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10MAT31

Third Semester B.E. Degree Examination, Dec.2014/Jan.2015
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. Expand $f(x)=\sqrt{1-\cos x}$, $0 < x < 2\pi$ in a Fourier series. Hence evaluate $\frac{1}{1.3}+\frac{1}{3.5}+\frac{1}{5.7}+\dots$ **(07 Marks)**

b. Find the half-range sine series of $f(x) = e^x$ in (0, 1). **(06 Marks)**

c. In a machine the displacement y of a given point is given for a certain angle x as follows:

x	0	30	60	90	120	150	180	210	240	270	300	330
y	7.9	8	7.2	5.6	3.6	1.7	0.5	0.2	0.9	2.5	4.7	6.8

Find the constant term and the first two harmonics in Fourier series expansion of y. **(07 Marks)**

2 a. Find Fourier transform of $e^{-|x|}$ and hence evaluate $\int_0^\infty \frac{\cos xt}{1+t^2}\,dt$. **(07 Marks)**

b. Find Fourier sine transform of $f(x)=\begin{cases} x, & 0<x\le 1 \\ 2-x, & 1\le x<2 \\ 0, & x>2 \end{cases}$. **(06 Marks)**

c. Solve the integral equation $\int_0^\infty f(x)\cos\lambda x\,dx = e^{-\lambda}$. **(07 Marks)**

3 a. Find various possible solution of one-dimensional heat equation by separable variable method. **(10 Marks)**

b. A rectangular plate with insulated surface is 10cm wide and so long compared to its width that it may be considered infinite in length without introducing an appreciable error. If the temperature of the short edge y = 0 is given by

$u = 20x, \quad 0 \le x \le 5$

$\quad = 20\,(10 - x), \quad 5 \le x \le 10$

and the two long edges x = 0, x = 10 as well as the other short edge are kept at 0°C. Find the temperature u(x, y). **(10 Marks)**

4 a. Fit a curve of the form $y = ae^{bx}$ to the data: **(07 Marks)**

x	1	5	7	9	12
y	10	15	12	15	21

b. Use graphical method to solve the following LPP:

Minimize $Z = 20x_1 + 30x_2$

Subject to $x_1 + 3x_2 \ge 5$;

$2x_1 + 2x_2 \ge 20$;

$3x_1 + 2x_2 \ge 24$;

$x_1, x_2 \ge 0$. **(06 Marks)**

c. Solve the following LPP by using simplex method:
Maximize $Z = 3x_1 + 2x_2 + 5x_3$
Subject to $x_1 + 2x_2 + x_3 \leq 430$
$3x_1 + 2x_3 \leq 460$
$x_1 + 4x_2 \leq 420$
$x_1 \geq 0, x_2 \geq 0.$ **(07 Marks)**

PART – B

5 a. Use the Gauss-Seidal iterative method to solve the system of linear equations. $27x + 6y - z = 85$; $6x + 15y + 2z = 72$; $x + y + 54z = 110$. Carry out 3 iterations by taking the initial approximation to the solution as (2, 3, 2). Consider four decimal places at each stage for each variable. **(07 Marks)**

b. Using the Newton-Raphson method, find the real root of the equation $x\sin x + \cos x = 0$ near to $x = \pi$, carryout four iterations (x in radians). **(06 Marks)**

c. Find the largest eigen value and the corresponding eigen vector of the matrix $A = \begin{pmatrix} 4 & 1 & -1 \\ 2 & 3 & -1 \\ -2 & 1 & 5 \end{pmatrix}$ by power method. Take $\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$ as the initial vector. Perform 5 iterations. **(07 Marks)**

6 a. Find f(0.1) by using Newton's forward interpolation formula and f(4.99) by using Newton's backward interpolation formula from the data: **(07 Marks)**

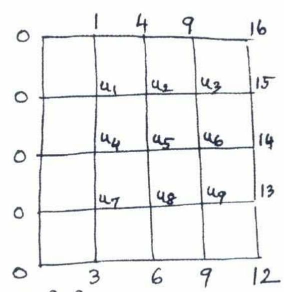
x	0	1	2	3	4	5
f(x)	-8	0	20	58	120	212

b. Find the interpolating polynomial f(x) by using Newton's divided difference interpolation formula from the data: **(06 Marks)**

