III ME, CV

USN | | | | | | | | | |

10MAT31

# Third Semester B.E. Degree Examination, June/July 2013

## Engineering Mathematics - III

Time: 3 hrs. Max. Marks:100

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





## PART – A

1 a. Obtain the Fourier series expansion of $f(x) = \begin{cases} x, & \text{if } 0 \le x \le \pi \\ 2\pi - x, & \text{if } \pi \le x \le 2\pi \end{cases}$ and hence deduce that $\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \ldots\ldots$ **(07 Marks)**

b. Find the half range Fourier sine series of $f(x) = \begin{cases} x, & \text{if } 0 < x < \pi/2 \\ \pi - x, & \text{if } \pi/2 < x < \pi \end{cases}$. **(06 Marks)**

c. Obtain the constant term and coefficients of first cosine and sine terms in the expansion of y from the following table: **(07 Marks)**

| x | 0 | 60° | 120° | 180° | 240° | 300° | 360° |
|---|---|---|---|---|---|---|---|
| y | 7.9 | 7.2 | 3.6 | 0.5 | 0.9 | 6.8 | 7.9 |

2 a. Find the Fourier transform of $f(x) = \begin{cases} a^2 - x^2, & |x| \le a \\ 0, & |x| > a \end{cases}$ and hence deduce $\int_0^\infty \frac{\sin x - x\cos x}{x^3} dx = \frac{\pi}{4}$. **(07 Marks)**

b. Find the Fourier cosine and sine transform of $f(x) = xe^{-ax}$, where $a > 0$. **(06 Marks)**

c. Find the inverse Fourier transform of $e^{-s^2}$. **(07 Marks)**

3 a. Obtain the various possible solutions of one dimensional heat equation $u_t = c^2 u_{xx}$ by the method of separation of variables. **(07 Marks)**

b. A tightly stretched string of length l with fixed ends is initially in equilibrium position. It is set to vibrate by giving each point a velocity $V_o \sin\left(\frac{\pi x}{l}\right)$. Find the displacement u(x, t). **(06 Marks)**

c. Solve $u_{xx} + u_{yy} = 0$ given u(x, 0) = 0, u(x, 1) = 0, u(1, y) = 0 and u(0, y) = $u_0$, where $u_0$ is a constant. **(07 Marks)**

4 a. Using method of least square, fit a curve $y = ax^b$ for the following data. **(07 Marks)**

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

b. Solve the following LPP graphically:
Minimize $Z = 20x + 16y$
Subject to $3x + y \ge 6$, $x + y \ge 4$, $x + 3y \ge 6$ and $x, y \ge 0$. **(06 Marks)**

c. Use simplex method to
Maximize $Z = x + (1.5)y$
Subject to the constraints $x + 2y \le 160$, $3x + 2y \le 240$ and $x, y \ge 0$. **(07 Marks)**

## PART – B

5 a. Using Newton-Raphson method find a real root of $x + \log_{10} x = 3.375$ near 2.9, corrected to 3-decimal places. **(07 Marks)**

b. Solve the following system of equations by relaxation method:
$12x + y + z = 31, \quad 2x + 8y - z = 24, \quad 3x + 4y + 10z = 58$ **(07 Marks)**

c. Find the largest eigen value and corresponding eigen vector of following matrix A by power method

$$A = \begin{bmatrix} 25 & 1 & 2 \\ 1 & 3 & 0 \\ 2 & 0 & -4 \end{bmatrix}.$$

Use $X^{(0)} = [1, 0, 0]^T$ as the initial eigen vector. **(06 Marks)**

6 a. In the given table below, the values of y are consecutive terms of series of which 23.6 is the $6^{th}$ term, find the first and tenth terms of the series. **(07 Marks)**

| x | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|
| y | 4.8 | 8.4 | 14.5 | 23.6 | 36.2 | 52.8 | 73.9 |

b. Construct an interpolating polynomial for the data given below using Newton's divided difference formula. **(07 Marks)**

| x | 2 | 4 | 5 | 6 | 8 | 10 |
|---|---|---|---|---|---|---|
| f(x) | 10 | 96 | 196 | 350 | 868 | 1746 |

c. Evaluate $\int_0^1 \frac{x}{1+x^2} dx$ by Weddle's rule taking 7-ordinates and hence find $\log_e 2$. **(06 Marks)**

