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10MAT31

Third Semester B.E. Degree Examination, Dec.2013/Jan.2014
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. Find the Fourier series expansion of the function $f(x) = |x|$ in $(-\pi, \pi)$, hence deduce that $\frac{\pi^2}{8} = \sum_{n=1}^{\infty} \frac{1}{(2n-1)^2}$. **(06 Marks)**

b. Obtain the half-range cosine series for the function, $f(x) = (x-1)^2$ in the interval $0 \le x \le 1$ and hence show that $\pi^2 = 8\left\{\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + ...\right\}$ **(07 Marks)**

c. Compute the constant term and first two harmonics of the Fourier series of f(x) given by, **(07 Marks)**

x	0	$\frac{\pi}{3}$	$\frac{2\pi}{3}$	π	$\frac{4\pi}{3}$	$\frac{5\pi}{3}$	2π
f(x)	1.0	1.4	1.9	1.7	1.5	1.2	1.0

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

b. Find the Fourier transform of $f(x) = \begin{cases} 1-x^2 & \text{for } |x| \le 1 \\ 0 & \text{for } |x| > 1 \end{cases}$ and evaluate $\int_0^{\infty} \frac{x\cos x - \sin x}{x^3} dx$. **(07 Marks)**

c. Find the inverse Fourier sine transform of $\frac{s}{1+s^2}$. **(07 Marks)**

3 a. Obtain the various possible solutions of two dimensional Laplace's equation, $u_{xx} + u_{yy} = 0$ by the method of separation of variables. **(07 Marks)**

b. Solve the one-dimensional wave equation, $C^2 \frac{\partial^2 u}{\partial x^2} = \frac{\partial^2 u}{\partial t^2}$, $0 < x < l$ under the following conditions (i) $u(0, t) = u(l, t) = 0$ (ii) $u(x, 0) = \frac{u_0 x}{l}$ where u_0 is constant (iii) $\frac{\partial u}{\partial t}(x,0) = 0$. **(07 Marks)**

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

4 a. Find the best values of a, b, c, if the equation $y = a + bx + cx^2$ is to fit most closely to the following observations. **(07 Marks)**

x	1	2	3	4	5
y	10	12	13	16	19

b. Solve the following by graphical method to maximize $z = 50x + 60y$ subject to the constraints, $2x + 3y \le 1500$, $3x + 2y \le 1500$, $0 \le x \le 400$ and $0 \le y \le 400$. **(06 Marks)**

c. By using Simplex method, maximize $P = 4x_1 - 2x_2 - x_3$ subject to the constraints, $x_1 + x_2 + x_3 \le 3$, $2x_1 + 2x_2 + x_3 \le 4$, $x_1 - x_2 \le 0$, $x_1 \ge 0$ and $x_2 \ge 0$. **(07 Marks)**

PART – B

5 a. Using Newton-Raphson method, find a real root of $x\sin x + \cos x = 0$ nearer to π, carryout three iterations upto 4-decimals places. **(07 Marks)**

b. Find the largest eigen value and the corresponding eigen vector of the matrix,

$$\begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$$

By using the power method by taking the initial vector as $[1\ 1\ 1]^T$ carryout 5-iterations. **(07 Marks)**

c. Solve the following system of equations by Relaxation method:
$12x + y + z = 31$; $2x + 8y - z = 24$; $3x + 4y + 10z = 58$ **(06 Marks)**

6 a. A survey conducted in a slum locality reveals the following information as classified below,

Income per day in Rupees 'x'	Under 10	10 – 20	20 – 30	30 – 40	40 – 50
Numbers of persons 'y'	20	45	115	210	115

Estimate the probable number of persons in the income group 20 to 25. **(07 Marks)**

b. Determine f(x) as a polynomials in x for the data given below by using the 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 using Simpson's $\left(\frac{1}{3}\right)^{rd}$ rule by taking 6 – equal strips and hence deduce an approximate value of $\log_e 2$. **(06 Marks)**

7 a. Solve the wave equation, $\frac{\partial^2 u}{\partial t^2} = 4\frac{\partial^2 u}{\partial x^2}$, subject to 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 4-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 the computation for two levels taking $h = \frac{1}{3}$ and $K = \frac{1}{36}$. **(07 Marks)**

c. Solve $u_{xx} + u_{yy} = 0$ in the following square region with the boundary conditions as indicated in the Fig. Q7 (c). **(06 Marks)**

