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10MAT31

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
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 in $(-\pi, \pi)$ for $f(x) = x\cos x$. **(07 Marks)**

b. Obtain the Fourier half range sine series,

$$f(x) = \begin{cases} \frac{1}{4} - x & \text{in } 0 < x < \frac{1}{2} \\ x - \frac{3}{4} & \text{in } \frac{1}{2} < x < 1 \end{cases}.$$ **(07 Marks)**

c. Obtain the constant term and the coefficients of the first cosine and sine terms in the Fourier expansion of y from the table. **(06 Marks)**

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

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

b. Find the Fourier sine transform of $e^{-|x|}$. **(07 Marks)**

c. Find the inverse Fourier sine transform of $f_s(\alpha) = \frac{e^{-a\alpha}}{\alpha}$, $a > 0$. **(06 Marks)**

3 a. Solve the wave equation $u_{tt} = c^2 u_{xx}$ given that $u(0,t) = 0 = u(2l,t)$, $u(x, 0) = 0$ and $\frac{\partial u}{\partial t}(x,0) = a\sin^3\frac{\pi x}{2l}$ **(07 Marks)**

b. Solve the boundary value problem $\frac{\partial u}{\partial t} = c^2\frac{\partial^2 u}{\partial x^2}$ $0 < x < l$, $\frac{\partial u}{\partial x}(0,t) = 0$, $\frac{\partial u}{\partial x}(l,t) = 0$, $u(x, 0)=x$. **(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. Fit a parabola $y = a + bx + cx^2$ for the data: **(07 Marks)**

x	0	1	2	3	4
y	1	1.8	1.3	2.5	2.3

b. Solve by using graphical method the L.P.P.
Minimize $z = 30x + 20y$
Subject to the constraints: $x - y \leq 1$
$x + y \geq 3$, $y \leq 4$
and $x \geq 0$, $y \geq 0$ **(07 Marks)**

c. Maximize $z = 3x + 4y$
subject to the constraints $2x + y \leq 40$, $2x + 5y \leq 180$,
$x \geq 0, y \geq 0$ using simplex method. **(06 Marks)**

PART – B

5 a. Find the fourth root of 12 correct to three decimal places by using regula Falsi method. **(07 Marks)**

b. Solve $9x-2y+z=50$, $x+5y-3z=18$, $-2x+2y+7z=19$ by relaxation method obtaining the solution correct to two decimal places. **(07 Marks)**

c. Find the largest eigen value and the corresponding eigen vector of, $\begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$ by using power method by taking initial vector as $[1 \quad 1 \quad 1]^T$. **(06 Marks)**

6 a. The table gives the values of $\tan x$ for $0.10 \le x \le 0.30$ **(07 Marks)**

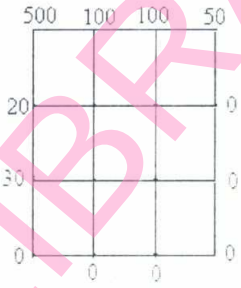
x	0.10	0.15	0.20	0.25	0.30
tanx	0.1003	0.1511	0.2027	0.2553	0.3093

b. Using Newton's forward and backward interpolation formula, calculate the increase in population from the year 1955 to 1985. The population in a town is given by, **(07 Marks)**

Year	1951	1961	1971	1981	1991
Population in thousands	19.96	39.65	58.81	77.21	94.61

c. Evaluate $\int_0^1 \frac{dx}{1+x}$ taking seven ordinates by applying Simpson's $\frac{3}{8}^{th}$ rule. Hence deduce the value of $\log_e 2$. **(06 Marks)**

