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10MAT31

Third Semester B.E. Degree Examination, June/July 2016
Engineering Mathematics – III

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Find the Fourier series for the function $f(x) = x(2\pi - x)$ in $0 \le x \le 2\pi$. Hence deduce that $\frac{\pi^2}{8} = 1 + \frac{1}{3^2} + \frac{1}{5^2} + - - - - -$. **(07 Marks)**

b. Find the half-range cosine series for the function $f(x) = (x-1)^2$ in $0 < x < 1$. **(06 Marks)**

c. Obtain the constant term and the co-efficient of the 1st sine and cosine terms in the Fourier series of y as given in the following table. **(07 Marks)**

x	0	1	2	3	4	5
y	9	18	24	28	26	20

2 a. Solve the integral equation :

$\int_0^\infty f(\theta(\cos\alpha\theta\, d\theta = \begin{cases} 1-\alpha, & 0 \le \alpha \le 1 \\ 0, & \alpha > 1 \end{cases}$. Hence evaluate $\int_0^\infty \frac{\sin^2 t}{t^2}\, dt$. **(07 Marks)**

b. Find the Fourier transform of $f(x) = e^{-|x|}$. **(06 Marks)**

c. Find the infinite Fourier cosine transform of e^{-x^2}. **(07 Marks)**

3 a. Solve two dimensional Laplace equation $u_{xx} + u_{yy} = 0$ by the method of separation of variables. **(07 Marks)**

b. Obtain the D'Alembert's solution of the wave equation $u_{tt} = C^2 u_{xx}$ subject to the conditions $u(x, 0) = f(x)$ and $\frac{\partial u}{\partial t}(x,0) = 0$. **(06 Marks)**

c. Solve the boundary value problem $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$, $0 < x < \ell$ subject to the conditions $\frac{\partial u}{\partial x}(0,t) = 0$; $\frac{\partial u}{\partial x}(\ell,t) = 0$, $u(x, 0) = x$. **(07 Marks)**

4 a. Find the equation of the best fit straight line for the following data and hence estimate the value of the dependent variable corresponding to the value of the independent variable x with 30. **(07 Marks)**

x	5	10	15	20	25
y	16	19	23	26	30

b. Solve by graphical method :
Max Z = x + 1.5 y
Subject to the constraints $x + 2y \le 160$
$3x + 2y \le 240$
$x \ge 0$; $y \ge 0$. **(06 Marks)**

c. Solve by simplex method :
max z = 3x + 5y
subject to $3x + 2y \le 18$
$x \le 4$
$y \le 6$
$x, y \ge 0$. **(07 Marks)**

PART – B

5 a. Using the method of false position, find a real root of the equation $x \log_{10} x - 1.2 = 0$, correct to 4 decimal places. **(07 Marks)**

b. By relaxation method, solve :
$10x + 2y + z = 9$; $x + 10y - z = -22$; $-2x + 3y + 10z = 22$. **(06 Marks)**

c. Find the largest Eigen value and the corresponding Eigen vector for the matrix $\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$ using Rayleigh's power method, taking $x_0 = [1\ 1\ 1]^T$. Perform 5 iterations. **(07 Marks)**

6 a. Find the cubic polynomial by using Newton's forward interpolation formula which takes the following values.

x	0	1	2	3
y	1	2	1	10

Hence evaluate f(4). **(07 Marks)**

b. Using Lagrange's formula, find the interpolating polynomial that approximate the function described by the following table.

x	0	1	2	5
f(x)	2	3	12	147

Hence find f(3). **(06 Marks)**

c. Evaluate $\int_4^{5.2} \log_e x \, dx$ using Weddler's rule by taking 7 ordinates. **(07 Marks)**

7 a. Solve $u_{xx} + u_{yy} = 0$ in the following square Mesh. Carry out two iterations. **(07 Marks)**