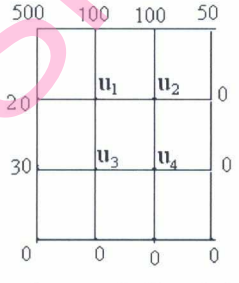

Fig. Q7 (c)

8 a. Find the z-transform of, (i) $\sinh n\theta$ (ii) $\cosh n\theta$ (iii) n^2 **(07 Marks)**

b. Find the inverse z-transform of, $\frac{2z^2 + 3z}{(z+2)(z-4)}$. **(06 Marks)**

c. Solve the difference equation, $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$ with $y_0 = y_1 = 0$ by using z-transform. **(07 Marks)**

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10ME32A/AU32A/MT32/TL32

Third Semester B.E. Degree Examination, Dec.2013/Jan.2014

Material 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. Sketch the unit cell of a HCP crystal structure. Calculate the number of atoms per unit cell. Derive an expression for the density of atomic packing factor. [Given c = 1.6339]. **(08 Marks)**

b. Explain different types of mechanism of diffusion in solids. **(08 Marks)**

c. Aluminum has a FCC structure and an atomic radius of 0.143 mm. Calculate volume of its unit cell in cubic meters. **(04 Marks)**

2 a. Define engineering stress and strain, and true stress strain. Find out the relationship between true strain and engineering strain. **(08 Marks)**

b. A steel rod of 10 mm diameter and 1.5 mt length is subjected to an axial tensile load of 1 kN. Determine: i) Stress, ii) Strain and iii) Elongation. Take modulus of elasticity of steel = 205×10^6 kN/m^2. **(06 Marks)**

c. Differentiate between slip and twinning deformation in materials. **(06 Marks)**

3 a. Define creep with a typical creep curves. Explain different stages of creep. **(06 Marks)**

b. Sketch the basic modes of fracture. List the difference between them. **(06 Marks)**

c. What is fatigue? Draw the SN curves for steel and aluminum alloys. **(08 Marks)**

4 a. Explain the homogeneous nucleation. Discuss the significance of critical radius of the nuclei. **(08 Marks)**

b. Define solid solution, and explain the different types of solid solution. **(06 Marks)**

c. State the Gibb's phase rule and explain with a simple example. **(06 Marks)**

PART – B

5 a. Draw the iron-carbon equilibrium diagram and label all the fields. Write the different invariation reactions. **(10 Marks)**

b. Explain the steps to construct TTT diagram. Draw a sketch of a TTT diagram label all the fields for an eutectoid steel. **(10 Marks)**

6 a. Define the process of heat treatment and classify the various heat treatment processes. **(08 Marks)**

b. Explain carburizing with a neat sketch. **(06 Marks)**

c. Define hardenabality of a material and list the factors affecting hardenability. **(06 Marks)**

7 a. Briefly describe the composition, properties and application of medium and high carbon steel. **(08 Marks)**

b. Briefly describe the composition, properties and application of grey cast iron. **(06 Marks)**

c. Discuss AIST-SAE designation of steel with examples. **(06 Marks)**

8 a. What is a composite material? How it is classified? Explain briefly. **(10 Marks)**

b. With a neat sketch, explain the hand lay up laminating process. **(10 Marks)**

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10ME/AU32B

Third Semester B.E. Degree Examination, Dec.2013/Jan.2014

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. Define metre in terms of wavelength standards. List the advantages of wavelength standards over material standards. **(06 Marks)**

b. Describe with a neat sketch:
i) Imperial standard yard
ii) Wringing phenomena of slip gauges **(08 Marks)**

c. Four length bars of basic length 100 mm are to be calibrated using a calibrated length bar of 400 mm whose actual length is 399.9992 mm. It was also found that length of bars B, C and D in comparison to A are +0.0002 mm, +0.0004 mm and –0.0001 mm respectively and the length of all the four bars put together in comparison to standard calibrated bar is +0.0003 mm longer. Determine the actual dimensions of all the four end bars. **(06 Marks)**

2 a. Differentiate between:
i) Hole basis and shaft basis system of tolerances
ii) Interchangeability and selective assembly. **(08 Marks)**

b. Write notes on:
i) Compound tolerances
ii) Gauge tolerance. **(04 Marks)**

c. Determine the dimensions of hole and shaft for a fit $30H_8f_7$. The given data are: $i = 0.45D^{1/3} + 0.001D$, IT8 = 25i, IT7 = 16i. Fundamental deviation for shaft 'f' is $-5.5D^{0.41}$. 30 mm diameter lies in the diameter step of 18-30 mm. Sketch the fit and comment on the same. **(08 Marks)**

