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06MAT31

Third Semester B.E. Degree Examination, June/July 2011
Engineering Mathematics

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Find a Fourier series to represent $f(x) = x - x^2$ from $x = -\pi$ to $x = \pi$ and deduce that $\frac{\pi^2}{12} = \frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \ldots\ldots$ **(07 Marks)**

b. If $f(x) = \begin{cases} x & 0 < x < \pi/2 \\ \pi - x & \pi/2 < x < \pi \end{cases}$

show that i) $f(x) = \frac{4}{\pi}\left[\sin x - \frac{1}{3^2}\sin 3x + \frac{1}{5^2}\sin 5x - \ldots\ldots\right]$

ii) $f(x) = \frac{\pi}{4} - \frac{2}{\pi}\left[\frac{1}{1^2}\cos 2x + \frac{1}{3^2}\cos 6x + \frac{1}{5^2}\cos 10x + \ldots\ldots\right]$ **(07 Marks)**

c. Obtain the Fourier series neglecting the terms higher than first harmonic.

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

(06 Marks)

2 a. Find the Fourier transform of the function $f(x) = \begin{cases} x, & |x| \le \alpha \\ 0 & |x| > \alpha \end{cases}$ where 'α' is a positive constant. **(06 Marks)**

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

Hence evaluate $\int_0^\infty \frac{\sin^2 t}{t^2} dt$ **(08 Marks)**

c. Find the finite Fourier sine transform of $f(x) = 2x$ in $0 \le x \le 4$. **(06 Marks)**

3 a. Form the Partial Differential equation by eliminating the arbitrary function from the equation $F(xy + z^2, x + y + z) = 0$ **(06 Marks)**

b. Solve: $xp - yq = y^2 - x^2$. **(07 Marks)**

c. Solve $py^3 + qx^2 = 0$ by the method of separation of variable. **(07 Marks)**

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

b. Find the deflections of a vibrating string of unit length fixed ends with initial velocity zero and initial deflections $f(x) = k(\sin x - \sin 2x)$. **(06 Marks)**

c. Solve $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ subject to the conditions

$u(0, y) = u(l, y) = u(x, 0) = 0$ and $u(x, a) = \sin\frac{n\pi x}{l}$. **(07 Marks)**

PART – B

5 a. Find the real root of the equation $xe^x = 2$ correct to three decimal places using Newton-Raphson method. **(07 Marks)**

b. Employ Gauss-Siedel iteration method to solve:

$20x + y - 2z = 17$

$2x - 3y + 20z = 25$

$3x + 20y - z = 18$

Carryout 3 iterations. **(07 Marks)**

c. Using Power method find the dominant eigen value and the corresponding eigen vector of the matrix $A = \begin{bmatrix} 4 & 1 & -1 \\ 2 & 3 & -1 \\ -2 & 1 & 5 \end{bmatrix}$ **(06 Marks)**

6 a. Using suitable interpolation formula, find the number of students who obtained marks between 40 and 45. **(07 Marks)**

Marks	30-40	40-50	50-60	60-70	70-80
No. of students	31	42	51	35	31

b. Using divided difference formula to find f(x) given data hence find f(4). **(07 Marks)**

x	0	2	3	6
f(x)	-4	2	14	158

c. Using Simpson's $\frac{1}{3}$rd Rule to find $\int_0^{0.6} e^{-x2}\,dx$ by taking seven ordinates. **(06 Marks)**

7 a. State and prove Euler's equation. **(07 Marks)**

b. Solve the variation problem $\sigma \int_0^{} (y^2 + x^2 y^1)dx = 0, y(0) = 0, y(1) = 1$. **(06 Marks)**

c. Find the path in which a particle in the absence of friction will slide from one point to another in the shortest time under the action of gravity. **(07 Marks)**

8 a. Find the z-transform of coshn θ and sinhn θ. **(06 Marks)**

b. Find the inverse z-transform of $\frac{z^3 - 20z}{(z-3)^2(z-4)}$. **(07 Marks)**

