USN | | | | | | | | | | | **06MAT31**

Third Semester B.E. Degree Examination, Dec. 07 / Jan. 08
Engineering Mathematics - III

Time: 3 hrs. Max. Marks:100

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

Part A

1 a. Find the Fourier series for the function $f(x)=x+x^2$ from $x=-\pi$ to $x=\pi$ and deduce that $\frac{\pi^2}{8}=\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+$.......... **(07 Marks)**

b. Obtain the cosine half-range Fourier series for $f(x)=Kx, \text{ in } 0\le x\le l/2$; $=K(l-x) \text{ in } l/2\le x\le l$. **(07 Marks)**

c. The following table gives the variating of periodic current over a period:

t (sec)	0	$T/6$	$T/3$	$T/2$	$2T/3$	$5T/6$	T
A (Amp)	1.98	1.30	1.05	1.30	-0.88	-0.25	1.98

Show that there is a direct current part of 0.75 amp in the variable current and obtain the amplitude of the first harmonic. **(06 Marks)**

2 a. Obtain the finite Fourier Cosine transform of the function $f(x)=e^{ax}$ in (0, l). **(07 Marks)**

b. Find the Fourier sine and cosine transforms of

$$f(x)=\begin{cases}x, & 0<x<2\\ 0, & \text{otherwise}\end{cases}.$$ **(07 Marks)**

c. Solve the integral equation,

$$\int_0^\infty f(x)\cos(\alpha x)dx=\begin{cases}1-\alpha, & 0\le\alpha\le1\\ 0, & \alpha>1\end{cases}.$$

Hence evaluate $\int_0^\infty \frac{1-\cos x}{x^2}dx$. **(06 Marks)**

3 a. Form the P.D.E by eliminating the arbitrary function from $z=y^2+2f\left(\frac{1}{x}+\log y\right)$. **(07 Marks)**

b. Solve $x^2\frac{\partial u}{\partial x}+y^2\frac{\partial u}{\partial y}=0$ by the method of separation of variables. **(07 Marks)**

c. Solve $(y^2+z^2)p+x(yq-z)=0$. **(06 Marks)**

4 a. Derive the one dimensional heat equation. **(07 Marks)**

b. Solve the wave equation $\frac{\partial^2 u}{\partial t^2}=C^2\frac{\partial^2 u}{\partial x^2}$ given $u(0,t)=0$; $u(l,t)=0$; $\frac{\partial u}{\partial t}=0$ when $t=0$ and $u(x,0)=u_0\sin\frac{\pi x}{l}$. **(07 Marks)**

c. Obtain the various possible solutions of the Laplace's equation $u_{xx}+u_{yy}=0$ by the method of separation of variables. **(06 Marks)**

Part B

5 a. Find the real root of the equation $3x=\cos x+1$ correct to four decimal places using Newton's method. (07 Marks)

b. Solve the system of equations,

$2x+y+z=10$

$3x+2y+3z=18$

$x+4y+9z=16$

by Gauss-Jordan method. (07 Marks)

c. Find the largest eigen value and the corresponding eigen vector of the following matrix by using power method.

$$A=\begin{bmatrix}2 & 0 & 1\\ 0 & 2 & 0\\ 1 & 0 & 2\end{bmatrix}$$

Taking $[1 \quad 0 \quad 0]^T$ as the initial eigen vector. Carry out four iterations. (06 Marks)

6 a. Given f(0) = 1, f(1) = 3, f(2) = 7, f(3) = 13. Find f(0.1) and f(2.9) using Newton Interpolation formula. (07 Marks)

b. Using Newton's divided difference formula evaluate f(8) and f(15), given that (07 Marks)

x	4	5	7	10	11	13
f(x)	48	100	294	900	1210	2028

c. Evaluate $\int_4^{5.2} \log_e x dx$ by using Weddle's rule, taking 7 ordinates. (06 Marks)