3 a. Explain with a neat sketch, the working of Solex pneumatic gauge. **(08 Marks)**

b. Explain with a neat sketch, the construction and working of LVDT. **(08 Marks)**

c. Show the arrangement of angle gauges, with a neat sketch by selecting minimum number of gauges for the angles 32°15′33″ and 54°36′42″. **(04 Marks)**

4 a. What is the best size wire? Derive an expression for the same in terms of the pitch and angle of the thread. **(06 Marks)**

b. Explain 3-wire method of measuring effective diameter of screw thread. **(08 Marks)**

c. Explain the principle of interferrometry. Write a note on optical flat. **(06 Marks)**

PART – B

5 a. With a neat block diagram, explain the generalized measurement system with an example to each stage. **(08 Marks)**

b. Distinguish between: i) Primary and secondary transducers
ii) Active and passive transducers **(06 Marks)**

c. Define the following terms with reference to measurement system:
i) Calibration ii) Sensitivity
iii) Hysterisis iv) Threshold value **(06 Marks)**

6 a. With a neat sketch, explain the working principle of a CRO. **(08 Marks)**
b. State the advantages of electrical signal conditioning elements. **(06 Marks)**
c. Explain with a neat sketch, Ballast circuit diagram. **(06 Marks)**

7 a. With a neat sketch, describe the Pirani gauge used for pressure measurement. **(08 Marks)**
b. With a neat sketch, explain the working principle of proving ring. **(06 Marks)**
c. Explain with a suitable diagram, the working of hydraulic dynamometer. **(06 Marks)**

8 a. Sketch and explain the working principle of optical pyrometer. **(08 Marks)**
b. Describe the steps to be taken for the preparation of specimen and mounting of strain gauges. **(06 Marks)**
c. What is a thermocouple? State the laws of thermocouple. **(06 Marks)**

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10ME/AU/TL33

Third Semester B.E. Degree Examination, Dec.2013/Jan.2014
Basic Thermodynamics

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Distinguish between:
i) Microscopic and macroscopic point of view.
ii) Temperature and thermal equilibrium and
iii) Intensive and extensive properties. **(06 Marks)**

b. Classify the following into open, closed and isolated system:
i) Evaporator; ii) Thermoflask; iii) Passenger's train when stop at platform; iv) Refrigerant in a refrigerator; v) Pressure cooker; vi) I.C. engine during compression/expansion stroke; vii) Boiler and viii) Throttle valve. **(08 Marks)**

c. Define a Quasi-static process. A platinum wire is used as a resistance thermometer. The wire resistance was found to be 10ohm and 16ohm at ice point and steam point respectively, and 30ohm at sulphur boiling point of 444.6°C. Find the resistance of the wire at 750°C, if the resistance varies with temperature by the relation. $R = R_0 (1 + \alpha t + \beta t^2)$. **(06 Marks)**

2 a. Does heat transfer inevitably causes a temperature rise? What is the other cause for rise in temperature? **(02 Marks)**

b. With a neat p-V diagram, derive an expression for workdone in each case of the following:
i) Isochoric process.
ii) Isobaric process.
iii) Isothermal process and
iv) Polytropic process. **(10 Marks)**

c. A piston device contains $0.05m^3$ of a gas initially at 200kPa. At this state, a linear spring having a spring constant of 150 kN/m is touching the piston but exerting no force on it. Now heat is transferred to the gas, causing the piston to rise and to compress the spring until the volume inside the cylinder doubles. If the cross-sectional area of the piston is $0.25m^2$, determine: i) a final pressure inside the cylinder; ii) the total work done by the gas and iii) the fraction of work done against the spring to compress it. **(08 Marks)**