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

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06ME32A

Third Semester B.E. Degree Examination, June/July 2011
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. Determine the coordination number and atomic packing factor for BCC lattice. **(05 Marks)**

b. The unit cell of chromium is cubic and contains two atoms. Determine the dimension of the chromium unit cell. [Given : atomic weight of Cr = 52, and density of Cr = 7.19 Mg m^{-3}]. **(05 Marks)**

c. What is crystal imperfection? Give the list of crystal imperfections, and explain any two. **(05 Marks)**

d. A plate of iron is exposed to carbon – rich and carbon – deficient conditions on two sides at 700°C. Calculate the diffusion flux of carbon through the plate if the concentration of carbon at the positions of 5mm and 10 mm beneath the carburizing surface are 1.2kg/m^3 and 0.8 kg/m^3 respectively. $D = 3 \times 10^{-11}$ m^2/s at this temperature. **(05 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. A copper rod of initial diameter 2mm fractures at a load of 110 kg. It's ductility is 75% reduction in area. Calculate the true stress at fracture. **(06 Marks)**

c. A zine crystal is being pulled in tension with the normal to its basal plane at 60° to the tensile axis, and with a slip direction at 40° to the tensile axis.

i) What is the resolved shear stress, τ, acting in the slip direction when a tensile stress of 0.69 MPa is applied?

ii) What tensile stress is necessary to reach the critical resolved shear stress, τ_c, of 0.94 MPa? **(06 Marks)**

3 a. What is Griffith's theory of brittle fracture? Derive the equation for critical stress for crack propagation. **(07 Marks)**

b. What are the factors affecting the fatigue life? **(04 Marks)**

c. Explain with sketch the different stages of creep deformation. What is the effect of stress and temperature on creep curve? **(09 Marks)**

4 a. Explain Hume – Rothery rules for solid solution behavior. **(05 Marks)**

b. Draw a binary phase diagram where the two metals are completely soluble in both solid and liquid state. State Gibb's phase rule and apply it to analyze different regions of the phase diagram. **(10 Marks)**

c. What is an invariant reaction? Illustrate peritectic invariant reaction with a neat diagram. **(05 Marks)**

PART – B

5 a. Draw Fe – Fe_3C phase diagram and label all the parts. Show the invariant points on it. Write the reactions occurring at these points indicating the temperature and composition of each point. **(09 Marks)**

b. With the help of the phase diagram, explain the solidification process of 0.6% C steel, as it cools from liquid phase, showing the microstructures at different stages. **(06 Marks)**

c. What is critical cooling rate? On what factors does it depend? **(05 Marks)**

6 a. Define the process of heat treatment and classify the various heat treatment processes. **(04 Marks)**

b. Define hardenability. Explain with neat sketches how you find it by Jominy – End quench test. **(08 Marks)**

c. Explain austempering and martempering with figures. **(08 Marks)**

7 a. Discuss AISI – SAE designation of steels, with examples. **(06 Marks)**

b. What are the salient features of cast iron? Discuss the classification of cast iron based on microstructure. **(06 Marks)**

c. Discuss the composition, properties, and uses of α – brasses and bronzes. **(08 Marks)**

8 a. Explain any four methods of preventing corrosion. **(08 Marks)**

b. Write short notes on :

i) Single metal galvanic cell corrosion.

ii) Passivation in stainless steel.

iii) Intergranular corrosion. **(12 Marks)**

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06ME33

Third Semester B.E. Degree Examination, June/July 2011
Basic Thermodynamics

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer FIVE full questions selecting at least TWO questions from part A and TWO questions from part B.***
2. Use of Thermodynamic Data Hand Book is allowed.