7 a. Derive the Euler's equation in the form $\frac{\partial f}{\partial y} - \frac{d}{dx}\left(\frac{\partial f}{\partial y'}\right)=0$. (07 Marks)

b. Find the extremal of the functional $\int_0^{\pi/2}\left[y^2-(y')^2-2y\sin x\right]dx$ under the conditions $y(0)=y\left(\pi/2\right)=0$. (07 Marks)

c. Find the geodesics on a surface, given that the arc length on the surface is $s=\int_{x_1}^{x_2}\sqrt{x\left[1+(y')^2\right]}dx$. (06 Marks)

8 a. Find the z-transforms of i) $(n+1)^2$ ii) sin(3n+5). (07 Marks)

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

c. Solve the difference equation,

$y_{n+2}+6y_{n+1}+9y_n=2^n$ with $y_0=y_1=0$ using Z transforms. (06 Marks)

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MATDIP301

Third Semester B.E. Degree Examination, Dec. 07 / Jan. 08

Advanced Mathematics – I

Time: 3 hrs.

Max. Marks:100

Note : *Answer any FIVE full questions.*

1 a. Find the n^{th} derivative of – i) $\cos(ax+b)$ ii) $\log(ax+b)$. **(06 Marks)**

b. Find the n^{th} derivative of $\frac{x}{(2x+1)(x+3)}$. **(07 Marks)**

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

2 a. With usual notation prove that $\tan\phi = r\frac{d\theta}{dr}$. **(06 Marks)**

b. Find the angle between the pairs of curves : $r=6\cos\theta$ $r=2(1+\cos\theta)$. **(07 Marks)**

c. Obtain Maclaurin's series expansion of the function $e^x \sin x$ up to the term containing x^4. **(07 Marks)**

3 a. If $u=\phi(x+ay)+\Psi(x-ay)$, prove that $\frac{\partial^2 u}{\partial y^2}=a^2\frac{\partial^2 u}{\partial x^2}$. **(07 Marks)**

b. Verify Euler's theorem for the function: $u=x\tan^{-1}\left(\frac{y}{x}\right)$. **(06 Marks)**

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

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

b. Find the value of $\int_0^1\left(\frac{x^4}{\sqrt{4-x^2}}dx\right)$. **(07 Marks)**

c. Evaluate $\int_0^1\int_{x^2}^{x}(x^2+3y+2)dydx$. **(07 Marks)**

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

b. Prove that $\beta(m,n)=2\int_0^{\pi/2}\sin^{2m-1}\theta\cos^{2n-1}\theta\,d\theta$ and hence evaluate $\int_0^{\pi/2}\sqrt{\tan x}\,dx$. **(07 Marks)**

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

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

b. Solve $x^2ydx-(x^3+y^3)dy=0$. **(07 Marks)**

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

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

b. Solve $\frac{d^{2y}}{dx^2}+4\frac{dy}{dx}+5y=2\cosh x$. **(07 Marks)**

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

8 a. Find the modulus and amplitude of $(1-\cos\alpha+i\sin\alpha)$. **(06 Marks)**

b. Prove that $(1+\cos\theta+i\sin\theta)^n+(1+\cos\theta-i\sin\theta)^n=2^{n+1}\cos^n\frac{\theta}{2}\cos\frac{n\theta}{2}$. **(07 Marks)**

c. Prove that $\sin^7\theta=-\frac{1}{64}(\sin 7\theta-7\sin 5\theta+21\sin 3\theta-35\sin\theta)$. **(07 Marks)**

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Third Semester B.E. Degree Examination, Dec. 07 / Jan. 08
Material Science and Metallurgy

Time: 3 hrs. Max. Marks:100

Note : *Answer any FIVE full questions.*

1 a. Sketch the unit cell of a HCP crystal structure and calculate the number of atoms per unit cell and derive an expression for the density of atomic packing. **(10 Marks)**
b. List the mechanisms of diffusion in solids and explain with sketches any two of them. **(10 Marks)**

