Total No. of Questions : 12] [Total No. of Printed Pages : 7

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F. E. Examination - 2008

ENGINEERING MATHEMATICS - I

(2003 Course)

Time : 3 Hours] **[Max. Marks : 100**

Instructions :

(1) Answer Q. No. 1 or Q. No. 2, Q. No. 3 or Q. No. 4, Q. No. 5 or Q. No. 6 from section I and Q. No. 7 or Q. No. 8, Q. No. 9 or Q. No. 10, Q. No. 11 or Q. No. 12 from section II.

*(2) Answers to the **two sections** should be written in **separate answer-books.***

(3) Figures to the right indicate full marks.

(4) Use of non-programmable calculator (electronic) is allowed.

(5) Assume suitable data, if necessary.

SECTION - I

Q.1) (A) Reduce the following matrix to its normal form and hence find the rank : **[05]**

$$\begin{bmatrix} 2 & 3 & 4 & 5 \\ 3 & 4 & 5 & 6 \\ 4 & 5 & 6 & 7 \\ 9 & 10 & 11 & 12 \end{bmatrix}$$

(B) Verify Cayley Hamilton Theorem for

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

Hence simplify the expression

$A^5 - 3A^4 - 8A^3 - 7A^2 - 10A - 41$ and obtain corresponding matrix. **[07]**

(C) Given the Transformation

$$Y = \begin{bmatrix} 1 & 1 & -2 \\ 2 & -1 & 1 \\ 3 & 1 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

Find the co-ordinates (x_1, x_2, x_3) corresponding to (2, 3, 0) in Y, where $Y = [y_1, y_2, y_3]^T$. **[05]**

Q.2) (A) Show that the following system of equations $3x + 4y + 5z = a$, $4x + 5y + 6z = b$, $5x + 6y + 7z = c$, will be consistent only when $a + c = 2b$. **[05]**

(B) Examine the following vectors for Linear Dependence or Independence. If Dependent, find the relation between the vectors

$x_1 = [1, -1, 2, 2]^T$, $x_2 = [2, -3, 4, -1]^T$, $x_3 = [-1, 2, -2, 3]^T$ **[05]**

(C) Find Eigen Values and Independent Eigen Vectors for the following Matrix : **[07]**

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

Q.3) (A) If $| i + z | = | i - z |$, show that z is completely Real. **[05]**

(B) If $\cosh(x) = \sec\theta$, then find the value of x, and hence show that $\theta = \frac{\pi}{2} - 2\tan^{-1}\left(e^{-x}\right)$ **[06]**

(C) Prove that $\cos\left[i \log\left(\frac{a + ib}{a - ib}\right)\right] = \frac{a^2 - b^2}{a^2 + b^2}$ **[06]**

Q.4) (A) Solve the equation $16x^4 - 8x^3 + 4x^2 - 2x + 1 = 0$. **[06]**

(B) If a and b are reals and

$$\cos\left(\frac{\pi}{4} + i\,a\right)\cosh\left(b + i\,\frac{\pi}{4}\right) = 1, \text{ then show that}$$

$$2b = \pm \log\left(2 + \sqrt{3}\right)$$ **[06]**

(C) If z_1, z_2, z_3 are vertices of an isosceles triangle right angled at z_2, then prove that

$$z_1^2 + 2z_2^2 + z_3^2 = 2z_2\left(z_1 + z_3\right)$$ **[05]**

Q.5) (A) If $y = e^x (\sin x + \cos x)$, prove that

$$y_n = 2^{\left(\frac{n+1}{2}\right)} \cdot e^x \cdot \sin\left[x + (n+1)\frac{\pi}{4}\right]$$ **[05]**

(B) If $y = \cosh(\sin^{-1} x)$, prove that

$$(1 - x^2)\, y_{n+2} - (2n + 1)\, x.y_{n+1} - (n^2 + 1)\, y_n = 0.$$ **[06]**

(C) Use Rolle's Theorem to prove that the equation

$$ax^2 + bx = \frac{a}{3} + \frac{b}{2} \text{ has a root between 0 and 1.}$$ **[05]**

Q.6) (A) If $y = \dfrac{2x + 3}{(x+1)^2 (x - 3)}$, find Y_n. **[05]**

(B) If $x = \sin t$, $y = \sin(at)$, then show that

$$(1 - x^2)\, y_{n+2} - (2n + 1)\, x.y_{n+1} - (n^2 - a^2)\, y_n = 0.$$ **[05]**

(C) Prove that $\dfrac{\pi}{6} + \dfrac{\sqrt{3}}{15} < \sin^{-1}\left(\dfrac{3}{5}\right) < \dfrac{\pi}{6} + \dfrac{1}{8}$. **[06]**

SECTION - II

Q.7) (A) Test the convergence of the series

$$\frac{x}{1} + \frac{1}{2} \cdot \frac{x^3}{3} + \frac{1 \cdot 3}{2.4} \cdot \frac{x^5}{5} + \frac{1 \cdot 3 \cdot 5}{2 \cdot 4 \cdot 6} \cdot \frac{x^7}{7} + \ldots\ldots$$ **[05]**

(B) Attempt **any one** of the following : **[04]**

(1) Determine absolute or conditional convergence of

$$\sum (-1)^n \cdot \frac{n^2}{n^3 + 1}$$

(2) Test for convergence of the series

$$1 + \frac{4}{2!} + \frac{4^2}{3!} + \frac{4^3}{4!} + \frac{4^4}{5!} + \ldots\ldots$$

(C) Attempt **any two** of the following : **[08]**

(1) Expand $[\log (1 + x)]^2$ in ascending powers of x.

(2) Prove that $\log(\sec x) = \frac{x^2}{2} + \frac{1}{3} \cdot \frac{x^4}{4} + \frac{2}{15} \cdot \frac{x^6}{6} + \ldots\ldots$

(3) Using Taylor's Theorem, express

$7 + (x + 2) + 3 (x + 2)^3 + (x + 2)^4 - (x + 2)^5$, in ascending powers of x.

Q.8) (A) Test the convergence of the series

$$\frac{1}{2} - \frac{2}{3} + \frac{3}{4} - \frac{4}{5} + \ldots\ldots$$ **[04]**

(B) Test for convergence of the series : **(Any One)** **[05]**

(1) $$1 + \frac{3}{7} \cdot x + \frac{3 \cdot 6}{7 \cdot 10} \cdot x^2 + \frac{3 \cdot 6 \cdot 9}{7 \cdot 10 \cdot 13} \cdot x^3 + \ldots\ldots$$

(2) $$\frac{1}{1 \cdot 3} + \frac{x}{2 \cdot 3^2} + \frac{x^2}{3 \cdot 3^3} + \frac{x^3}{4 \cdot 3^4} + \ldots\ldots$$

(C) Attempt **any two** of the following : **[08]**

(1) Expand $\left[1+ x + 2x^2\right]^{1/2}$ in powers of $(x - 1)$.

(2) Expand $\log\left[\log(1 + x)^{1/x}\right]$ in powers of x upto x^4.

(3) Expand $\tan^{-1}\left\{\frac{\sqrt{1 + x^2} - 1}{x}\right\}$ in powers of x upto fourth term.

Q.9) (A) Attempt **any two** of the following : **[08]**

(1) Evaluate $\lim_{x\to 0} \frac{x \cdot e^x - \log(1 + x)}{x^2}$

(2) Evaluate $\lim_{n\to\infty} \frac{1^2 + 2^2 + 3^2 + ... + n^2}{n^3}$

(3) Evaluate $\lim_{x\to\infty} \left[\frac{1^{1/x} + 2^{1/x} + 3^{1/x}}{3}\right]^x$

(B) If $u = \log (x^3 + y^3 + z^3 - 3xyz)$, prove that

$$\left(\frac{\partial}{\partial x} + \frac{\partial}{\partial y} + \frac{\partial}{\partial z}\right)^2 u = \frac{-9}{(x+ y + z)^2}$$ **[05]**

(C) If u is a homogeneous function of x and y of degree p and $X = \frac{\partial u}{\partial x}$, $Y = \frac{\partial u}{\partial y}$, and if $u = f(X, Y)$, prove that

$$X \cdot \frac{\partial u}{\partial x} + Y\frac{\partial u}{\partial y} = \left(\frac{p}{p-1}\right)u.$$ **[04]**

Q.10) (A) Attempt **any two** of the following : **[08]**

(1) Evaluate $\lim_{x \to 0} \dfrac{(1+x)^{1/x} - e + \dfrac{ex}{2}}{x^2}$

(2) Evaluate $\lim_{x \to \infty} \left(\dfrac{ax - 1}{ax + 1}\right)^x$

(3) Evaluate $\lim_{x \to \infty} \dfrac{e^{1/x} + e^{2/x} + e^{3/x} + \ldots\ldots + e^{x/x}}{x}$

(B) If $u = \dfrac{1}{x^2} + \dfrac{1}{y^2} + \dfrac{(\log x - \log y)}{x^2 + y^2}$, then show that

$$x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + 2u = 0.$$ **[04]**

(C) If $x = \cos\theta - r\sin\theta$, $y = \sin\theta + r\cos\theta$,

then show that $\dfrac{\partial r}{\partial x} = \dfrac{x}{r}$, $\dfrac{\partial \theta}{\partial x} = -\dfrac{\cos\theta}{r}$. **[05]**

Q.11) (A) Find the stationary values of

$[\sin x \cdot \sin y \cdot \sin(x + y)]$ **[06]**

(B) For the Transformation $x = e^u \cdot \cos v$, $y = e^u \cdot \sin v$,

prove that $\dfrac{\partial(x, y)}{\partial(u, v)} \cdot \dfrac{\partial(u, v)}{\partial(x, y)} = 1$. **[05]**

(C) The H.P. required to propel a steamer varies as the cube of the velocity and square of the length. If there is 3% increase in velocity and 4% increase in length, find the percentage increase in H.P. **[05]**

Q.12) (A) If $u + v^2 = x$, $v + w^2 = y$, $w + u^2 = z$, find $\left(\frac{\partial u}{\partial x}\right)$. **[05]**

(B) Examine the following for functional Dependence or Independence. If Dependent, find the relation between them.