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

b. Solve numerically the equation $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ subject to the conditions $u(0, t) = 0 = u(1, t)$, $t \geq 0$ and $u(x, 0) = \sin \pi x$, $0 \leq x \leq 1$. Carryout computations for two levels taking $h = \frac{1}{3}$ and $k = \frac{1}{36}$. **(07 Marks)**

c. Solve the elliptic equation $u_{xx} + u_{yy} = 0$ for the following square mesh with boundary values as shown in Fig.Q7(c). **(06 Marks)**

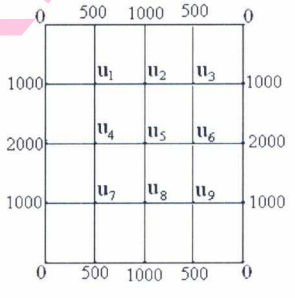


Fig.Q7(c)

8 a. Find the z-transform of: i) $\sin h\, n\theta$; ii) $\cos h\, n\theta$. **(07 Marks)**

b. Obtain the inverse z-transform of $\frac{8z^2}{(2z-1)(4z-1)}$. **(07 Marks)**

c. Solve the following difference equation using z-transforms:
$y_{n+2} + 2y_{n+1} + y_n = n$ with $y_0 = y_1 = 0$ **(06 Marks)**

* * * * *

USN | | | | | | | | | | |

10ME32A/AU32A/TL32/MT32

# Third Semester B.E. Degree Examination, June/July 2013

## Materials 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. Explain: i) APF, ii) Coordination number. Show that atomic packing factor of FCC crystal structure is higher than that of BCC crystal structure. **(10 Marks)**

b. Discuss the principal types of point defects found in crystals. Explain their significance. **(06 Marks)**

c. How do you distinguish between steady state and non-steady state diffusion? **(04 Marks)**

2 a. Explain in detail the mechanical properties in elastic and plastic region. **(10 Marks)**

b. Discuss how the slip phenomenon differs in case of a polycrystal to the single crystal. **(06 Marks)**

c. Distinguish between slip and twinning. **(04 Marks)**

3 a. How fractures are classified? State and explain different types of fracture giving appearance of the fracture in each case. **(10 Marks)**

b. What is meant by creep? With the help of creep curve, explain different stages of creep. **(06 Marks)**

c. Write a brief note fatigue properties. **(04 Marks)**

4 a. Define nucleation. Derive an expression for the critical size of the nucleus for homogeneous nucleation. **(08 Marks)**

b. Describe the solidification mechanism in a pure metal. Distinguish between homogeneous and heterogeneous nucleation. **(06 Marks)**

c. Discuss the factors worked out by Hume-Rothery that governs the formation of an ideal solid solution. **(06 Marks)**

### PART – B

5 a. Draw iron-carbon equilibrium diagram and mark on it all salient temperatures, composition and phases involved. Elaborate the invariant reactions. **(10 Marks)**

b. State Gibb's phase rule and explain the terms associated with it. **(06 Marks)**

c. Explain the lever rule with an example. **(04 Marks)**

6 a. What is the purpose of case hardening? Discuss the different methods of case hardening. **(10 Marks)**

b. What is T-T-T diagram? How is it different from phase diagram? Describe the various transformed products of austenite on cooling. **(06 Marks)**

c. How do you distinguish normalizing, full annealing and process annealing? **(04 Marks)**

7 a. State the properties and uses of grey cast iron, malleable cast iron, spheroidal cast iron and white cast ion. **(10 Marks)**

b. Distinguish between the following:

i) Hypo-eutectoid and hyper-eutectoid steels

ii) Hypo-eutectic and hyper-eutectic cast irons. **(06 Marks)**

c. Write a note on Al-Si alloys. **(04 Marks)**

8 a. Define composite material and give the classification of composites. Enumerate important characteristics of composites. **(08 Marks)**

b. Describe the features of fibrous composites, laminated composites and particulate composites. **(08 Marks)**

c. Explain the role of reinforcement and matrix materials in a composite. **(04 Marks)**

