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10MAT31

Third Semester B.E. Degree Examination, Dec.2017/Jan.2018
Engineering Mathematics – III

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Find the Fourier series for the function $f(x) = x + x^2$ over the interval $-\pi \le x \le \pi$. Hence deduce that:

i) $\frac{\pi^2}{12} = \frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \ldots\ldots$ ii) $\frac{\pi^2}{6} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \ldots\ldots$ **(07 Marks)**

b. Expand the function $f(x) = x(\pi - x)$ over the interval $(0, \pi)$ in half range Fourier cosine series. **(06 Marks)**

c. Find the constant term and the first two harmonies for the function f(θ) given by the following table: **(07 Marks)**

θ (in degrees)	0	60	120	180	240	300	360
f(θ)	0.8	0.6	0.4	0.7	0.9	1.1	0.8

2 a. Show that the Fourier transform of the function

$$f(x) = \begin{cases} 1 - x^2, & |x| \le 1 \\ 0, & |x| > 1 \end{cases} \text{ is } F(\alpha) = \frac{2\sqrt{2}}{\alpha^3\sqrt{\pi}}(\sin\alpha - \alpha\cos\alpha).$$

Hence deduce that $\int_0^\infty \frac{\sin x - x\cos x}{x^3}\,dx = \frac{\pi}{4}$. **(07 Marks)**

b. Find the Fourier cosine transform of $f(x) = \frac{1}{1+x^2}$. **(06 Marks)**

c. If the Fourier sine transform of f(x) is given by $F_s(u) = \frac{\pi}{2}e^{-2u}$, find the function f(x). **(07 Marks)**

3 a. Find the various possible solutions of two-dimensional Laplace equation by method of separation of variables. **(07 Marks)**

b. Obtain the D'Aiembert'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 one-dimensional heat equation $c^2 u_{xx} = u_t$, $0 < x < \pi$ subject to the conditions $u(0, t) = 0$, $u(\pi, t) = 0$, $u(x,0) = u_0 \sin x$ where u_0 is a non-zero constant. **(07 Marks)**

4 a. Find a curve of the best fit of the form $y = ax^b$ to the following data: **(07 Marks)**

x	1	2	3	4	5
y	0.5	2	4.5	8	12.5

b. For conducting a practical examination, the chemistry department of a college requires 10, 12 and 7 units of 3 chemicals x, y and z respectively. The chemicals are available in 2 types of boxes: Box A and Box B. Box A contains 3, 2 and 1 units of x, y, z respectively and cost Rs.300. Box B contains 1, 2 and 2 units of x, y, z respectively and costs Rs.200. Find how many boxes of each type should be bought by the department so that the total cost is minimum. Solve graphically. **(06 Marks)**

c. Solve the following LPP by simplex method:
Maximize $z = 2x_1 + 4x_2 + 3x_3$
Subject to the constraints $3x_1 + 4x_2 + 2x_3 \le 60$ $2x_1 + x_2 + 2x_3 \le 40$
$x_1 + 3x_2 + 2x_3 \le 80$ $x_1, x_2, x_3 \ge 0$ **(07 Marks)**

PART – B

5 a. Use Newton-Raphson method to find an approximate root of the equation $x \log_{10} x = 1.2$ correct to 5 decimal places that is near 2.5. **(07 Marks)**

b. Use Relaxation method to solve the following system of linear equations:
$8x + 3y + 2z = 13$ $x + 5y + z = 7$ $2x + y + 6z = 9$ **(06 Marks)**

c. Find the numerically largest eigen value and the corresponding eigen vector of the matrix $A = \begin{bmatrix} 5 & 0 & 1 \\ 0 & -2 & 0 \\ 1 & 0 & 5 \end{bmatrix}$ by power method taking $X^{(0)} = [1 \quad 0 \quad 0]^T$. Perform 6 iterations. **(07 Marks)**

6 a. Find the interpolating polynomial for the function y = f(x) given by f(0) = 1, f(1) = 2, f(2) = 1, f(3) = 10. Hence evaluate f(0.75) and f(2.5). **(07 Marks)**

b. Apply Lagrange's method to find the value of x corresponding to f(x) = 15 from the following data: **(06 Marks)**

x	5	6	9	11
f(x)	12	13	14	16

c. Evaluate $\int_0^1 \frac{dx}{1+x^2}$ by using Simpson's $\frac{3}{8}^{th}$ rule dividing the interval (0, 1) into 6 equal parts.
Hence deduce the approximate value of π. **(07 Marks)**