$u = y + z$, $v = x + 2z^2$, $w = x - 4yz - 2y^2$ **[05]**

(C) Prove that the stationary values of

$$u = \frac{x^2}{a^4} + \frac{y^2}{b^4} + \frac{z^2}{c^4}, \text{ where } lx + my + nz = 0$$

and $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$, are given by the roots of the equation

$$\frac{l^2a^4}{1 - a^2u} + \frac{m^2b^4}{1 - b^2u} + \frac{n^2c^4}{1 - c^2u} = 0. \quad \textbf{[06]}$$

Total No. of Questions : 12] [Total No. of Printed Pages : 7

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F. E. Examination - 2008

ENGINEERING MATHEMATICS - II

(2003 Course)

Time : 3 Hours] **[Max. Marks : 100**

Instructions :

(1) In section I, attempt Q. No. 1 or Q. No. 2, Q. No. 3 or Q. No. 4, Q. No. 5 or Q. No. 6. In section II, attempt Q. No 7 or Q. No. 8, Q. No. 9 or Q. No. 10, Q. No. 11 or Q. No. 12.

*(2) Answers to the **two sections** should be written in **separate answer-books**.*

(3) Neat diagrams must be drawn wherever necessary.

(4) Figures to the right indicate full marks.

(5) Use of non-programmable electronic pocket calculator is allowed.

(6) Assume suitable data, if necessary.

SECTION - I

Q.1) (a) Form the differential equation for which $xy = ae^{x} + be^{-x} + x^{3}$ is a solution. **[05]**

(b) Solve **any three :** **[12]**

(1) $\frac{dy}{dx} = \frac{x\sin x}{2e^{y}\sinh y}$

(2) $(1 + y^{2})\,dx + (x - \tan^{-1}y)\,dy = 0$

(3) $(y^{3} - 2x^{2}y)\,dx + (2xy^{2} - x^{3})\,dy = 0$

(4) $\frac{dy}{dx} = \frac{x - y + 1}{x + y - 3}$

OR

Q.2) (a) Solve **any three** : **[12]**

(1) $\frac{dy}{dx} = 1 + 3x^2e^{-y}$

(2) $(2x + e^x \log y)\, y\, dx + e^x dy = 0$

(3) $\left[\log\left(x^2 + y^2\right) + \frac{2x^2}{x^2 + y^2}\right] dx + \frac{2xy}{x^2 + y^2}\, dy = 0$

(4) $(xdy - ydx) + \frac{1}{x^2 + y^2}(xdx + ydy) = 0$

(b) Form the differential equation of family of circles of fixed radius a with centres on x–axis. **[05]**

Q.3) Solve **any three** :

(a) A particle moving in a straight line with an acceleration $K\left[x + \frac{a^4}{x^3}\right]$ is directed towards origin. If it starts from rest at a distance a from origin, prove that it will arrive at origin at the end of time $\frac{\pi}{4\sqrt{k}}$. **[06]**

(b) The charge Q on a plate of a condenser of capacity C is charged through a resistance R by steady voltage V. If Q = 0 at t = 0, **[05]** show that $Q = CV\left[1 - e^{-t/RC}\right]$.

(c) One dimensional steady state heat conduction for a hollow cylinder with constant thermal conductivity k in the region $a \leq r \leq b$, the temperature T at a distance r is given by

$$\frac{d}{dr}\left[r\frac{dT}{dr}\right] = 0$$

with $T = T_1$ when $r = a$ and $T = T_2$ when $r = b$. Use this to determine steady state temperature T in a cylinder in terms of r. **[06]**

(d) A body originally at 80°C cools down to 60°C in 20 minutes, the temperature of surrounding air being 40°C.

(1) What will be the temperature of the body after 40 minutes from the original ?

(2) Find the time required to cool down the body to 70°C. **[05]**

OR

Q.4) Solve **any three** of the following :

(a) Find the orthogonal trajectories of $xy = C$. **[05]**

(b) Determine the least velocity with which a particle must be projected vertically upwards so that it does not return to the earth. Assume that it is acted upon by the gravitational attraction of earth only. **[06]**

(c) A particle executes SHM when it is 2 cm from the mid path, its velocity is 10 cm/sec. and when it is 6 cm. from centre of its path, its velocity is 2 cm/sec. Find its period and greatest acceleration. **[06]**

(d) In a circuit containing inductance L = 640 H, resistance $R = 250\Omega$ and voltage E = 500 volts. Current i is being zero when t = 0. Find the time that elapses, before it reaches 50% of its maximum value. **[05]**

Q.5) (a) A sphere S has points (1, –2, 3) and (4, 0, 6) as opposite ends of a diameter. Find the equation of sphere having the intersection of S with the plane $x + y - 2z + 6 = 0$ as its great circle. **[06]**

(b) Find the equation of a right circular cone passing through (2, –2, 1) with vertex at origin and axis parallel to the line

$$\frac{x - 2}{5} = \frac{y - 1}{1} = \frac{z + 2}{1}.$$ **[05]**

(c) Find the equation of right circular cylinder which passes through the section of the sphere $x^2 + y^2 + z^2 = 25$ made by plane $x + 2y + 2z = 0$. **[05]**

OR

Q.6) (a) Find the equation of a sphere passing through the point (3, 1, 2) and which meets XOY plane in a circle with centre at (1, –2, 0) and radius 3 units. **[06]**

(b) Prove that the equation

$$x^2 - 2y^2 + 3z^2 - 4xy + 5yz - 6zx + 8x - 19y - 2z - 20 = 0$$

represents a cone. Find the co-ordinates of its vertex. **[05]**

(c) Find the equation of right circular cylinder whose axis is $\frac{x - 2}{2} = \frac{y - 1}{1} = \frac{z}{3}$ and which passes through the point (0, 0, 3). **[05]**

SECTION - II

Q.7) (a) Find Fourier Series for the periodic function :

$f(x) = 0 \quad -2 < x < -1$

$= 1 + x \quad -1 < x < 0$ Period 4

$= 1 - x \quad 0 < x < 1$

$= 0 \quad 1 < x < 2$ **[08]**

(b) If $I_n = \int_0^{\infty} e^{-x} \sin^n x \, dx$,

show that $I_n = \frac{n(n - 1)}{n^2 + 1} I_{n-2}$

hence find I_4 **[05]**

(c) Evaluate $= \int_0^{\infty} \sqrt[8]{x} \; e^{-\sqrt{x}} dx$ **[04]**

OR

Q.8) (a) The displacement y of a part of a mechanism is tabulated with corresponding angular movement x^o of the crank. Find fourier series for y upto second harmonic.

x^o	0	30	60	90	120	150	180	210	240	270	300	330
y	1.80	1.10	0.30	0.16	1.50	1.30	2.16	1.25	1.30	1.52	1.76	2.00

[08]

(b) $I_{m,n} = \int \cos^m x \sin nx dx$,

find the reduction formula connecting $I_{m,n}$ with $I_{m-1, n-1}$. **[05]**

(c) Show that $\int_0^\infty \frac{dx}{1+x^4} = \frac{\pi}{2\sqrt{2}}$ **[04]**

Q.9) (a) Trace the following curves : **(Any Two)** **[08]**

(1) $y^2 (a^2 - x^2) = a^3 x$

(2) $x = a(t + \sin t)$, $y = a(1 + \cos t)$

(3) $r = a + b\cos\theta$ when $a < b$

(b) Prove that

$$\frac{1}{x}\frac{d}{da}\,\text{erfc}(ax) = -\frac{1}{a}\frac{d}{dx}\,\text{erf}(ax).$$ **[04]**

(c) If $y = \int_0^x f(t) \sin a(x - t)\, dt$, show that **[05]**

$$\frac{d^2y}{dx^2} + a^2 y = af(x)$$

OR

Q.10) (a) Trace the following curves : **(Any Two)** **[08]**

(1) $r = a\sin 4\theta$

(2) $y^2 = \dfrac{x^2\left(x^2 - 4a^2\right)}{x^2 - a^2}$

(3) $\left(\dfrac{x}{a}\right)^{2/3} + \left(\dfrac{y}{b}\right)^{2/3} = 1$

(b) Evaluate $\int xyds$ along the arc of the ellipse $\dfrac{x^2}{a^2} + \dfrac{y^2}{b^2} = 1$ in the first quadrant. **[05]**

(c) Prove that $\int_0^1 x^P (\log x)^n \, dx = \dfrac{(-1)^n \, n!}{(p+1)^{n+1}}$

where n is a positive integer and $p > -1$ **[04]**

Q.11) (a) Evaluate $\int\int y\,dx\,dy$ over the area bounded by $y = x^2$ and $x + y = 2$, integrating w.r.t. x first. **[06]**

(b) Evaluate $\iiint \dfrac{dxdydz}{\sqrt{a^2 - x^2 - y^2 - z^2}}$

over the volume of the sphere $x^2 + y^2 + z^2 = a^2$ in the positive octant. **[05]**

(c) Find the total area included between the two cardioides $r = a(1 + \cos\theta)$ and $r = a(1 - \cos\theta)$ **[05]**

OR

Q.12) (a) Find the volume bounded by the cylinders $y^2 = x$, $x^2 = y$ and the planes $z = 0$ and $x + y + z = 2$. **[05]**

(b) The law of density ρ of a sphere of radius a is $\rho = \rho_0 \frac{\sin(kr)}{nr}$ where r is the distance from the centre, ρ_0, k and n are constants. Find the average density. **[06]**

(c) Find the centroid of the loop of the curve $r^2 = a^2 \cos 2\theta$. **[05]**

Total No. of Questions : 12] [Total No. of Printed Pages : 4

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F. E. Examination - 2008

APPLIED SCIENCE - I

(2003 Course)

Time : 3 Hours] [Max. Marks : 100

Instructions :

*(1) Answer **three** questions from section I and **three** questions from section II.*

*(2) Answers to the **two sections** should be written in **separate books**.*

(3) Black figures to the right indicate full marks.

(4) Neat diagrams must be drawn wherever necessary.

(5) Use of logarithmic tables, slide rule, mollier charts, electronic pocket calculator and steam tables is allowed.