7 a. Solve the Laplace's equation $u_{xx}+u_{yy}=0$, given that **(07 Marks)**



b. Solve $\frac{\partial^2 u}{\partial t^2}=4\frac{\partial^2 u}{\partial x^2}$ subject to $u(0,t)=0$; $u(4,t)=0$; $u(x,0)=x(4-x)$. Take h = 1, K = 0.5 upto Four steps. **(07 Marks)**

c. Solve the equation $\frac{\partial u}{\partial t}=\frac{\partial^2 u}{\partial x^2}$ subject to the condition $u(x, 0) = \sin \pi x$, $0 \le x \le 1$, $u(0,t)=u(1,t)=0$ using Schmidt's method. Carry out computations for two levels, taking $h=\frac{1}{3}$, $K=\frac{1}{36}$. **(06 Marks)**

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

b. Obtain the inverse z-transform of, $\frac{4z^2-2z}{z^3-5z^2+8z-4}$. **(07 Marks)**

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

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10ME/AU32A

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
Material Science and Metallurgy

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define Unit cell, Co-ordination number. **(04 Marks)**
b. Draw the FCC Lattice and calculate its atomic packing factor. **(08 Marks)**
c. Explain Crystal imperfections with figures. **(08 Marks)**

2 a. Define Engineering Stress and Strain and True stress and strain. Find out the relationship between True strain and Engineering strain. **(08 Marks)**
b. Define the following terms : i) Yield strength ii) Offset yield strength iii) Ductility iv) Ultimate strength v) Toughness. **(08 Marks)**
c. Compare Plastic deformation by slip and twinning. **(04 Marks)**

3 a. Explain types of fractures with figures. **(08 Marks)**
b. Draw the Creep curve and explain briefly. **(06 Marks)**
c. Explain types of fatigue loading with examples. **(06 Marks)**

4 a. Define Solid solutions and explain different types of solid solutions with figures. **(08 Marks)**
b. Explain the Mechanism of solidification. **(05 Marks)**
c. Explain the Construction of phase diagram with figure. **(07 Marks)**

PART – B

5 a. Draw the Fe – Fe_3C Equilibrium diagram and label the phases. **(10 Marks)**
b. Explain the construction of T.T.T diagram with figure and label it. **(10 Marks)**

6 a. Differentiate between Austempering and Martempering of steels. **(06 Marks)**
b. Write a brief note on annealing and normalizing heat treatments process. **(06 Marks)**
c. Explain Carburizing and flame hardening in brief. **(08 Marks)**

7 a. Mention the composition, properties and application of malleable iron. **(08 Marks)**
b. Briefly describe the properties and applications of α - Brasses and red brasses and mention their compositions. **(06 Marks)**
c. Write a brief note on aluminium and its alloys. **(06 Marks)**

8 a. With a neat sketch, explain the production of Fibre – reinforced plastics (any one method). **(10 Marks)**
b. Explain the advantages and applications of composite material. **(10 Marks)**

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10ME/AU32B

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Describe with neat sketches : i) Imperial standard yard ii) International prototype meter. **(06 Marks)**

b. Distinguish between line and end standards. Give examples. **(04 Marks)**

c. Three 100mm gauges are measured on a comparator by wringing them together and then comparing with 300mm gauge, also intercomparing them. The 300mm gauge actually measures 300.0025mm. And three gauges together have a combination length of 300.0035mm. Gauge 'A' is 0.002mm longer than 'B' but shorter than 'C' by 0.001mm. Determine correct length of each gauge. **(10 Marks)**

2 a. Define the terms : i) Allowance ii) Tolerance iii) FIT iv) LIMITS. **(08 Marks)**

b. How do you classify plain gauges? Sketch and explain solid plug gauge and snap gauge. **(08 Marks)**

c. A 20mm diameter shaft and bearing are to be assembled with a clearance fit. The tolerance and allowances are as below : Allowance = 0.002mm ; Tolerance on hole = 0.005mm ; Tolerance on shaft = 0.003mm. Find the limits of size of the hole and shaft with hole basis and shaft basis systems. The tolerances are disposed of unilaterally. **(04 Marks)**