* * * * *

USN | | | | | | | | | | |

10ME32B/AU32B

# Third Semester B.E. Degree Examination, June/July 2013

## 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. What is metrology? State the objectives of metrology. **(06 Marks)**

b. Briefly explain limits, fits and tolerances. **(06 Marks)**

c. Using M112 set of slip gauges, build the following dimensions:
i) 52.498
ii) 48.3275 **(08 Marks)**

2 a. Explain universal interchangeability and selective assembly. **(06 Marks)**

b. What do you understand by line and end standard? Explain wavelength standard. **(06 Marks)**

c. Determine the tolerances on the hole and the staff for a precision running fit designated by 50 $H_7g_6$. Given:
i) 50 mm lies between 30-50 mm
ii) i (microns) = $0.45(D)^{1/3} + 0.001D$
iii) Fundamental deviation for 'H' hole = 0
iv) Fundamental deviation for 'g' shaft = $-2.5\ D^{0.34}$
v) 1T7 = 16i
vi) 1T6 = 10i
State the actual maximum and minimum sizes of the hole and shaft and maximum and minimum clearances. **(08 Marks)**

3 a. What is a comparator? Explain Johnson Mikrokartor comparator with a neat sketch. **(06 Marks)**

b. What are the advantages of electrical comparators? Explain the principle of optical comparator. **(07 Marks)**

c. Describe with a neat sketch, the construction and working of LVDT. **(07 Marks)**

4 a. Explain with a neat sketch the terminology of screw threads. **(06 Marks)**

b. Explain the principle of autocollimator with a neat sketch. **(06 Marks)**

c. Derive an expression for the effective diameter of a screw thread by 3-wire method. **(08 Marks)**

### PART – B

5 a. Explain with suitable examples, the three stages of measurement system. **(06 Marks)**

b. Define: i) Calibration
ii) Precision
iii) Accuracy
iv) Sensitivity
v) Linearity. **(10 Marks)**

c. Compare electrical and mechanical transducers. **(04 Marks)**

6 a. Explain with a sketch, the principle of:
   i) piezo-electric transducer
   ii) ionization transducer. **(08 Marks)**

b. Explain with a block diagram, the general telemetering system. **(06 Marks)**

c. Explain the working of:
   i) stylus type oscillograph
   ii) x-y plotter. **(06 Marks)**

7 a. Explain with a neat sketch, multiple lever platform balance. **(06 Marks)**

b. What are the types of dynamometers? Explain with a neat sketch, hydraulic dynamometer. **(08 Marks)**

c. Explain the operation of McLeod gage and pirani gage. **(06 Marks)**

8 a. What are the methods of strain measurement? Explain the principle of electrical resistance strain gauge. **(06 Marks)**

b. What is a thermocouple? Briefly explain the laws of thermocouple. **(06 Marks)**

c. Write notes on:
   i) Strain gauge factor
   ii) Temperature compensation
   iii) Cross sensitivity
   iv) Strain gauge bonding materials. **(08 Marks)**

* * * * *

USN | | | | | | | | | | |

10ME/AU/TL33

# Third Semester B.E. Degree Examination, June/July 2013
## 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 tables permitted.*





### PART – A

1 a. Classify the following as open/closed/isolated systems:
i) Tree; ii) Printer; iii) Baking of bread in an oven; iv) Fan. **(04 Marks)**

b. Define the following with examples:
i) Property; ii) Cycle; iii) Path function; iv) Reference temperature; v) Quasistatic process; vi) Thermodynamic equilibrium; vii) Macroscopic approach; viii) State point. **(08 Marks)**

c. Develop a linear temperature scale '°B' where in ice and normal human body temperature are assumed as two fixed points and assigned the values 0°B and 50°B respectively. If the temperature of human body on Celsius scale is 36.7°C, obtain the relation between 'B' scale and Celsius scale and find out water boiling temperature in 'B' scale. **(08 Marks)**

2 a. Define 'work' from thermodynamic point of view and derive an expression for flow work. **(06 Marks)**

b. Define 'heat' and bring out dissimilarities between heat and work. **(06 Marks)**

c. A gas contained in a cylinder fitted with a piston loaded with a small number of weights is at 1.3 bar pressure and 0.03m$^3$ volume. The gas is heated until the volume increases to 0.1m$^3$. Calculate the work done by the gas in the following processes: i) Pressure remains constant; ii) Temperature remains constant; iii) $PV^{1.3} = C$ during the process. Show the processes on P-V diagram. **(08 Marks)**