Constants : $m_e = 9.1 \times 10^{-31}$kg

$c = 3 \times 10^8$ m/s

$h = 6.623 \times 10^{-34}$ J-s

SECTION - I

Q.1) (A) How can Netwon's Rings be obtained in the Laboratory ? Show that the diameter of n^{th} Dark Ring is directly proportional to square root of natural number. **[06]**

(B) State the fundamental postulates of special theory of Relativity. Derive the Mass-Energy Relation. **[06]**

(C) A parallel beam of monochromatic light of wavelength $\lambda = 5890\ A^{\circ}$ is incident on a thin film of $\mu = 1.5$ such that the angle of refraction is 60°. Find the minimum thickness of the film so that it appears dark. For normal incidence, what is the thickness required ? **[04]**

OR

Q.2) (A) Show that the measured value of length of the rod is greatest when it is at rest relative to an observer. Discuss the results observed due to the motion of observer. **[03]**

A length of rocket ship is 100m on ground. When the Observer is in flight, its length observed on the ground is 99m. Calculate the speed of the Observer. **[03]**

(B) Explain the phenomenon of interference in parallel sided thin film in reflected light. [04]

An oil drop of volume 0.2cc is dropped on the surface of a water tank of area 1 sq m. The thin film spread uniformly over the whole surface and white light reflected normally is observed through a spectrometer. The spectrum is seen to contain a first dark band whose centre has a wavelength of 5.5×10^{-5} cm. Find the refractive index of oil. [03]

(C) Explain the working of non-reflecting coating. [03]

Q.3) (A) Obtain the condition for maxima and minima in the Fraunhofer Diffraction due to single slit. [06]

(B) Give the Magnetostriction Method of Generating Ultrasonic Waves. [06]

(C) Explain Rayleigh's Criteria for Resolution and determine the resolving power of telescope. [05]

OR

Q.4) (A) State Bragg's Law of X-ray Diffraction. Explain the construction and working of Bragg's X-ray Spectrometer. [06]

(B) Explain the following applications of Ultrasonic Waves :

(1) Echo Sounding [03]

(2) Cavitation [02]

(3) Flaw Detection [03]

(C) What is the highest order of spectrum which may be seen with the light of wavelength 6328 A^{o} by means of a grating with 3000 lines/cm ? [03]

Q.5) (A) Explain the Construction of Nicol Prism. Explain how a Nicol Prism can be used as an Analyser and Polarizer. [06]

(B) Explain the principle, construction and working of Betatron. Determine the Betatron Condition. [06]

(C) Four hydrogen nuclei are fused to form one helium atom. Find the amount of energy released in MeV and Joules, given that,

Atomic Mass of He atom = 4.0039 amu

Atomic Mass of H atom = 1.0076 amu

Mass of Positron = 0.000549 amu [02]

(D) What are the Retardation Plates ? Explain the working of Half Wave Plate. [03]

OR

Q.6) (A) How do you analyse the given Beam of Light. [06]

(B) Explain the principle, construction and working of Cyclotron and determine the maximum energy gained by the particle. [06]

(C) A Cyclotron with a dee radius of 50 cm is used to accelerate Deuteron. The frequency of the oscillator is 3MHz. Calculate their energy as they emerge. Given $M_d = 3.34 \times 10^{-27}$ kg. [02]

(D) Calculate the ratio of the intensity of transmitted light through the combination of two Nicols, when the principal planes of two Nicols are at 30° to each other. [03]

SECTION - II

Q.7) (A) What is a Covalent Solid ? State general characteristics of Covalent Solids. Give structure of any one Covalent Solid. [05]

(B) Explain the point defects in Ionic Solids. [05]

(C) What are the types of Symmetries in Crystals ? Explain the Law of Rational Indices. Draw the diagram showing (110) planes. [06]

OR

Q.8) (A) Explain the Hexagonal Close Packing, Cubic Close Packing and Body Centred Packing of Metal Atoms and mention co-ordination number of atoms in each of them. [06]

(B) Explain the Mesomorphic Phase. Give the types and applications of Mesomorphic Phase of Solids. [06]

(C) Distinguish the Amorphous and Crystalline Solids. [04]

Q.9) (A) What is a Secondary Pollutant ? Give the formation reactions, favourable conditions of formation and effects for photochemical smog. [06]

(B) (1) 100 ml of a water sample requires 18.5 ml of $\frac{M}{50}$ disodium EDTA for end point in titration. 100 ml of the same water sample after boiling and filtration, takes 10.7 ml of the disodium EDTA for end point in titration. Calculate temporary and permanent hardness of the water sample in ppm $CaCO_3$ equivalent. [05]

(2) 50 ml of a water sample in Mohr's Method of Titration, takes 4.6 ml of $\frac{N}{50}$ $AgNO_3$ for end point. Find the amount of chloride ions in mg/lit. in the water sample. [02]

(C) Explain principle, working and advantages of 'Reverse Osmosis' Technique. [04]

OR

Q.10) (A) State the general principle involved in Internal Treatment of Boiler Scales. Give any two Methods of Internal Treatment. [05]

(B) Define B.O.D. Give its determination. State the importance of B.O.D. [05]

(C) (1) Define 'Electrodialysis' and 'Caustic Embrittlement. [03]

(2) A zeolite bed gets exhausted on softening of 5000 lit. of water of hardness 250 ppm $CaCO_3$ equivalent. Calculate the number of litres of 10% NaCl solution required for its regeneration. [04]

Q.11) (A) Give a note on 'Polymer Composites'. [05]

(B) Explain Effect of Temperature on Organic Polymers. State the factors affecting glass transition temperature. [05]

(C) (1) Explain Suspension Polymerisation Technique. [03]

(2) Give Mechanism of Cationic Polymerisation. [04]

OR

Q.12) (A) Classify Polymers on the basis of (i) Heat Effect (ii) Number of Monomers (iii) Chemical Structure, with appropriate examples. [06]

(B) Account shortly on 'Biodegradable Polymers'. [05]

(C) Give formation reaction, properties and uses of **any two** of the following polymers : [06]

(1) Butyl Rubber

(2) ABS Plastics

(3) Polystyrene

Total No. of Questions : 12] [Total No. of Printed Pages : 3

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F. E. Examination - 2008

ENGINEERING GRAPHICS - II

Time : 4 Hours] [Max. Marks : 100

Instructions :

(1) All questions are compulsory.

*(2) Answers to the **two sections** should be written in **separate books.***

(3) Black figures to the right indicate full marks.

(4) Your answers will be valued as a whole.

(5) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(6) Assume suitable data, if necessary.

SECTION - I

Q.1) Line AB is inclined at 35° to HP and 45° to VP. Mid point of the line is 50 mm above HP while end point B is 75 mm infront of VP. Draw projections when length of side view of the line measures 80mm. Keep point 'A' nearer to both reference planes. Find true length of the line and also locate traces. **[16]**

OR

Q.2) Two electric lamp posts, each 11 meter high, produce shadows of lengths 8 meters and 4 meters respectively on ground, of a pole 5 meter in height. The angle between the shadows is 75°. Determine graphically the distance from the pole-top to the bulb of each post. Take suitable scale. **[16]**

Q.3) A circular plate of 100 mm diameter has a central square hole of 50mm sides. The circular plate is held on a point of its circumference on one of the reference planes such that one of the diagonals of the square hole is parallel to VP and makes 30° with HP, while the other diagonal makes 45° with VP. Draw projections of the circular plate and find the anlges the plate makes with HP and VP. **[16]**

OR

Q.4) A regular pentagonal plane ABCDE of 40 mm sides, has side AB in HP making an angle of 15° with VP. The plane makes an angle of 50° with HP and the point D lies in VP. Draw projections of the plane and find its angle with VP. **[16]**

Q.5) A square pyramid, 50 mm side of base and height 80 mm has a corner of base on HP and 45mm infront of VP. The slant edge through that corner makes an angle of 50° with HP. The apex is in VP. Draw projections of the solid and find the angle made by its base with VP. **[18]**

OR

Q.6) A triangular prism of 60 mm sides and axis 80mm rests on HP on one of its rectangular faces with axis perpendicular to V.P. A pentagonal prism of 30 mm side of base and 60 mm height rests centrally over the triangular prism such that the rectangular faces of both the prisms coincide. The side of pentagon also coincides with the longer edge of the triangular prism. Draw projections of the solids in combination on an AVP which makes 60° to VP. **[18]**

SECTION - II

Q.7) A tetrahedron PQRS has 70 mm long edge. The face PQR is on HP with edge PQ perpendicular to VP. The solid is cut by an AIP such that true shape of the section is trapezoid of 40 mm and 18 mm parallel sides. Draw the sectional plan, elevation and the true shape of the section. Mention the inclination of AIP. **[16]**

OR

Q.8) A cylinder of 60mm diameter and 70mm height rests on H.P. on its base with axis perpendicular to H.P. It has a square hole of 20 mm side cut centrally. The faces of the hole are equally inclined to V.P. The cylinder is cut by an AIP making 55° angle and passing through the mid point of axis. Draw the sectional plan and true shape of the section. **[16]**

Q.9) A right circular cone of diameter of base 96 mm and height 110 rests on the circular edge on ground with axis making 30° to H.P. and parallel to V.P. The development of this cone has a circular hole of 84 mm diameter cut centrally and touching the base of the cone at its highest point in elevation. Draw the remaining part of the surface of solid in two views. **[16]**

OR

Q.10) A hexagonal pyramid of 40 mm side of base has 80mm height of the axis. It rests on HP on its base. An AIP making 45° and passing through mid point of the axis cuts the pyramid. If the remaining bottom part of the solid is entirely enveloped by a thin metal sheet, draw the development of the sheet. Assume one pair of sides of base perpendicular to V.P. **[16]**

Q.11) A vertical square prism of 50 mm side has one of the faces making an angle of 30° with V.P. A hole of 65 mm diameter having axis parallel to both the reference planes and 5 mm away from the axis of the prism is drilled through it. Draw three views showing the intersection curves. **[18]**

OR

Q.12) A cone of 70 mm diameter of base and 75 mm height is kept on H.P. on its base. A vertical hole of 40 mm diameter is drilled through it. If the axis of the hole is 8 mm away from that of the cone and plane containing both the axes is parallel to V.P., draw the projections showing the curves of intersection. **[18]**

Total No. of Questions : 12] [Total No. of Printed Pages : 4

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F. E. Examination - 2008

APPLIED SCIENCE - II

(2003 Course)

Time : 3 Hours] [Max. Marks : 100

Instructions :

*(1) Answer any **three** questions from each section.*

*(2) Answers to the **two sections** should be written in **separate books.***

(3) Black figures to the right indicate full marks.

(4) Use of logarithmic tables, slide rule, mollier charts, electronic pocket calculator and steam tables is allowed.

(5) Neat diagrams must be drawn wherever necessary.

(6) Assume suitable data, if necessary.

Constants : $h = 6.63 \times 10^{-34}$ J-sec.

$m = 9.1 \times 10^{-31}$ kg

$e = 1.6 \times 10^{-19}$ C

$c = 3 \times 10^{8}$ m/sec.