3 a. What is a Comparator? List essential characteristics of a good comparator. **(06 Marks)**

b. Briefly describe construction and working of a SOLEX pneumatic comparator. **(08 Marks)**

c. Explain how a sine bar is used to measure the angle of a component of large size. **(06 Marks)**

4 a. Write a short note on Optical flats. **(04 Marks)**

b. Illustrate the following methods :
i) Measurement of minor diameter using two V – pieces.
ii) Measurement of effective diameter using thread micrometer. **(08 Marks)**

c. Describe with neat sketch, the working principle and applications of Tool Makers Microscope. **(08 Marks)**

PART – B

5 a. Explain the following terms : i) Accuracy and precision ii) Repeatability iii) Error iv) Systematic error's. **(08 Marks)**

b. Sketch and explain generalized measuring system taking pressure gauges as an example. **(08 Marks)**

c. List the advantages and disadvantages of capacitive transducers. **(04 Marks)**

6 a. Briefly explain the following : i) Chopper Amplifier ii) Carrier Amplifier. **(06 Marks)**

b. With a neat diagram, explain the following :
i) Light Beam type oscillograph ii) X – Y Plotter. **(14 Marks)**

7 a. Define Force. What are the basic methods of measurement of force? **(06 Marks)**

b. With a neat diagram, explain the working of a mechanical dynamometer and list its limitations. **(08 Marks)**

c. Briefly discuss principle of Pirani gauge. **(06 Marks)**

8 a. What is a Thermocouple? Explain the principle on which it works and list its advantages and limitations. **(08 Marks)**

b. Write a brief note on Optical pyrometer with its advantages and disadvantages. **(08 Marks)**

c. What are Electrical Strain gauges? Discuss. **(04 Marks)**

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10ME33

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
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 steam table permitted.

PART – A

1 a. Distinguish between:
i) Intensive and extensive properties.
ii) Microscopic and macroscopic point of view.
iii) Adiabatic boundary and a diathermic boundary. **(06 Marks)**

b. With neat diagram, explain the working of constant volume gas thermometer for measurement of temperature. **(08 Marks)**

c. State Zeroth law of thermodynamics. The temperature T on a thermometric scale is defined as T = a/n k + b where a and b are constant. The values of K are found to be 1.83 and 6.78 at 0°C and 100°C respectively calculate the temperature for a value of K = 2.42. **(06 Marks)**

2 a. With a neat P-V diagram, derive an expression for work done during polytropic process ($PV^n = C$). **(05 Marks)**

b. Explain p-dv work and prove that work in a path function. **(06 Marks)**

c. A fluid contained in a horizontal cylinder with a frictionless lead proof piston is continuously agitation by means of a stirrer passing through the cylinder cover. The cylinder diameter is 0.4m. During the stirring process lasting 10 minutes, the piston slowly moves out a distance of 0.485m against the atmospheric pressure of 101kpa. The network done by fluid during the process is 2kJ. The speed of the electric motor driving the stirrer is 840 rpm. Determine the torque in the shaft. **(09 Marks)**

3 a. Write the steady flow energy equation and modify the SFEE for the following cases:
i) Adiabatic expansion of steam in turbine.
ii) Horizontal steam nozzle with negligible entrance velocity. **(06 Marks)**

b. A slow chemical reaction takes place in a fluid at a constant pressure of 0.1 MPa. The fluid is surrounded by a perfect heat insulator during the reaction which begins at state 1 and ends at state 2. The insulation is then removed and 105 kJ of heat flow to the surroundings as the fluid goes to state 3. The following data are observed for the fluid at state 1, 2 and 3.