PART – A

1 a. Distinguish between following with an example for each.
   i) Intensive and Extensive property.
   ii) Point and path function.
   iii) Quasistatic and actual process. **(12 Marks)**

   b. The temperature t on a Celsius scale is defined in terms of property p by the relation $p = e^{(t-B)/A}$, where A and B are constants. Experiments gives value of p of 1.86 and 6.81 at the ice and steam point respectively. Obtain relation for t and also find the temperature t for the reading of P = 2.5. **(08 Marks)**

2 a. Explain with an example how thermodynamic work id different to mechanics definition of work. **(06 Marks)**

   b. What are the similarities and dissimilarities between heat and work? **(06 Marks)**

   c. A system containing 5 kg of a substance is stirred with a torque of 1Nm at a speed of 500rpm for 24 hours. The system mean while expands from $1.5m^3$ to $2m^3$ against a constant pressure of 5 bar. Determine the magnitude and direction of net transfer. **(08 Marks)**

3 a. Show that energy is a property of the system. **(06 Marks)**

   b. A closed rigid vessel containing 10kg of oxygen at 290K is supplied with heat until its pressure becomes two fold that of initial value. Identify the process and calculate the final temperature, change in internal energy, enthalpy and heat interaction across the system boundary. Take $C_v = 0.65$ kJ | Kg^0 K and R = 259.8 J/kg K. **(06 Marks)**

   c. Air flows steadily at the rate of 0.5 kg/s through an air compressor entering at 7 m/s, with a pressure of 100 k Pa and a specific volume of 0.95 m^3/kg and leaving at 5 m/s, with a pressure of 700k Pa and specific volume of 0.19 m^3/kg. The internal energy of the air leaving of 90 KJ/kg greater than that of air entering. Cooling water in the compressor jackets absorbs heat from the air at a rate of 58 KW. Compute the rate of shaft work input to the air in KW and find the ratio of input to output pipe diameters. **(08 Marks)**

4 a. Why it is impossible to carry out the Carnot cycle in real engines? **(04 Marks)**

   b. What is a Thermodynamic Temperature Scale and deduce the relation between Q and T as proposed by Lord Kelvin. **(06 Marks)**

   c. There are three reservoiers at temperature of 827^0C 127^0C, and 27^0C in parallel. A reversible heat engine operates between 827^0C and 127^0 and a reversible refrigerator operates between 27^0C and 127^0C respectively, 502 kJ of heat are extracted from the reservoier at 827^0C by the heat engine and 251kJ of heat are absorbed by the refrigerator from the reservioer at 27^0C. Find the net amount of heat delivered to the reservoir at 127^0C. Can the heat engine drive the refrigerator and still deliver net amount of work? If so how much? **(10 Marks)**

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.

PART – B

5 a. State and prove principle of increase in entropy? **(06 Marks)**

b. A heat engine is supplied with 278 kJ/s of heat at a constant fixed temperature of 283^0C and the heat rejections take place at 5^0C. The following results were reported.
i) 208 kJ/s of heat rejected. ii) 139 kJ/s of heat rejected. iii) 70 kJ/s of heat rejected.
Classify which of the results report a reversible cycle, irreversible cycle or impossible cycle. **(06 Marks)**

c. Ten grams of water at 20^0C is converted into ice at -10^0C at constant atmospheric pressure. Assuming specific heat of liquid water to remain constant at 4.184 J/g^{0}C and that of ice to be half of this value, and taking the latent heat of fusion of ice at 0^0C to be 335 J/g, Calculate the total entropy change of the system. **(08 Marks)**

6 a. Define availability and show that availability for a closed system is equals to $To(S_0-S_1) - (U_0 - U_1) - P_0 (V_0 - V_1)$ when U, S and V are the internal energy, entropy and volume of system and U_0, S_0 & V_0 are their final values when the system comes to equilibrium with its environment. **(08 Marks)**

b. A closed system contains 2 kg of air during an adiabatic expansion process and there occurs a change in its pressure from 500 k Pa to 1000 k Pa and in its temperature from 350 k to 320k. If the volume-doubles during the process, make calculations for maximum work, the change in availability and irreversibility. Take for air $C_V = 0.718$ kJ/kg K and
R = 0.287 kJ/kg K. The surrounding conditions are 100 K pa and 300 K. **(12 Marks)**

