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06MAT31

Third Semester B.E. Degree Examination, Dec.08/Jan.09
Engineering Mathematics III

Time: 3 hrs. Max. Marks:100

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

PART - A

1 a. Find the Fourier series fort he function $f(x) = |x|$ in $-\pi \le x \le \pi$.

Hence deduce that $\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+\ldots\ldots=\frac{\pi^2}{8}$ (06 Marks)

b. Expand the function f(x) defined by

$$f(x)=\begin{cases}\frac{1}{4}-x & \text{for } 0<x<\frac{1}{2}\\ x-\frac{3}{4} & \text{for } \frac{1}{2}<x<1\end{cases}$$

In a half – range sine series. (07 Marks)

c. Obtain the complex Fourier series for the function

$$f(x)=\begin{cases}0 & \text{for } 0<x<l\\ a & \text{for } 1<x<2l\end{cases}$$

Over the interval $(0, 2l)$. (07 Marks)

2 a. Find the Fourier transform of $f(x)=\begin{cases}1-x^2, & \text{for } |x|\le 1\\ 0, & \text{for } |x|>1\end{cases}$

Hence evaluate $\int_0^\infty \left(\frac{x\cos x-\sin x}{x^3}\right)\cos\frac{x}{2}dx$. (06 Marks)

b. Solve the integral equation :

$$\int_0^\infty f(\theta)\cos\alpha\theta d\theta=\begin{cases}1-\alpha, & 0\le\alpha\le 1\\ 0, & \alpha>1\end{cases}$$

Hence evaluate $\int_0^\infty \frac{\sin^2 t}{t^2}dt$. (07 Marks)

c. Show that the inverse finite Fourier sine transform of

$$F_s(n)=\frac{1}{n}\left\{1+\cos n\pi-2\cos\frac{n\pi}{2}\right\}$$

is $f(x)=\begin{cases}1, & 0\le x\le \pi/2\\ -1, & \pi/2<x\le\pi\end{cases}$ (07 Marks)

3 a. Form a partial differential equation by eliminating the arbitrary functions f and g from the relation

$Z = f(y + 2x) + g(y - 3x)$ (06 Marks)

b. Solve the equation $\frac{\partial^2 z}{\partial x^2}=x+y$, given that $z = y^2$ when $x = 0$, and $\frac{\partial z}{\partial x}=0$, when $x = 2$. (07 Marks)

c. Solve : $(y + z)p + (z + x)q = x + y$. (07 Marks)

4 a. Derive the one-dimensional heat equation. **(06 Marks)**

b. Obtain D′ Alembert's solution of the one dimensional wave equation:

$\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$. **(07 Marks)**

c. Solve the 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) $u(x,0) = u_o \text{ Sin } \frac{\pi x}{l}$; iii) $\frac{\partial u}{\partial t}(x,0) = 0$ **(07 Marks)**

5 **PART - B**

a. Using the Regula – Falsi method, find the root of the equation $xe^x = \cos x$ that lies between 0.4 and 0.6. Carry out four iterations. **(06 Marks)**

b. Solve the following system of equations by using the Gauss – Jordan method :

$x + y + z = 9$

$2x + y - z = 0$

$2x + 5y + 7z = 52$. **(07 Marks)**

c. Using the power method, find the largest eigenvalue and the corresponding eigenvector of the matrix

$$A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & 1 \\ 2 & -1 & 3 \end{bmatrix}$$

Taking $[1, 1, 1]'$ as the initial eigenvector. Perform five iterations. **(07 Marks)**

6 a. Find the interpolating polynomial for the function $y = f(x)$ given by $f(0) = 1$, $f(1) = 2$, $f(2) = 1$ $f(3) = 10$. Hence evaluate $f(0.75)$. **(06 Marks)**

b. Apply Lagrange's formula to find a root of the equation $f(x) = 0$, given that $f(30) = -30$, $f(34) = -13$, $f(38) = 3$, $f(42) = 18$. **(07 marka)**

c. Evaluate $\int_0^{\pi/2} \sqrt{\cos\theta}\, d\theta$ by using the Simpson's $\frac{1}{3}$ rule, taking 9 ordinates. **(07 Marks)**

7 a. Derive Euler's equation in the form

$\frac{df}{\partial y} - \frac{d}{dx}\left(\frac{\partial f}{\partial y'}\right) = 0$ **(06 Marks)**

b. Find the external of the functional

$I = \int_0^{\pi/2} (y^2 - y'^2 - 2y \text{ Sin} x)dx$

Under the end conditions $y(0) = y\left(\pi/2\right) = 0$. **(07 Marks)**

c. Prove that catenary is the curve which when rotated about a line generates a surface of revolution of minimum area. **(07 Marks)**