3 a. For a non-flow system, show that the heat transferred is equal to the change in enthalpy of a system. **(04 Marks)**

b. A gas undergoes a thermodynamic cycle consisting of the following processes: i) Process 1-2: constant pressure P = 1.4 bar, $V_1 = 0.028m^3$, $W_{12} = 10.5kJ$; ii) Process 2-3: compression with pV = constant, $U_3 = U_2$ and iii) Process 3-1: constant volume, $U_1 - U_3 = -26.4$ kJ. There are no significance change in KE and PE. i) Calculate the net work for the cycle; ii) Calculate the heat transfer for the process 1 – 2; ii) Show that $\sum_{cycle} Q = \sum_{cycle} W$, and iv) Sketch the cycle on p-V diagram. **(08 Marks)**

c. In a certain steady flow process, 12 kg of fluid per minute enters at a pressure of 1.4 bar, density 25 kg/m^3, velocity 120 m/s and internal energy 920 kJ/kg. The fluid properties at exit are 5.6 bar, density 5 kg/m^3, velocity 180 m/s, and internal energy 720 kJ/kg. During the process, the fluid rejects 60 kJ/s of heat and rises through 60m. Determine work done during the process in kW. **(08 Marks)**

4 a. State the limitations of first law of thermodynamics. Illustrate with examples. **(04 Marks)**

b. Prove that Kelvin-Plank and Clausius statements of second law of thermodynamics are equivalent. **(06 Marks)**

c. A heat pump working on the Carnot cycle takes in heat from a reservoir at 5°C and delivers heat to a reservoir at 60°C. The heat pump is driven by a reversible heat engine which takes in heat from a reservoir at 840°C and rejects heat to a reservoir at 60°C. The reversible heat engine also drives a machine that absorbs 30kW. If the heat pump extracts 17kJ/s from the 5°C reservoir, determine: i) the rate of heat supply from the 840°C source and ii) the rate of heat rejection to the 60°C sink. **(10 Marks)**

PART – B

5 a. Prove that whenever a system executes a compete cyclic process, the quantity $\oint \frac{dQ}{T} \leq 0$.

Hence prove that entropy is a property of the system. **(08 Marks)**

b. Explain principle of increase of entropy. **(06 Marks)**

c. In a shell and tube heat exchanger 45kg of water per minute is heated from 30°C to 85°C by hot gases which enter the heat exchanger at 225°C. If the flow rate of gases is 90 kg/min, find the net change of entropy of the universe. **(06 Marks)**

6 a. Draw the phase equilibrium diagram for a pure substance on T-S plot with relevant constant property lines. **(05 Marks)**

b. What is the main objective of quality measurement? With a neat sketch, explain throttling calorimeter. **(07 Marks)**

c. What do you understand by degree of superheat? Steam initially at 1.5MPa, 300°C expands reversibly and adiabatically in a steam turbine to 40°C. Determine the ideal work output of the turbine per kg of steam. **(08 Marks)**

7 a. Derive Clausius Clayperon's equation for evaporation of liquid and explain the significance. **(06 Marks)**

b. Distinguish between: i) Ideal gas and real gas and ii) Perfect gas and semiperfect gas. **(04 Marks)**

c. 0.5 kg of air is compressed reversibly and adiabatically from 80kPa, 60°C to 0.4MPa and is then expanded at constant pressure and to the original volume. Sketch these processes on the p-V and T-s planes. Compute the heat transfer and work transfer for the whole path. **(10 Marks)**

8 a. Explain the following:

i) Generalized compressibility chart.

ii) Law of corresponding states and

iii) Compressibility factor. **(06 Marks)**

b. Derive Vander Waal's constants in terms of critical properties. **(08 Marks)**

c. Determine the pressure exerted by CO_2 in a container of $1.5m^3$ capacity when it contains 5kg at 27°C. i) Using ideal gas equation and ii) Using Vander Waal's equation. **(06 Marks)**

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10ME/AU/PM/TL34

Third Semester B.E. Degree Examination, Dec.2013/Jan.2014

Mechanics of Materials

Time: 3 hrs. Max. Marks:100

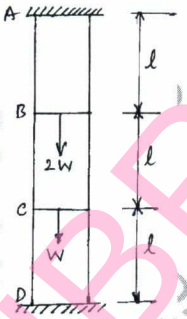
Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Define: i) True stress ii) Factor of safety iii) Poisson's ratio iv) Principle of superposition **(04 Marks)**

b. A bar of uniform thickness 't' tapers uniformly from a width of b_1 at one end to b_2 at other end, in a length of 'L'. Find the expression for the change in length of the bar when subjected to an axial force P. **(08 Marks)**

c. A vertical circular steel bar of length 3l fixed at both of its ends is loaded at intermediate sections by forces W and 2W as shown in Fig.Q2(c). Determine the end reactions if W = 1.5 kN. **(08 Marks)**



2 a. Define: i) Volumetric strain, ii) Bulk modulus. **(02 Marks)**

b. A bar of rectangular cross section shown in Fig.Q2(b) is subjected to stresses σ_x, σ_y and σ_z in x, y and z directions respectively. Show that if sum of these stresses is zero, there is no change in volume of the bar.