State	Volume (m^3)	t°C
1	0.03	20
2	0.3	370
3	0.06	20

For the fluid system calculate E_2 and E_3 if $E_1 = 0$. **(08 Marks)**

c. Steam having a specific enthalpy of 2930 kJ/kg flows through a turbine nozzle and after expansion leave the nozzle with an enthalpy 2260 kJ/kg. If the flow is adiabatic determine the exit velocity if (i) the initial velocity is 3600 m/min; (ii) the initial velocity is neglected. **(06 Marks)**

4 a. State and prove carnot theorem. **(06 Marks)**

b. Define Kelvin-Plank and Clausius statements of second law of thermodynamics. **(04 Marks)**

c. Define the following terms: i) Heat engine cycle; ii) Refrigeration effect. **(04 Marks)**

d. An inventor claims that his engine has the following specification. Heating value of the fuel = 74,500 kJ/kg temperature limits 750°C and 25°C. Power developed 75kW fuel burned 0.07kg/min state whether the claim is valid or not. **(06 Marks)**

PART – B

5 a. State and prove Clausius inequality. **(06 Marks)**

b. Starting from first law of thermodynamics. Show that the change in entropy for a reversible isobaric compression process is given by $(s_2 - s_1) = mC_p \log e \frac{v_2}{v_1}$. **(06 Marks)**

c. $0.04m^3$ of nitrogen contained in a cylinder behind a piston is initially at 1.05 bar and 15°C. The gas is compressed isothermally and reversibly until the pressure is 4.8 bar calculate:

i) The change in entropy.

ii) The heat flow and

iii) The workdone.

Sketch the process on a p-v and T-s diagram. Assume nitrogen to act as a perfect gas molecular weight (M) of nitrogen is 28. **(08 Marks)**

6 a. Define: i) Triple point; ii) Saturated liquid; iii) Dryness fraction. **(04 Marks)**

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

c. Steam at 10 bar and 200°C undergoes a reversible polytropic process to 1 bar according to the law $pv^{1.15} = c$. Determine the final specific volume, the final temperature and heat transferred for the process. **(09 Marks)**

7 a. Write Maxwell's equations and state their importance in thermodynamics. **(06 Marks)**

b. Derive the first and second T-ds equations. **(06 Marks)**

c. Show that for a perfect gas, the difference between the specific heats ($C_p - C_v$) can be expressed as

$$C_p - C_v = \left[p + \left(\frac{\partial u}{\partial v} \right)_T \right] \left(\frac{\partial v}{\partial T} \right)_P = pv\beta + v\beta \left(\frac{\partial u}{\partial v} \right)_T$$

where β is the coefficient of volume expansion. **(08 Marks)**

8 a. Define the following terms:

i) Partial pressure of a gas in a mixture.

ii) Mole fraction of gas.

iii) Mass fraction of a gas. **(06 Marks)**

b. Derive Vander Waal's constants in terms of critical properties. **(06 Marks)**

c. $0.1m^3$ of hydrogen initially at 1.2 MPa, 200°C undergoes a reversible isothermal expansion process to 0.1 MPa. Determine: i) The work done; ii) The heat transfer; iii) Change in enthalpy and iv) Change in entropy. R = 4.124 kJ/kg K. For hydrogen C_p = 14.4 kJ/kg K, C_v = 10.276 kJ/kg K. **(08 Marks)**

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10ME/AU34

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
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. Explain stress-strain curve with salient points. **(06 Marks)**

b. Obtain an expression extension of a bar with continuously varying rectangular cross section. **(08 Marks)**

c. Determine the reactions at the two ends of the bar if the diameter is 25mm and modulus of elasticity is 200 GPa as shown in the Fig.Q.1(c). **(06 Marks)**

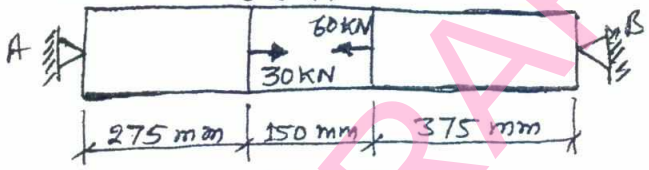

Fig.Q.1(c)

