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MATDIP301

Third Semester B.E. Degree Examination, December 2011

Advanced Mathematics - I

Time: 3 hrs. Max. Marks:100

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

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

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

c. Find the real part of $\frac{1}{1+\cos\theta+i\sin\theta}$. **(07 Marks)**

2 a. Find the n^{th} derivative of $\cos x\cos 2x\cos 3x$. **(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 $\frac{x+2}{x+1}+\log\left(\frac{x+2}{x+1}\right)$. **(07 Marks)**

3 a. State and prove Euler's theorem. **(06 Marks)**

b. Given $u=\sin\left(\frac{x}{y}\right)$, $x=e^t$, $y=t^2$, find $\frac{du}{dt}$ as a function of t. **(07 Marks)**

c. If $x=r\cos\theta$, $y=r\sin\theta$, find $\frac{\partial(x,y)}{\partial(r,\theta)}$ and $\frac{\partial(r,\theta)}{\partial(x,y)}$. **(07 Marks)**

4 a. Find the angle of intersection of the curves $r=a(1+\cos\theta)$ and $r=b(1-\cos\theta)$. **(06 Marks)**

b. Find the pedal equation of the curve $\frac{2a}{r}=1-\cos\theta$. **(07 Marks)**

c. Expand $e^{\sin x}$ by Maclaurin's series upto the term containing x^4. **(07 Marks)**

5 a. Obtain the reduction formula for $I_n=\int_0^{\pi/2}\sin^n x\,dx$ where n is a positive integer. **(06 Marks)**

b. Evaluate : $\int_1^5\int_1^{x^2}x(x^2+y^2)dx\,dy$. **(07 Marks)**

c. Evaluate : $\int_0^1\int_0^2\int_1^2 x^2yz\,dx\,dy\,dz$. **(07 Marks)**

6 a. Prove that $\beta(m, n) = \dfrac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$. **(06 Marks)**

b. Show that $\Gamma(n) = \int_0^1 \left(\log\dfrac{1}{x}\right)^{n-1} dx$. **(07 Marks)**

c. Express $\int_0^{\pi/2} \sqrt{\tan\theta}\, d\theta$ in terms of Gamma function. **(07 Marks)**

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

b. Solve : $(1 + e^{x/y})dx + e^{x/y}\left(1 - \dfrac{x}{y}\right)dy = 0$. **(07 Marks)**

c. Solve : $(x^2 - ay)dx = (ax - y^2)dy$. **(07 Marks)**

8 a. Solve : $\dfrac{d^4y}{dx^4} + 8\dfrac{d^2y}{dx^2} + 16y = 0$. **(06 Marks)**

b. Solve : $(D-2)^2 y = 8(e^{2x} + \sin 2x)$. **(07 Marks)**

c. Solve : $(D^3 + 4D)y = \sin 2x$. **(07 Marks)**

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06MAT31

Third Semester B.E. Degree Examination, December 2011
Engineering Mathematics

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Find a Fourier series to represent $f(x) = \begin{cases} 0 & -\pi \le x \le 0 \\ x^2 & 0 \le x \le \pi \end{cases}$. **(06 Marks)**

b. Find half range cosine series of $f(x) = 1 - \frac{x}{l}$ in (o, l). **(07 Marks)**

c. Compute the Fourier coefficients a_0, a_1, a_2, b_1 and b_2 for f(x) tabulated below: **(07 Marks)**

x	0	1	2	3	4	5
f(x)	9	18	24	28	26	30

2 a. Find Fourier transform of,

$f(x) = \frac{1}{2a} \quad |x| \le a$

$= 0 \quad |x| > a$ **(06 Marks)**

b. Find Fourier cosine transform of e^{-ax}, $a \ge 0$, hence find $\int_0^\infty \frac{\cos \alpha x}{a^2 + \alpha^2} dx$. **(07 Marks)**

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

3 a. Form the second order partial differential equation of $z = xf(ax + by) + g(ax + by)$. **(06 Marks)**

b. Solve : $(y + zx)z_x - (x + yz)z_y = x^2 - y^2$. **(07 Marks)**

c. Solve : $3u_x + 2u_y = 0$, given $u(x, 0) = 4e^{-x}$ using method of separation of variables. **(07 Marks)**