SECTION - I

APPLIED PHYSICS

Q.1) (A) Show that the energy of an electron is quantized when enclosed in a rigid box. **[07]**

(B) What is Uncertainty Principle. Give one experiment to prove its validity. **[06]**

(C) In a T.V. Set, electrons are accelerated by a p.d. of 10 kV. What is the wavelength associated with these electrons ? **[04]**

OR

Q.2) (A) Explain Davisson and Germer Experiment for the determination of wavelength of electrons. **[07]**

(B) Derive Schrödinger's time independent wave equation. **[06]**

(C) Derive an expression for the De Broglie wavelength in terms of energy. **[04]**

Q.3) (A) With the help of neat diagram explain the lasing action of a semi-conductor laser. **[07]**

(B) Explain : **[06]**

(1) Meissner Effect

(2) Effect of External Magnetic Field on Super-conductors

(C) Define and explain the terms ; **[04]**

(1) Pumping

(2) Active System

OR

Q.4) (A) What is Holography ? Explain the process of hologram recording and reconstruction. **[07]**

(B) What is Super-conductivity ? Differentiate between Type I and Type II Super-coductors. **[06]**

(C) Enumerate any four Industrial Applications of Ferrites. **[04]**

Q.5) (A) Give the energy band picture of a P-N junction diode and explain the effect of biasing on the band picture. **[06]**

(B) Show that the vertical displacement made by the electrons in a magnetic field is inversely proportional to the axial velocity of the electrons. **[06]**

(C) Calculate the number of acceptors to be added to a Germanium sample to obtain the resistivity of 10Ω cm.

Given $\mu = 1700$ cm^2/volt-sec. **[04]**

OR

Q.6) (A) Explain J.J. Thomson's method of determining the e/m ratio of electrons. **[06]**

(B) Derive an expression for conductivity in an intrinsic and extrinsic semi-conductors. **[06]**

(C) Electrons accelerated by a potential difference of 150 volts enter in an electric field at an angle of 50° with the normal to the interface of the higher potential and get refracted at an angle of 35° with the normal. Find the potential difference between the two regions. **[04]**

SECTION - II

APPLIED CHEMISTRY

Q.7) (A) Explain how Boy's Gas calorimeter is used to measure calorific value of gaseous fuels. **[07]**

(B) Write short note on refining of petroleum. **[06]**

(C) 0.250 gms of coal sample was burnt in stream of oxygen at 1290°C in a combustion tube. There was increase of Mg-perchlorate unit by 0.025 gm and that of Soda-lime unit by 0.800 gm after combustion. Find out % of C and H of coal sample. **[04]**

OR

Q.8) (A) What is Proximate analysis ? Mention the principle involved in the analysis of each of these constituents. **[07]**

(B) (1) Give the advantages and disadvantages of power alcohol. **[03]**

(2) The coal containing 5% hydrogen (dry/moisture free basis) and 10% moisture has gross calorific value of 33.5 MJ/kg. Calculate Net Calorific Value of Coal. Latent heat of water vapour is 2.45 MJ/kg. **[03]**

(C) A sample of coal was found to have the following composition :

$C = 75\%$, $H_2 = 5.2\%$, $O_2 = 12.8\%$, $S = 1.2\%$, $N_2 = 3.7\%$, ash = 2.1%. Calculate the minimum amount of air necessary for complete combustion of 1 kg of coal. **[04]**

Q.9) (A) Explain construction, working, reactions and applications of Lead-Acid Storage Battery. **[07]**

(B) Explain Reversible, Irreversible and Concentration Cell. **[06]**

(C) Write a note on 'Surface Conversion Coatings'. **[04]**

OR

Q.10) (A) Define Wet Corrosion. Give the mechanism of hydrogen evolution and oxygen absorption. **[07]**

(B) How metal is protected by using cathodic protection method ? **[06]**

(C) Define the following terms : **[04]**

(1) Battery

(2) Energy Density

(3) Passivity or Passivation

(4) Flow Battery

Q.11) (A) Give the principle, working and applications of Thin Layer Chromatography. **[06]**

(B) State and derive Beer's Law and Lamberts Law. **[06]**

(C) Explain transitions involved in UV-Spectroscopy. **[04]**

OR

Q.12) (A) Write the principle, instrumentation and working of IR-Spectroscopy with diagram. **[06]**

(B) Explain in detail Paper Chromatography. **[06]**

(C) What are Electromagnetic Radiations ? Give their characteristics. **[04]**

Total No. of Questions : 12] [Total No. of Printed Pages : 7

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F. E. Examination - 2008

BASIC ELECTRICAL ENGINEERING

(2003 Course)

Time : 3 Hours] **[Max. Marks : 100**

Instructions :

(1) From section 1 attempt one question each from the pairs of Q. Nos. 1 and 2, Q. Nos. 3 and 4, Q. Nos. 5 and 6. From section II attempt one question each from the pairs of Q. Nos. 7 and 8, Q. Nos. 9 and 10, Q. Nos. 11 and 12.

*(2) Answers to the **two sections** must be written in **separate answer-books**.*

(3) Black figures to the right indicate full marks.

(4) Neat diagrams must be drawn wherever necessary.

(5) Use of non-programmable scientific pocket calculator is allowed.

(6) Assume suitable data, if any.

SECTION - I

Q.1) (A) Explain maintenance procedure for Lead Acid Batteries. **[04]**

(B) Define Resistance Temperature Coefficient (RTC). State its Unit and state if it is true that RTC can have (i) Zero Value, (ii) Negative Value and (iii) Positive Value. **[06]**

(C) A resistance element having cross sectional area of $10mm^2$ and length of 10 meter takes a current of 4 Amp from 220V supply at temperature of 20^oC. Find out (i) the resistivity of the material and (ii) current it will take when temperature rises to 60^oC. Assume $\alpha_{20} = .0003/^oC$ **[06]**

OR

Q.2) (A) With neat sketch explain construction and working of Nickel Cadmium Cell. **[05]**

(B) Define Insulation Resistance and derive expression for it for Single Core Cable. **[05]**

(C) With usual notations prove that

$(\alpha_1 - \alpha_2) = \alpha_1\alpha_2\ (t_2 - t_1)$. **[06]**

Q.3) (A) Classify and explain Electrical Networks. **[04]**

(B) For the circuit shown in Fig. A, find the voltage across 4Ω resistance by source transformation. **[06]**

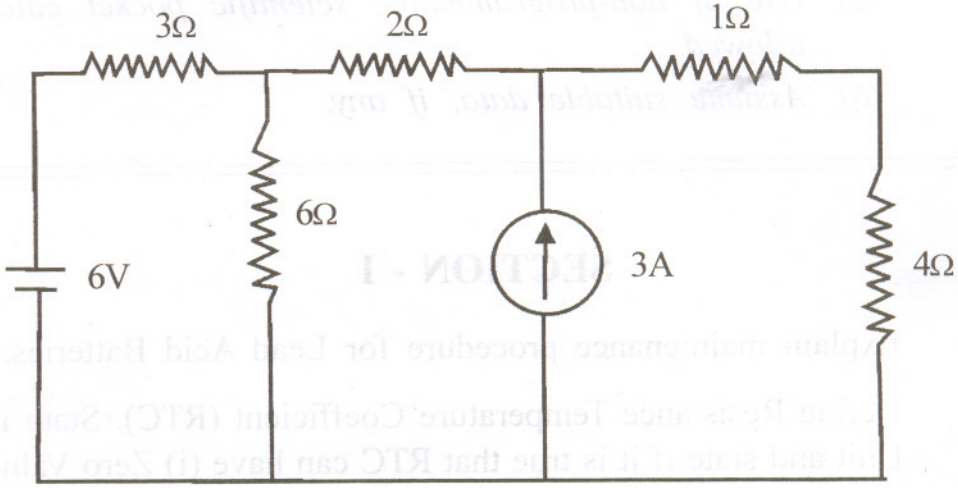

Fig. A

(C) For the circuit shown in Fig. B, find the value of unknown resistance 'R' so that maximum power will be transferred to load. Hence find maximum power. **[07]**

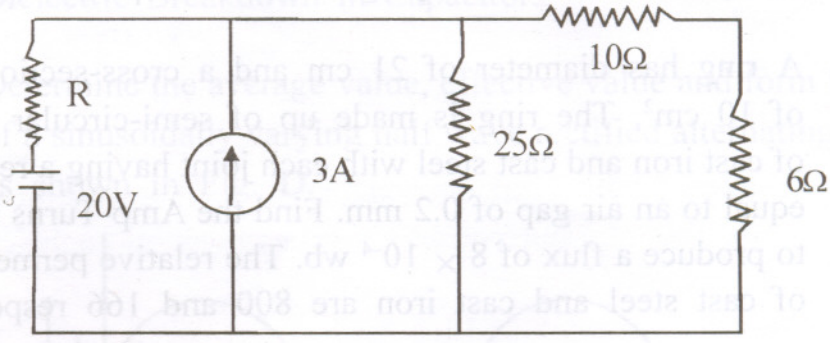

Fig. B

OR

Q.4) (A) State and explain Thevenin's Theorem. **[04]**

(B) Draw the Norton's Equivalent Circuit for the circuit shown in Fig. C. **[07]**

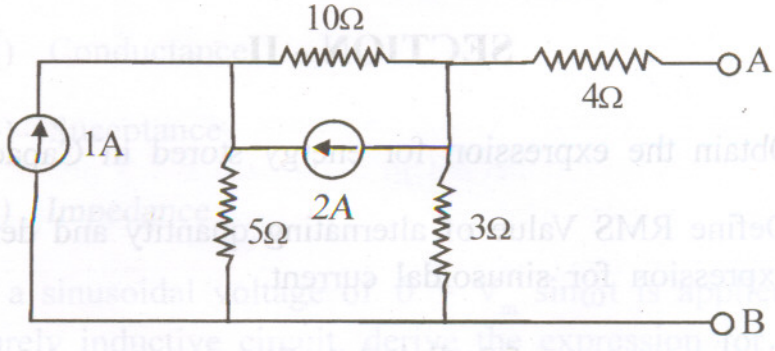

Fig. C

(C) Derive the formulae to convert Star Connected Network into its equivalent Delta Connected Network. **[06]**

Q.5) (A) State the factors affecting value of the Self Inductance of the coil. **[04]**

(B) Derive the expression for force experienced by two long straight conductors carrying current and placed in vacuum. **[05]**

(C) A ring has diameter of 21 cm and a cross-sectional area of 10 cm^2. The ring is made up of semi-circular sections of cast iron and cast steel with each joint having a reluctance equal to an air gap of 0.2 mm. Find the Amp-Turns required to produce a flux of 8×10^{-4} wb. The relative permeabilities of cast steel and cast iron are 800 and 166 respectively. **[08]**

OR

Q.6) (A) Derive the expression for coefficient of coupling between two coupled coils and hence define coefficient of coupling. **[06]**

(B) Define as related to magnetism : (i) Absolute Permeability (ii) Magnetic Field Intensity (iii) Permeance (iv) Coercive Force (v) Relative Permeability. **[05]**

(C) Compare Electric Circuit and Magnetic Circuit. **[06]**

SECTION - II

Q.7) (A) Obtain the expression for energy stored in Capacitor. **[05]**

(B) Define RMS Value of alternating quantity and derive its expression for sinusoidal current. **[05]**

(C) Two capacitors of 2μF and 4μF are connected in (i) parallel and (ii) series across 100V DC supply.