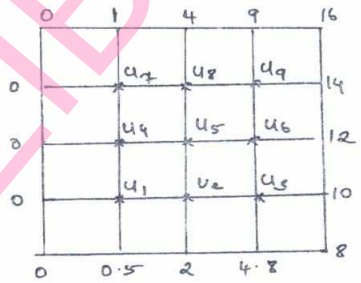

Fig. Q7(a)

b. The transverse displacement of a point at a distance x from one end to any point 't' of a vibrating string satisfies the equation : $\frac{\partial^2 u}{\partial t^2} = 25\frac{\partial^2 u}{\partial x^2}$ with boundary condition u(0, t) = u(5, t) = 0 and initial condition $u(x, 0) = \begin{cases} 20x & \text{for } 0 \le x \le 1 \\ 5(5-x) & \text{for } 1 \le x \le 5 \end{cases}$ and $u_t(x, 0) = 0$ solve by taking h = 1, k = 0.2 upto t = 1. **(06 Marks)**

c. Find the solution of the equation $u_{xx} = 2u_t$ when u(0, t) = 0 and u(4, t) = 0 and u(x, 0) = x(4 – x) taking h = 1. Find values upto t = 5. **(07 Marks)**

8 a. Find the Z – transformation of the following : i) $3n - 4\sin\frac{\pi}{4} + 5a^2$ ii) $\frac{a^n e^{-a}}{n!}$. **(07 Marks)**

b. Find the inverse Z – transformation of $\frac{4z^2 - 2z}{z^3 + 5z^2 + 8z - 4}$. **(06 Marks)**

c. Solve the difference equation : $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$; given $y_0 = y_1 = 0$ using Z – transformation. **(07 Marks)**

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10ME32A/AU32A/MT32

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

Material Science and Metallurgy

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. ***Missing data may be assumed suitably, if any.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. Define APF. With a neat sketch obtain an expression for density packing factor of HCP structure. **(08 Marks)**

b. Give brief classification of crystal defects. Explain them briefly. **(06 Marks)**

c. List the factors affecting diffusion. Explain them briefly. **(06 Marks)**

2 a. Define engineering stress and strain and true stress and true strain. Establish the relationship between true strain and engineering strain. **(07 Marks)**

b. List and explain the mechanical properties in elastic and plastic region. **(07 Marks)**

c. Define CRSS? Obtain the expression for the same. **(06 Marks)**

3 a. Explain: i) Cup and cone fracture ii) Ductile to Brittle transition. **(08 Marks)**

b. What are the different fatigue protection methods? Explain briefly. **(06 Marks)**

c. What is stress relaxation? Derive an expression for the same. **(06 Marks)**

4 a. What is solid solution? With neat sketches explain different types of solid solution. **(06 Marks)**

b. Explain Hume-Rothary rules and Gibbs phase rule. **(06 Marks)**

c. Differentiate Homogeneous and Heterogeneous nucleation. How do you compute the critical size of nucleus and activation energy for the homogeneous nucleation? **(08 Marks)**

PART – B

5 a. A binary alloy of composition 60%A and 40%B consists two phases namely liquid and solid at a particular temperature. The composition of solid phase is 23%B and that of liquid phase is 68% B. Estimate the amount of solid and liquid phases is the alloy. **(08 Marks)**

b. Draw Fe – Fe_3C diagram and show all phases, fields, temperature and composition. Write all invariant reactions. Also explain the solidification of steel containing 0.4%C. **(12 Marks)**

6 a. Explain TTT diagram (for 0.8%C steel) by super imposing the cooling curves on it. **(12 Marks)**

b. Differentiate between :
i) Austempering and martempering
ii) Annealing and Normalising **(08 Marks)**

7 a. Give composition, micro structure, properties and applications of different types of cast – Irons. **(12 Marks)**

b. Write a note on Magnesium alloys and Titanium alloys. **(08 Marks)**

8 a. Define composite. Give brief classification of composites. **(06 Marks)**

b. With neat sketch explain production of composites, by pultrusion process. **(08 Marks)**

c. Enumerate the merits, demerits and application of composites. **(06 Marks)**

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10ME/AU32B

Third Semester B.E. Degree Examination, June/July 2016
Mechanical Measurements & Metrology

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define 'Metre' and 'Yard' according to wavelength standards. List the advantages of wavelength standard. **(08 Marks)**

b. Compare the characteristics of line standards and end standards based on an example for each. **(06 Marks)**

c. What are airy points? Calculate the distance between two airy points for an 'Imperial Standard yard' and 'International prototype metre'. **(06 Marks)**