3 a. With a neat sketch, explain the famous 'Joules experiment' to show that energy transfer to an adiabatic system is a function of end states only. **(04 Marks)**

b. For isotherming nonflow and steady flow processes show that $\int_1^2 pdv = -\int_1^2 vdp$. **(06 Marks)**

c. Simplify SFEE equation for a case of throttle value. **(02 Marks)**

d. An ideal gas ($\gamma$ = 1.4) expands reversibly in a turbine from 10 bar to 1 bar. Assume that process law is P = 12-5V, where 'P' is in bar and 'V' is in m$^3$/kg. If the heat loss from the turbine is 200 kJ/kg, calculate the shaft work done. **(08 Marks)**

4 a. Define Kelvin-Plank statement, Clausius statement of II$^{nd}$ law of thermodynamics and show that they are equivalent. **(08 Marks)**

b. Using Kelvin-Plank statement show that free expansion process is irreversible. **(04 Marks)**

c. A heat pump working on a reversed Carnot cycle takes in energy from a reservoir maintained at 5°C and delivers it to another reservoir where temperature is 77°C. The heat pump derives power for its operation from a reversible heat engine operating with in the higher and lower temperatures of 1077°C and 77°C. For every 100 kJ/kg of energy supplied to reservoir at 77°C, estimate the energy taken from the reservoir at 1077°C. **(08 Marks)**

## PART – B

5 a. Derive Clausius inequality for a cycle. **(08 Marks)**

b. Using entropy principle show that mixing of two fluids is an irreversible process. **(06 Marks)**

c. One kg of water at 273K is heated to 373K by first bringing it in contact with reservoir at 323K and then reservoir at 373K. What is the change in entropy of universe? **(06 Marks)**

6 a. With neat sketches indicate various parameters on typical T-S and H-S diagrams. **(06 Marks)**

b. With a neat sketch, explain how throttling calorimeter can be used to measure the dryness fraction of wet vapour. **(06 Marks)**

c. Stream at 1MPa and 250°C enters a nozzle with a velocity of 60m/s and leaves the nozzle at 10kPa. Assuming the flow process to be isentropic and the mass flow rate to be 1kg/s determine: i) The exit velocity; ii) The exit diameter of nozzle. **(08 Marks)**

7 a. Obtain four max well relations for a simple compressible system in the form $\left(\frac{\partial M}{\partial y}\right)_x = \left(\frac{\partial N}{\partial x}\right)_y$. **(08 Marks)**

b. Obtain Clausius clapeyron relation involving the saturation temperature and pressure. **(06 Marks)**

c. Determine the enthalpy of vapourization of water at 200°C using Clapeyron equation. **(06 Marks)**

8 a. State and explain Amagat's law. **(06 Marks)**

b. State and explain law of corresponding states. **(06 Marks)**

c. A mixture of methane with, just enough oxygen to permit combustion, is burned. The temperature and pressure of the final mixture are 27°C and 101.3 kPa respectively. Calculate:

i) Mass traction of reactants.

ii) The volume traction of products.

iii) The partial pressure of water vapour in the products of combustion and

iv) Volume of products. **(08 Marks)**

* * * * *

USN | | | | | | | | | | |

10ME/AU/PM/TL34

# Third Semester B.E. Degree Examination, June/July 2013
## Mechanics of Materials

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 suitably assumed wherever necessary.***



### PART – A

1 a. The tensile test was conducted on a mild steel bar. The following data was obtained from the test:

| | |
|---|---|
| Diameter of steel bar | = 16mm |
| Gauge length of the bar | = 80mm |
| Load at proportionality limit | = 72 kN |
| Extension at a load of 60 kN | = 0.115mm |
| Load at failure | = 80 kN |
| Final gauge length of bar | = 104mm |
| Diameter of the rod at failure | = 12mm |

Determine: i) Young's modulus; ii) Proportionality limit; iii) True breaking stress and iv) Percentage elongation. **(10 Marks)**

b. A brass bar having cross-sectional area 300mm$^2$ is subjected to axial forces as shown in Fig.Q.1(b). Find the total elongation of the bar. E = 84 GPa. **(10 Marks)**