Determine : (i) Energy stored in each capacitor and (ii) Equivalent capacitance of their combination in each case. **[06]**

OR

Q.8) (A) Define Average Value of alternating quantity and derive its expression for sinusoidal current. **[05]**

(B) Explain what do you understand by Dielectric Strength and Dielectric Breakdown in Capacitors. **[05]**

(C) Determine the average value, effective value and form factor of a sinusoidally varying half wave rectified alternating current as shown in Fig. D. **[06]**

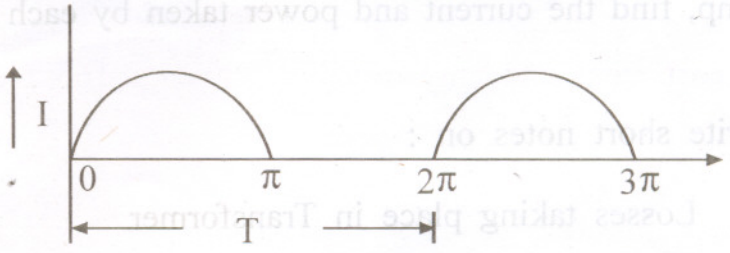

Fig. D

Q.9) (A) Define the following and state their units :

(1) Active Power

(2) Reactive Power

(3) Conductance

(4) Suceptance

(5) Impedance **[05]**

(B) If a sinusoidal voltage of $\vartheta = V_m \sin\omega t$ is applied across purely inductive circuit, derive the expression for current drawn and power consumed. **[05]**

(C) Two impedances $Z_1 = 30 \angle 45^\circ \Omega$ and $Z_2 = 45 \angle 30^\circ \Omega$ are connected in parallel across single phase 230V, 50Hz supply. Calculate the (i) current drawn (ii) p.f. and (iii) power consumed by circuit. **[08]**

OR

Q.10) (A) Sketch the waveforms of voltage, current drawn & power consumed when $\vartheta = V_m \sin\omega t$ volt is applied across R-C series circuit and state expression for current and power consumed. **[05]**

(B) Sketch Impedance Triangle and Admittance Triangle and define Admittance and Impedance. **[05]**

(C) Two impedances $(8 + j\ 6)\Omega$ and $(3 - 4j)\Omega$ are connected in parallel. If the total current drawn by the combination is 25 Amp, find the current and power taken by each impedance. **[08]**

Q.11) (A) Write short notes on : **[06]**

(1) Losses taking place in Transformer

(2) Auto-Transformer

(B) Define : **[06]**

(1) Phase Sequence

(2) Balanced Load

(3) Symmetrical Supply, with Reference to Three-phase Circuits.

(C) Three coils each having resistance of 10Ω and inductance of 0.03H are connected in delta across a 3 phase 400 volt 50Hz supply. Calculate the current drawn and power consumed by load. **[04]**

OR

Q.12) (A) With the help of circuit diagram explain the method of performing direct load test on single phase transformer. Explain how we can calculate efficiency and regulation from data noted from test. **[10]**

(B) State the relations between line and phase values of voltage and current for 3-phase Star Connected and Delta Connected Load. State the equation for Active and Reactive Power consumed by three phase load. **[06]**

Total No. of Questions : 12] [Total No. of Printed Pages : 4

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F. E. Examination - 2008

BASIC ELECTRONIC ENGINEERING

(2003 Course)

Time : 3 Hours] **[Max. Marks : 100**

Instructions :

(1) Answer three questions from Section I (Q. 1 or Q. 2, Q. 3 or Q. 4, Q. 5 or Q.6) and three questions from Section II (Q. 7 or Q. 8, Q. 9 or Q. 10, Q. 11 or Q. 12).

*(2) Answers to the **two sections** should be written in **separate books**.*

(3) Black figures to the right indicate full marks.

(4) Use of logarithmic tables, slide rule, mollier charts, electronic pocket calculator and steam tables is allowed.

(5) Neat diagrams must be drawn wherever necessary.

(6) Assume suitable data, if necessary.

SECTION - I

Q.1) (A) Differentiate Zener Breakdown and Avalanche Breakdown. **[04]**

(B) A bridge rectifier is applied with input from a stepdown transformer having turns Ratio 8 : 1 and input 230V, 50Hz. If the $R_f = 1\Omega$, $R_S = 10\Omega$ and $R_L = 2k\Omega$, find :

(1) DC Power Input

(2) P/V Across each Diode

(3) Percentage Efficiency

(4) Percentage Regulation at Full Load **[08]**

(C) Explain principal of operation of LED. State various materials used to fabricate LEDs. [04]

OR

Q.2) (A) Why Photodiode is not used in forward biased condition and give advantages and disadvantages of Photodiode. [05]

(B) Why biasing is needed in a transistor ? Explain the self biasing with relevant circuit diagram. [05]

(C) Derive the expression for O/P voltage and ripple factor of bridge full wave rectifier using capacitive filter. [06]

Q.3) (A) Draw neat block diagram of series and shunt voltage regulators and explain their operation in brief. [08]

(B) What are the advantages of IC regulators over discrete component ? [04]

(C) Explain how Ri and Ro affect the performance of the Voltage Amplifier. [04]

OR

Q.4) (A) Draw and explain the frequency response of a typical RC Coupled Amplifier. What is Bandwidth ? Explain the procedure to find bandwidth from frequency response of amplifier. [08]

(B) Derive the equation of DC load line for a CE amplifier and explain the criteria for selection of the operating point. [04]

(C) For a regulated DC power supply, the output voltage varies from 12V to 11.6V, when the load current varies from 0 to 100mA, which is the maximum value of I_L. If the AC line voltage and temperature are constant, calculate the load regulation, percentage load regulation and output resistance of power supply. [04]

Q.5) (A) Explain threshold level, fan-in and fan-out concept. [06]

(B) Explain NAND, NOR and EX-OR gates with the help of Boolean expression and truth table. [06]

(C) Verify the following Boolean functions : [06]

(1) $AB + \overline{A}C + BC = AB + \overline{A}C$

(2) $(A + BC)(B + \overline{C}A) = AB + A\overline{C}$

OR

Q.6) (A) The square wave is applied as one of the inputs to a gate, second input of the gate is connected to a ground. Draw the output wave form if the gate is (i) OR (ii) NAND (iii) EX–OR. **[06]**

(B) Draw the logic diagram to implement the Boolean expression with minimum number of NAND gates : **[06]**

$$Y = \overline{\left(A + \overline{B} + \overline{C}\right)}\left(A\overline{B} + \overline{A} + \overline{B} + \overline{C}\right) + C\overline{D}.$$

(C) Design half adder circuit using K-map. **[06]**

SECTION - II

Q.7) (A) The amplifier has a bandwidth of 150kHz and the voltage gain of 50. What will be the bandwidth and gain if an amplifier is of 5% negative feedback. **[04]**

(B) Explain the effect of negative feedback on :

(1) Input resistance of an amplifier

(2) Output resistance of an amplifier

(3) Gain of the amplifier

(4) B.W. of the amplifier **[06]**

(C) What is an OP-Amplifier ? Draw and explain its block diagram. **[06]**

OR

Q.8) (A) Explain the conditions necessary to produce sustained oscillations. **[04]**

(B) Draw a neat circuit diagram for Wien-bridge Oscillator using OP-amp. Also calculate the frequency of oscillation for this circuit, where R = 50 kΩ and C = 0.001nf. **[06]**

(C) Draw and explain the workings of the following : **[06]**

(1) Summing Amplifier

(2) Difference Amplifier

Q.9) (A) Explain working principal of piezoelectric transducer and give the advantages and disadvantages of piezoelectric transducer. [08]

(B) State the principal of operation, material used and any two applications of a thermister and also explain principal of operation of RTD. [08]

OR

Q.10)(A) What is a Transducer ? Compare active and passive transducer. Give example of each. [06]

(B) Draw construction details of LVDT. Explain its working and state its applications. [08]

(C) Explain the principal of operation of thermocouple. [02]

Q.11)(A) What is a need of CRO while performing electronic practicals ? Explain Auto Sweep Mode and Normal Sweep Mode in CRO and how will you measure unknown frequency on CRO ? [12]

(B) State the application of astable multivibrator using IC 555 and explain any one. [06]

OR

Q.12)(A) Draw and explain block diagram of dual trace CRO. List applications of CRO. [08]

(B) Write short notes on **any two** : [10]

(1) Weighing Machine

(2) Burglar Alarm

(3) PA system.

Total No. of Questions : 12] [Total No. of Printed Pages : 11

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F. E. Examination - 2008

ENGINEERING MECHANICS

(2003 Course)

Time : 3 Hours] **[Max. Marks : 100**

Instructions :

(1) Answer Q.1 or Q.2, Q.3 or Q.4 and Q.5 or Q.6 from section I and Q.7 or Q.8, Q.9 or Q.10 and Q.11 or Q.12 from section II.

*(2) Answers to the **two sections** should be written in **separate answer-books**.*

(3) Figures to the rights indicate full marks.

(4) Neat diagrams must be drawn wherever necessary.

(5) Use of electronic pocket calculator is allowed.

(6) Assume suitable data, if necessary and clearly state them.

(7) Use of cell phone is prohibited in the examination hall.