2 a. Explain the following showing the designation of each:
i) Clearance fit ii) Interference fit iii) Transition fit **(12 Marks)**

b. Determine the tolerances on the hole and the shaft for a fit designated by $50H_7g_6$ and sketch the fit. Given i) 50 mm lies between 30 – 50mm ii) i(microns) = $0.45(D)^{1/3} + 0.001$ D iii) Fundamental deviation for 'H' hole = 0 iv) Fundamental deviation for 'g' shaft = $-2.5D^{0.34}$. v) IT7 = 16i and IT6 = 10i. **(08 Marks)**

3 a. What are the accuracy requirements of a sine bar? Calculate the height of slip gauges to be built up from M112 set to locate 200 mm sine bar at 16°. Use 2 protector slip gauges of 2.5 mm. **(08 Marks)**

b. Explain the principle of mechanical-optical comparator with suitable sketch. Write the formulae for mechanical, optical and overall magnification of such systems. **(08 Marks)**

c. Explain the principle of Back pressure gauges with a sketch. **(04 Marks)**

4 a. Explain the formation of interference bands using an optical flat. **(05 Marks)**

b. Explain the process of measurement of major diameter from a Bench micrometer. **(05 Marks)**

c. Derive an expression for chordal thickness and chordal addendum of a gear tooth in terms of module and number of teeth of the gear. **(10 Marks)**

PART – B

5 a. Define the terms 'Accuracy' and 'Precision'. With the help of a schematic diagram and example, explain the following characteristics of a measuring instrument:
i) Precise but not accurate ii) Accurate but not precise iii) Accurate and precise. **(12 Marks)**

b. Differentiate between the following :
i) Primary and secondary transducers ii) Active and passive transducers.
Give an example for each. **(08 Marks)**

6 a. With a schematic diagram, explain Ballast circuit. **(08 Marks)**

b. Explain the inherent problems of mechanical intermediate modifying systems. **(08 Marks)**

c. Write a note on Telemetry. **(04 Marks)**

7 a. Explain the working of an analytical balance with a sketch. Define sensitivity of the balance. Show that sensitivity of an analytical balance is independent of the weight being compared but depends on the construction parameters of balance. **(12 Marks)**

b. Explain measurement of vacuum pressure using thermal conductivity gauge. **(08 Marks)**

8 a. Explain the laws of thermocouples and write the classification of thermocouple materials. **(10 Marks)**

b. Explain with neat sketches the construction and working of disappearing filament pyrometer. **(10 Marks)**

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10ME/AU33

Third Semester B.E. Degree Examination, June/July 2016
Basic 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 charts and Tables is permitted.***

PART – A

1 a. Distinguish between :
   i) Macroscopic and Microscopic approaches
   ii) Diathermic and adiabatic walls
   iii) Intensive and extensive properties
   iv) Thermal equilibrium and Mechanical equilibrium
   v) Quasistatic and actual process
   vi) Point function and path function. **(12 Marks)**

b. The readings t_A and t_B of two Celsius thermometers A and B agree at the ice point (0°C) and steam point (100°C), but else where they are related by the equation $t_A = L + mt_B + nt_B^2$ where ℓ, m and n are constants, when both the thermometers are immersed in a well stirred bath, A registers 51°C whereas B registers 50°C. Determine the reading on B when A registers 25°C. **(08 Marks)**

2 a. Starting from a common stage point, draw the following process on the PV – plane and derive an expression for the work done in each case
   i) Isobaric process
   ii) Isothermal process
   iii) Polytropic process. **(09 Marks)**

b. Distinguish between heat and work in thermodynamics. **(04 Marks)**

c. A spherical balloon has an initial diameter of 25cm and contains air at 1.2 bar. Because of heating the diameter of the balloon increases to 30cm and during the heating process the pressure is found to be proportional to the diameter. Calculate the work done during the process. **(07 Marks)**

3 a. State First Law of Thermodynamics for a process and show that energy is a property of the system. **(06 Marks)**

b. Derive the steady flow energy equation for a single stream of fluid entering and a single stream of fluid leaving the control volume. **(06 Marks)**

c. The following expression gives the specific heat at constant pressure of a gas that undergoes a non flow constant pressure process $c_p = \left[2.5 + \frac{60}{T+40}\right] kJ/kg\ K$, where T is in °C. The pressure during the process is maintained at 2 bar and the volume changes from 0.3 to 0.56 m^3/kg. The corresponding change in temperature is from 25°C to 300°C. Determine
   i) Work done and heat added
   ii) Change in internal energy and enthalpy. **(08 Marks)**