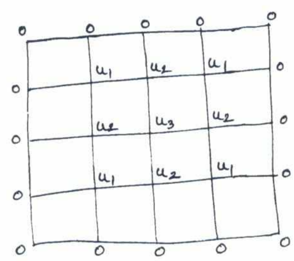
x	0	1	2	3	4	5
f(x)	3	2	7	24	59	118

c. Evaluate $\int_0^{1.2} e^x \, dx$ using Weddle's rule. Taking six equal sub intervals, compare the result with exact value. **(07 Marks)**

7 a. Solve $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ in the following square mesh. Carry out two iterations. **(07 Marks)**



b. Solve the Poisson's equation $\nabla^2 u = 8x^2y^2$ for the square mesh given below with u = 0 on the boundary and mesh length, h = 1. **(06 Marks)**



c. Evaluate the pivotal values of $\frac{\partial^2 u}{\partial t^2} = 16\frac{\partial^2 u}{\partial x^2}$ taking h = 1 upto t = 1.25. The boundary conditions are u(0, t) = 0, u(5, t) = 0, $\frac{\partial u}{\partial t}(x,0) = 0$, u(x, 0) = $x^2(5 - x)$. **(07 Marks)**

8 a. Find the Z-transforms of i) $\left(\frac{1}{2}\right)^n + \left(\frac{1}{3}\right)^n$ ii) $3^n \cos\frac{\pi n}{4}$. **(07 Marks)**

b. State and prove initial value theorem in Z-transforms. **(06 Marks)**

c. Solve the difference equation $u_{n+2} - 2u_{n+1} + u_n = 2^n;\ u_0 = 2, u_1 = 1$. **(07 Marks)**

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10ME32A/AU32A/MT32/TL32

Third Semester B.E. Degree Examination, Dec.2014/Jan.2015
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. Classify in detail the different types of crystal imperfections. Explain with a neat sketch the edge dislocation. **(08 Marks)**

b. Illustrate steady state and non-steady state diffusion. **(06 Marks)**

c. Steel gear, having carbon content of 0.2% is to be gas carburized to achieve carbon content of 0.90% at the surface and 0.4% at 0.5mm depth from the surface. If the process is to be carried out at 927°C, find the time required for carburization. Take diffusion co-efficient of carbon in given steel = 1.28×10^{-11} mt^2/sec. Given data: **(06 Marks)**

Z	erf(z)
0.75	0.7112
Z	0.7143
0.8	0.7421

2 a. Derive an expression for critical resolved shear stress for slip in a crystal structure. **(06 Marks)**

b. Establish the relationship between engineering stress and true stress also show the relationship of engineering strain and true strain. **(06 Marks)**

c. Consider a tensile specimen of 5mm diameter and 25mm gauge length. If its diameter is reduced to 4mm through plastic deformation. What is its length at this stage? Also find engineering stress, true stress, engineering strain and true strain where load applied is 500N. **(08 Marks)**

3 a. Illustrate the stages in the cup and cone fracture with suitable sketches. **(08 Marks)**

b. Define stress relaxation. Derive the corresponding expression. **(06 Marks)**

c. A fatigue test is made with mean stress, σ_m = 120MPa and stress-amplitude σ_a = 165MPa find σ_{max}, σ_{min}, σ_{range} and σ_{ratio}. **(06 Marks)**

4 a. Explain the mechanism of solidification. **(06 Marks)**

b. What is a solid solution? Mention the types of solid solution. Also enumerate Hume-Rothary rules governing the formation of solid solution. **(08 Marks)**

c. A cooling curve is shown in figure below, determine the following:

i) The pouring temperature
ii) The solidification temperature
iii) The super heat
iv) The cooling rate, just before solidification begins
v) The total solidification time
vi) The local solidification time. **(06 Marks)**