2 a. A copper rod of initial diameter 2 mm fractures at a load of 110 kg. Its ductility is 75% reduction in area. Calculate the true stress at fracture. **(06 Marks)**
b. Differentiate between slip and twinning deformations in materials. **(06 Marks)**
c. Define hardness and explain in detail the Brinell hardness testing. **(08 Marks)**

3 a. Explain with sketch the ductile to brittle transition in materials. **(05 Marks)**
b. Explain with sketch the different stages of creep deformation. **(10 Marks)**
c. Explain the process of stress relaxation. **(05 Marks)**

4 a. What is a 'Solid solution'? List the Hume Rothery rules for the formation of substitutional solid solution. **(06 Marks)**
b. Give typical examples for eutectic and eutectoid reactions mentioning for each the temperature and composition at which it occurs. **(04 Marks)**
c. Two metals A and B have their melting points at 900^0 C and 800^0 C respectively. The alloy pair forms a eutectic at 600^0 C of composition 60% B. They have unlimited liquid solubilities. The Solid solubility of A in B is 10% and that of B in A is 5% at eutectic temperature and remains constant till 0^0 C. Draw and label all the fields. Find the liquid and solid phase percentages in an alloy of 20% B at 650^0 C. **(10 Marks)**

5 a. Draw a neat sketch of iron-carbon equilibrium diagram and show all the phase fields, temperature, compositions on it. Explain the solidification mode of a hyper eutectoid steel of 3% C as it cools from liquid phase **(10 Marks)**
b. Explain the steps to construct TTT diagram. Draw a labeled sketch of a TTT diagram for an eutectoid steel. **(10 Marks)**

6 a. Define the process of heat treatment and classify the various heat treatment processes. **(10 Marks)**
b. Explain Normalizing heat treatment process with a sketch. **(05 Marks)**
c. Define hardenability of a material and list the factors affecting hardenability in steels. **(05 Marks)**

7 a. Classify the different types of steels and explain the effect of alloying elements on steel. **(10 Marks)**
b. Explain modification of Al–Si alloy. **(05 Marks)**
c. List the alloying elements and applications of Magnesium based alloys. **(05 Marks)**

8 a. Explain the general methods of corrosion prevention. **(10 Marks)**
b. Write short notes on any two :
i) Intergranular corrosion
ii) Stress corrosion cracking
iii) Cavitation damage. **(10 Marks)**

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Third Semester B.E. Degree Examination, Dec. 07 / Jan. 08

Basic Thermodynamics

Time: 3 hrs. Max. Marks:100

Note : ***1. Answer any FIVE full questions.***
2. Use of thermodynamics data handbook permitted.

1 a. Distinguish between:
i) Open system and closed system
ii) Macroscopic and microscopic approaches
iii) Point function and path function
iv) Intensive and extensive properties
v) Diathermic and adiabatic walls. **(10 Marks)**

b. State the concept of temperature and equality of temperature. Two Celsius thermometers 'A' and 'B' agree at ice point and steam point and the related equation is $t_A = L + Mt_B + Nt_B^2$, where L, M and N are constants. When both thermometers are immersed in fluid, 'A' registers 26^0C while 'B' registers 25^0C. Determine the reading of 'A' when 'B' reads 37.4^0C. **(10 Marks)**

2 a. Starting from a common state point, draw the following processes on the P-V plane and write expression for the work in each case:
i) Isochoric process ii) Isobaric process iii) Isothermal process iv) Isentropic process
v) Polytropic process. **(10 Marks)**

b. Distinguish between heat and work in thermodynamics. **(04 Marks)**

c. A cylinder contains 1 kg of a certain fluid at an initial pressure of 20 bar. The fluid is allowed to expand reversibly behind a piston according to law pV^2 = constant until the volume is doubled. The fluid is then cooled reversibly at constant pressure until the piston regains its original position; heat is then supplied reversibly with the piston firmly locked in position until the pressure rises to the original value of 20 bar. Calculate the net work done by the fluid, for an initial volume of 0.05 m^3. **(06 Marks)**