4 a. State and prove that Kelvin Planck and clausius statements of second Law of Thermodynamics are equivalent. **(12 Marks)**

b. A heat engine working on Carnot cycle absorbs heat from three thermal reservoirs at 1000K, 800K and 600K. The engine does 10kW of network and rejects 400kJ/min of heat to a heat sink at 300K. If the heat supplied by the reservoir at 1000K is 60% of the heat supplied by the reservoir at 600K. Make calculations for the quantity of heat absorbed by each reservoir. **(08 Marks)**

PART – B

5 a. State and prove Clausius inequality. **(08 Marks)**

b. Show that entropy of an isolated system either increases or in the limit remains constant. **(06 Marks)**

c. A lump of steel of mass 8kg at 1000K is dropped in 80kg of oil at 300K. Make calculations for the entropy change of steel, the oil and the universe. Take specific heats of steel and oil as 0.5kJ/Kg K and 3.5 kJ/kg K respectively. **(06 Marks)**

6 a. With a neat sketch explain the measurement of dryness fraction of steam by using throttling calorimeter. Also indicate throttling process on TS and HS diagram. **(08 Marks)**

b. A vessel of volume $0.04m^3$ contains a mixture of saturated water and saturated steam at a temperature of 240°C. The mass of the liquid present is 8kg. find the pressure, the mass, the specific volume, the enthalpy, the entropy and the internal energy. **(10 Marks)**

c. Define the following :
i) Pure substance ii) Critical point. **(02 Marks)**

7 a. Explain the following :
i) Maxwell's relations
ii) Clausius – Clapeyron equation. **(10 Marks)**

b. 1kg of air undergoes a cyclic process comprising three process 1 – 2 , 2 – 3, and 3 – 1. At state 1, the pressure and temperature are 1MPa and 27°C. 1 – 2 is an constant pressure process, 2 – 3 is adiabatic process and 3 – 1 is a isothermal process. At state 3, P = 100KPa.
i) Sketch the cycle on PV – Coordinates
ii) Find the heat and work interactions in each the three processes and the net work per cycle
iii) Analyse quantitatively whether the cycle is reversible or Irreversible. **(10 Marks)**

8 a. Explain the following :
i) Compressibility Factor
ii) Vander Waals equation of state
iii) Law of corresponding states
iv) Compressibility chart. **(08 Marks)**

b. State Gibb's Dalton Law of partial pressures and hence derive an expression for the gas constant 'R' of a mixture of gases. **(06 Marks)**

c. A mixture of ideal gases consists of 3kg of nitrogen and 54 kg of carbon dioxide at a pressure of 300KPa and a temperature of 20°C Find
i) Mole fraction of each constituent
ii) The equivalent molecular weight of mixture
iii) The equivalent gas constant of the mixture
iv) The partial pressure of each gas. **(06 Marks)**

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10ME/AU34

Third Semester B.E. Degree Examination, June/July 2016
Mechanics of Materials

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. State Hooke's law. Sketch the typical stress – strain diagram for mild steel indicating all salient points and zones on it. **(04 Marks)**

b. Derive an expression for the extension of uniformly tapering circular bar subjected to axial load. **(08 Marks)**

c. A round bar with stepped portion is subjected to the forces as shown in fig.Q1(c). Determine the magnitude of force P, such that net deformation in the bar does not exceed 1mm. E for steel is 200 GPa and Aluminium is 70 GPa. Big end diameter and small end diameter of the tapering bar are 40mm and 12.5mm respectively. **(08 Marks)**

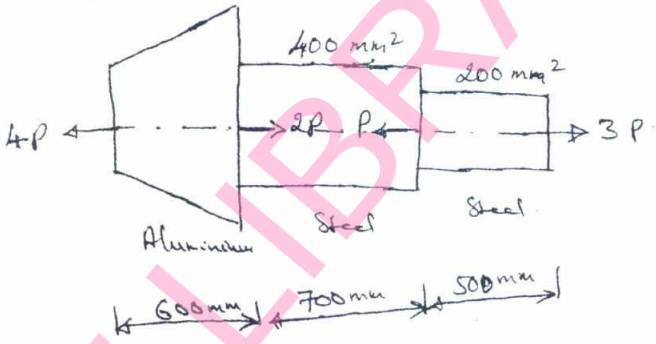

Fig.Q1(c)