Fig.Q.1(b)

2 a. A bar of 20mm diameter is tested in tension. It is observed that when a load of 37.7kN is applied, the extension measured over a gauge length of 200mm is 0.12mm and contraction in diameter is 0.0036mm. Find Poisson's ratio and elastic constants E, G, K. **(08 Marks)**

b. A composite bar made up of aluminium and steel is held between two supports as shown in Fig.Q.2(b). The bars are stress free at a temperature of 42°C. What will be the stresses in the two bars with the temperature drops to 24°C. If i) The supports are unyielding; ii) the supports come nearer to each other by 0.1mm. The cross-sectional area of steel bar is 160mm$^2$ and that of aluminium bar is 240mm$^2$, $E_A = 0.7 \times 10^5$ MPa, $E_S = 2 \times 10^5$ MPa, $\alpha_A = 24 \times 10^{-6}$ per °C and $\alpha_S = 12 \times 10^{-6}$ per °C. **(12 Marks)**

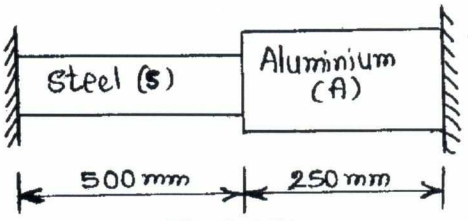


Fig.Q.2(b)

3 a. Show that the sum of the normal stresses on any two planes at right angles in a general two dimensional stress system is constant. **(08 Marks)**

b. At a certain point in a strained material the values of normal stresses across two planes at right angles to each other are 80MPa and 32MPa, both tensile and there is a shear stress of 32MPa clock wise on the plane carrying 80MPa stresses across the planes as shown in Fig.Q.3(b). Determine:

i) Maximum and minimum normal stresses and locate their planes.

ii) Maximum shear stress and specify its plane. **(12 Marks)**

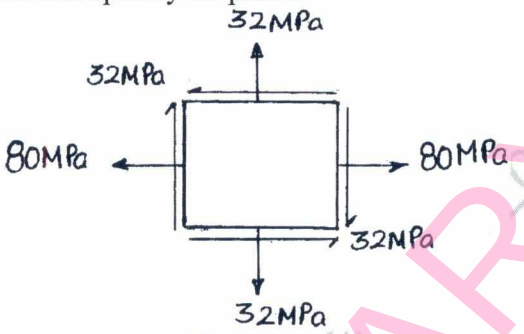


Fig.Q.3(b)

4 a. State Castigliano's theorem. Where do you use it? **(03 Marks)**

b. The bar with circular cross-section as shown in Fig.Q.4(b) is subjected to a load of 10kN. Determine the strain energy stored in it. Take $E = 2.1 \times 10^5$ N/mm$^2$. **(07 Marks)**

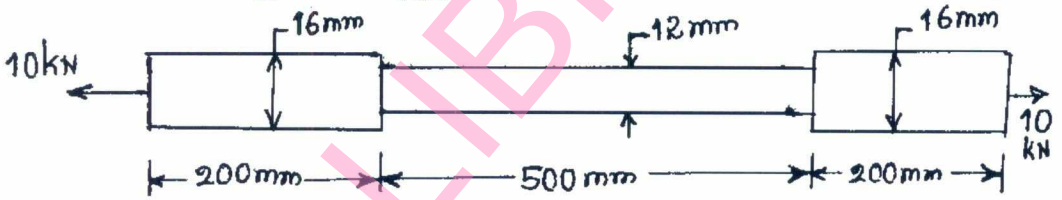


Fig.Q.4(b)

c. A thin cylindrical shell 1m in diameter and 3m long has a metal thickness of 10mm. It is subjected to an internal fluid pressure of 3MPa. Determine the change in length, diameter and volume. Also find the maximum shearing stress in the shell. Assume Poison's ratio is 0.3 and E = 210GPa. **(10 Marks)**

## PART – B

5 a. Explain the terms:

i) Sagging bending moment.

ii) Hogging bending moment.