8 a. Find the Z –transforms of

i) Coshn θ; ii) Sin (3n +5). **(06 Marks)**

b. Obtain the inverse Z – transform of

$\frac{3z^2 + z}{(5z-1)(5z+2)}$. **(07 Marks)**

c. By employing Z – transform, Solve the difference equation : $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$, with $y_0 = y_1 = 0$. **(07 Marks)**

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MATDIP 301

Third Semester B.E. Degree Examination, Dec 08 / Jan 09
Advanced Mathematics - I

Time: 3 hrs. Max. Marks:100

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

1 a. Define modulus and amplitude of a complex number x+iy and express $\frac{a+ib}{c+id}$ in x+iy form. **(06 Marks)**

b. Reduce $1 - \cos\alpha + i\sin\alpha$ to the modulus amplitude form. **(07 Marks)**

c. If $\alpha + i\beta = \frac{1}{a+ib}$ then prove that $(\alpha^2+\beta^2)(a^2+b^2) = 1$ **(07 Marks)**

2 a. Find the n^{th} derivative of $\frac{x}{(x-1)(2x+3)}$. **(06 Marks)**

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

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

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

b. If u is a homogeneous function of degree 'n' in x and y, then prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = nu$. **(07 Marks)**

c. If $x = r\cos\theta$, $y = r\sin\theta$, then prove that $J.J' = 1$. **(07 Marks)**

4 a. Find the angle of intersection of curves $r = \sin\theta + \cos\theta$ and $r = 2\sin\theta$. **(06 Marks)**

b. Find the pedal equation of the curve $r^m = a^m.\sin m\theta$. **(07 Marks)**

c. Using Maclaurin's series, expand $e^{\sin x}$ upto the terms containing x^4. **(07 Marks)**

5 a. Obtain the reduction formula for $I_n = \int_0^{\pi/2} \cos^n\theta d\theta$, n being a positive integer and hence evaluate I_6. **(06 Marks)**

b. Evaluate $\int_0^5 \int_0^{x^2} x(x^2+y^2)dxdy$. **(07 Marks)**

c. Evaluate $\int_0^1 \int_0^{\sqrt{1-x^2}} \int_0^{\sqrt{1-x^2-y^2}} xyzdxdydz$. **(07 Marks)**

6 a. Define Beta, Gamma functions and prove that $\overline{|(n+1)} = n\overline{|n}$. **(06 Marks)**

b. Prove that $\beta(m, n) = \dfrac{\lceil(m).\lceil n}{\lceil(m+n)}$ **(07 Marks)**

c. Express the intergral $\int_0^1 \dfrac{dx}{\sqrt{1-x^2}}$ in terms of Gamma functions. Prove that $\sqrt{(n+1)} = n!$, provided n is a positive integer. **(07 Marks)**

7 a. Solve $\dfrac{dy}{dx} = (4x+y+1)^2$. **(06 Marks)**

b. Solve $(x^2-y^2)\,dx - xydy = 0$. **(07 Marks)**

c. Solve $\dfrac{dy}{dx} + \dfrac{y\cos x + \sin y + y}{\sin x + x\cos y + x} = 0$ **(07 Marks)**

8 a. Solve $\dfrac{d^2y}{dx^2} + \dfrac{dy}{dx} + y = \sin 2x$. **(06 Marks)**

b. Solve $(D^2+2D+1)y = x^2$. **(07 Marks)**

c. Solve $\dfrac{d^2y}{dx^2} + 5\dfrac{dy}{dx} + 6y = e^{2x}$. **(07 Marks)**

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06ME32A

Third Semester B.E. Degree Examination, Dec.08/Jan.09
Material Science and Metallurgy