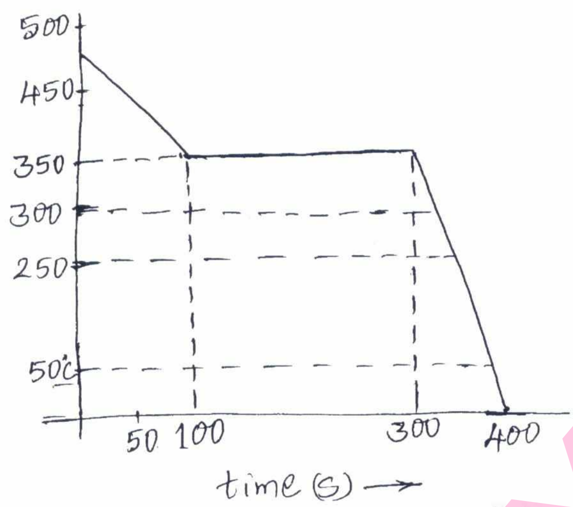

Fig.Q.4(c)

PART – B

5 a. Draw the Iron-Carbon equilibrium diagram and label it. Show the invariant points on it. Write the reactions occurring at these points indicating the temperature and composition of each phase. **(10 Marks)**

b. Two metals A and B have their melting points at 900°C and 800°C respectively. The alloy pair forms an eutectic at 600°C of composition 60% B. They have unlimited liquid solubilities. The solid solubility of A in B is 10% and that of B in A is 5% at eutectic temperature and remains constant till 0°C. Draw the phase diagram and label all the fields. Find the amount of liquid and solid phases in an alloy of 20% B at 650°C. **(10 Marks)**

6 a. Draw the TTT diagram for eutectoid steel and explain the different micro structures obtained at various cooling rates. **(10 Marks)**

b. Mention the types of heat treatment processes. Explain with a suitable sketch the full annealing process. **(10 Marks)**

7 a. Explain the structure, composition and properties of gray cast iron. **(06 Marks)**

b. Briefly explain the effect of alloying elements on properties of steel. **(06 Marks)**

c. Write a short note on the copper and its alloys. **(08 Marks)**

8 a. Define composite material. Give the classification based on matrix, geometry of reinforcement and construction. Also explain briefly the production of filament winding process with a neat sketch. **(10 Marks)**

b. Explain with a neat sketch the pultrusion process and mention its applications. **(10 Marks)**

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10ME/AU32B

Third Semester B.E. Degree Examination, Dec.2014/Jan.2015
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer any FIVE full questions, selecting atleast TWO questions from each part.***
2. Draw neat sketches.

PART – A

1 a. Define metrology. State and explain the objectives of metrology. **(06 Marks)**
b. Sketch and explain: i) International prototype metre; ii) Imperial standard yard. **(10 Marks)**
c. Write the slip gauge combination to build the following dimensions using M-87 slip gauge set: i) 49.3825mm; ii) 87.3215mm. **(04 Marks)**

2 a. Determine the dimensions of the shaft and hole for a fit $30H_8d_{10}$ and sketch the fit, given
i) i(micron) $i = 0.45\ D^{1/3} + 0.001D$.
ii) Upper deviation for 'd' shaft = $-16_D^{0.44}$.
iii) 30mm falls in the diameter steps of 18-30mm.
iv) $IT_8 = 25i$
v) $IT_{10} = 64i$
vi) Fundamental deviation = 0. **(12 Marks)**
b. With a neat sketch, explain the different types of fits with examples. **(08 Marks)**

3 a. List the characteristics of comparator. **(05 Marks)**
b. Explain with a neat sketch, the construction and working of Johnson Mikrokator and state advantages. **(10 Marks)**
c. List the advantages and disadvantages of optical comparator. **(05 Marks)**

4 a. Explain with a diagram, the method to measure minor diameter of internal screw thread using taper parallels and rollers. **(10 Marks)**
b. Derive an expression for best size wire. **(06 Marks)**
c. What are various types of errors on screw threads and explain the reasons for the same? **(04 Marks)**

PART – B

5 a. With a neat block diagram, explain the three stages of generalized measurement system, with an example. **(10 Marks)**
b. Explain with neat sketch capacitive transducers of changing area and changing distance. **(10 Marks)**

6 a. With a neat block diagram, explain the working principle of Cathode Ray oscilloscope. **(10 Marks)**
b. What are X-Y plotters? With a block diagram, explain its working. **(10 Marks)**

7 a. Explain Prony brake dynamometer with neat sketch. **(10 Marks)**
b. With a neat sketch, explain Mc Leod gauge. **(10 Marks)**

8 a. With a neat sketch, explain the working principle of optical pyrometer. **(10 Marks)**
b. Write short notes on the following: i) Gauge factor; ii) Bonding methods; iii) Thermo couple; iv) Bonding materials. **(10 Marks)**

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Third Semester B.E. Degree Examination, Dec.2014/Jan.2015
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 thermodynamic data handbook is permitted.