2 a. Derive an equation for volumetric strain for triaxial stress system. **(06 Marks)**

b. A compound bar is made of a central steel plate 60mm wide and 10mm thick to which copper plates 40mm wide by 5mm thick are connected rigidly on each side. The length of the bar at normal temperature is one meter. If the temperature is raised by 80°C, determine the stresses in each metal and the change in length. Take E_s = 200GPa, E_c = 100GPa, $\alpha_s = 12 \times 10^{-6}$/°C and $\alpha_c = 17 \times 10^{-6}$/°C. **(14 Marks)**

3 a. State of stress at a point in a strained material with tensile stress of 180 N/mm^2 in x-direction, tensile stress of 120 N/mm^2 in y-direction and shear stress of 80 N/mm^2. Determine:

i) The direction of the principal planes.
ii) The magnitude of principal stresses and
iii) The magnitude of the maximum shear stress and its direction.

Indicate all the above planes by a sketch. **(10 Marks)**

b. The bi-axial stress system subjected to a tensile stress of 60 N/mm^2, compressive stress of 40N/mm^2 in x and y directions respectively and shear stress 10 N/mm^2. Determine using Mohr's circle principal stresses, maximum shear stress and its directions. **(10 Marks)**

4 a. A cylindrical shell is 3m long and is having one meter internal diameter and 15mm thickness. Calculate the maximum intensity of shear stress induced and also the changes in the dimensions of shell if it is subjected to an internal fluid pressure of 1.5 N/mm^2. Take $E = 2 \times 10^5$Pa and Poissons ratio is 0.3. **(10 Marks)**

b. A thick cylindrical pipe of outside diameter 300mm and internal diameter 200mm is subjected to an internal fluid pressure of 14N/mm^2. Determine the maximum hoop stress developed in the cross section. What is the percentage of error if the maximum hoop stress is found from the equation for thin pipes? **(10 Marks)**

PART – B

5 a. Draw the shear force and bending moment diagrams for the cantilever beam shown in the Fig.Q.5(a). **(08 Marks)**

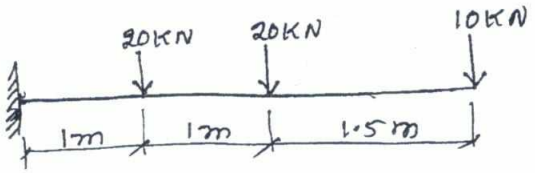

Fig.Q.5(a)

b. For the beam AC shown in the Fig.Q.5(b), determine the magnitude of the load P acting at C, such that the reaction at supports A and B are equal. Draw shear force and bending moment diagrams and locate the point of contra flexure if any **(12 Marks)**

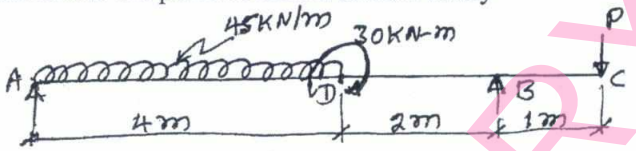

Fig.Q.5(b)

6 a. Derive bending equation $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$. **(10 Marks)**

b. A simply supported beam of span 5m has a cross section 150mm × 250mm. If the permissible stress is 10N/mm^2, find: i) maximum intensity of uniformly distributed load it can carry; ii) maximum concentrated load P applied at 2m from an end it can carry. **(10 Marks)**

7 a. Derive deflection equation for a simply supported beam subjected to uniformly distributed load. **(10 Marks)**

b. Determine the deflection at points C, D and E in the beam shown in the Fig.Q.7(b). Take E = 200 kN/mm^2 and I = 60 × 10^6 mm^4. **(10 Marks)**

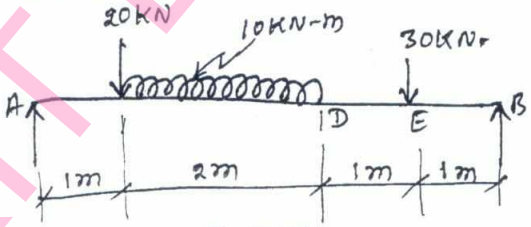

Fig.Q.7(b)