3 a. Show that energy is a property of the system. Define the specific heats at constant volume and constant pressure. **(10 Marks)**

b. Define steady flow process. A piston and cylinder machine contains a fluid system, which passes through a complete cycle of four processes. During a cycle, the sum of all heat transfer is –170 kJ. The system completes 100 cycles per min. Complete the following table showing the method for each item, and compute the net rate of work output in kW.

Process	Q (kJ/min)	W (kJ/min)	ΔE (kJ/min)
a – b	0	2,170	-
b – c	21,000	0	-
c – d	-2,100	-	-36,600
d – a	-	-	-

(10 Marks)

4 a. Define the thermal efficiency of a heat engine cycle. Can be this 100%? **(02 Marks)**

b. Describe the working of a carnot cycle and show $\eta_{th} = 1 - \frac{T_2}{T_1}$. **(08 Marks)**

c. A reversible heat engine operates between two reservoirs at temperature of 600°C and 40°C. The engine drives a reversible refrigerator, which operates between reservoirs at temperatures of 40°C and –20°C. The heat transfer to the heat engine is 2000 kJ and the net work output of the combined engine refrigerator plant is 360 kJ.

i) Evaluate the heat transfer to the refrigerant and the net heat transfer to the reservoir at 40°C.

ii) Reconsider (i) given that the efficiency of the heat engine and the COP of the refrigerator are each 40% of their maximum possible values. **(10 Marks)**

5 a. State and prove Clausius theorem. **(08 Marks)**

b. What do you understand by the entropy principle? **(02 Marks)**

c. Air at 20°C and 1.05 bar occupies 0.025 m^3. The air is heated at constant volume until the pressure is 4.5 bar, and then cooled at constant pressure back to original temperature. Calculate:

i) The net heat flow from the air ii) The net entropy change.

Sketch the process on T-S diagram. **(10 Marks)**

6 a. Explain the concept of available and unavailable energy. When does the system become dead? **(06 Marks)**

b. Write a brief note on the law of degradation of energy. **(04 Marks)**

c. 8 kg of air at 650 K and 5.5 bar pressure is enclosed in a closed system. If the atmosphere temperature and pressure are 300 K and 1 bar respectively, determine;

i) The availability if the system goes through the ideal work producing process

ii) The availability and effectiveness if the air is cooled at constant pressure to atmospheric pressure without bringing it to complete dead state. Take C_V = 0.718 kJ/kgK; C_P = 1.005 kJ/kgK. **(10 Marks)**

7 a. Define the following:

i) Pure substance ii) Triple point iii) Critical point. **(06 Marks)**

b. With a neat sketch explain the measurement of dryness fraction of steam by using "Throttling calorimeter". **(08 Marks)**

c. Determine the amount of heat, which should be supplied to 2 kg of water at 25°C to convert it into steam at 5 bar and 0.9 dry. **(06 Marks)**

8 a. Distinguish between real gas and ideal gas. **(04 Marks)**

b. Starting from the relation Tds = du + pdv, show that for an ideal gas undergoing a reversible adiabatic process, the law for the process is given by $Tv^{\gamma-1}$ = a constant. **(08 Marks)**

c. A mass of 0.25 kg of an ideal gas has a pressure of 300 kPa, a temperature of 80°C, and a volume of 0.07 m^3. The gas undergoes an irreversible adiabatic process to a final pressure of 300 kPa and final volume of 0.10 m^3, during which the work done on the gas is 25 kJ. Evaluate the C_P and C_V of the gas and the increase in entropy of the gas. **(08 Marks)**