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 space lattice. Find out basic atoms and packing factors or packing densities for B.C.C. and F.C.C. Draw concerned figures. **(08 Marks)**

b. Explain crystal imperfections with figures. **(08 Marks)**

c. State Fick's laws of diffusion. **(04 Marks)**

2 a. Define Engg. Stress and strain and true stress and strain. Find out the relationship between True stress and Engg. Stress. **(08 Marks)**

b. Define hardness. Draw the figure of Brinell Hardness Testing machine and label the parts. **(05 Marks)**

c. Explain Slip and Twinning with figures. **(07 Marks)**

3 a. Explain types of fractures with figures. **(06 Marks)**

b. Explain creep curve. **(08 Marks)**

c. Explain factors affecting fatigue life. **(06 Marks)**

4 a. Define solid solutions and explain different types of solid solutions with figures. **(08 Marks)**

b. State Gibb's Phase rule and define the terms used. Discuss its importance. **(06 Marks)**

c. Explain the construction of phase diagram with figure. **(06 Marks)**

PART – B

5 a. Draw Fe-C 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. **(08 Marks)**

b. Explain the construction of TTT diagram with figure and label it. **(08 Marks)**

c. Define Martensite, Cementite, Austenite and Ferrite. **(04 Marks)**

6 a. Define Hardenability. Explain Jominy end quench tests with related figures. **(10 Marks)**

b. Explain Austempering and Martempering with figures. **(10 Marks)**

7 a. Explain different types of cast irons with microstructures. **(08 Marks)**

b. Write short note on Al-alloy. **(04 Marks)**

c. Define Brasses. Explain season cracking of brass and how to eliminate it. **(04 Marks)**

d. Define Bronze. Explain Tin bronze's antifriction properties. **(04 Marks)**

8 a. Write a note on passivation. **(06 Marks)**

b. Explain the alloying method for corrosion protection. **(07 Marks)**

c. Explain cathodic protection with figures. **(07 Marks)**

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06ME33

Third Semester B.E. Degree Examination, Dec.08/Jan.09
Basic Thermodynamics

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions choosing at least two questions from each part.***

Part A

1 a. Mention the characteristics of a thermodynamic property. **(04 Marks)**

b. Explain thermodynamic equilibrium. **(08 Marks)**

c. The temperature t on a certain Celsius thermometric scale is given by means of a property through a relation $t = a\ln P + b$ where a and b are constants and P is the property of the fluid. If, at the ice point and steam points the values of P are found to be 4 and 20 respectively, what will be temperature reading corresponding to a reading of P = 16? **(08 Marks)**

2 As an engineering student suggest the most economical process when it is desired to compress one mole of air ($\gamma = 1.4$) from an initial state of 300 K and 1 bar to a final state of 300 K and 10 bar from among the following processes:

a. Isothermal compression.

b. Cooling at constant pressure followed by heating at constant volume.

c. Adiabatic compression followed by cooling at constant volume and

d. Heating at constant volume followed by cooling at constant pressure.

Take the value of R = 8.314 J/mol K. **(20 Marks)**

3 a. State the important consequences of the first law of thermodynamics and show that perpetual motion machine of the first kind is impossible. **(08 Marks)**

b. In a thermal power plant operating in a steady state an adiabatic steam turbine receives 1 kg/s of superheated steam at 3 MPa and 400°C. The steam enters the turbine with a velocity of 10 m/s at an elevation of 10 m above the ground level. The steam leaves the turbine at 0.1 bar with 10% moisture content. The velocity of steam at exit is 3 times that at inlet and the exit is at an elevation of 40% of inlet. Show that it is safe to ignore the changes in kinetic energy and potential energy.

Given : P = 3 MPa and t = 400°C; h = 3232.5 kJ/kg; P = 0.1 bar;

$h_f = 191.83$ kJ/kg ; $h_g = 2584.8$ kJ/kg **(12 Marks)**

4 a. Show that of all heat engines working between two given thermal reservoirs, the Carnot engine is the most efficient one. **(08 Marks)**

b. It is proposed to produce 1000 kg of ice per hour from liquid water at 0°C in summer when the ambient atmospheric temperature is 37°C. It is planned to use a heat engine to operate the refrigeration plant. Hot water at 70°C, produced by solar heating acts as a source to the heat engine which uses atmosphere as the sink. Calculate i) the power required by the refrigeration plant ii) the ratio of the energy extracted from freezing water to that absorbed by heat engine and iii) the rate of rejection of heat by both the devices. Take enthalpy of fusion of water at 0°C as 333.43 kJ/kg. **(12 Marks)**

Part B

5 a. Apply the Clausius inequality for a system undergoing an irreversible cyclic change and show that the entropy change of the system is given by $ds \geq \frac{\delta Q}{T}$ **(06 Marks)**

b. Two identical blocks of mass m are at temperatures T_1 and T_2 and act as source and sink for the operation of a heat engine. Determine the maximum amount of work that can be obtained if the specific heat of the blocks is C in both cases. **(06 Marks)**

c. An inventor claims to have designed a heat engine, which absorbs 260 kJ of energy as heat from a reservoir at 52°C and delivers 72 kJ of work. His claim includes that the engine rejects 100 kJ and 88 kJ of energy to the reservoirs at 27°C and 2°C respectively. Verify the claim. How is the temperature of the source to be altered in accordance with the verification, if necessary? **(08 Marks)**