2 a. Define Poisson's ratio. Derive an expression for volumetric strain of a rectangular bar, subjected to normal stress along the axis. **(10 Marks)**

b. When a bar of 25mm diameter is subjected to a pull of 61kN, the extension on a 50mm gauge length is 0.1mm and decrease in diameter is 0.013mm. Calculate the values of elastic constants E, G, K and μ. **(10 Marks)**

3 a. Derive an expression for the normal stress and shear stress on a plane inclined at 'θ' to the vertical axis in a biaxial stress system. **(08 Marks)**

b. At a point in a loaded elastic member, there are normal stresses of 60MPa and 40MPa (both tensile) respectively, at right angles to each other with positive shear stress of 20MPa. Draw the Mohr's circle diagram and find i) Principal stresses and their planes ii) Maximum shear stress and its plane. **(12 Marks)**

4 a. Derive an expression for strain energy stored in a plain bar subjected to axial load F. **(05 Marks)**

b. Derive an expression for circumferential stress for thin cylinder. **(05 Marks)**

c. A thick cylinder of 500mm inner diameter is subjected to an internal pressure of 9MPa. Taking the allowable stress for the material of the cylinder as 40MPa, determine the wall thickness of the cylinder. **(10 Marks)**

PART – B

5 a. Derive an expression to establish a relationship between the intensity of load, shear force and bending moment. **(05 Marks)**

b. Draw the shear force and bending moment diagram for the beam shown in fig. Q5(b). Locate the point of contra flexure. **(15 Marks)**

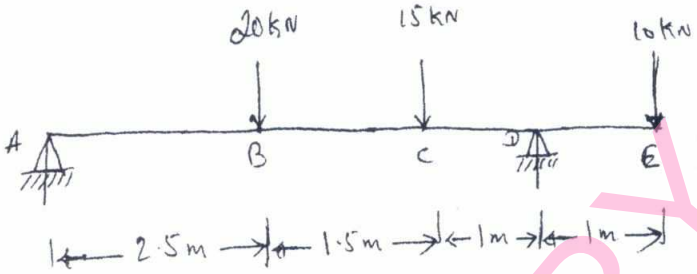

Fig.Q5(b)

6 a. List the assumptions made in simple bending theory and establish the relationship between bending stress and radius of curvature. **(10 Marks)**

b. A uniform I – section beam is 100mm wide and 150mm deep with a flange thickness of 25mm and web thickness of 10mm. The beam is simply supported over a span of 5m. It carries a udℓ of 83.4kN/m throughout its length. Determine the bending stress in the beam. **(10 Marks)**

7 a. Find the expression for the slope and deflection of a cantilever of length L carrying uniformly distributed load over the whole length. **(10 Marks)**

b. A beam of length 6mts is simply supported at its ends and carries two point loads of 48kN and 40kN at a distance of 1m and 3m respectively from the left support. Find i) Deflection under each load ii) Maximum deflection iii) Point at which maximum deflection occurs. Take $E = 2 \times 10^5$ MPa and $I = 85 \times 10^6$ mm^4. **(10 Marks)**

8 a. Determine the diameter of the shaft which will transmit 440kW at 280 rpm, if maximum torsional shear stress is to be limited to 40N/mm^2. Assume G = 84kN/mm^2. **(10 Marks)**

b. A solid round bar of 60mm diameter and 2.5m long is used as a strut. Find the safe compressive load for the strut if i) Both ends are hinged ii) Both ends are fixed. Take $E = 2 \times 10^5$ N/mm^2 and factor of safety = 3. **(10 Marks)**

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10ME/AU35

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

Manufacturing Process – I

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Classify manufacturing processes. Explain factors to be considered while selecting a process for a given application. **(10 Marks)**

b. List the various types of patterns. Explain the different types of pattern allowances, with neat sketches. **(10 Marks)**

2 a. List the types of moulding sand. Discuss the desirable properties of moulding sand. **(10 Marks)**

b. With a neat sketch, explain the working principle of Jolt and Sqeeze moulding machine. **(10 Marks)**