7 a. With a neat sketch brief the working of a Throttling calorimeter to determine the quality of steam. **(08 Marks)**

b. Draw the phase equilibrium diagram for water on P – T coordinates, indicating triple and critical point. **(06 Marks)**

c. A rigid vessel having a volume of 0.01m^3 contains 4.5 kg of water at 35^0C. Calculate the quality of the mixture and masses of liquid and vapour. **(06 Marks)**

8 a. For an Ideal gas prove PV^r = constant for a system undergoing a reversible adiabatic process. **(08 Marks)**

b. What are law of corresponding states? And compressibility chart? **(06 Marks)**

c. 1.25 m^3 of air at 180^0C at 8 bar is undergoing a constant pressure until the volume is doubled. Determine the change in entropy and enthalpy of air. **(06 Marks)**

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06ME34

Third Semester B.E. Degree Examination, June/July 2011
Mechanics of Materials

Time: 3 hrs. Max. Marks:100

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

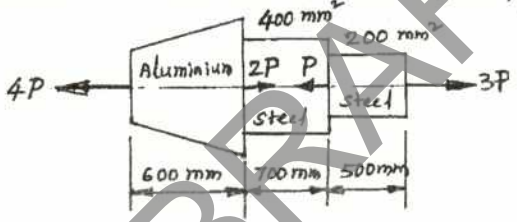
PART – A

1 a. Define the following terms :
i) Hooke's law ; ii) True stress ; iii) Proof stress ; iv) Poisson's ratio. **(04 Marks)**

b. Derive an expression for the extension of a tapering bar whose diameter d_1 at one end tapers linearly to a diameter d_2 at the other end in a length L, under an axial pull P and the elastic modulus of its material is E. **(08 Marks)**

c. A round bar with stepped portion is subjected to the forces as shown in Fig.Q.1(c). Determine the 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 40 mm and 12.5 mm respectively. **(08 Marks)**

Fig.Q.1(c).



2 a. Explain volumetric strain and obtain the expression for volumetric strain for a circular bar. **(05 Marks)**

b. Establish a relationship between the modulus of elasticity and modulus of rigidity. **(07 Marks)**

c. A steel rod of 20mm diameter passes centrally through a copper tube of 50mm external diameter and 40mm internal diameter. The tube is enclosed at each end by rigid plates of neglible thickness. The nuts are tightened lightly on the projecting parts of the rod. If the temperature of the assembly is raised by 50°C, calculate the stress developed in the copper and steel members. Take E for steel and copper as 200 GPa and 100 GPa respectively. Coefficient of expression for steel and copper are 12×10^{-6} /°c and 18×10^{-6} /°c respectively. **(08 Marks)**

3 a. Derive an expression for the normal stress and shear stress on a plane inclined at 'θ' to the vertical axis in a biaxial stress system with shear. Also prove that the sum of normal stresses on any two mutually perpendicular planes are always constant. **(12 Marks)**

b. At a point in a loaded elastic member, there are normal stresses of 60 MPa and 40 MPa (both tensile) respectively, at right angles to each other with positive shearing stress of 20 MPa. Draw the Mohr's circle diagram and find : i) Principal stresses and their planes ; ii) Maximum shear stress and its plane. **(08 Marks)**

4 a. A thin cylinder of diameter d, thickness t, is subjected to an internal pressure of P. Prove that the change in volume, $dV = \frac{pd}{4tE}(5-4\mu)V$ where, E = Young's modulus, μ = Poisson's ratio and V = Volume of the cylinder. **(08 Marks)**

b. A thick cylinder of 500 mm inner diameter is subjected to an internal pressure of 9 MPa. Taking the allowable stress for the material of the cylinder as 40 MPa, determine the wall thickness of the cylinder. Also plot the stress distribution across the wall thickness of the cylinder. **(12 Marks)**

PART – B

5 a. Define shear force and bending moment. **(04 Marks)**

b. Draw the shear force and bending moment diagrams for the beam shown in Fig.Q.5(b). Also calculate the maximum bending moment. **(16 Marks)**

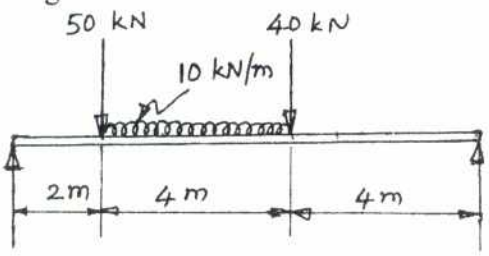


Fig.Q.5(b).