PART – A

1 a. Explain what do you understand by thermodynamic equilibrium. **(06 Marks)**

b. Name a few measurements or quantities that can be conveniently used as thermometric properties in order to quantify the temperature. **(04 Marks)**

c. What are intensive and extensive properties? Give examples for each. **(04 Marks)**

d. In 1709, Sir Issac Newton proposed a new temperature scale. On this scale, the temperature was a linear function on Celsius scale. The reading on this at ice point (0°C) and normal human body temperature (37°C) were 0°N and 12°N, respectively. Obtain the relation between the Newton scale and the Celsius scale. **(06 Marks)**

2 a. Show that heat and work are path function and not properties of the system. **(06 Marks)**

b. Specify the most widely used sign convention for work and heat interaction. **(04 Marks)**

c. List the difference between work and heat. **(04 Marks)**

d. The piston of an oil engine, of area $0.0045 m^2$ moves downwards 75mm, drawing $0.00028 m^3$ of fresh air from the atmosphere. The pressure in the cylinder is uniform during the process at 80kPa, while the atmospheric pressure is 101.375 kPa, the difference being due to the flow resistance in the induction pipe and the inlet valve. Estimate the displacement work done by the air. **(06 Marks)**

3 a. Describe the classic paddle wheel experiment performed by Joule. What conclusion was drawn based on the experimental observations? **(10 Marks)**

b. A turbo compressor delivers $2.33 m^3/s$ at 0.276 MPa, 43°C which is heated at this pressure to 430°C and finally expanded in a turbine which delivers 1860kW. During the expansion, there is a heat transfer of 0.09 MJ/s to the surroundings. Calculate the turbine exhaust temperature if changes in kinetic and potential energy are negligible. Assume for air $R = 0.287$ kJ/kg K, $C_p = 1.005$ kJ/kg K. **(10 Marks)**

4 a. What is thermal energy reservoir? Explain source and sink. **(04 Marks)**

b. Establish equivalence of Kelvin-Plank and Clausius statements. **(06 Marks)**

c. Two reversible heat engines A and B are arranged in series, A rejecting heat directly to B. Engine A receives 200kJ at a temperature of 421°C from a hot source, while engine B is in communication with a cold sink at a temperature of 4.4°C. If the work output of A is twice that of B, find:

i) The intermediate temperature between A and B.
ii) The efficiency of each engine.
iii) The heat rejected to the cold sink. **(10 Marks)**

PART – B

5 a. Establish the inequality of Clausius. **(08 Marks)**

b. What is available and unavailable energy? **(04 Marks)**

c. A lump of steel of mass 10kg at 627°C is dropped in 100kg of oil at 30°C. The specific heats of steel and oil are 0.5 kJ/kg K and 3.5 kJ/kg K respectively. Calculate the entropy change of steel, the oil and the universe. **(08 Marks)**

6 a. What is meant by a pure substance? Can we treat air as a pure substance? **(06 Marks)**

b. Name the widely used thermodynamic diagrams for a pure substance. **(04 Marks)**

c. The following observations were recorded in an experiment with a combined separating and throttling calorimeter.
Pressure in the steam main 15bar,
Mass of water drained from the separator 0.55kg,
Mass of steam condensed after throttle valve 4.2kg,
Pressure and temperature after throttling 1 bar, 120°C.
Evaluate the dryness fraction of the steam in the main. **(10 Marks)**