iii) Point of contraflexure. **(06 Marks)**

b. What are the different types of loads acting on a beam? Explain with sketches. **(06 Marks)**

c. A simply supported beam of span 6m is subjected to a concentrated load of 25kN acting at a distance of 2m from the left end. Also subjected to an uniformly distributed load of 10kN/m over the entire span. Draw the bending moment and shear force diagrams indicating the maximum and minimum values. **(08 Marks)**

6 a. Enumerate the assumptions made in the theory of simple bending. **(04 Marks)**

b. A cantilever of square section 200mm × 200mm, 2m long, just fails in flexure when a load of 12kN is placed at is free end. A beam of the same material and having a rectangular cross section 150mm wide and 300mm deep is simply supported over a span of 3m. Calculate the minimum central concentrated load required to break the beam. **(08 Marks)**

c. A rolled I section of size 50mm × 75mm is used as a beam, with an effective span of 3 meters. The flanges are 5mm thick and web is 3.75mm thick. Calculate the uniformly distributed load the beam can carry if the maximum intensity of shear stress induced is limited to $40N/mm^2$. **(08 Marks)**

7 a. Show that for a simply supported beam of length '$l$' carrying a concentrated load W at its mid span, the maximum deflection in $Wl^3/48EI$. **(10 Marks)**

b. A simply supported steel beam having uniform cross-section is 14m span and is simply supported at its ends. It carries a concentrated load of 120kN and 80kN at two points 3m and 4.5m from the left and right end respectively. If the moment of inertia of the section is $160 \times 10^7$ $mm^4$ and E = 210 GPa, calculate the deflection of the beam at load points. **(10 Marks)**

8 a. A hollow circular steel shaft has to transmit 60kW at 210 rpm such that the maximum shear stress does not exceed 60MPa. If the ratio of internal to external diameter is equal to ¾ and the value of rigidity modulus is 84 GPa, find the dimensions of the shaft and angle of twist in a length of 3m. **(10 Marks)**

b. A 1.5m long column has a circular cross section of 50mm diameter. One end of the column is fixed in direction and position and the other end is free. Taking the factor of safety as 3, calculate the safe load using.

Rankine's formula taking yield stress $560N/mm^2$ and $\alpha = \frac{1}{1600}$.

Euler's formula, taking E = $1.2 \times 10^5 N/mm^2$. **(10 Marks)**

* * * * *

USN | | | | | | | | | | |

10ME/AU/TL35

# Third Semester B.E. Degree Examination, June/July 2013
## 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 the basic steps involved in a casting process. **(06 Marks)**
b. What are pattern allowances? Explain any two. **(05 Marks)**
c. What are additives? List the various additives used in moulding sand. **(04 Marks)**
d. Explain with neat sketch sweep pattern. **(05 Marks)**

2 a. Describe the desirable properties of a moulding sand. **(06 Marks)**
b. What are the casting defects? Explain any two. **(06 Marks)**
c. With neat sketch, explain Jolt-squeeze moulding machine. **(08 Marks)**

3 a. Explain briefly the following with sketches:
i) $CO_2$ – moulding ii) Shell moulding. **(10 Marks)**
b. Explain the following with neat sketch,
i) Centrifuging ii) Squeeze-casting. **(10 Marks)**

4 a. Explain the construction and working of direct electric arc furnace. List the advantages. **(10 Marks)**
b. Explain with neat sketch working principle of resistance furnace. List the advantages, disadvantages and applications. **(10 Marks)**

### PART – B

5 a. Define welding. Give classification of welding process. **(06 Marks)**
b. Explain Inert Gas Metal Arc Welding (MIG) and Atomic hydrogen welding process. **(08 Marks)**
c. Explain briefly forward and backward welding methods in gas welding. **(06 Marks)**

6 a. Explain the principle of seam welding with neat sketch. **(06 Marks)**
b. With neat sketch, explain projection welding process. List the advantages of projection welding. **(08 Marks)**
c. With neat sketch, explain explosive welding process. List the applications. **(06 Marks)**

7 a. Discuss the factors affecting weldability of metals. **(06 Marks)**
b. Explain the parameters affecting Heat Affected Zone (HAZ) briefly. **(06 Marks)**
c. Explain briefly welding defects and its causes. **(08 Marks)**