SECTION - I

Q.1) (A) Four forces acting on a triangle ABC are shown in Fig. 1(A). The sum of moments of these forces at point C is 2000 N-mm clockwise. If resultant of force system is in horizontal direction, find its magnitude and point of application. **[10]**

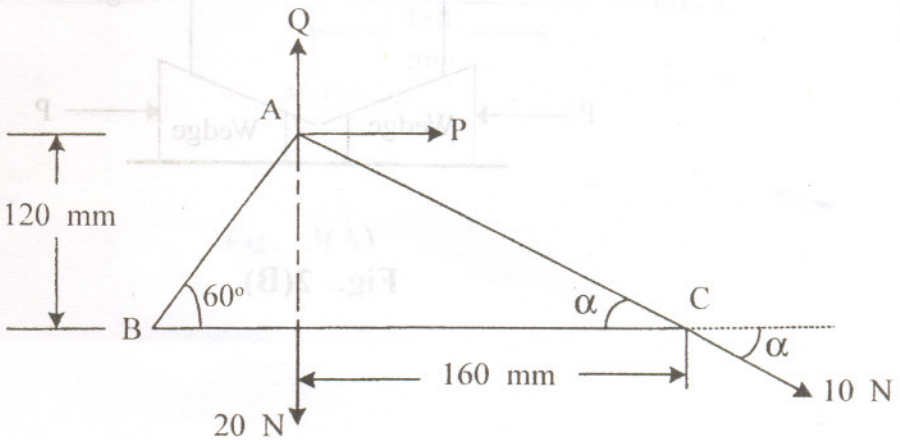

Fig. 1(A)

(B) A beam AB of 5 m length is supported as shown in Fig. 1(B). If AD, AE and BF carry equal axial force, determine the location x of load 1000 N. **[08]**

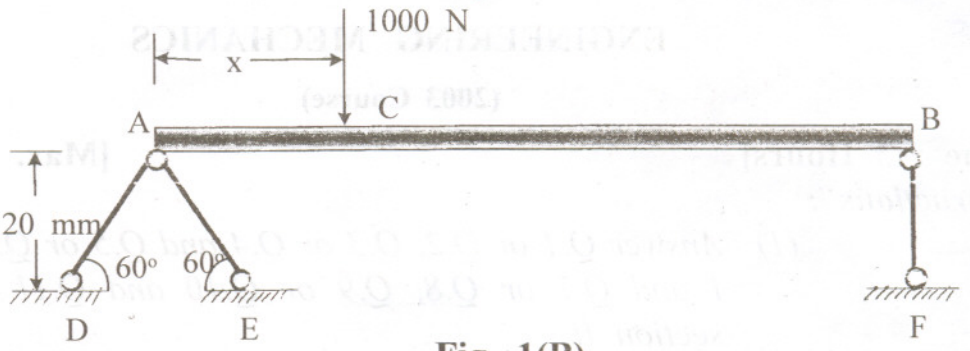

Fig. 1(B)

OR

Q.2) (A) Show that for a body sliding freely down the inclined plane, angle of repose is equal to the angle of friction. **[04]**

(B) A block of 1000 N is to be raised up by means of force P each acting on wedges as shown in Fig. 2(B). If angle of friction at all rubbing surfaces is 15°, determine P. Ignore weight of wedge. **[08]**

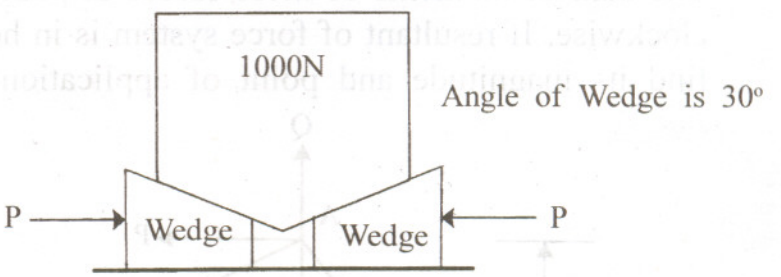

Fig. 2(B)

(C) Locate the centroid of reamining lamina with respect to O, if shaded part is removed. Refer Fig. 2(C). **[06]**

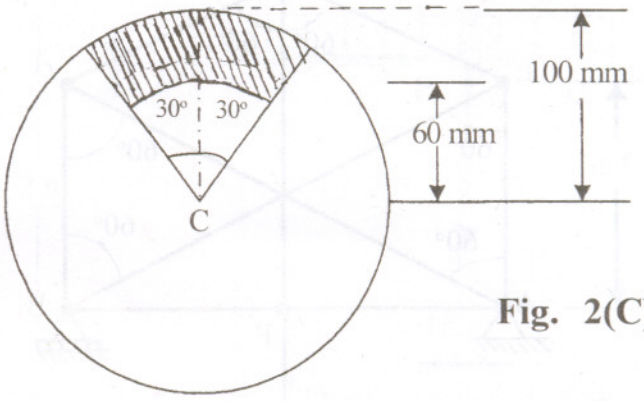

Fig. 2(C)

Q.3) (A) A Z-shaped lamina of uniform width of 20 mm is subjected to four forces as shown in Fig. 3(A), find equilibrant in magnitude and direction. **[06]**

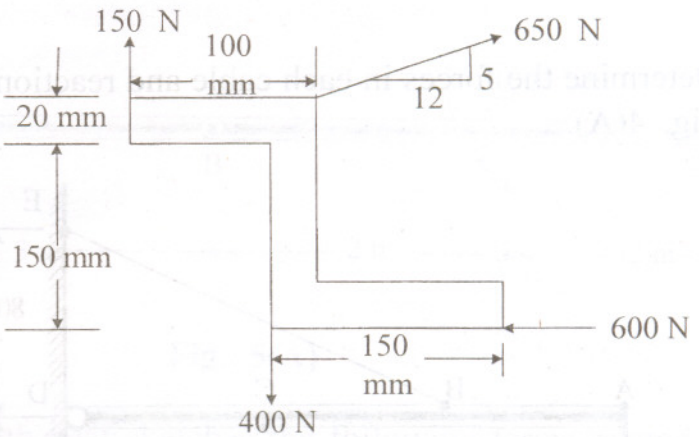

Fig. 3(A)

(B) Determine the forces in all members of truss shown in Fig. 3(B). A, B, C, D, E and F are pinned joints. **[10]**

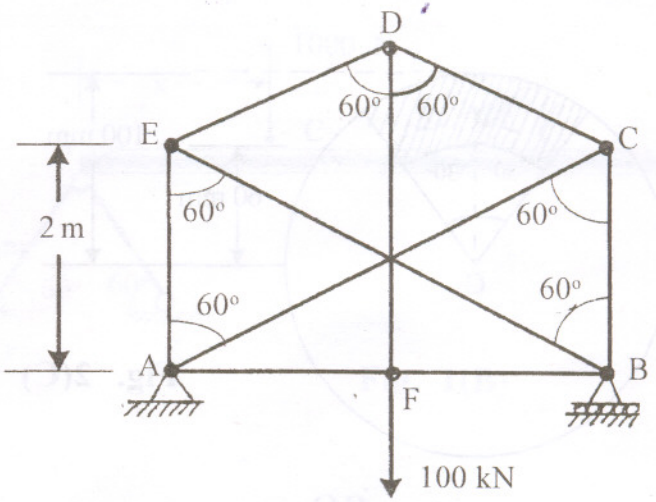

Fig. 3(B)

OR

Q.4) (A) Determine the forces in each cable and reaction at roller D. Refer Fig. 4(A). **[06]**

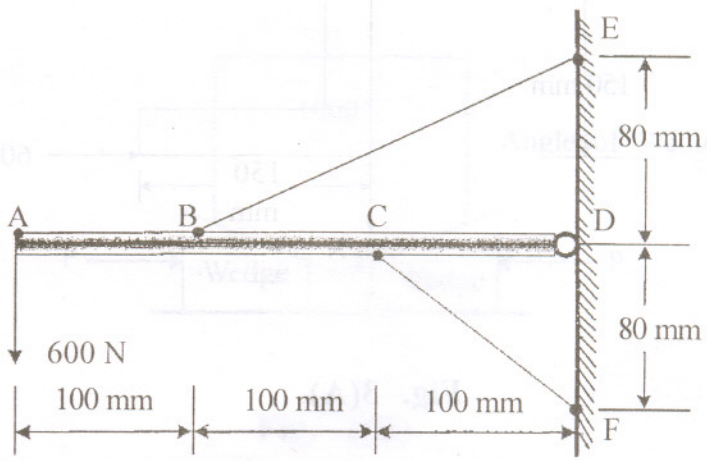

Fig. 4(A)

(B) Two bars ABC and DBE are pinned together at B. Ends A and D are hinged. Under loading as shown in Fig. 4(B), determine reaction at A and D. Neglect weight of bars. **[10]**

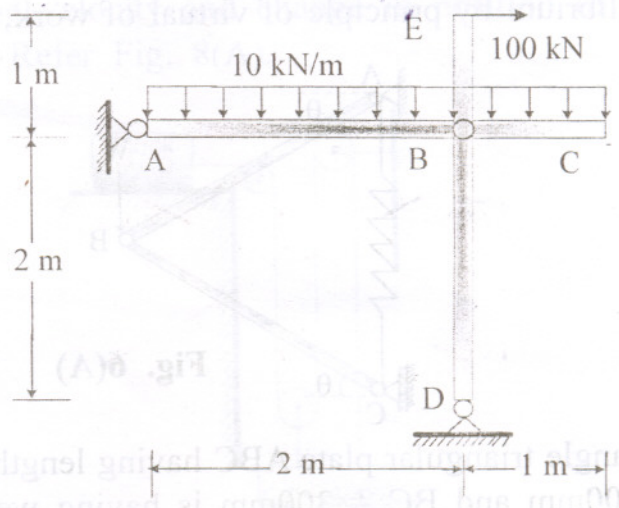

Fig. 4(B)

Q.5) (A) Two beams AB and BCD are pin connected together at B as shown in Fig. 5 (A). Determine by virtual work principle, fixing moment and reaction at A. Verify the result using principle of statics. **[10]**

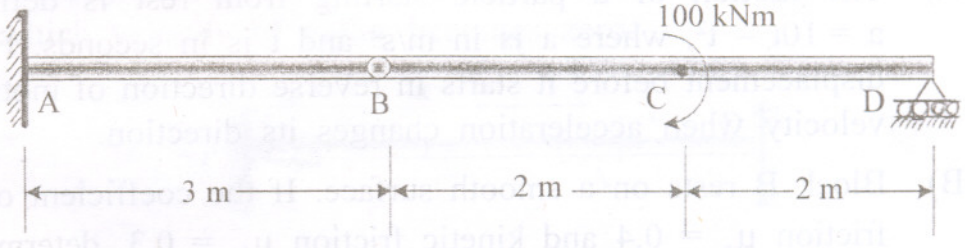

Fig. 5(A)