7 a. Show that the internal energy of an ideal gas is a function of temperature only. **(08 Marks)**

b. A gas of mass 1.5kg undergoes a quasistatic expansion which follows a relationship $P = a + bV$, where a and b are constants. The initial and final pressures are 1000kPa and 200kPa respectively and the corresponding volumes are $0.2m^3$ and $1.2m^3$. The specific internal energy of the gas is given by the relation $u = 1.5\ PV - 85$ kJ/kg, where P is the kPa and V is in m^3/kg. Calculate the net heat transfer and the max internal energy of the gas attained during expansion. **(12 Marks)**

8 a. Explain: i) Dalton's law of partial pressure; ii) Amagat's law of additive volumes; iii) Law of corresponding states. **(06 Marks)**

b. Explain generalized compressibility chart. **(04 Marks)**

c. A balloon of spherical shape 6m in diameter is filled with hydrogen gas at a pressure of 1 bar abs and 20°C. At a later time, the pressure of the gas is 94% of its original pressure at the same temperature.

i) What mass of the original gas must have escaped if the dimensions of the balloon is not changed.

ii) Find the amount of heat removed to cause the same drop in pressure at constant volume. Take C_v for hydrogen as 10400 J/kg K. **(10 Marks)**

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Third Semester B.E. Degree Examination, Dec.2014/Jan.2015

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 and explain typical stress strain curve for aluminium. **(04 Marks)**

b. The tensile test was conducted on a mild steel bar. The following data was obtained from the test:
Diameter of steel bar = 16mm
Load at proportionality limit = 72kN
Load at failure = 80kN
Diameter of the rod at failure = 12mm
Gauge length of the bar = 80mm
Extension at a load of 60kN = 0.115mm
Final gauge length of bar = 104mm
Determine: i) Young's modulus; ii) Proportionality limit; iii) True breaking stress; iv) Percentage elongation. **(08 Marks)**

c. Determine the magnitude of the load P necessary to produce zero net change in the length of the straight bar shown in Fig.Q.1(c). Area of cross section = 400mm^2. **(08 Marks)**

Fig.Q.1(c)

2 a. Explain volumetric strain and obtain the expression for volumetric strain for a circular bar. **(05 Marks)**

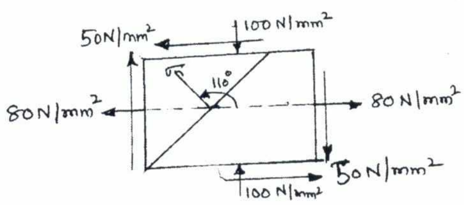
b. Establish a relationship between the modulus of elasticity and modulus of rigidity. **(07 Marks)**

c. A compound bar is made up of a central steel plate 50mm wide and 10mm thick to which copper plate 50mm wide and 5 mm thick are connected rigidly on each side. The length of the compound bar at room temperature is 1000mm. If the temperature is raised by 100°C, determine the stress in each material and change in length of the compound bar.
Assume E_S = 200GPa, E_C = 100 GPa, $\alpha_S = 12 \times 10^{-6}$/°C and $\alpha_C = 18 \times 10^{-6}$/°C. **(08 Marks)**

3 a. A point in a plate grider is subjected to a horizontal tensile stress of 100N/mm^2 and vertical shear stress of 60 N/mm^2. Find the magnitude of principle stresses and its location. **(10 Marks)**

b. An element with the stresses acting on it, is as shown in Fig.Q.3(b) by Mohr's circle method, determine: i) Normal and shear stress acting on a plane whose normal is at an angle of 110° with respect to X-axis; ii) Principal stresses and its locations; iii) Maximum shear stresses and its location. **(10 Marks)**

Fig.Q.3(b)



4 a. The maximum stress produced by a pull in a bar of length 100mm is $100 N/mm^2$. The area of cross sections and length are as shown in Fig.Q.4(a). Calculate the strain energy stored in the bar if $E = 2 \times 10^5 N/mm^2$. **(10 Marks)**