3 a. With a neat sketch, explain the different steps involved in shell moulding process and mention its advantages and disadvantages. **(10 Marks)**

b. Name the centrifugal casting methods. With a neat sketch, explain the working of vertical and horizontal type centrifugal casting processes. **(10 Marks)**

4 a. With a neat sketch, explain coreless induction furnace and mention its merits and demerits. **(10 Marks)**

b. Sketch and explain the construction and operation of a cupola. **(10 Marks)**

PART – B

5 a. With a neat sketch, explain Thermit welding process. Mention its merits and demerits. **(10 Marks)**

b. Explain with sketches, the forward and backward welding methods. **(10 Marks)**

6 a. Explain projection welding process with a sketch. List out the advantages of projection welding. **(10 Marks)**

b. Explain briefly the following with sketches:
i) Seam welding ii) Explosive welding **(10 Marks)**

7 a. What is meant by HAZ? Explain the various regions of HAZ in low carbon steel during welding. **(10 Marks)**

b. Discuss the various types of welding defects, their causes and remedies. **(10 Marks)**

8 a. Differentiate between brazing and soldering. List out merits, demerits and applications of these two processes. **(10 Marks)**

b. Explain the magnetic particle inspection method to test welded part with advantages and limitations. **(10 Marks)**

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10ME/AU36B

Third 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. Define the following terms: i) Specific weight ii) Kinematic viscosity iii) Specific gravity iv) Specific volume. **(04 Marks)**

b. Calculate the dynamic viscosity of an oil, which is used for lubrication between a square plate of size $0.8m \times 0.8m$ and an inclined plane with angle of inclination 30°. The weight of the square plate is 300 N and it slides down the inclined plane with a uniform velocity of 0.3 m/s. The thickness of oil film is 1.5 mm. **(06 Marks)**

c. Define the capillarity. Obtain an expression for capillary ripe of a liquid. **(05 Marks)**

d. Define surface tension. Prove that the relationship between surface tension and pressure inside a droplet of liquid is given by, $P = \frac{4\sigma}{d}$. **(05 Marks)**

2 a. State and prove the Pascal's law. **(10 Marks)**

b. Derive an expression for total pressure and centre of pressure for a vertically immersed surface. **(10 Marks)**

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

b. Define the equation of continuity. Obtain an expression for continuity equation for a three-dimensional steady incompressible flow. **(10 Marks)**

4 a. Derive Bernoulli's equation and state the assumptions made. **(10 Marks)**

b. A non-uniform part of a pipe line 5 m long is laid at a slope of 2 in 5. Two pressure gauges each fitted at upper and lower ends read 20 N/cm^2 and 12.5 N/cm^2. If the diameters at the upper and lower ends are 15 cm and 10 cm respectively. Determine the quantity of water flowing per second. **(10 Marks)**

PART – B

5 a. Define venturimeter. Derive the expression for rate of flow through venturimeter. **(10 Marks)**

b. Using Buckingham's π-theorem, show that the velocity through a circular orifice is given by, $V = \sqrt{2gH}\phi\left[\frac{D}{H}, \frac{\mu}{\rho VH}\right]$, where H is the head causing flow. D is the diameter of the orifice, 'μ' is co-efficient of viscosity, 'ρ' is the mass density and 'g' is the acceleration due to gravity. **(10 Marks)**

6 a. Derive Darcy's formula to calculate the frictional head loss in a pipe. **(08 Marks)**

b. Define the terms : i) Hydraulic gradient line ii) Total energy line. **(04 Marks)**

c. Determine the rate of flow of water through a pipe of diameter 20 cm and length 50 m when one end of the pipe is connected to a tank and other end of the pipe is open to the atmosphere. The pipe is horizontal and height of water in the tank is 4 m above the centre of pipe. Consider all minor losses and take f = 0.009. **(08 Marks)**

7 a. Derive an expression for Hagen-Poiseuille's formula. **(12 Marks)**

b. A fluid of visocosity 0.7 N-S/m^2 and Sp.gr. 1.3 is flowing through a circular pipe of diameter 100 mm. The maximum shear stress at the pipe wall is given as 196.2 N/m^2.
Find : (i) the pressure gradient (ii) The average velocity and (iii) Reynold's number of the flow. **(08 Marks)**