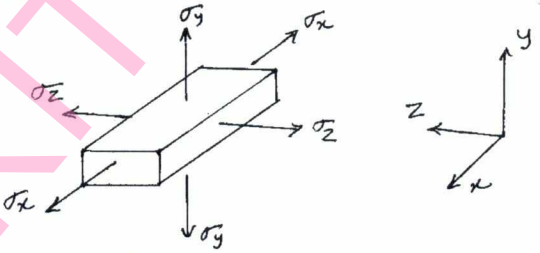


Fig.Q2(b) **(09 Marks)**

c. Rails are laid such that there is no stress in them at 24°C. If the rails are 32 m long, determine:
i) The stress in the rails at 80°C, when there is no allowance for expansion
ii) The stress in the rails at 80°C, when there is an expansion allowance of 8 mm per rail.
iii) The expansion allowance for no stress in the rails at 80°C.
Coefficient of linear expansion $\alpha = 11 \times 10^{-6}$/°C and Young's modulus E = 205 GPa. **(09 Marks)**

3 a. Derive the expressions for normal and tangential stress on a plane inclined at 'θ' to the plane of stress in x-direction in a general two dimensional stress system and show that sum of normal stress in any two mutually perpendicular directions is constant. **(12 Marks)**

3 b. The state of stress in a two dimensionally stressed body is shown in Fig.Q3(b). Determine graphically (by drawing Mohr's circle), the principal stresses, principal planes, maximum shear stress and its planes. **(08 Marks)**

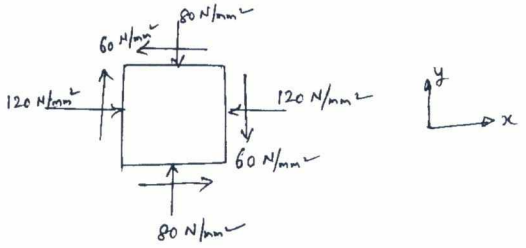


Fig.Q3(b)

4 a. A beam of length l is simply supported at its ends. The beam carries a uniformly distributed load of w per unit run over the whole span. Find the strain energy stored by the beam. **(06 Marks)**

b. A water main 80 cm diameter contains water at a pressure head of 100 m. If the weight density of water is 9810 N/m^3, find the thickness of the metal required for the water main. Given the permissible stress as 20 N/mm^2. **(06 Marks)**

c. A pipe of 400 mm internal diameter and 100 mm thickness contains a fluid at a pressure of 8 N/mm^2. Find the maximum and minimum hoop stress across the section. Also, sketch the radial pressure distribution and hoop stress distribution across the section. **(08 Marks)**

PART – B

5 a. Define a beam. Explain with simple sketches, different types of beams. **(06 Marks)**

b. Draw the shear force and bending moment diagrams for the overhanging beam carrying uniformly distributed load of 2 kN/m over the entire length and a point load of 2 kN as shown in Fig.Q5(b). Locate the point of contra flexure. **(14 Marks)**

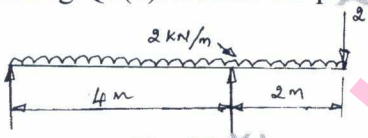


Fig.Q5(b)

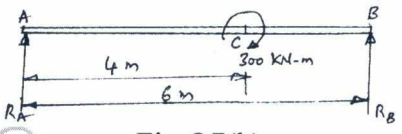


Fig.Q7(b)

6 a. State the assumptions made in the theory of simple bending. **(02 Marks)**

b. A simply supported cast iron square beam of 800 mm length and 15 mm × 15 mm in section fails on applying a load of 360 N at the mid span. Find the maximum uniformly distributed load that can be applied safely to a 40 mm wide, 75 mm deep and 1.6 m long cantilever made of the same material. **(08 Marks)**

c. Show that the shear stress across the rectangular section varies parabolically. Also show that the maximum shear stress is 1.5 times the average shear stress. Sketch the shear stress variation across the section. **(10 Marks)**