7 a. Solve the wave equation $u_{tt} = 4u_{xx}$ subject to the conditions u(0, t) = 0, u(4, t) = 0, $u_t(x, 0) = 0$ and u(x, 0) = x(4 – x) by taking h = 1, k = 0.5 upto four steps. **(07 Marks)**

b. Find the numerical solution of the equation $u_{xx} = u_t$ when u(0, t) = 0, u(1, t) = 0, $t \ge 0$ and $u(x,0) = \sin \pi x$, $0 \le x \le 1$. Carryout computations for two levels taking $h = \frac{1}{3}$ and $k = \frac{1}{36}$. **(07 Marks)**

c. Solve Laplace's equation $u_{xx} + u_{yy} = 0$ for the following square mesh with boundary values as shown in the following Fig.Q7(c).

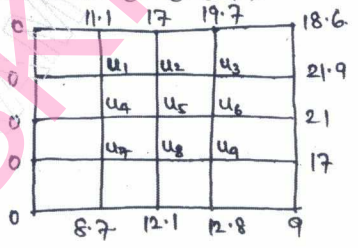

Fig.Q7(c) **(06 Marks)**

8 a. Find the z-transform of $5n^2 + 4\cos\frac{n\pi}{2} - 4^{n+2}$ and $\sinh n\theta$. **(06 Marks)**

b. Obtain in inverse z-transform of $\frac{z(2z+3)}{(z+2)(z-4)}$. **(07 Marks)**

c. Using z-transforms, solve $u_{n+2} + 3u_{n+1} + 2u_n = 3^n$ given $u_0 = 0$, $u_1 = 1$. **(07 Marks)**

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10ME32A/AU32A

Third Semester B.E. Degree Examination, Dec.2017/Jan.2018
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. Define Atomic Packing factor. Derive an expression for atomic packing factor for HCP. **(06 Marks)**

b. What is Diffusion? Explain. Give the laws governing diffusion with conditions. **(08 Marks)**

c. Compare twin and tilt boundary defects in metals. Explain how they are useful in manufacturing process. **(06 Marks)**

2 a. Define i) Resilience ii) Tensile strength iii) Hardness iv) Ductility. **(08 Marks)**

b. A specimen of 5mm diameter and 25mm gauge length is subjected to tensile test. If its diameter is reduced to 4mm through plastic deformation, what is its length? Also calculate engineering stress, engineering strain , true stress and true strain at the end of the deformation where the load is 500N. **(08 Marks)**

c. Explain Brinell Hardness Testing. **(04 Marks)**

3 a. Draw the typical creep curve and explain different stages of creep. **(08 Marks)**

b. What is fatigue? Explain with S-N curves for the fatigue life of ferrous and non – ferrous materials. **(08 Marks)**

c. Differentiate between ductile and brittle fracture. **(04 Marks)**

4 a. Define Solid solution and explain different types of solid solution with figures. **(08 Marks)**

b. What are Hueme – Rothery's rules? **(05 Marks)**

c. Explain the construction of phase diagram. **(07 Marks)**

PART – B

5 a. Draw the Fe – C diagram and label the phases. Show the invariant points on it. Write the reactions occurring at these points indicating the temperature and composition of the reactions. **(12 Marks)**

b. Draw the TTT diagram for eutectoid steel and explain the effect of cooling rate in forming different microstructure. **(08 Marks)**

6 a. What is Harden ability? Explain the Joniney End Quench test to find the hardenability. **(08 Marks)**

b. Explain the following Heat treatments :
i) Annealing ii) Hardening iii) Case Hardening iv) Flame Hardening. **(12 Marks)**

7 a. Explain different types of Cast Iron with Microstructure. **(10 Marks)**

b. Explain composition and properties and applications of : **(10 Marks)**
i) Gun metal ii) Aℓ - Silicon alloy iii) Phosphor bronze iv) Aℓ - Zinc alloy.