6 a. Derive an expression for the bending stress and radius of curvature for a straight beam subjected to pure bending. Also state the assumptions made in the theory of simple bending. **(12 Marks)**

b. A simply supported beam of I section carries a uniformly distributed load of 40 kN/m run on entire span of beam of length 10m. If I section is having dimensions as shown in Fig.Q.6(b), determine the maximum stress produced due to bending. **(08 Marks)**

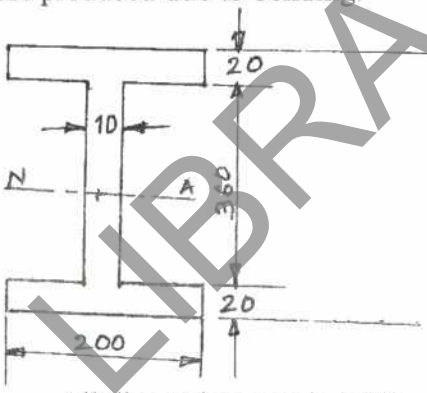


Fig.Q.6(b).

All dimensions are in MM.

7 a. Derive an expression with usual notations for the maximum deflection in a simply supported beam subjected to point load at the mid span. **(08 Marks)**

b. Find the maximum deflection and the maximum slope for the beam loaded as shown in Fig.Q.7(b). Take flexural rigidity, EI = 15×10^9 kN.mm^2. **(12 Marks)**

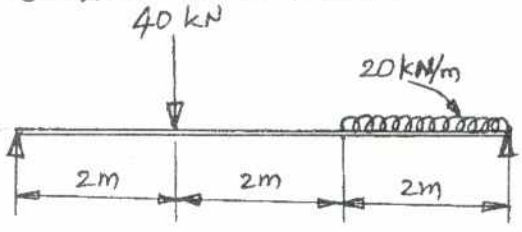


Fig.Q.7(b).

8 a. A solid shaft is to transmit 192 kW at 450 rpm. Taking allowable stress for the shaft material as 70 MPa, find the diameter of the solid shaft. What percentage of saving in weight would by obtained, if this shaft were to be replaced by hollow shaft, whose internal diameter is 0.8 times its external diameter? The length of the shaft, power to be transmitted and speed are equal in both cases. **(10 Marks)**

b. Derive an expression for the critical load in a column subjected to compressive load, when both the ends are hinged. Also mention the assumptions made in the derivation. **(10 Marks)**

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06ME35

Third Semester B.E. Degree Examination, June/July 2011
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. Enumerate the different steps involved in making a casting. **(05 Marks)**
b. Explain the terms pattern, core, mould and casting in foundry process. **(04 Marks)**
c. What is construction allowance? Discuss briefly why contraction allowance is important for pattern. **(06 Marks)**
d. What are additives? List the various additives used in moulding sand. **(05 Marks)**

2 a. Describe the desirable properties of moulding sand. **(05 Marks)**
b. What is meant by a core? Explain briefly different binders used for making the cores. **(05 Marks)**
c. Explain the function of each component in a gating system with a neat sketch. **(05 Marks)**
d. Explain with a neat sketch, sand slinger moulding machine. **(05 Marks)**

3 a. With neat sketch, explain briefly the different steps involved in a shell moulding process. **(08 Marks)**
b. Explain any **two** of the following casting processes with neat sketch :
i) Squeeze casting process
ii) True centrifugal casting
iii) Hot chamber die casting process. **(12 Marks)**