8 a. Derive Euler's equation of a column for both ends hinged. **(10 Marks)**

b. Determine the diameter of solid shaft which will transmit 440kW at 280rpm. The angle of twist must not exceed one degree per metre length and the maximum torsional shear stress is to be limited to 40N/mm^2. Assume G = 84kN/mm^2. **(10 Marks)**

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10ME/AU35

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
Manufacturing Processes - 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 basic steps involved in Sand Casting process. **(05 Marks)**

b. What is Pattern? What are the factors to be considered while selecting a pattern material? **(05 Marks)**

c. What are the additives used in foundry sand? Mention the purpose and percentage of each additive used. **(05 Marks)**

d. Write a brief note on BIS colour coding of patterns. **(05 Marks)**

2 a. Explain briefly the essential requirements of base sand used in foundry. **(05 Marks)**

b. With necessary sketches, explain the following :
i) Balanced core ii) Kiss core. **(05 Marks)**

c. With reference to the gating system, explain the following terms :
i) Riser ii) Pouring basin iii) Runner iv) Sprue and v) Ingate. **(05 Marks)**

d. Write a note on Sand Slinger. **(05 Marks)**

3 a. With a neat sketch, explain sweep moulding process. **(05 Marks)**

b. With necessary sketches, briefly explain the steps involved in the CO_2 moulding process. List the advantages and limitations of the process. **(10 Marks)**

c. Explain squeeze casting technique, with suitable diagram. **(05 Marks)**

4 a. List the factors considered for selecting the melting furnace. **(04 Marks)**

b. With suitable sketch, explain electric resistance furnace. **(06 Marks)**

c. What are the differences between direct and indirect arc furnaces? **(04 Marks)**

d. What are the various zones of Cupola furnace? Write the reactions taking place in each zone. **(06 Marks)**

PART – B

5 a. What are the advantages and disadvantages of welding over other manufacturing processes? **(06 Marks)**

b. With suitable sketch, explain submerged arc welding process. Mention its advantages and limitations. **(08 Marks)**

c. Explain Forward and Backward gas welding techniques. **(06 Marks)**

6 a. Explain the principle of resistance welding. Mention its applications. **(06 Marks)**

b. Explain Seam welding process. **(06 Marks)**

c. With neat sketches, explain friction welding process. Mention its advantages and limitations. **(08 Marks)**

7 a. Explain the measures to minimize the shrinkage in welded joints. **(06 Marks)**

b. What is heat affected zone? Discuss the parameters affecting heat affected zone. **(08 Marks)**

c. Explain different welding defects, their causes and remedies. **(06 Marks)**

8 a. Highlight the differences between Soldering and Brazing. **(05 Marks)**

b. Briefly explain the different fluxes used in soldering. **(06 Marks)**

c. With suitable sketches, explain the various steps involved in the liquid dye penetrate testing of weld components. **(09 Marks)**

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10ME36B/AU36B

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
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 following terms:
   i) Mass density
   ii) Newtonian fluid
   iii) Capillarity. **(06 Marks)**

   b. Calculate the gauge pressure and absolute pressure within a droplet of water of 0.4cm diameter and a jet of water 0.4cm diameter. Assume surface tension of water as 0.073 N/m and atmospheric pressure as 101300 N/m^2. **(06 Marks)**

   c. A flat plate 0.1m^2 area is pulled at 30cm/sec relative to another plate located at a distance of 0.01cm from it, the fluid separating them being water of viscosity 0.001 N-sec/m^2. Find the force and power required to maintain the velocity. **(08 Marks)**

2 a. Define and derive hydrostatic law. **(06 Marks)**

   b. Two U-tube manometers, one upright and other inverted type are connected across a water line and on oil line as shown in Fig.Q.2(a). If h_1 = 5cm, then what will be reading h_2? **(06 Marks)**