8 a. Explain the classification of Composites. **(04 Marks)**

b. Explain with neat sketches any two types of PMC manufacturing. **(08 Marks)**

c. Write a note on advantages and disadvantages of composites materials and its applications. **(08 Marks)**

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10ME32B/AU32B

Third Semester B.E. Degree Examination, Dec.2017/Jan.2018
Mechanical Measurements 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. State the objectives of metrology. **(06 Marks)**

b. Explain with sketches : i) International Prototype Meter ii) Imperial Standard yard. **(14 Marks)**

2 a. Explain the following : i) Geometrical Tolerance ii) Positional Tolerance. **(08 Marks)**

b. Determine the tolerances on the hole and shaft designated by $30H_8\ d_{10}$, given : Diameter step 18 – 30mm , IT8 = 25i , IT10 = 64i.
Fundamental Deviation for 'd' = $-16D^{0.44}$; $i = 0.45\sqrt[3]{D} + 0.001D$.
State the maximum and minimum sizes of the hole and shaft and maximum and minimum clearances. Also sketch the fit. **(12 Marks)**

3 a. What are Comparators? Explain the need and basic features of a comparator. **(10 Marks)**

b. Explain the working principle of Sigma comparator. **(10 Marks)**

4 a. Explain the errors in Screw threads. **(06 Marks)**

b. Explain how Chordal addendum is measured by using gear tooth vernier caliper. **(06 Marks)**

c. Explain the principle of Auto collimator with sketch. **(08 Marks)**

PART – B

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

b. With neat sketches, discuss briefly any two types of elastic pressure transducers. **(10 Marks)**

6 a. Explain the following : i) Piezo – electric transducer ii) Ionization Transducer. **(10 Marks)**

b. With a neat block diagram, explain the principle of CRO. **(10 Marks)**

7 a. Explain with a sketch, the principle of Mc Leod Gauge. **(08 Marks)**

b. Explain the working principle of proni brake dynamometer. **(06 Marks)**

c. With a sketch, explain the principle of proving ring. **(06 Marks)**

8 a. What is a Thermo couple? Explain briefly the Laws of Thermo couple. **(06 Marks)**

b. Sketch and explain the working principle of Optical pyrometer. **(08 Marks)**

c. Explain the working principle of strain gauge. **(06 Marks)**

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10ME/AU33

Third Semester B.E. Degree Examination, Dec.2017/Jan.2018
Basic Thermodynamics

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting atleast TWO questions from each part.*
2. Use of steam tables, gas tables, charts etc are permitted.

PART – A

1 a. Distinguish between the followings with example:
i) Macroscopic and microscopic view point.
ii) Thermodynamic system and control volume.
iii) Extensive and intensive property.
iv) Thermal equilibrium and thermodynamic equilibrium.
v) Quasi static and spontaneous process. **(10 Marks)**

b. State Zeroth law of thermodynamics and explain the working of constant volume gas thermometer. **(05 Marks)**

c. The e.m.f. in a thermocouple with test junction at t°c on the gen thermometer scale and reference junction at ice point is given by $E = 0.2t - 5 \times 10^{-4}t^2$, mV. The milli voltmeter is calibrated at ice point and steam points. What will this thermometer read in a place where gen thermometer reads 50°C? **(05 Marks)**

2 a. State and explain the thermodynamic work with an example. **(06 Marks)**

b. Determine the work transfer for the following cases:
i) Electrical work
ii) Shaft work
iii) Flow work
iv) Stretching a wire and
v) Changing the area of a surface film. **(05 Marks)**

c. What are the similarities and dissimilarities between work transfer and heat transfer? **(05 Marks)**

d. When the valve of an evacuated bottle is opened, atmospheric air rushes into it. If the atmospheric pressure is 101.325 kPa, and 0.6 m^3 of air enters into the bottle. Calculate the work done by the air. **(04 Marks)**

3 a. With the help of Joules experiment, explain the first law of thermodynamics for a closed system. Also state its limitation. **(07 Marks)**

b. Show that energy is a property of the system. **(05 Marks)**

c. Write down the energy equation for flow processes and reduce the same for the followings with significance:
i) Steady flow energy equation
ii) Nozzle
iii) Throttling device
iv) Compressor
v) Filling of an evacuated tank. **(08 Marks)**