4 a. How are melting furnaces classified? **(04 Marks)**
b. With a neat sketch describe the operation of a cupola furnace. **(08 Marks)**
c. With a neat sketch explain the working of electric arc furnace. **(08 Marks)**

PART – B

5 a. Define welding and give the classification of welding processes. **(04 Marks)**
b. Explain with a neat sketch submerged arc welding process and mention its advantages. **(06 Marks)**
c. Explain any **two** welding processes with neat sketch:
i) TIG welding ii) MIG welding iii) Atomic hydrogen welding. **(10 Marks)**

6 a. Explain the principle of resistance welding with a neat sketch. Discuss the variables responsible for resistance welding. **(08 Marks)**
b. Explain the following welding processes with a neat sketch:
i) Explosive welding process ii) Electron beam welding process. **(12 Marks)**

7 a. Define weldability. What are the factors that affect the weldability of steel? **(06 Marks)**
b. Explain : i) Solidification of the weld ii) Heat affected zone during welding. **(08 Marks)**
c. Write notes on : i) Flux used in welding ii) Welding defects. **(06 Marks)**

8 a. What is NDT? **(02 Marks)**
b. Differentiate between soldering, brazing and welding. **(06 Marks)**
c. Explain magnetic particle inspection of welds. **(06 Marks)**
d. Explain the brazing process, its advantages and limitations. **(06 Marks)**

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MATDIP301

Third Semester B.E. Degree Examination, June/July 2011
Advanced Mathematics – I

Time: 3 hrs. Max. Marks:100

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

1 a. Express $\frac{(1+i)(2+i)}{3+i}$ in the form a + i b. **(05 Marks)**

b. Put the complex number $1-i\sqrt{3}$ in polar form. **(05 Marks)**

c. Simplify $\frac{(\cos 6\theta - i\sin 6\theta)^3(\cos 2\theta + i\sin 2\theta)^7}{(\cos 4\theta - i\sin 4\theta)^3}$. **(05 Marks)**

d. Find the cube roots of 1 – i. **(05 Marks)**

2 a. Find the n^{th} derivative of $e^{ax}\sin(bx + c)$. **(06 Marks)**

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

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

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

b. Show that the curves $r = a(1+\cos\theta)$ and $r = a(1-\cos\theta)$ interest orthogonally. **(07 Marks)**

c. Expand $\log(1+x)$ in ascending power's of x as for as the terms containing x^4. **(07 Marks)**

4 a. If $u = e^{ax+by}f(ax-by)$, prove that $b\frac{\partial u}{\partial x} + a\frac{\partial u}{\partial y} = 2abu$. **(06 Marks)**

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

c. If $u = x^2+y^2+z^2$, $v = xy+yz+zx$, $w = x+y+z$. find $J\left(\frac{u,v,w}{x,y,z}\right)$. **(07 Marks)**

5 a. Obtain the reduction formula for $\int\cos^n x\,dx$ where 'n' is a positive integer and hence evaluate $\int\cos^5 x\,dx$. **(06 Marks)**

b. Evaluate $\int_0^1 x^6\sqrt{1-x^2}\,dx$. **(07 Marks)**

c. Evaluate $\int_{-c}^{c}\int_{-b}^{b}\int_{-a}^{a}(x^2+y^2+z^2)\,dz\,dy\,dx$. **(07 Marks)**

6 a. Evaluate $\int_0^{\infty} x^{3/2} e^{-4x} dx$. **(06 Marks)**

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

c. Prove that $\int_0^{\pi/2} \sqrt{\sin\theta}\, d\theta \times \int_0^{\pi/2} \frac{1}{\sqrt{\sin\theta}} d\theta = \pi$. **(07 Marks)**

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

b. Solve $\frac{dy}{dx} = \cos(x+y+1)$. **(07 Marks)**

c. Solve $x^2y\, dx - (x^3 + y^3)\, dy = 0$. **(07 Marks)**

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

b. Solve $(D^2 + 3D + 2)y = x^2 + 3x + 1$. **(07 Marks)**

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

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