4 a. With suitable assumptions, derive one dimensional equation for heat flow. **(06 Marks)**

b. Solve : $\frac{\partial^2 u}{\partial t^2} = c^2 u_{xx}$ by the method of separation of variables. **(07 Marks)**

c. Solve $u_{xx} + u_{yy} = 0$, for $0 < x < a$, $0 < y < b$ and $u(x, 0) = 0$; $u(x, b) = 0$; $u(0, y) = 0$; $u(a, y) = f(y)$. **(07 Marks)**

PART – B

5 a. Find the third approximate root of $xe^x - 2 = 0$, by Regula Falsi method. **(06 Marks)**

b. Using Gauss Seidel method of iteration, find a, b, c (4^{th} iteration values), given $5a - b = 9$, $a - 5b + c = -4$, $b - 5c = 6$ taking $\left(\frac{9}{5}, \frac{4}{5}, \frac{6}{5}\right)$ as first approximation. **(07 Marks)**

c. Find all the eigen values and the eigen vector corresponding to smallest eigen value of :

$$\begin{bmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{bmatrix}$$ **(07 Marks)**

6 a. Given the following table of x and f(x), fit a Lagrangian polynomial and hence find f(1) and f(4). **(06 Marks)**

x	-1	0	2	3
f(x)	-8	3	1	2

b. Using Newton's dividend different formula, find f(2, 5) given:

x	-3	-1	0	3	5
f(x)	-30	-22	-12	330	3458

(07 Marks)

c. Tabulate the values $y = \log_e x$, $4 \le x \le 5.2$, in steps of 0.2 and find $\int_4^{5.2} \log_e x \, dx$ using Simpons' $\frac{3}{8}$ rule. **(07 Marks)**

7 a. Derive eulers' equation for extremal value in the form $\frac{\partial f}{\partial y} - \frac{d}{dx}\left(\frac{\partial f}{\partial y'}\right) = 0$. **(06 Marks)**

b. Determine the plane curve down which a particle will slide down without friction from $A(x_1, y_1)$ to $B(x_2, y_2)$ in shortest time. **(07 Marks)**

c. The curve 'C' joining the two points $A(x_1, y_1)$ to $B(x_2, y_2)$ is rotated about x-axis, find equation of 'C' such that the solid of resolution has minimum surface area. **(07 Marks)**

8 a. Find $z(e^{-an} \sin n\theta)$ and $z(n \cos n\theta)$. **(06 Marks)**

b. Find z^{-1} of $\left\{\frac{4z^2 - 2z}{z^3 - 5z^2 + 8z - 4}\right\}$. **(07 Marks)**

c. Solve : $u_{n+2} + 2u_{n+1} + u_n = n$ given $u_0 = u_1 = 0$. **(07 Marks)**

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06ME32A

Third Semester B.E. Degree Examination, December 2011
Materials 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, coordination number, vacancy and grain boundary. **(04 Marks)**

b. Draw a neat sketch of a BCC unit cell. Derive the relation between lattice parameters and atomic radius for the BCC unit cell. Calculate its atomic packing factor. **(08 Marks)**

c. Explain edge dislocation, with the help of a neat sketch. **(04 Marks)**

d. Explain briefly the vacancy mechanism of diffusion. **(04 Marks)**

2 a. Define engineering stress and true stress. Derive the relation between the two. **(06 Marks)**

b. A tensile specimen of 10mm diameter and 100mm gauge length is subjected to a tensile test. If its diameter is reduced to 8mm by applying a load of 1500N, what is its final length? Also determine engineering stress, engineering strain, true stress and true strain. **(06 Marks)**

c. Explain Vickers hardness testing, in brief. **(04 Marks)**

d. When a 3000 kg load is applied through a 10mm diameter ball in a Brinell test on steel, an indentation of 3.1mm is produced. Determine the BHN of the metal. **(04 Marks)**

3 a. Sketch the basic modes of fracture. List the differences between them. **(06 Marks)**

b. Explain with the help of a sketch, the fatigue behaviour of metals. State any three methods to improve fatigue resistance. **(07 Marks)**

c. With the help of a neat sketch, explain the different stages in a creep curve. Give two examples for creep resistant materials. **(07 Marks)**