4 a. State Kelvin-Plank and Clausius statement of second law of thermodynamics and show that former is equivalent to later. **(08 Marks)**

b. What are the causes of irreversibility? Explain how it makes a process irreversible (any one). **(07 Marks)**

c. Which is the more effective way to increase the efficiency of a Carnot engine: to increase T_1, keeping T_2 constant or to decrease T_2, keeping T_1 constant? **(05 Marks)**

PART – B

5 a. State and derive the inequality of Clausius. **(07 Marks)**

b. Explain the principle of entropy. **(05 Marks)**

c. Three identical finite bodies of constant heat capacity are at temperatures 300, 300 and 100K. If no heat and work are supplied from out-side, what is the highest temperature to which any one of the bodies can be raised by the operation of heat engines or refrigerators. **(08 Marks)**

6 a. Explain phase equilibrium diagram of water with aid of p-v and p-T diagram. Why does fusion line have negative slope? **(09 Marks)**

b. Explain the construction of T-S diagram for a pure substance i.e. 1 kg of ice at -5°C to steam at 150°C. **(06 Marks)**

c. Explain any one method of determination of dryness fraction of steam. **(05 Marks)**

7 a. Show that for an ideal gas the internal energy depends only on its temperature. **(08 Marks)**

b. Write down the first and second T_{ds} equation, and derive the expression for the difference in heat capacities, c_p and c_v. What does the expression signify? **(12 Marks)**

8 a. Write down the Vander Waals equation of state. How it differs from ideal gas equation of state? Explain. **(06 Marks)**

b. With aid of compressibility chart for nitrogen, explain how it deviates from ideal gas equation. **(06 Marks)**

c. A mixture of ideal gas contains of 3kg of nitrogen, and 5kg 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 the mixture.
iii) The equivalent gas constant of the mixture, and
iv) The partial pressure of mixture. **(08 Marks)**

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10ME/AU34

Third Semester B.E. Degree Examination, Dec.2017/Jan.2018
Mechanics of Materials

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define : (i) Elasticity (ii) Poisson's ratio (iii) Hooke's law (iv) Principle of superposition. **(04 Marks)**

b. Prove that deformation in a uniform bar due to self weight is equal to half the deformation due to the force equal to its self weight. **(06 Marks)**

c. A stepped bar is subjected to forces as shown in Fig. Q1 (c). Find the maximum value of P that will not exceed a stress in steel of 140 MPa, in aluminium of 90 MPa or in bronze of 100 MPa. **(10 Marks)**

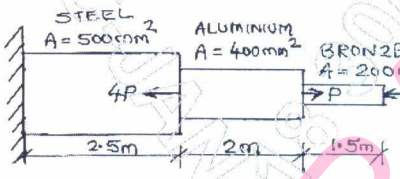

Fig. Q1 (c)

2 a. Define : (i) Volumetric strain (ii) Modulus of rigidity **(02 Marks)**

b. Derive relation $E = 3K(1-2\mu)$ between Young's modulus (E), bulk modulus (K) and Poisson's ratio (μ). **(08 Marks)**

c. A steel tube of 30 mm external diameter and 20 mm internal diameter encloses a copper rod of 15 mm diameter to which it is rigidly joined at each end. If, at a temperature of 10°C there is no longitudinal stress, calculate stresses in rod and tube when the temperature is raised to 200°C. Take E for steel and copper as 2.1×10^5 N/mm^2 and 1×10^5 N/mm^2 respectively. The value of α for steel and copper is given as 11×10^{-6} /° C and 18×10^{-6} /° C respectively. **(10 Marks)**

3 a. Show that sum of the normal stresses on any two planes at right angles in a general two dimensional stress system is constant. **(06 Marks)**

b. Sketch the Mohr's circle for the following cases: **(04 Marks)**

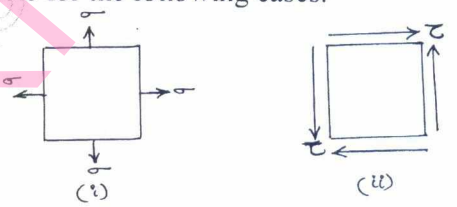

Fig. Q3 (b)

c. A point in a strained material is subjected to the stresses as shown in Fig.Q3 (c). Evaluate principal stresses and locate principal planes. Sketch the planes. **(10 Marks)**