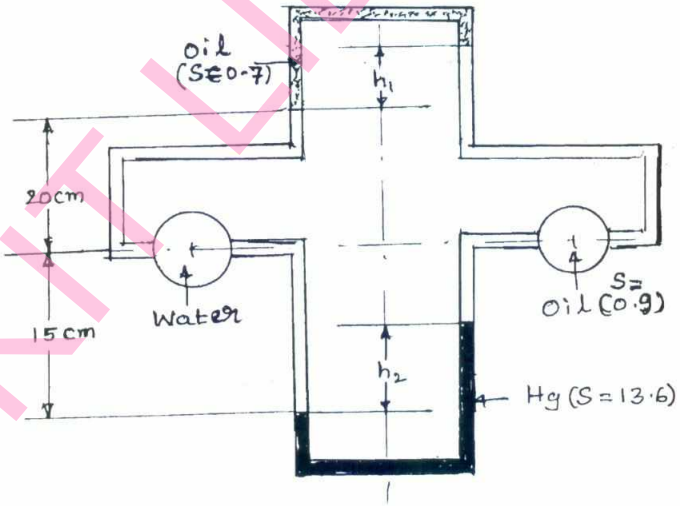

Fig.Q.2(b)

   c. A circular plate of 2m in diameter is submerged in oil of special gravity 0.8, such that its greatest and least depths below the free surface are 3.5m and 2m respectively. Find the total pressure on one face of the plate and depth of centre of pressure. **(08 Marks)**

3 a. Write differences between following:
   i) Stable and unstable equilibrium of floating bodies.
   ii) Steady and unsteady flow.
   iii) Stream line and streak line. **(09 Marks)**

b. A cylindrical belay is 2m in diameter, 2.5m long and weighs 21582N. The density of sea water is 1025 kg/m^3 show that the body cannot float with its axis vertical. **(05 Marks)**

c. If for a 2-dimensional potential flow, the velocity potential is given by $\phi = x(2y - 1)$. Determine the velocity at point P(4, 5). Also determine the value of stream function Ψ at point P. **(06 Marks)**

4 a. With suitable assumptions, derive Euler equation of motion along stream line, further reduce it to Bernoulli's equation. **(10 Marks)**

b. A pump has tapering pipe running full of water. The pipe is placed vertically with diameter at the base 1.2m and at the top 0.6m respectively. The pressure at the upper end is 240mm of Hg (Vaccum), while the pressure at the lower end is 15 kPa. Assume head loss to be 20% of difference in velocity head, calculate the discharge. The flow is vertically upwards and difference in elevation is 3.9m. **(10 Marks)**

PART – B

5 a. Derive equation for actual discharge flowing through V-notch. **(06 Marks)**

b. A pitot static tube is mounted on an airoplane. The plane is flying into still air at a height of 1km, where ambient conditions are P = 0.9 bar and T = 278K. If difference of pressure reading is 0.02 bar, how fast is the plane is going? **(06 Marks)**

c. The lift force F_L on an airfoil depends on the mass density ρ of the medium, velocity of flow v, a characteristic length L, the viscosity μ and angle of attack α (alpha). Obtain an expression for the lift force. **(08 Marks)**

6 a. Derive expressions for Darcy's equation and Chezy's equation for fluid flowing through circular pipe. **(10 Marks)**

b. Determine the rate of flow of water through a pipe of diameter 20cm and length 50m, when one end of the pipe is connected to tank and other end of pipe is open to the atmosphere. The pipe is horizontal and height of the water in the tank is 4m, above the centre of the pipe. Consider all minor losses and take f = 0.009, also draw HGL and TEL. **(10 Marks)**