7 a. A cantilever 120 mm wide and 200 mm deep is 2.5 m long. What is the uniformly distribution load which the beam can carry in order to a deflection of 5 mm at the free end? Take E = 200 GN/m^2. **(04 Marks)**

b. A horizontal beam AB is simply supported at A and B, 6 m apart. The beam is subjected to a clockwise couple of 300 kN-m at a distance of 4 m from the left end as shown in Fig.Q7(b). If E = 2 × 10^5 N/mm^2 and I = 2 × 10^8 mm^4, determine: i) The deflection at the point where the couple is acting; ii)The maximum deflection. **(16 Marks)**

8 a. Derive torsion equation with usual notations. State the assumptions in the theory of pure torsion. **(10 Marks)**

b. Derive an expression for Euler's buckling load in a column when both ends are fixed. **(10 Marks)**

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10ME/AU35

Third Semester B.E. Degree Examination, Dec.2013/Jan.2014
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. List and briefly explain the different steps involved in a casting process. **(08 Marks)**

b. Discuss in detail the different materials used in making a pattern. **(06 Marks)**

c. Briefly discuss the importance of binders and additives used in sand moulding. **(06 Marks)**

2 a. List the types of moulding sand. Discuss the desirable properties of moulding sand. **(08 Marks)**

b. With neat sketch, explain jolt type moulding machine. **(07 Marks)**

c. List casting defects. Discuss any two. **(05 Marks)**

3 a. With neat sketches, describe the shell moulding process. List advantages of the process. **(10 Marks)**

b. What is die-casting? With a neat and labeled sketch, explain cold chamber diecasting process. **(10 Marks)**

4 a. With neat sketch, show the construction details of a Cupola furnace. Also indicate different zones and write the reactions taking place in each of the zones. **(10 Marks)**

b. With neat sketch, explain the working of a direct arc electric furnace. **(10 Marks)**

PART – B

5 a. Explain the following, with neat sketches:
i) Submerged arc welding.
ii) Oxy-acetylene welding.
and their field of applications. **(12 Marks)**

b. With neat sketch, explain forward and backward welding methods. **(08 Marks)**

6 a. With neat sketches, explain the following:
i) Seam welding
ii) Projection welding. **(12 Marks)**

b. With a sketch, explain the electron beam welding process and mention its applications. **(08 Marks)**

7 a. With neat sketch, explain heat affected zone (HAZ) and its various regions. **(10 Marks)**

b. Explain the different welding defects, their causes and remedies. **(10 Marks)**

8 a. What is non-destructive testing? Explain with neat sketch ultrasonic inspection and its application areas. **(10 Marks)**

b. With neat sketch, explain fluroscent particle inspection process and its application areas. **(10 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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10ME/AU36B

Third Semester B.E. Degree Examination, Dec.2013/Jan.2014
Fluid Mechanics

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define the following terms and mention their SI units:
   i) Capillarity.
   ii) Dynamic viscosity.
   iii) Weight density.
   iv) Bulk modulus. **(06 Marks)**

b. Explain the effect of temperature variation on viscosity of liquids and gasses. **(04 Marks)**

c. Two large plane surfaces are 2.4cm apart. The space between the surface is filled with glycrene. What force is required to drag a very thin plate of surface area 0.5 square meters between the two large plane surfaces at a speed of 0.6 m/s, if the thin plate is at a distance of 0.8cm from one of the plane surface? Take $\mu = 8.1 \times 10^{-1}$ N-s/m^2. **(07 Marks)**

d. Derive an expression for surface tension of a soap bubble. **(03 Marks)**

2 a. Define the following:
   i) Gauge pressure.
   ii) Vaccum pressure.
   iii) Centre of pressure.
   iv) Hydrostatic law. **(08 Marks)**

b. A Caisson for closing the entrance to dry dock is of trapezoidal form 16m wide at the top and 10m wide at the bottom and 6m deep. Find the total pressure and centre of pressure on the Caisson if the water on the outside is just level with the top and dock is empty. **(08 Marks)**

c. What is a manometer? How they are classified? **(04 Marks)**

3 a. If for a two-dimensional potential flow, the velocity potential is given by $\phi = x(2y - 1)$, determine the velocity at point P(4, 5). Determine also the value of stream function at the point P. **(10 Marks)**

b. Derive an expression for metacentric height of a floating body using analytical method. **(10 Marks)**

4 a. Derive Euler's equation of motion for an ideal gas. **(08 Marks)**

b. State Bernoulli's theorem for steady flow of an incompressible fluid. **(02 Marks)**