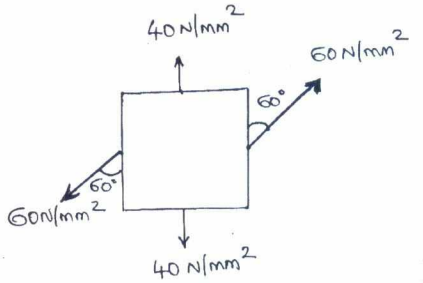

Fig. Q3 (c)

4 a. Derive the expressions for circumferential and radial stresses in the wall of thick cylinder (Lame's equation). **(10 Marks)**

b. The maximum stress produced by a pull in a bar of length 1 m is 150 N/mm^2. The bar details are given in Fig. Q4 (b). Calculate strain energy stored in the bar if E = 200 GPa. **(10 Marks)**

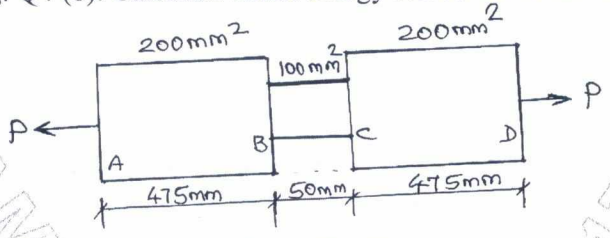

Fig. Q4 (b)

PART – B

5 a. Derive an expression to establish a relationship between the intensity of load W, shear force F and bending moment M in the beam. **(06 Marks)**

b. A beam 8 m long is simply supported at two points and loaded with concentrated loads, two UDL and a couple as shown in Fig. Q5 (b). Draw SF and BM diagrams. **(14 Marks)**

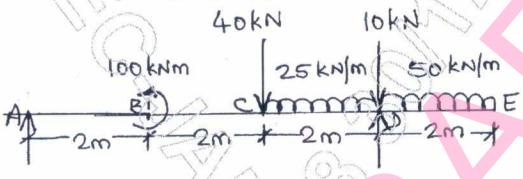

Fig. Q5 (b)

6 a. Prove that the maximum shear stress is 1.5 times the average shear stress in a beam of rectangular cross section. **(06 Marks)**

b. A T-shaped cross section of a beam of flange 200mm × 50mm and web 200mm × 50mm is subjected to a bending moment of 15 kNm and a shear force of 10 kN at a particular section. Draw the bending stress and shear stress distribution diagrams across the section. Indicate values at salient points. **(14 Marks)**

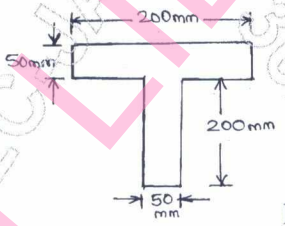

Fig. Q6 (b)

7 a. Derive an expression $EI\frac{d^2y}{dx^2} = M$, with usual notations. **(08 Marks)**

b. A Cantilever of length 3 m and cross section 150 mm width and 300 mm in depth is loaded as shown in Fig. Q7 (b). Take $E = 2.1\times10^5$ N/mm^2. Calculate maximum slope and maximum deflection. **(12 Marks)**

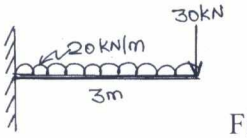

Fig. Q7 (b)

8 a. State at least 4 assumptions made in the Euler's theory of columns, and derive an expression for Euler's formula for a column when both ends are fixed. **(10 Marks)**

b. A hollow shaft of diameter ratio $\frac{3}{5}$ is required to transmit 700 kW at 110 rpm. The maximum torque being 12% greater than the mean. The shearing stress is not exceed 60 MPa and twist in the length of 3 meters not to exceed 1°. Calculate the minimum external diameter. Take $G = 0.8\times10^5$ MPa. **(10 Marks)**

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10ME/AU35

Third Semester B.E. Degree Examination, Dec.2017/Jan.2018
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. Explain briefly the different types of manufacturing process and mention their applications. **(08 Marks)**

b. With an illustration explain any two types of patterns. **(08 Marks)**

c. Write a note on binders and additives. **(04 Marks)**

2 a. Explain briefly the characteristics of foundry sand. **(06 Marks)**

b. What is riser? With an illustration, explain different types of risers. **(06 Marks)**

c. With an illustration, explain sand slinger in mould making process. **(08 Marks)**