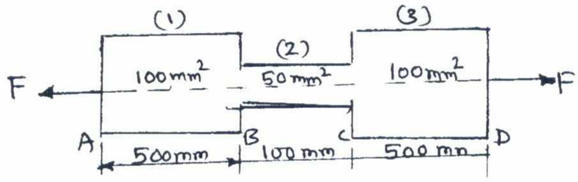


Fig.Q.4(a)

b. A thick cylinder with internal diameter 80mm and external diameter 120mm is subjected to an external pressure of $40 N/mm^2$, when the internal pressure is $120 N/mm^2$, calculate circumferential stress at external and internal surfaces of the cylinder. Plot the variation of circumferential stress and radial pressure on the thickness of the cylinder. **(10 Marks)**

PART – B

5 a. Derive expressions relating load, shear force and bending moment with usual notations. **(05 Marks)**

b. Draw the SFD and BMD for the over hanging beam shown in Fig.Q.5(b). Indicate all significant values including point of contra flexure. **(15 Marks)**

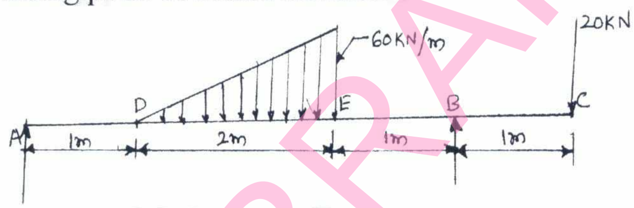


Fig.Q.5(b)

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

b. Derive an expression for relationship between bending stress and radius of curvature. **(06 Marks)**

c. An I section has the following dimensions. Flanges 200mm × 10mm; web 380mm × 8mm. The maximum shear stress developed in the beam is $20 N/mm^2$. Find the sheer force to which the beam is subjected. **(10 Marks)**

7 a. Derive an expression $EI\frac{d^2y}{dx^2} = M$ with usual notations. **(10 Marks)**

b. A beam of length 5m and of uniform rectangular section is simply supported at its ends. It carries a uniformly distributed load of 9kN/m run over the entire length. Calculate the width and depth of the beam if permissible bending stress is $7 N/mm^2$ and central deflection is not to exceed 1cm. take E for beam material $= 1 \times 10^4 N/mm^2$. **(10 Marks)**

8 a. A hollow shaft having an inside diameter 60% of its outer diameter, is to replace a solid shaft transmitting the same power at the same speed. Calculate the percentage saving in material, if the material to be used is also the same. **(10 Marks)**

b. A hollow C.I. column whose outside diameter is 200mm has a thickness of 20mm. It is 4.5m long and is fixed at both ends. Calculate the safe load by Rankine's formula using a factor of safety of 4. Calculate the slenderness ratio and the ratio of Euler's and Rankine's critical loads. Take $f_c = 550 N/mm^2$, $a = \frac{1}{1600}$ in Rankine's formula and $E = 9.4 \times 10^4 N/mm^2$. **(10 Marks)**

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Third Semester B.E. Degree Examination, Dec.2014/Jan.2015
Manufacturing Process - I

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Briefly explain the steps involved in metal casting process, with a neat flow diagram. **(10 Marks)**
b. List the types of patterns and explain any 3 of them, with neat sketches. **(10 Marks)**

2 a. What are the desirable properties of moulding sand? **(05 Marks)**
b. Explain briefly the different casting defects during casting process. **(05 Marks)**
c. With a neat sketch, explain the working principle of Jolt & Squeeze moulding machine. **(10 Marks)**

3 a. With a neat sketch, explain the steps involved in shell moulding. **(10 Marks)**
b. What are the steps involved in investment casting? Explain in brief, with neat sketches. **(10 Marks)**

4 a. Explain the construction and working principle of 'CUPOLA' furnace, with neat sketch. **(12 Marks)**
b. Explain with a neat sketch, working of coreless induction furnace. **(08 Marks)**

PART – B

5 a. Sketch and explain TIG welding process and its application. **(07 Marks)**
b. Explain with a neat sketch, the Submerged Arc Welding (SAW) process. **(07 Marks)**
c. With a neat sketch, explain the Oxy – acetylene gas welding process. **(06 Marks)**

6 a. Sketch and explain the Thermit welding process and mention the advantages, disadvantages and applications. **(10 Marks)**
b. With a neat sketch, explain the Laser Beam welding process and mention its advantages, disadvantages and applications. **(10 Marks)**

7 Write short notes on :
a. Residual stresses in welding.
b. Electrode using in welding.
c. Welding defects.
d. HAZ in welding. **(20 Marks)**

8 a. Differentiate Soldering and Brazing. **(05 Marks)**
b. What are the different Non – Destructive Testing (NDT) methods and explain with neat sketches of Magnetic Particle Inspection and Radiographic Inspection method. **(15 Marks)**

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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.