4 a. State Hume – Rothery rules that govern the formation of solid solutions. **(04 Marks)**

b. Draw neatly labeled sketches of eutectic phase diagrams for a binary system with i) no solid solubility and ii) partial solid solubility. **(06 Marks)**

c. Describe the phase rule and lever rule in brief. **(04 Marks)**

d. A binary alloy system contains two solid phases α and β at a particular temperature. The compositions of α and β are A – 5% B and A – 95% B respectively. Calculate the amount of α and β in i) A – 40% B alloy and ii) A – 70% B alloy at that temperature. **(06 Marks)**

PART – B

5 a. Draw a neat labeled iron – carbon phase diagram. Write the three invariant reactions taking place in the system. **(10 Marks)**

b. Draw the schematic microstructures of slowly cooled eutectoid steel and hypo – eutectoid steel. **(04 Marks)**

c. Briefly explain the TTT diagram for eutectoid steel. **(06 Marks)**

6 a. Compare annealing and normalizing heat treatments adopted for steels. **(06 Marks)**

b. Explain carburizing and flame hardening, in brief. **(06 Marks)**

c. Define hardenability. Explain with a neat sketch, the Jominy end quench test of determining the hardenability of steels. **(08 Marks)**

7 a. Briefly describe the composition, properties and applications of medium and high carbon steels. **(10 Marks)**

b. State the properties and applications of gray cast iron. **(04 Marks)**

c. Write a note on brasses. **(06 Marks)**

8 a. Define corrosion. State its effects. **(03 Marks)**

b. Briefly explain the mechanism of corrosion. **(05 Marks)**

c. Write a note on passivity. **(04 Marks)**

d. List various methods of corrosion prevention. Explain cathodic protection with examples. **(08 Marks)**

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06ME34

Third Semester B.E. Degree Examination, December 2011
Mechanics of Materials

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define: i) Hooke's law ii) Poisson's ratio iii) Elastic limit iv) Modulus of rigidity **(04 Marks)**

b. Derive an expression for the extension of a member subjected to a tensile load P. The length of the member being L and its Young's modulus is E. **(04 Marks)**

c. A member ABCD is subjected to point loads P_1, P_2, P_3 and P_4 as shown in Fig.Q1(c). Calculate the force P_2 necessary for equilibrium, if $P_1 = 45$ kN, $P_3 = 450$ kN and $P_4 = 130$ kN Determine the total elongation of the member, assuming the modulus of elasticity to be 2.1×10^5 N/mm^2. **(12 Marks)**

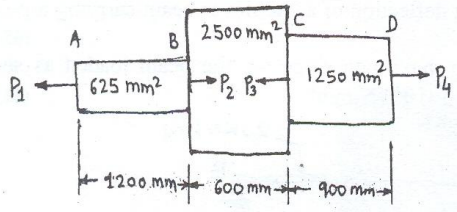

Fig.Q1(c)

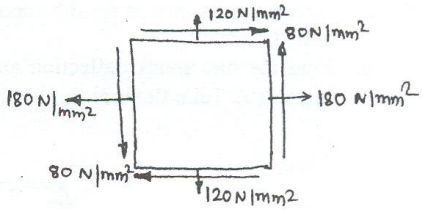

Fig.Q3(c)

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

b. Establish the relationship between Young's modulus (E), modulus of rigidity (G) and Poisson's ratio (γ). **(08 Marks)**

c. A steel rail is 12.6m long and is laid at a temperature of 24°C. The maximum temperature expected is 44°C.

i) Estimate the minimum gap between two rails to be left so that temperature stresses do not develop.

ii) Calculate the thermal stresses developed in the rails if a gap of 2mm is provided for expansion.

iii) If the stress developed is 20 MN/m^2 , what is the gap left between the rails?

Take $E = 2\times10^5$ MN/m^2 and $\alpha = 12\times10^{-6}$/°C. **(10 Marks)**

3 a. Define: i) Principal stresses ii) Principal planes. **(04 Marks)**

b. In a general two dimensional stress system, show that sum of normal stresses in any two mutually perpendicular directions is constant. **(06 Marks)**

c. The state of stress at a point in a strained material is as shown in Fig.Q3(c). Determine i) The direction of principal planes ii) The magnitude of principal stresses iii) The magnitude of maximum shear stress & its direction. Indicate all the above planes by a sketch. **(10 Marks)**

4 a. A cylindrical shell is 3m long and is having 1m internal diameter and 15mm thickness. Calculate the maximum intensity of shear stress induced and also the changes in dimensions of the shell, if it is subjected to an internal fluid pressure of 1.5 N/mm^2.