8 a. Compare soldering and brazing processes. Mention their advantages and disadvantages. **(10 Marks)**
b. What is NDT? Explain radiography and Eddy current method of inspection of metals. **(10 Marks)**

* * * * *

USN | | | | | | | | | | |

10ME/AU/IP/IM/MA36B

# Third Semester B.E. Degree Examination, June/July 2013
# 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. Give reasons:
   i) Viscosity of liquids decreases on heating where as viscosity of gases increases on heating. Rain drops and tiny dew drops are spherical in shape.
   ii) The miniscus of water is concave upwards while miniscus of mercury is convex upwards. **(06 Marks)**

b. Derive the expression for surface tension on a liquid droplet and soap bubble. **(06 Marks)**

c. The space between two square flat parallel plates is filled with oil. Each side of the plate is 800mm. Thickness of oil film is 20mm. The upper plate moves at a uniform velocity of 3.2 m/sec, when a force of 50N is applied to upper plate. Determine:
   i) Shear stress.
   ii) Dynamic viscosity of oil in poise.
   iii) Power absorbed in moving the plate.
   iv) Kinematic viscosity in stokes if the specific gravity of oil is 0.9. **(08 Marks)**

2 a. Define: i) Total pressure; ii) Centre of pressure. **(02 Marks)**

b. Obtain the expressions for horizontal and vertical components of the resultant hydrostatic force on a submerged curved surface. **(08 Marks)**

c. An equilateral triangular plate of 6m side is immersed in water with its base at 5m below the free surface. The apex a plate is 9m below free surface of water. Determine the total pressure on the plate and location of centre of pressure below the free surface. **(10 Marks)**

3 a. Define Buoyancy and centre of Buoyancy. **(02 Marks)**

b. Write the differences between Langrangian and Eulerian approaches. **(02 Marks)**

c. A cone of sp-gravity S1 is floating in water with its apex downwards. It has a diameter D and vertical height H. Show that for stable equilibrium of cone $H < \frac{1}{2}\left[\frac{D^2 S^{1/3}}{1-S^{1/3}}\right]^{1/2}$. **(08 Marks)**

d. If for a two dimensional potential flow, the velocity potential function is $\phi = x(2y-1)$. At point P(4, 5), determine;
   i) The velocity at that point; ii) The value of stream function. **(08 Marks)**

4 a. Derive Euler's equation of motion along a stream line. **(06 Marks)**

b. State the momentum equation. How will you apply the momentum equation for determining the force exerted by a flowing liquid on a pipe bend? **(06 Marks)**

c. A conical tube is fixed vertically with its smaller end upwards and it forms a part of pipeline. The velocity at the smaller end is 4.5 m/s and at the large end is 1.5 m/s. Length of the conical tube is 1.5m. The pressure at the upper end is equivalent to head of 10m of water.
   i) Neglecting the frictional loss, determine the pressure at the lower end of tube.
   ii) If head loss in the tube is $0.3\ (V_1-V_2)^2/2g$, where $V_1$ and $V_2$ are velocities at smaller and larger end respectively, determine the pressure at the larger end assuming flow downward. **(08 Marks)**

## PART – B

5 a. Derive an expression for discharge over a V-notch. **(07 Marks)**

b. Explain briefly the three types of similarities. **(03 Marks)**

c. Define and explain i) Reynold's number; ii) Euler's number. **(02 Marks)**

d. The variables controlling the motion of a floating vessel in water are the drag force F, which depends on speed V, the length L, mass density $\rho$, dynamic viscosity $\mu$ and accln due to gravity g. Derive the expression for F using Buckingham's $\pi$-theorem. **(08 Marks)**

6 a. Derive Darcy-Weisbach expression for friction head loss in pipe flow. **(06 Marks)**

b. Define the following terms and briefly explain:

i) Hydraulic gradient line (HGL).

ii) Total energy line (TEL). **(04 Marks)**

c. A horizontal pipeline 40m long is connected to a water tank at one end and discharges freely into the atmosphere at the other end. For the first 25m of its length from the tank, the pipe is 150m diameter and its diameter suddenly enlarged to 300mm. The height of water level in the tank is 8m above the centre of pipe. Considering all the losses of head which occur, determine the rate of flow f = 0.01 for both sections of pipe. **(10 Marks)**

7 a. Derive Hagen-Poseuille equation for a laminar flow in a circular tube. **(10 Marks)**

b. Water at 15°C flows between two large parallel plates at a distance of 1.6mm apart. Determine:

i) The maximum velocity.

ii) The pressure drop/unit length.

iii) The shear stress at the walls of the plates if the average velocity is 0.2 m/s.