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Third Semester B.E. Degree Examination, Dec.2014/Jan.2015

Fluid Mechanics

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define the following fluid properties:
i) Density ii) Specific volume
iii) Viscosity iv) Specific gravity **(06 Marks)**

b. Define surface tension. Prove that the relation between surface tension and pressure inside a droplet of liquid in excess of outside pressure is given by $P = \frac{4\sigma}{d}$. **(06 Marks)**

c. The space between two flat parallel plates is filled with oil. Each side of the plate is 60 cm. The thickness of the oil film is 12.5 mm. The upper plate which moves at 2.5 m/s requires a force of 98.1 N to maintain the speed. Determine the following:
i) The dynamic viscosity of the oil in poise.
ii) The kinematic viscosity of the oil in strokes if the specific gravity of the oil is 0.95. **(08 Marks)**

2 a. State and prove the Pascal's law. **(06 Marks)**

b. An inverted U-tube manometer is connected to two horizontal pipes A and B through which water is flowing. The vertical distance between the axes of these pipes is 30 cm, when an oil of specific gravity 0.8 is used as a gauge fluid. The vertical height of water columns in the two limbs of the inverted U-tube manometer are found to be same and equal to 35 cm. Determine the difference of pressure between the pipes. **(06 Marks)**

c. A rectangular surface is 2m wide and 3m deep it lies in vertical plane in water. Determine the total pressure and position of centre pressure on the plane surface when its upper edge is horizontal and (i) coincides with water surface, (ii) 2.5 m below the free water surface. **(08 Marks)**

3 a. Derive the continuity equation in Cartesian coordinates. **(06 Marks)**

b. A block of wood of specific gravity 0.7 floats in water. Determine the metacentric height of the block if its size is 2m × 1m × 0.8m. **(08 Marks)**

c. Define the following terms:
i) Meta centre and meta centric height
ii) Buoyancy and centre of buoyancy **(06 Marks)**

4 a. Derive the Euler's equation of motion along a stream line. Also derive Bernoulli's equation from Euler's equation of motion and list the assumptions made for deriving Bernoulli's equation. **(10 Marks)**

b. A pipe line carrying oil of specific gravity 0.87, changes in diameter from 200 mm diameter at position A to 500 mm diameter at a position B which is 4m at a higher level. If the pressure at A and B are 9.81 N/cm^2 and 5.886 N/cm^2 respectively and the discharge is 200 litres/sec. Determine the loss of head and direction of flow. **(10 Marks)**

PART – B

5 a. Derive an expression for discharge through V-notch. **(06 Marks)**

b. A 30 cm × 15 cm venturimeter is provided in a vertical pipe line 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 cm. The differential U-tube mercury manometer shows a gauge deflection of 25 cm. Calculate the:

i) Discharge of the oil.

ii) Pressure difference between the entrance section and the throat section. Take the coefficient of meter as 0.98 and specific gravity of mercury is 13.6. **(10 Marks)**

c. State Buckingham's π theorem. **(04 Marks)**

6 a. Derive Chezy's equation for loss of head due to friction in pipes. **(06 Marks)**

b. Define the following terms:

i) Hydraulic gradient line

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

c. A pipe line 300 mm in diameter and 3200 m long is used to pump up 50 kg/s of an oil whose density is 950 kg/m^3 and whose kinematic viscosity is 2.1 stokes. The centre of the pipe line at the upper end is 40 m, above than that at the lower end. The discharge at the upper end is atmospheric. Find the pressure at the lower end and draw the hydraulic gradient line and the total energy line? **(10 Marks)**