Take $E = 2\times10^5$ N/mm^2 and $\gamma = 0.3$. **(10 Marks)**

b. A pipe of 400mm internal diameter and 100mm thickness contains a fluid at a pressure of 80 N/mm^2. Find the maximum and minimum hoop stress across the section. Also sketch the radial and hoop stress distribution across the section. **(10 Marks)**

PART – B

5 a. Classify beams (based on type of supports) and loads and sketch them. **(06 Marks)**

b. Draw the shear force and bending moment diagrams for the beam shown in Fig.Q5(b).

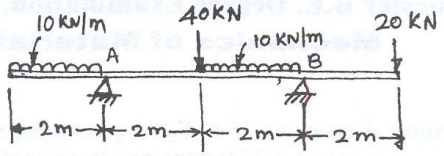

Fig.Q5(b) **(14 Marks)**

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

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

c. A cast iron beam has an I section with a top flange 80mm×40mm, web 120mm×20mm and bottom flange 160mm×40mm. If the tensile stress is not to exceed 30N/mm^2 and compressive stress 90 N/mm^2, what is the maximum uniformly distributed load the beam carry over a simply supported span of 6m, if the large flange is in tension. **(10 Marks)**

7 a. Derive an expression for the maximum deflection of a cantilever beam carrying a point load at its free end. **(08 Marks)**

b. Find the maximum deflection and the maximum slope for the beam loaded as shown in Fig.Q7(b). Take flexural rigidity EI = 15×10^9 kN.mm^2. **(12 Marks)**

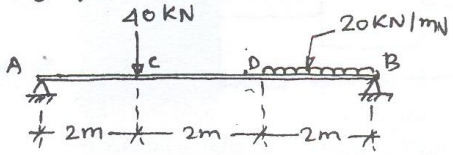

Fig.Q7(b)

8 a. State the assumptions made in the theory of pure torsion. **(04 Marks)**

b. Determine the diameter of a solid shaft which will transmit 440 kW at 280 rpm. The angle of twist must not exceed one degree per meter length and the maximum torsional stress is to be limited to 40 N/mm^2. Assume G = 84 kN/mm^2. **(08 Marks)**

c. A 2m long pin ended column of square cross section is to be made of wood. Assuming E = 12 GPa and the allowable stress being limited to 12 MPa, determine the size of the column to support a load of 95 kN. Use a factor of safety 3 and the Euler's crippling load for buckling. **(08 Marks)**

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06ME35

Third Semester B.E. Degree Examination, December 2011
Manufacturing Processes – I

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Classify manufacturing processes. Explain briefly the various factors to be considered while selecting a process for a given application. **(10 Marks)**

b. List the various types of patterns. Explain the different types of pattern allowances, with neat sketches. **(10 Marks)**

2 a. Sketch and explain the different types of gates. Bring out the requirements of a riser. **(10 Marks)**

b. Sketch and explain the working of a jolt – squeeze type of a moulding machine. **(10 Marks)**

3 a. With neat sketches, explain the investment casting process. **(10 Marks)**

b. With a neat sketch, explain the continuous casting process. Bring out its advantages. **(10 Marks)**

4 a. Sketch and explain the principle and working of a high frequency induction furnace. **(10 Marks)**

b. Sketch and explain the construction and operation of a cupola. **(10 Marks)**

PART – B

5 a. Sketch and explain the metal inert gas welding (MIG). Bring out its advantages and limitations. **(10 Marks)**

b. Classify welding processes and bring out the advantages and limitations of welding. **(10 Marks)**

6 a. With neat sketches, bring out the differences between spot and seam welding. **(10 Marks)**

b. Explain electron beam welding, with a neat sketch and bring out its advantages and limitations. **(10 Marks)**

7 a. What is meant by HAZ? Explain the various regions of HAZ in low carbon steel during welding, with a neat sketch. **(10 Marks)**

b. Discuss the various types of weld defects, their causes and remedies. **(10 Marks)**

8 a. Differentiate between brazing and soldering. Bring out the advantages, limitations and applications of these two processes. **(10 Marks)**

b. What is meant by NDT? With a neat sketch, explain the X – ray radiography and bring out its advantages and limitations. **(10 Marks)**

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