(B) Explain with neat sketches the following terms related to space forces : **[06]**

(1) Representation of force in vector form

(2) Condition of equilibrium for concurrent and parallel forces

OR

Q.6) (A) Two bars AB and BC of equal length L are pinned at B. Ends A and C are connected by means of spring of stiffness k. Unstreched length of spring is S. Show that $\sin\theta = (W + 2kS)/4kL$, for equilibrium by principle of virtual of work, Refer Fig. 6(A). **[08]**

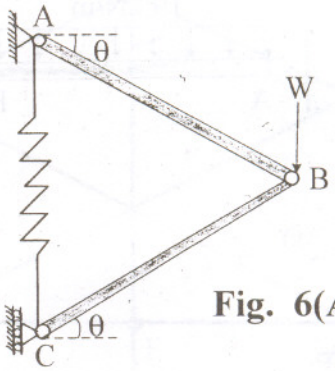

Fig. 6(A)

(B) A right angle triangular plate ABC having lengths AB = 400mm, AC = 300mm and BC = 300mm is having weight 50 N. It is held in Equilibrium by means of three parallel wires connected to points A, B and C in such a way that plate ABC remains in horizontal plane. Determine the tension in three wires. **[08]**

SECTION - II

Q.7) (A) The motion of a particle starting from rest is defined by $a = 10t - t^2$, where a is in m/s^2 and t is in seconds. Find the displacement before it starts in reverse direction of motion and velocity when acceleration changes its direction. **[08]**

(B) Block B rests on a smooth surface. If the coefficient of static friction $\mu_s = 0.4$ and kinetic friction $\mu_k = 0.3$, determine the acceleration of each block if A is pushed by a force : (a) P = 30 N, (b) P = 250 N. Refer Fig. 7(B) **[08]**

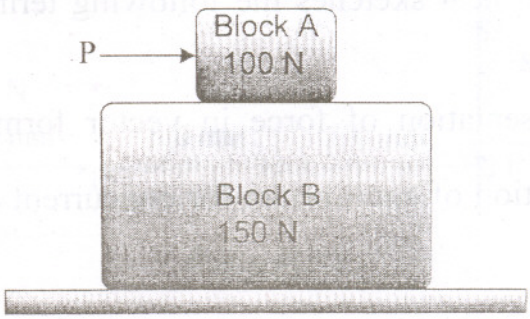

Fig. 7(B)

OR

Q.8) (A) Block B starts from rest and moves downward with a constant acceleration. Knowing that after slider block A has moved 400mm, its velocity is 4 m/s, determine (a) acceleration of blocks A and B, (b) the velocity and change in position of block B after 2s. Refer Fig. 8(A). **[08]**

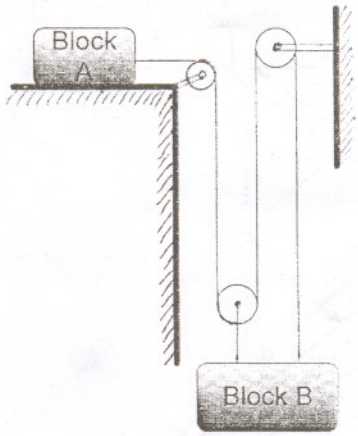

Fig. 8(A)

(B) A smooth 10N collar C fits loosely on the horizontal shaft as shown in Fig. 8(B). If the spring is unstreched at x = 0, the collar is given an initial velocity of 4.5 m/s. Determine the velocity of collar when x = 1m. Also find the value of x at which velocity of collar becomes zero. **[08]**

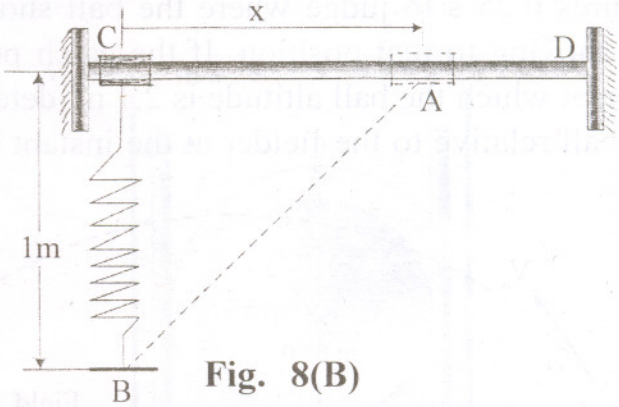

Fig. 8(B)

Q.9) (A) The train travels along a track having the shape of spiral, $r = (1000/\theta)$, where θ is in radian. If the angular rate is constant $\dot{\theta} = 0.2$ rad./s, determine the radial and transverse components of its velocity and acceleration when $\theta = 9\pi/4$ rad. **[08]**

(B) A 0.3 kg collar D can slide on portion AB of a rod which is bent as shown in Fig. 9(B). Knowing that $\alpha = 40^{\circ}$ and that the rod rotates about the vertical AC at a constant rate of 5 rad./s, determine the value of radius r for which the collar will not slide on the rod if the effect of friction between the rod and collar is neglected. **[08]**

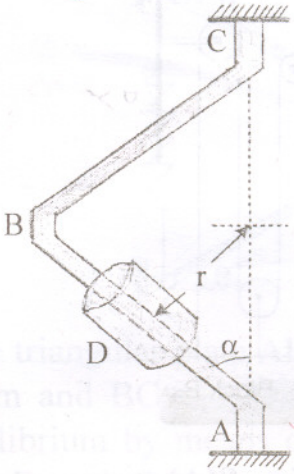

Fig. 9(B)

OR

Q.10) (A) A batsman hits the ball A with an initial velocity of 30 m/s at an angle of 30° to the horizontal as shown in Fig. 10(A). The initial position of the ball is 0.9 m above the ground level. Fielder B requires 0.25 s to judge where the ball should be caught and begins moving to that position. If the catch position is the field location at which the ball altitude is 2.1 m, determine the velocity of the ball relative to the fielder at the instant the catch is made. **[08]**

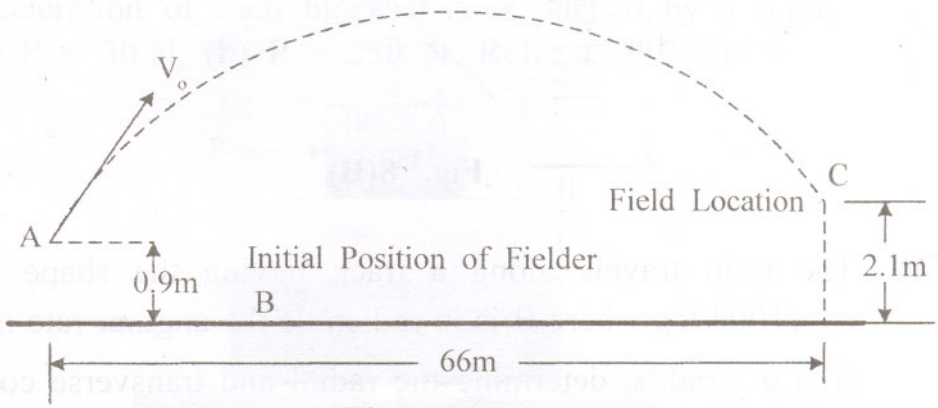

Fig. 10(A)

(B) The simple pendulum as shown in Fig. 10(B) is released from rest at A with the string horizontal and swings downward under the influence of gravity. Express the velocity v of the bob and the tension T in the string as a function of θ. **[08]**

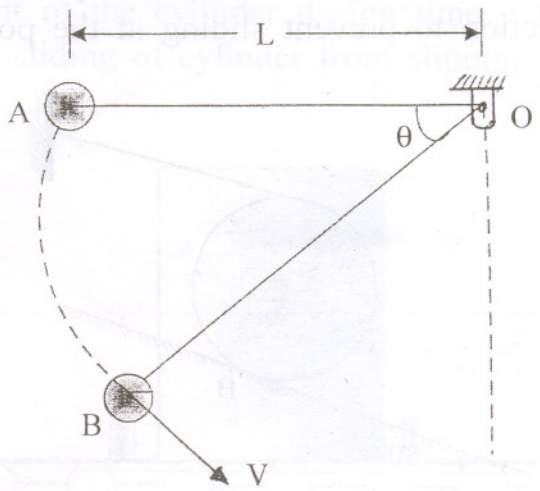

Fig. 10(B)

Q.11)(A) The sliding rails A and B engage the rims of the double wheel without slipping as shown in Fig. 11(A). For the specified velocities of A and B, determine the angular velocity ω of the wheel and the magnitude of the velocity of point P. **[08]**

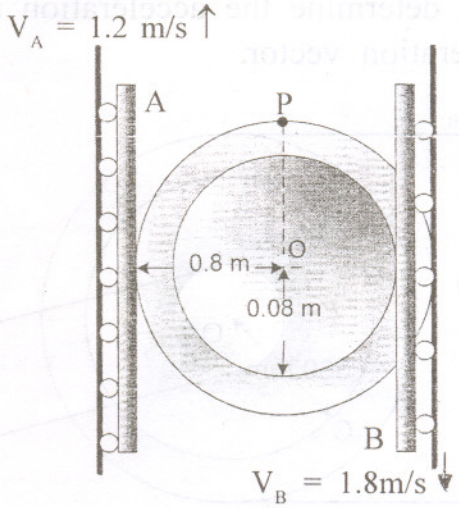

Fig. 11(A)

(B) A solid homogeneous right circular cylinder of weight W and radius r is supported on an inclined plane as shown in Fig. 11(B). The string wound around the circumference is attached to fixed support at A and is parallel to the plane. Find the acceleration of mass center C of the cylinder down the plane if the coefficient of kinetic friction to prevent sliding at the point of contact B is $\mu_k = 1/3$. **[10]**

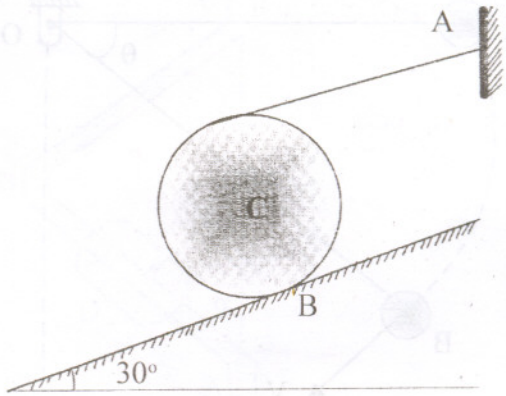

Fig. 11(B)