7 a. Prove that the maximum velocity in a circular pipe for viscous flow is equal to two times the average velocity of the flow. **(10 Marks)**

b. An oil of specific gravity 0.7 is flowing through a pipe of diameter 300 mm at the rate of flow 500 lit/s. Find the following:

i) Head lost due to friction

ii) Power required to maintain the flow. **(06 Marks)**

c. Define the following:

i) Viscosity gradient

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

8 a. Differentiate between:

i) Pressure drag and friction drag

ii) Stream body and bluff body

iii) Lift and drag **(08 Marks)**

b. Define Mach number and derive the same. **(04 Marks)**

c. A flat plate 1.5 m × 1.5 m moves at 50 km/hr in stationary air of density 1.15 kg/m^3. If the coefficient of drag and lift are 0.15 and 0.75 respectively. Determine:

i) The lift force

ii) The drag force

iii) The resultant force

iv) Power required to keep the plate in motion. **(08 Marks)**

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MATDIP301

Third Semester B.E. Degree Examination, Dec.2014/Jan.2015
Advanced Mathematics – I

Time: 3 hrs. Max. Marks:100

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

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.

1 a. Express : $\frac{(3+i)(1-3i)}{2+i}$ in the form x + iy. **(05 Marks)**

b. Find the modulus and amplitude of the complex number $1 + \cos\alpha + i\sin\alpha$. **(05 Marks)**

c. If $(3x - 2iy)(2 + i)^2 = 10(1 + i)$, then find the values of x and y. **(05 Marks)**

d. Prove that $(\cos\theta_1 + i\sin\theta_1)(\cos\theta_2 + i\sin\theta_2) = \cos(\theta_1 + \theta_2) + i\sin(\theta_1 + \theta_2)$. **(05 Marks)**

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

b. If $y = a\cos(\log x) + b\sin(\log x)$ prove that $x^2y_{n+2} + (2n + 1)xy_{n+1} + (n^2 + 1)y_n = 0$. **(07 Marks)**

c. Compute the n^{th} derivatives of sin x sin 2x sin 3x. **(07 Marks)**

3 a. With usual notations prove that $\frac{1}{p^2} = \frac{1}{r^2} + \frac{1}{r^4}\left(\frac{dr}{d\theta}\right)^2$. **(06 Marks)**

b. Prove that the curves cuts $r^n = a^n\cos n\theta$, and $r^n = b^n\sin n\theta$ orthogonally. **(07 Marks)**

c. Expand $\log(1 + \sin x)$ in powers of x by Maclaurin's theorem up to the terms containing x^3. **(07 Marks)**

4 a. If $u = x^2y + y^2z + z^2x$, prove that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = (x + y + z)^2$. **(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 $u = e^x\cos y$, $v = e^x\sin y$, find $J = \frac{\partial(u,v)}{\partial(x,y)}, J' = \frac{\partial(x,y)}{\partial(u,v)}$ and verify $JJ' = 1$. **(07 Marks)**

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

b. Evaluate : $\int_0^1\int_x^{\sqrt{x}}(x^2 + y^2)dxdy$. **(07 Marks)**

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

6 a. Define Gamma function. Prove that $\Gamma(n + 1) = n\Gamma(n)$. **(06 Marks)**

b. With usual notation prove that : $\beta(m,n) = \frac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$. **(07 Marks)**

c. Prove that $\beta\left(m,\frac{1}{2}\right) = 2^{2m-1}\beta(m,m)$. **(07 Marks)**

7 a. Solve : $\sec^2 x \tan y \, dx + \sec^2 y \tan x \, dy = 0$. **(05 Marks)**

b. Solve : $\frac{dy}{dx} = 1 + \frac{y}{x} + \left(\frac{y}{x}\right)^2$. **(05 Marks)**

c. Solve : $\frac{dy}{dx} + y \cot x = \sin x$. **(05 Marks)**

d. Solve : $(x^2 + y)dx + (y^3 + x)dy = 0$. **(05 Marks)**

8 a. Solve : $\frac{d^3y}{dx^3} - 6\frac{d^2y}{dx^2} + 11\frac{dy}{dx} - 6y = 0$. **(06 Marks)**

b. Solve : $y'' - 6y' + 9y = e^x + 3^x$. **(07 Marks)**

c. Solve : $\frac{d^2y}{dx^2} + 4y = x^2 + \sin 3x$. **(07 Marks)**

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