8 a. Explain the terms: lift and drag. **(04 Marks)**

b. A flat plate 1.5m×1.5m moves at 50 km/hour in stationary air of density 1.15 kg/m^3. If the co-efficients of drag and lift are 0.15 and 0.75 respectively. Determine
i) The lift force ii) The drag force iii) The resultant force and
iv) The power required to keep the plate in motion. **(06 Marks)**

c. Explain the following terms:
i) Mach number ii) Subsonic flow iii) Sonic flow iv) Super sonic flow. **(04 Marks)**

d. Find the velocity of bullet fired in standard air if the Mach angle is 30°. Take R = 287.14 J/kg K and K = 1.4 for air. Assume temperature as 15°C. **(06 Marks)**

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MATDIP301

Third Semester B.E. Degree Examination, June/July 2016
Advanced Mathematics – I

Time: 3 hrs. Max. Marks:100

Note: *Answer any FIVE full questions.*

1 a. Express the complex number $\frac{(1+i)(1+3i)}{(1+5i)}$ in the form a + ib. **(06 Marks)**

b. Find the modulus and amplitude of $1 + \cos\theta + i\sin\theta$. **(07 Marks)**

c. Find the cube root of $1 - i$. **(07 Marks)**

2 a. Find the n^{th} derivative of $e^{ax}\cos(bx + c)$. **(06 Marks)**

b. Find the n^{th} derivative of $\frac{6x}{(x-2)(x+2)(x-1)}$. **(07 Marks)**

c. If $y = \sin^{-1}x$, prove that $(1 - x^2)y_{n+2} - (2n + 1)x\, y_{n+1} - n^2y_n = 0$. **(07 Marks)**

3 a. Find the angle of intersection of the curves $r^2\sin 2\theta = a^2$, $r^2\cos 2\theta = b^2$. **(06 Marks)**

b. Find the nodal equation of the curve $r(1 - \cos\theta) = 2a$. **(07 Marks)**

c. Expand log (secx) upto the term containing x^4 using Maclaurin's series. **(07 Marks)**

4 a. If $u = x^3 - 3xy^2 + x + e^x\cos y + 1$, show that $u_{xx} + u_{yy} = 0$. **(06 Marks)**

b. If $u = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$, prove that $xu_x + yu_y + zu_z = 0$. **(07 Marks)**

c. Find $\frac{\partial(u,v,w)}{\partial(x,y,z)}$, where $u = x + y + z$, $v = y + z$, $w = z$. **(07 Marks)**

5 a. Obtain reduction formula for $\int \cos^n x\, dx$, where n is positive integer. **(06 Marks)**

b. Evaluate $\int_0^2 \frac{x^4}{\sqrt{4-x^2}}dx$. **(07 Marks)**

c. Evaluate $\int_{-c}^{c}\int_{-b}^{b}\int_{-a}^{a}(x^2 + y^2 + z^2)\,dz\,dy\,dx$. **(07 Marks)**

6 a. Prove that: i) $\Gamma(n+1) = n\,\Gamma(n)$ and ii) $\Gamma(n+1) = n!$ for a positive integer n. **(06 Marks)**

b. Prove that $\beta(m, n) = \dfrac{\Gamma(m)\,\Gamma(n)}{\Gamma(m+n)}$. **(07 Marks)**

c. Show that $\int_0^{\pi/2} \dfrac{d\theta}{\sqrt{\sin\theta}} \cdot \int_0^{\pi/2} \sqrt{\sin\theta}\, d\theta = \pi$. **(07 Marks)**

7 a. Solve $\dfrac{dy}{dx} = (9x + y + 1)^2$. **(06 Marks)**

b. Solve $ye^{xy}\,dx + (xe^{xy} + 2y)\,dy = 0$. **(07 Marks)**

c. Solve $\dfrac{dy}{dx} + y\cot x = \cos x$. **(07 Marks)**

8 a. Solve $\dfrac{d^2y}{dx^2} - 6\dfrac{dy}{dx} + 9y = 5e^{-2x}$. **(06 Marks)**

b. Solve $(D^2 - 4D + 13)y = \cos 2x$. **(07 Marks)**

c. Solve $(D^2 + 2D + 1)y = x^2 + 2x$. **(07 Marks)**

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