The viscosity of water at 15°C is given as 0.01 poise. **(10 Marks)**

8 a. Define the following and write their equations:

i) Drag; ii) Lift; iii) Displacement thickness; iv) Momentum thickness. **(08 Marks)**

b. Explain Mach angle and Mach cone. **(02 Marks)**

c. A kite 0.8m × 0.8m weighing 3.924 N assumes an angle of 12° to horizontal. The string attached to the kite makes an angle of 45° to the horizontal. The pull on the string is 24.525 N when the wind is blowing at a speed of 30 km/hr. Find the corresponding coefficient of drag and lift. Density of air is given as 1.25 kg/m$^3$. **(10 Marks)**

* * * * *

USN | | | | | | | | | | |

MATDIP301

# Third Semester B.E. Degree Examination, June/July 2013

## Advanced Mathematics – I

Time: 3 hrs. Max. Marks:100

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





1 a. Find modulus and amplitude of $1+\cos\theta+i\sin\theta$. **(06 Marks)**

b. If n is positive integer, prove that $(\sqrt{3}+i)^n+(\sqrt{3}-i)^n=2^{n+1}\cos\left(\frac{n\pi}{2}\right)$. **(07 Marks)**

c. Find the cube root of $1+i$ and represent them in the Argand diagram. **(07 Marks)**

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

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

c. Find the $n^{th}$ derivative of $\frac{x^2}{(x+2)(2x+3)}$. **(07 Marks)**

3 a. Prove that $\tan\phi=r\frac{d\theta}{dr}$ with usual notations. **(06 Marks)**

b. Find the pedal equation for the curve $r=a(1+\cos\theta)$. **(07 Marks)**

c. Expand $f(x)=\sqrt{1+\sin 2x}$ using Maclaurin's series upto $4^{th}$ term. **(07 Marks)**

4 a. If $u=\tan^{-1}\left(\frac{x^3+y^3}{x-y}\right)$, prove that $x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y}=\sin 2u$. **(06 Marks)**

b. 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)**

c. If $u=\tan^{-1}x+\tan^{-1}y$ and $V=\frac{x+y}{1-xy}$, find the value of $\frac{\partial(u,v)}{\partial(x,y)}$. **(07 Marks)**

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

b. Evaluate $\int_0^2 x^{5/2}\sqrt{2-x}\,dx$. **(07 Marks)**

c. Evaluate $\int_1^2\int_3^4(xy+e^y)dydx$. **(07 Marks)**

6 a. Evaluate $\int_0^1\int_0^1\int_0^1 e^{x+y+z}dxdydz$. **(06 Marks)**

b. Prove that $\left|\frac{1}{2}\right| = \sqrt{\pi}$. **(07 Marks)**

c. Show that $\int_0^{\pi/2}\sqrt{\sin\theta}\,d\theta \times \int_0^{\pi/2}\frac{1}{\sqrt{\sin\theta}}d\theta = \pi$ **(07 Marks)**

7 a. Solve $xy\frac{dy}{dx} = 1 + x + y + xy$. **(06 Marks)**

b. Solve $\left[x\tan\left(\frac{y}{x}\right) - y\sec^2\left(\frac{y}{x}\right)\right]dx + x\sec^2\left(\frac{y}{x}\right)dy = 0$ **(07 Marks)**

c. Solve $\frac{dy}{dx} + y\cot x = 4x\,\text{cosec}\,x$. **(07 Marks)**

8 a. Solve $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 9y = 2e^{3x}$. **(06 Marks)**

b. Solve $\frac{d^2y}{dx^2} - \frac{dy}{dx} - 2y = \sin 2x$. **(07 Marks)**

c. Solve $\frac{d^2y}{dx^2} + 4y = 1 + x^2$ **(07 Marks)**

* * * * *