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06ME35

Third Semester B.E. Degree Examination, Dec. 07 / Jan. 08

Manufacturing Process - I

Time: 3 hrs. Max. Marks:100

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

1 a. Briefly discuss the steps involved in making a casting. **(06 Marks)**
b. Discuss the different materials used in making a pattern. **(07 Marks)**
c. What are the different allowances given on a pattern? Explain briefly. **(07 Marks)**

2 a. With a sketch, explain the process of making a given sand mould. **(10 Marks)**
b. Sketch and explain a Jolt moulding machine. **(10 Marks)**

3 a. Explain the procedure of shell moulding highlighting its advantages. **(10 Marks)**
b. Sketch and explain a centrifugal casting machine, highlighting its application. **(10 Marks)**

4 Write explanatory notes on:
a. Cupola and its working. **(12 Marks)**
b. Casting defects, its causes and remedies. **(08 Marks)**

5 Explain the following welding process with necessary sketches and its field of application:
a. Tungsten inert gas welding. **(10 Marks)**
b. Submerged arc welding. **(10 Marks)**

6 Sketch and explain the following welding processes and its uses:
a. Spot welding **(10 Marks)**
b. Thermit welding. **(10 Marks)**

7 a. Explain the different types of electrodes in use and the importance of coating. **(10 Marks)**
b. Explain the different welding defects, its causes and remedies. **(10 Marks)**

8 Explain the following types of non destructive methods of inspection, with necessary sketches:
a. X rays. **(10 Marks)**
b. Magnetic particle inspection. **(10 Marks)**

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Third Semester B.E Degree Examination, Dec. 07 / Jan. 08

Mechanics of Materials

Time: 3 hrs. Max. Marks:100

Note : *1. Answer any FIVE full questions.*
2. Missing data, if any may suitably be assumed.

1 a. Explain clearly with neat sketches, if any, the following i) Proof stress ii) Secant Modulus iii) Elasticity iv) Strain Hardening. **(08 Marks)**

b. A stepped bar is subjected to an external loading as shown in fig. 1(b). Calculate the change in the length of the bar. Take E = 200 GPa for steel, E = 70 MPa for Aluminum and E = 100 GPa for Copper. **(08 Marks)**

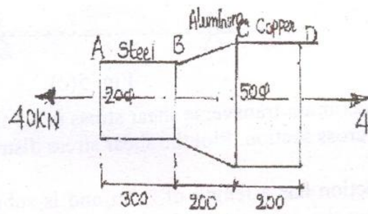

Fig. 1(b)

c. Explain briefly the Principle of Super position. **(04 Marks)**

2 a. Prove that volumetric strain is equal to sum of the three principal strains $\epsilon_V = \epsilon_X + \epsilon_y + \epsilon_z$. **(05 Marks)**

b. A cube of 100mm side is subjected to $10 N/mm^2$ (Tensile) $8 N/mm^2$ (compressive) and $6 N/mm^2$ (Tensile) acting along X, Y and Z planes respectively. Determine the strains along the three directions and the change in volume. Take Poissons ratio = 0.25 and $E = 2 \times 10^5 N/mm^2$. **(05 Marks)**

c. A steel tube of 25mm external diameter and 18mm internal diameter encloses a copper rod of 15mm diameter. The ends are rigidly fastened to each other. Calculate the stress in the rod and the tube. when the temperature is raised from 15^0 to 200^0C. Take $\alpha_{st} = 11 \times 10^{-6}/ {}^0C$, $\alpha_{cu} = 18 \times 10^{-6}/ {}^0C$, $E_{st} = 200$ GPa, $E_{cu} = 100$ GPa. **(10 Marks)**

3 a. Derive expressions for Normal stress and shear stress on a plane inclined at θ to the vertical axis in a biaxial stress system with shear stress as shown in fig.3(a). Hence, prove that the sum of Normal stresses on any two mutually perpendicular planes are always constant. **(10 Marks)**

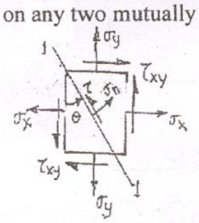

Fig.3(a)