6 a. Explain Availability. **(05 Marks)**

b. What is the availability function for a non-flow process? **(05 Marks)**

c. Explain second law efficiency. **(05 Marks)**

d. In a thermal power plant, superheated steam at 50 bar and 400°C enters an adiabatic turbine and leaves as wet steam of quality 0.9 at 1 bar to the atmosphere at 30°C. Calculate the second law of efficiency of the turbine.
Take for steam at 50 bar and 400°C
$h_1 = 3198.3$ kJ/kg and $S_1 = 6.6508$ kJ/kg K
and at 0.1 bar
$h_f = 191.83$ kJ/kg and $h_g = 2584.8$ kJ/kg
$S_f = 0.6493$ kJ/kg K and $S_g = 8.1511$ kJ/kg K **(05 Marks)**

7 a. Define : i) Isothermal compressibility ii) Isentropic compressibility and iii) Coefficient of volume expansion. **(06 Marks)**

b. Explain the terms: i) Saturated liquid ii) Saturated power iii) Saturation temperature iv) Saturation pressure. **(08 Marks)**

c. Sketch and explain the PT diagram for water. **(06 Marks)**

8 a. Derive Vander Waal's constants in terms of critical properties. **(12 Marks)**

b. Define compressibility factor and explain its significance. **(03 Marks)**

c. A cylinder of 0.01 m^3 volume is filled with 0.727 kg of n-octane (C_8H_{18}) at 427.85 K. Assuming that n-octane obeys the Vander Waal's equation of state calculate the pressure of the gas in the cylinder. Take the constants a and b as 3.789 Pa $(m^3/mol)^2$ and 2.37×10^{-4} m^3/mol respectively. **(05 Marks)**

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06ME34

Third Semester B.E. Degree Examination, Dec 08 / Jan 09
Mechanics of Materials

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define i) Poisson's Ratio ii) Bulk modulus iii) Factor of safety. **(03 Marks)**

b. Derive an expression for total deformation of a tapering rectangular bar of cross – section b_1 and b_2, when it is subjected to an axial force 'P'. **(07 Marks)**

c. A round bar with stepped portion is subjected to the forces as shown in fig.1(c). Determine magnitude of force P, such that net deformation in the bar does not exceed 1mm. E for steel is 200 GPa and that for Aluminium is 70 GPa. Big end diameter and small end diameter of the tapering bar are 40mm and 12.5mm respectively. **(10 Marks)**

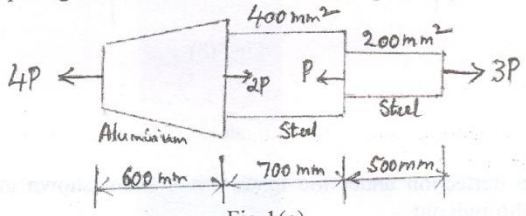

Fig.1(c)

2 a. Derive an expression for relationship between Young's modulus, modulus of Rigidity and Poisson's ratio. **(10 Marks)**

b. A compound bar is made of a central steel plate 60mm wide and 10mm thick to which copper plates 40mm wide and 5mm thick are connected rigidly on each side. The length of the bar at normal temperature is 1 meter. If the temperature is raised by 80^0C, determine the stresses in each metal and change in length. Take $E_s = 200$ GN/m^2 ; $E_c = 100$ GN/m^2 ; $\alpha_s = 12\times 10^{-6}/^0$C ; $\alpha_c = 17\times 10^{-6}/^0$C. **(10 Marks)**

3 a. Define Principal Stresses and Principal Planes. **(03 Marks)**

b. Prove that the sum of normal stresses on any two mutually perpendicular planes is a constant in a general two dimensional stress system. **(07 Marks)**

c. A plane element is subjected to stresses as shown in fig.3(c). Determine principal stresses, maximum shear stress and their planes. Sketch the planes determined. **(10 Marks)**

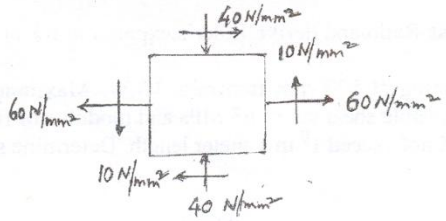

Fig.3(c)