7 a. Derive Hagen Poiseulle equation for loss of head due to friction in pipe of length L. **(08 Marks)**

b. A lubricating oil of viscosity 1 poise, and sp. gravity 0.9 is pumped through a 30mm diameter pipe. If the pressure drop per meter length of the pipe is 20kN/m^2. Determine: i) Mass flow rate; ii) The shear stress at the pipe wall; iii) the Reynold's number of flow and iv) The power required per 50m length of the pipe to maintain the flow. **(12 Marks)**

8 a. Define the following terms:
i) Lift; ii) Drag; iii) Displacement thickness; iv) Energy thickness; v) Mach number. **(15 Marks)**

b. A projectile travels in air of pressure 1.01043×10^5N/m^2 at 10°C at a speed of 1500km/hr. Find Mach number and Mach angle. Take K = 1.4 and R = 287 J/kg K. **(05 Marks)**

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MATDIP301

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
Advanced Mathematics - I

Time: 3 hrs. Max. Marks:100

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

1 a. Express the $\frac{3}{1+i}-\frac{1}{2-i}+\frac{1}{1-i}$ in the form of a + ib. **(06 Marks)**

b. Find the cube roots of 1 - i. **(07 Marks)**

c. Prove that $\left(\frac{1+\cos\theta+i\sin\theta}{1+\cos\theta-i\sin\theta}\right)^n = \cos n\theta + i\sin n\theta$. **(07 Marks)**

2 a. Find the nth derivative of $e^{ax}\cos(bx+c)$. **(07 Marks)**

b. Find the nth derivative of $\frac{x}{(x-1)(2x+3)}$. **(06 Marks)**

c. 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)**

3 a. With usual notations P.T $\tan\phi = \frac{rd\theta}{dr}$. **(06 Marks)**

b. Find the angle between the pairs of curves

$r = a\log\theta \quad r = \frac{a}{\log\theta}$. **(07 Marks)**

c. Find the Pedal equation to the curve $r = a(1+\sin\theta)$. **(07 Marks)**

4 a. State and prove Euler's theorem of Homogeneous functions. **(06 Marks)**

b. If $u = f(x-y, y-z, z-x)$

P.T $\frac{\partial u}{\partial x}+\frac{\partial u}{\partial y}+\frac{\partial u}{\partial z}=0$. **(07 Marks)**

c. If $u = \tan^{-1}x + \tan^{-1}y$, $V = \frac{x+y}{1-xy}$

S.T $\frac{\partial(u,v)}{\partial(x,y)}=0$. **(07 Marks)**

5 a. Obtain the Reduction formula for $\int \sin^m x \cos^n x\,dx$. Where m, n are positive integers. **(07 Marks)**

b. Evaluate $\int_1^2\int_0^{2-y} xy\,dx\,dy$. **(06 Marks)**

c. Evaluate $\int_0^3\int_0^2\int_0^1 (x+y+z)\,dz\,dx\,dy$. **(07 Marks)**

6 a. Prove that $\left[\left(\frac{1}{2}\right)\right] = \sqrt{\pi}$. **(06 Marks)**

b. Prove that $\int_0^\infty x^2e^{-x^4}dx \times \int_0^\infty e^{-x^4}dx = \frac{\pi}{8\sqrt{2}}$. **(07 Marks)**

c. Evaluate the Integral $\int_0^1 x^5(1-x)^6\,dx$. **(07 Marks)**

7 a. Solve $(D^3 - 3D - 2)y = 0$. **(06 Marks)**

b. Solve $(y'' + y) = e^{-x} + \cos x + x^3$. **(07 Marks)**

c. Solve $y'' - 2y' + y = xe^x \sin x$. **(07 Marks)**

8 a. Solve $\frac{dy}{dx} = \frac{x(2\log x + 1)}{\sin y + y\cos y}$. **(06 Marks)**

b. Solve $x \log x \frac{dy}{dx} + y = 2 \log x$. **(07 Marks)**

c. Solve $(2xy + y - \tan y)\,dx + (x^2 - x\tan^2 y + \sec^2 y)\,dy = 0$. **(07 Marks)**

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