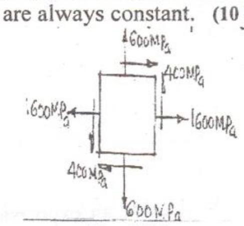

Fig. 3(b)

b. Using Mohr's circle, determine the principle stresses and the planes, Max. shear stress and the planes. Show the same on the elements separately. Refer fig.3(b). **(10 Marks)**

4 a. Prove that the volumetric strain in a thin cylinder is given by $\epsilon_V = (2.\epsilon_C + \epsilon_L)$ Where ϵ_C = hoop strain , ϵ_L = long strain and express the same in terms of diameter of the cylinder (D), thickness (t), Youngs modulus (E), internal pressure (P) and Poisson's ratio (μ). **(10 Marks)**

b. A thick cylinder with Internal diameter 80mm and External diameter 120mm is subjected to an external pressure of 40 kN/m^2, when the internal pressure is 120 kN/m^2. Calculate the circumferential stress at external and internal surfaces of the cylinder. Plot the variation of circumferential stress and Radial pressure on the thickness of the cylinder. **(10 Marks)**

5 a. Briefly explain different types of beam supports. **(03 Marks)**

b. Derive expressions relating Load, Shear Force and Bending Moment (M) with usual notations. **(05 Marks)**

c. Draw SF and BM diagrams for the loading pattern on the beam shown in fig.5(c). Indicate where the Inflexion and contraflexure points are located. Also locate the maximum BM with its magnitude. **(12 Marks)**

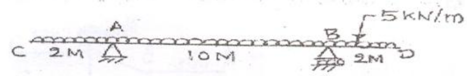

Fig. 5(c)

6 a. Prove that the maximum transverse shear stress is 1.5 times the average shear stress in a beam of a rectangular cross section. Plot the shear stress distribution. What assumptions are made in the above? **(10 Marks)**

b. A beam of T section has a length of 2.5m and is subjected to a point load as shown in the fig.6(b). Calculate the compressive bending stress and plot the stress distribution across the cross section of the beam. The maximum tensile stress is limited to 300 MPa. Calculate the value of W. **(10 Marks)**

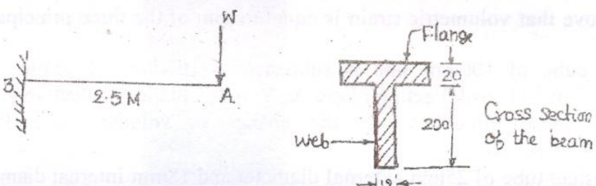

Fig. 6(b)

All dimensions are in mm.

7 a. A beam of length 4m is simply supported at the ends and carries two concentrated loads of 20kN and 30kN at distance 1.5m and 2.5m from left end. Refer fig.7(a). Find the deflection at mid span. Take E = 200 GPa and Moment of Inertial $I = 3\times10^8$ mm^4 of the cross section. **(10 Marks)**

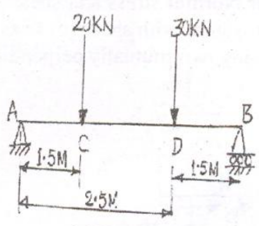

Fig. 7(a)

b. Derive an expression relating slope, deflection and radius of curvature in a beam from first principle in terms E, I and M, with usual notations. **(07 Marks)**

c. Explain how the deflection in beams can be reduced. **(03 Marks)**

8 a. Derive an expression for the critical load in a column subjected to compressive load, when one end is fixed and the other end free. **(10 Marks)**

b. Find the diameter of the shaft required to transmit 60kW at 150 rpm if the maximum torque is 25% of the mean torque for a maximum permissible shear stress of 60 MN/m^2. Find also the angle of twist for a length of 4m. Take G = 80 GPa. **(10 Marks)**

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