3}=\frac{y+9}{-16}=\frac{z-10}{7} \text{ and } \frac{x-15}{3}=\frac{y-29}{8}=\frac{z-5}{-5}.$$ **(07 Marks)**

c. Find the equation of the plane containing the point (2, 1, 1) and the line,

$$\frac{x+1}{2}=\frac{y-2}{3}=\frac{z+1}{-1}$$ **(06 Marks)**

3 a. Find the constant 'a' so that the vectors $2\hat{i}-\hat{j}+\hat{k}$, $\hat{i}+2\hat{j}-3\hat{k}$ and $3\hat{i}+a\hat{j}+5\hat{k}$ are co-planar. **(07 Marks)**

b. If $\vec{a}=2\hat{i}+3\hat{j}-4\hat{k}$ and $\vec{b}=8\hat{i}-4\hat{j}+\hat{k}$ then prove that $\vec{a}$ is perpendicular to $\vec{b}$ and also find $\left|\vec{a}\times\vec{b}\right|$. **(07 Marks)**

c. Find the volume of the parallelopiped whose co-terminal edges are represented by the vectors,

$\vec{a}=\hat{i}+\hat{j}+\hat{k}$, $\vec{b}=2\hat{i}+3\hat{j}-\hat{k}$ and $\vec{c}=\hat{i}-\hat{j}-\hat{k}$ **(06 Marks)**

4 a. Find the velocity and acceleration of a particle moves along the curve $\vec{r}=e^{-2t}\hat{i}+2\cos 5t\hat{j}+5\sin 2t\hat{k}$ at any time 't'. **(07 Marks)**

b. Find the directional derivative of x^2yz^3 at (1, 1, 1) in the direction of $\hat{i}+\hat{j}+2\hat{k}$. **(07 Marks)**

c. Find the divergence of the vector $\vec{F}=(xyz+y^2z)\hat{i}+(3x^2+y^2z)\hat{j}+(xz^2-y^2z)\hat{k}$. **(06 Marks)**

5 a. $\vec{F}=(x+y+1)\hat{i}+\hat{j}-(x+y)\hat{k}$, show that $\vec{F}\cdot\text{curl}\vec{F}=0$. **(07 Marks)**

b. Show that the vector field, $\vec{F}=(3x+3y+4z)\hat{i}+(x-2y+3z)\hat{j}+(3x+2y-z)\hat{k}$ is solenoidal. **(07 Marks)**

c. Find the constants a, b, c such that the vector field,

$\vec{F}=(x+y+az)\hat{i}+(x+cy+2z)\hat{j}+(bx+2y-z)\hat{k}$ is irrotational. **(06 Marks)**

6 a. Prove that $L(\sin at) = \frac{a}{s^2 + a^2}$. **(07 Marks)**

b. Find $L[\sin t \quad \sin 2t \quad \sin 3t]$. **(07 Marks)**

c. Find $L[\cos^3 t]$. **(06 Marks)**

7 a. Find the inverse Laplace transform of $\frac{1}{(s+1)(s+2)(s+3)}$. **(07 Marks)**

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

c. Find $L^{-1}\left[\frac{s+2}{s^2 - 4s + 13}\right]$. **(06 Marks)**

8 a. Solve the differential equation, $y'' + 2y' + y = 6te^{-t}$ under the conditions $y(0) = 0 = y'(0)$ by Laplace transform techniques. **(10 Marks)**

b. Solve the differential equation, $y'' - 3y' + 2y = 0 \quad y(0) = 0, \quad y'(0) = 1$ by Laplace transform techniques. **(10 Marks)**

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