4 a. Derive an expression for circumferential and longitudinal stress for thin cylinder. **(10 Marks)**

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

PART – B

5 a. What are the different types of beams? Explain briefly. **(05 Marks)**

b. For the beam shown in fig.5(b), draw shear force and Bending moment diagram. Locate the point of contra flexure if any. **(15 Marks)**

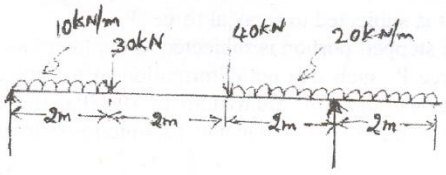

Fig.5(b)

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

b. Determine the deflection under the loads in the beam shown in fig.6(b). Take flexural rigidity as EI through out. **(10 Marks)**

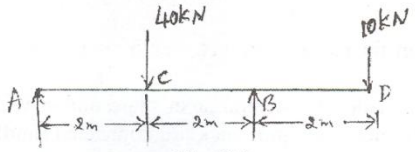

Fig.6(b)

7 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. A Cantilever of square section 200mm × 200mm, 2 meter long just fails in flexure when a load of 12kN is placed at its free end. A beam of same material and having a rectangular cross section 150mm wide and 300mm deep is simply supported over a span of 3m. Calculate the minimum central concentrated load required to break the beam. **(10 Marks)**

8 a. Define Slenderness Ratio and derive Euler's expression for buckling load for column with both ends hinged. **(10 Marks)**

b. A solid shaft rotating at 500 rpm transmits 30kW. Maximum torque is 20% more than mean torque. Allowable shear stress 65 MPa and modulus of rigidity 81GPa, angle of twist in the shaft should not exceed 1^0 in 1 meter length. Determine suitable diameter. **(10 Marks)**

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06ME35

Third Semester B.E. Degree Examination, Dec.08/Jan.09
Manufacturing Process - 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. With a simple flow chart, show the different steps involved in casting process (sand moulding). **(05 Marks)**

b. List down the functions of a pattern. **(05 Marks)**

c. What is a binder? How are they classified? Which is the common binder employed for regular castings. **(05 Marks)**

d. Explain the need for an additive in moulding sand. Mention the type of additives used for different requirement, as an example. **(05 Marks)**

2 a. With a neat sketch show all the details of green sand mould (cross section), which is ready to receive molten metal. **(05 Marks)**

b. With a neat diagram show how carbon dioxide core is made. Give the reaction involved in bonding. **(05 Marks)**

c. Show the different components of a horizontal gating system for a large plate casting with a neat figure. **(05 Marks)**

d. Draw a neat sketch of a Jolt type molding machine. Show all the details on it, including the pattern and mould box. **(05 Marks)**

3 a. Describe investment shell moulding process. Give all the details with neat sketches. What are the advantages of the process? **(10 Marks)**

b. Explain cold chamber die casting process with neat sketches. Include all the details on the sketch. What are the limitations of the process. **(10 Marks)**

4 a. How are melting furnaces classified? Give the basis. **(05 Marks)**

b. With a neat sketch, explain the melting operations involved in a Cupola furnace. Show various zones in it. Mention the popular metal/alloy that can be produced in the furnace. **(10 Marks)**

c. What are casting defects? Explain the cause for any two defects. **(05 Marks)**

Part B

5 a. Explain clearly the principle of Arc Welding Process. **(05 Marks)**

b. Briefly highlight submerged arc welding process with a neat figure. **(07 Marks)**

c. What is oxy-acetylene welding? Explain the reaction involved. Identify the different zones in the gas flame. **(08 Marks)**

6 a. What is the principle of resistance welding? Mention the major application of the process. **(05 Marks)**

b. Differentiate between Butt and Seam welding with neat figures. **(05 Marks)**

c. Describe laser-welding process with a neat figure. List the advantages and limitations of the process. Identify the important application. **(10 Marks)**

7 a. Write a short note on electrodes and filler rods. **(05 Marks)**

b. After welding a medium carbon steel, what changes are observed in the microstructure. Explain in detail the different zones formed with a neat and clear figure. What is its influence on the weld properties? **(10 Marks)**

c. Write a note on shrinkage and residual stresses in welds. **(05 Marks)**

8 Write short notes on any four:

a. Parameters in soldering. b. Furnace brazing.

c. Chemicals and fluxes in brazing and soldering d. Significance of inspection methods (NDT)

e. Ultrasonic inspection. f. Eddy current inspection. **(20 Marks)**

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