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

PART – B

5 a. Derive an expression for the discharge over a triangular notch in terms of water over the crest of the notch. **(08 Marks)**

b. A 30cm × 15cm 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 30cm. The differential U-tube mercury manometer shows a gauge deflection of 25cm. Calculate: i) The discharge of oil; ii) the pressure difference between the entrance section and the throat section. Take coefficient of meter as 0.98 and specific gravity of mercury as 13.6. **(09 Marks)**

c. What are the methods of dimensional analysis? Describe Buckingham's π-theorem for dimensional analysis. **(03 Marks)**

6 a. Derive an expression for the loss of head due to sudden enlargement of a pipe. **(10 Marks)**

b. Determine the difference in the elevations between the water surfaces in the two tanks which are connected by a horizontal pipe of diameter 300mm and length 400m. The rate of flow through the pipe is 300 litres/sec. Consider all losses and take f = 0.008. Also draw HGL and TEL. **(10 Marks)**

7 a. Derive an expression for Hagen Poiseullie formulae. **(10 Marks)**

b. An oil of viscosity 0.1 N-s/m^2 and relative density 0.9 is flowing through a circular pipe of diameter 50mm and length 300m. The rate of flow of fluid through the pipe is 3.5 litres/sec. Find the pressure drop in a length of 300m and also the shear stress at the pipe wall. **(10 Marks)**

8 a. Define terms: i) Drag; ii) Lift; iii) Displacement thickness; iv) Boundary layer thickness; v) Energy thickness. **(10 Marks)**

b. For the velocity profile for laminar boundary layer flows given as $\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$, find an expression for boundary layer thickness (δ). Shear stress (τ_0) interms of Reynold's number. **(10 Marks)**

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MATDIP301

Third Semester B.E. Degree Examination, Dec.2013/Jan.2014

Advanced Mathematics – I

Time: 3 hrs. Max. Marks:100

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

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

b. Find the modulus and amplitude of $\frac{(3-\sqrt{2i})^2}{1+2i}$. **(07 Marks)**

c. Expand $\cos^8\theta$ in a series of cosines multiples of θ. **(07 Marks)**

2 a. Find the n^{th} derivative of sin(ax + b). **(06 Marks)**

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

c. Find the nth derivative of $\left[\frac{1}{5(x-1)} + \frac{-3/2}{\left(\frac{-3}{2}-1\right)(2x+3)}\right]$. **(07 Marks)**

3 a. Using Taylor's theorem, express the polynomial $2x^3 + 7x^2 + x - 6$ in powers of (x – 1). **(06 Marks)**

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

c. If $Z = x^3 + y^3 - 3axy$ then prove that $\frac{\partial^2 z}{\partial y \partial x} = \frac{\partial^2 z}{\partial x \partial y}$. **(07 Marks)**

4 a. If $u = x \log xy$ where $x^3 + y^3 + 3xy = 1$, find $\frac{du}{dx}$. **(06 Marks)**

b. If z = f(x, y) and $x = e^u + e^{-v}$ and $y = e^{-u} - e^v$, prove that $\frac{\partial z}{\partial u} - \frac{\partial z}{\partial v} = x \cdot \frac{\partial z}{\partial x} - y\frac{\partial z}{\partial y}$. **(07 Marks)**

c. If $u = x + 3y^2 - z^3$, $v = 4x^2yz$, $w = 2z^2 - xy$, find the value of $\frac{\partial(u, v, w)}{\partial(x, y, z)}$ at (1, –1, 0). **(07 Marks)**

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

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

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

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

b. Find the value of $\left|\overline{\left(\frac{1}{2}\right)}\right.$. **(07 Marks)**

c. Prove that $\beta(m, n) = \frac{\overline{|(m)}\,\overline{|(n)}}{\overline{|(m+n)}}$. **(07 Marks)**

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

b. Solve $\frac{dy}{dx} = \frac{x^2 - y^2}{xy}$ which is homogeneous in x and y. **(07 Marks)**

c. Solve $\frac{dy}{dx} - \frac{y}{x+1} = e^{3x}(x+1)$. **(07 Marks)**

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

b. Solve $\frac{d^2y}{dx^2} - 3\frac{dy}{dx} + 2y = \sin 2x$. **(07 Marks)**

c. Solve $(D^2 - 1)y = x \sin 3x + \cos x$. **(07 Marks)**

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