3 a. With an illustration, explain flaskless moulding process. Mention its advantages. **(10 Marks)**

b. With an illustration, explain continuous casting process and mention its applications. **(10 Marks)**

4 a. With an illustration, explain electrical resistance furnace and mention its limitations. **(08 Marks)**

b. With an illustration, explain construction and operations of CUPOLA furnace. **(12 Marks)**

PART – B

5 a. Define welding. Give a broad classification of welding. **(05 Marks)**

b. With an illustration, explain submerged arc welding process. **(09 Marks)**

c. With an illustration, explain different types of gas flames in gas welding process. **(06 Marks)**

6 a. With an illustrations, explain the following:
(i) Butt welding process.
(ii) Spot welding process. **(12 Marks)**

b. With an illustration, explain the operations of electron beam welding. **(08 Marks)**

7 a. Explain the parameters which effects if on heat affected zone in welding. **(05 Marks)**

b. Write a note on the following:
(i) Welding rods.
(ii) Fluxes in welding. **(06 Marks)**

c. Explain defects, causes and remedies in welding. **(09 Marks)**

8 a. Differentiate between soldering and brazing. **(06 Marks)**

b. Write a note on fluorescent particle method used to detect the defects on component. **(06 Marks)**

c. With an illustration, explain Radiography test used in welding. **(08 Marks)**

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10MEB306/10AUB306

Third Semester B.E. Degree Examination, Dec.2017/Jan.2018

Fluid Mechanics

Time: 3 hrs. Max. Marks:100

Note: *Answer any 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) Kinematic viscosity
ii) Dynamic viscosity
iii) Surface tension
iv) Specific gravity
v) Specific volume **(10 Marks)**

b. A single column U-tube manometer, made of glass tubing having a nominal inside diameter of 2.5 mm, has been used to measure pressure in a pipe or vessel containing air. If the limb opened to atmosphere is 10 percent oversize, find the error in mm of mercury in the measurement of air pressure due to surface tension effects. It is stated that mercury is the manometric fluid for which surface tension $\sigma = 0.514$ N/m and angle of contact $\alpha = 140^\circ$. **(05 Marks)**

c. Calculate the density, specific weight of one litre of petrol of specific gravity = 0.7. **(05 Marks)**

2 a. Differentiate between Absolute and Gauge pressure. **(04 Marks)**

b. Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in liquid. **(08 Marks)**

c. A circular opening 3m diameter, in a vertical side of a tank is closed by a disc of 3m diameter which can rotate about a horizontal diameter. Calculate:
i) The force on the disc and
ii) The torque required to maintain the disc in equilibrium in the vertical position when the head of water above the horizontal diameter is 4m. **(08 Marks)**

3 a. Explain the terms:
i) Meta centre
ii) Meta centric height **(04 Marks)**

b. How will you determine the meta centric height of a floating body experimentally? Explain with neat sketch. **(08 Marks)**

c. A piece of wood (specific gravity = 0.6) of 10 cms square in cross section and 2.5 m long floats in water. How much lead (specific gravity = 12) need to be fastened at the lower end of the stick so that it flows upright with 0.5 m length out of water? **(08 Marks)**

4 a. Derive Bernoulli's equation starting from fundamentals, and state assumptions made. **(10 Marks)**

b. The water is flowing through a taper pipe of length 100 m having diameter 600 mm at the upper end and 300 mm at the lower end, at the rate of 50 liters/second. The pipe has a slope of 1 in 30. Find the pressure at the lower end if the pressure at the higher level is 19.62 N/cm^2. **(10 Marks)**

PART – B

5 a. Derive an expression for the discharge through a venturimeter. **(10 Marks)**

b. A 30 cm × 15 cm venturimeter is provided in a vertical pipeline carrying oil of specific gravity 0.9 the flow being upwards. The difference in elevation of the throat section and entrance section of the venturimeter is 30 cms. The differential U-tube mercury manometer shows a gauge deflection of 25 cms. Calculate:

i) The discharge of oil.

ii) The pressure difference between the entrance section and throat section.

Take the coefficient of meter as 0.98 and specific gravity of mercury as 13.6. **(10 Marks)**

6 a. Explain the following:

i) Major energy loss

ii) Minor energy loss

iii) Loss of head due to sudden enlargement

iv) Hydraulic gradient line

v) Total energy line **(10 Marks)**

b. For a town water supply, a main pipe line of diameter 0.4 m is required. As pipes more than 0.35 m diameter are not readily available, two parallel pipes of the same diameter were used for water supply. If the total discharge in the parallel pipes is same as in the single main pipe, find the diameter of the parallel pipe. Assume the coefficient of friction is same for all pipes. **(10 Marks)**

7 a. Define the terms:

i) Velocity gradient

ii) Pressure gradient. **(04 Marks)**

b. Derive an expression for the velocity distribution for viscous flow through a circular pipe. Also sketch the velocity distribution and shear stress distribution across a section of the pipe. **(08 Marks)**

c. A crude oil of viscosity 0.97 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 100 mm and of length 10 m. Calculate the difference of pressure at the two ends of the pipe. If 100 kg of the oil is collected in a tank in 30 seconds. Assume laminar flow. **(08 Marks)**

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

b. Explain laminar boundary layer and turbulent boundary layer. **(08 Marks)**

c. Air is flowing over a smooth plate with a velocity of 10 m/s. The length of the plate is 1.2 m and the width 0.8 m. If laminar boundary layer exists up to a value of $R_e = 2 \times 10^5$, find the maximum distance from the leading edge upto which laminar boundary layer exists. Find the maximum thickness of laminar boundary layer if the velocity profile is given $\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$. Take kinematic viscosity for air = 0.15 stokes. **(08 Marks)**

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MATDIP301

Third Semester B.E. Degree Examination, Dec.2017/Jan.2018
Advanced Mathematics - I

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 modulus and amplitude of $\frac{4+2i}{2-3i}$. **(06 Marks)**

b. Express the complex number $2 + 3i + \frac{1}{1-i}$ in the form a + ib. **(07 Marks)**

c. Simplify $\frac{(\cos 3\theta + i\sin 3\theta)^4(\cos 4\theta - i\sin 4\theta)^5}{(\cos 4\theta + i\sin 4\theta)^3(\cos 5\theta + i\sin 5\theta)^{-4}}$. **(07 Marks)**

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

b. Find the n^{th} derivative of $\frac{x^2}{2x^2+7x+6}$. **(07 Marks)**

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

3 a. If ϕ is the angle between the tangent and radius vector to the curve $r = f(\theta)$ at any point (r, θ), prove that $\tan\theta = \frac{rd\theta}{dr}$. **(06 Marks)**

b. Find the angle of intersection between the curves $r^n = a^n\cos n\theta$ and $r^n = b^n\sin n\theta$. **(07 Marks)**

c. Using Maclaurin's series, expand tan x up to the term containing x^5. **(07 Marks)**

4 a. If $Z = f(x + ct) + \phi(x - ct)$, prove that $\frac{\partial^2 z}{\partial t^2} = C^2\frac{\partial^2 z}{\partial x^2}$. **(06 Marks)**

b. If $u = \sin^{-1}\left(\frac{x^2+y^2}{x+y}\right)$ prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ tan u. **(07 Marks)**

c. If $u = f(x-y, y-z, z-x)$, prove that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$. **(07 Marks)**

PART – B

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

b. Using reduction formula evaluate $\int_0^a \frac{x^7}{\sqrt{a^2-x^2}}dx$. **(07 Marks)**

c. Evaluate $\int_0^1\int_0^1 e^{x+y}\,dx\,dy$. **(07 Marks)**

6 a. Evaluate $\int_0^1 \int_0^2 \int_1^2 x^2yz \, dxdydz$. **(07 Marks)**

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

c. Prove that $\Gamma\left(\frac{1}{2}\right) = \sqrt{\pi}$. **(06 Marks)**

7 a. Solve $3e^x \tan y \, dx + (1-e^x) \sec^2 y dy = 0$. **(06 Marks)**

b. Solve $(2x + 3y + 4)dx - (4x + 6y + 5) dy = 0$. **(07 Marks)**

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

8 a. Solve $\frac{d^2y}{dx^2} + 4\frac{dy}{dx} + 5y = -2 \cos hx$. **(06 Marks)**

b. Solve $(D^2 - 4D + 3)y = \sin 3x \cos 2x$. **(07 Marks)**

c. Solve $\frac{d^2y}{dx^2} + 4y = x^2 + \cos 2x$. **(07 Marks)**

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