OR

Q.12)(A) The compound pulley rotates about the fixed axis at O. At a certain instant, point A on the belt of the smaller pulley has a velocity of $V_A = 1.5$ m/s and point B on the belt of the larger pulley has on acceleration $a_B = 45$ m/s^2 as shown in Fig. 12(A). For this instant determine the acceleration a_C of point C and draw the acceleration vector. **[09]**

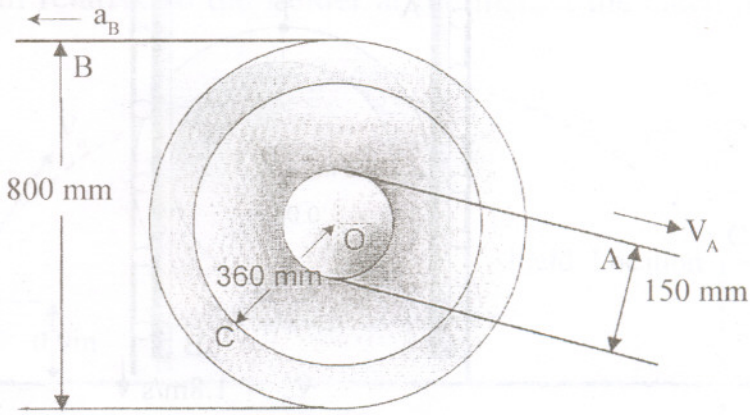

Fig. 12(A)

(B) Solid homogeneous cylinder 400 mm high and 250 mm in diameter is supported by a flat conveyor belt which moves horizontally. If the speed of the belt increases according to $v = 1.2 + 0.9t^2$ m/s, where t is in seconds. Calculate the value of t for which the cylinder begins to tip over and the displacement of the cylinder during time t. Cleats on the belt prevent the sliding of cylinder from slipping. Refer Fig.12(B). **[09]**

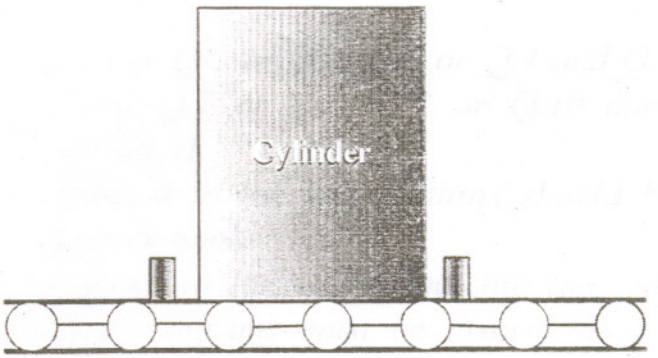

Fig. 12(B)

Total No. of Questions : 12] [Total No. of Printed Pages : 4

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F. E. Examination - 2008

BASIC MECHANICAL ENGINEERING

(2003 Course)

Time : 3 Hours] **[Max. Marks : 100**

Instructions :

*(1) Answers to the **two sections** should be written in **separate books**.*

(2) Black figures to the right indicate full marks.

(3) Neat diagrams must be drawn wherever necessary.

(4) Use of logarithmic tables, slide rule, mollier charts, electronic pocket calculator and steam tables is allowed.

(5) Assume suitable data, if necessary.

SECTION - I

Q.1) (A) What is Quasi-equilibrium Process ? Discuss its importance. **[06]**

(B) Explain Thermodynamic Equilibrium. **[04]**

(C) The work and heat per degree change of temperature for a process executing a non flow process is given by $\frac{\delta W}{\delta T}$ = 160 WS /° C and $\frac{\delta Q}{\delta T}$ = 200 J /° C. Determine change in internal energy of a system when its temperature increases from 60°C to 110°C. **[06]**

OR

Q.2) (A) Derive steady flow energy equation for reciprocating pump with offset piping. **[06]**

(B) State and explain First Law of Thermodynamics. **[04]**

(C) A thermocouple with test junction at T°C on a gas thermometer scale gives emf as, $e = 0.22t - 5.5 \times 10^{-4}t^2$ mϑ. The milivoltmeter is calibrated at ice and steam points. What will be the reading on this voltmeter when gas thermometer reads 60°C ? **[06]**

Q.3) (A) With neat sketch explain construction and working of Lancashire Boiler. **[10]**

(B) With neat sketch explain construction and working of Household Refrigerator. **[06]**

OR

Q.4) (A) With neat sketch explain construction and working of Four Stroke C.I. Engine. **[08]**

(B) Explain with schematic sketch Closed Cycle Gas Turbine Plant. **[05]**

(C) Why Priming is required in Centrifugal Pumps ? **[03]**

Q.5) (A) Derive an expression for Heat Conduction through infinitely long hollow cylinder. **[05]**

(B) Explain with neat sketch construction and working of Ocean Thermal Plant. **[07]**

(C) A metal piece 50 cm long is in the form of sector of circle of 10 cm radius and includes an angle of $\pi/2$. The thermal conductivity of the metal piece varies as

$K = K_o (1 + \alpha T)$ where $K_o = 111.63$ W/m°K and $\alpha = -1 \times 10^{-4}$ W/mK^2. Calculate the heat transfer rate when two ends of metal piece are maintained at 100°C and 20°C respectively. **[06]**

OR

Q.6) (A) With neat sketch explain construction and working of Nuclear Power Plant. **[08]**

(B) A metal piece having c/s as semicircle with radius 10 cm has its ends maintained at 200°C and 80°C. If heat flow takes place only along its length 50 cm, estimate rate of heat transfer through it. The thermal conductivity varies as

$$K = 0.2 \left[\frac{T}{100} + \frac{T^2}{200} \right]$$ where T is in °C **[06]**

(C) What is Fin ? What are different types of Fins ? Prove that fin increases rate of heat transfer. [04]

SECTION - II

UNIT - 4

Q.7) (A) Describe with suitable sketches the functions of the following lathe parts : [08]

(1) Lathe Bed

(2) Tail Stock

(3) Head Stock

(4) Carriage

(B) Explain TIG Welding with sketch. [06]

(C) State the advantages of Soldering and Brazing. [04]

OR

Q.8) (A) What is the function of Grinding Machine ? Explain Centreless Grinding with sketch. [06]

(B) What is Sawing ? Draw sketch of Power Saw and explain its working. [07]

(C) What are the important components of a NC System ? State the advantages of NC machine tools over conventional machine tools. [05]

UNIT - 5

Q.9) (A) Explain the following with neat diagrams : [06]

(1) Embossing

(2) Angle Bending

(3) Notching

(B) Explain Wire Drawing with a neat sketch. [04]

(C) Explain the following terms : [06]

(1) Hook's Law

(2) Strain

(3) Modulus of Rigidity

(4) Working Stress

(5) Stress

(6) Compressive Stress

OR

Q.10) (A) What are the Modes of Failure of Mechanical Components ? Give example of each. [06]

(B) Define any six important Engineering Properties of a Material. [06]

(C) Define the following : [04]

(1) Tolerance

(2) Actual Size

(3) Allowance

(4) Design Size

UNIT - 6

Q.11) (A) What are the advantages and disadvantages of Rope Drives compared to Chain Drives ? [04]

(B) How Gears are classified ? What are the functions of Gears ? Give the fields of applications of different types of Gears. [08]

(C) What are the main differences between a Shaft and an Axle ? Why the shafts are made round in cross-section ? [04]

OR

Q.12) (A) What is the function of a Flywheel ? What is the difference between Flywheel and Governor ? [06]

(B) Differentiate between Rolling Contact Bearing and Sliding Contact Bearing. [04]

(C) Explain Oldhams Coupling with a neat sketch. [06]

Total No. of Questions : 12] [Total No. of Printed Pages : 4

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F. E. Examination - 2008

BASIC CIVIL ENGINEERING

(2003 Course)

Time : 3 Hours] [Max. Marks : 100

Instructions :

(1) Attempt Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6 from section I and Q.7 or Q.8, Q.9 or Q.10, Q.11 or Q.12 from section II.

*(2) Answers to the **two sections** should be written in **separate books**.*

(3) Black figures to the right indicate full marks.

(4) Neat diagrams must be drawn wherever necessary.

(5) Use of logarithmic tables, slide rule, mollier charts, electronic pocket calculator and steam tables is allowed.

SECTION - I

Q.1) (A) Explain the importance of Environmental Engineering in 21st Century. **[06]**

(B) Explain the role of a Civil Engineer in the construction of Chemical Plants. **[06]**

(C) Give 2 practical applications of each of the following : **[04]**

(1) Valuation

(2) Foundation Engineering

OR

Q.2) (A) Infrastructure Development is an essential aspect of Civil Engineering in 21st Century. Explain in detail. **[06]**

(B) Explain the role of the Civil Engineer in : **[03+03=06]**

(1) Mechanical Engineering

(2) Electrical Engineering

(C) What is meant by GAUGE of a Rail ? Explain with neat sketch BROAD GAUGE. **[04]**

Q.3) (A) Enlist any 4 parts of a Prismatic Compass. Explain function of each in brief. **[02+04=06]**

(B) Explain with neat sketch the procedure of setting a perpendicular offset using an open-cross-staff. **[06]**

(C) Convert following R.B. into W.C.B. and draw suitable sketches : **[04]**

(1) S 78° 30' E

(2) S 25° 00' W

(3) N 45° 00' E

(4) N 35° 30' W

OR

Q.4) (A) Explain with neat sketches the Principles of Surveying. **[04]**

(B) A regular hexagon ABCDEF is run in clockwise direction, in an area free of local attraction. If the F.B. of line AB is 22° 30', find the F.B. and B.B. of all the lines. Draw suitable sketch. Show all calculations. Express all the results in tabular form. **[08]**

(C) Explain the following terms : **[02+02=04]**

(1) Scale

(2) R.F.

Q.5) (A) Following readings were observed on a continuously sloping ground. The readings were taken on the C/L of the road, with a 4m levelling staff, at a horizontal interval of 20 m. The first reading was taken on a B.M. of R.L. 250 m. Tabulate the readings in the level page of a field book by Collimation Plane Method. 2.960, 1.625, 0.875, 3.780, 2.560, 1.245, 3.885, 2.375, 1.245, 0.540.

(1) Calculate R.L. of all the points.

(2) Determine the longitudinal gradient of road. **[08]**

(B) Enlist various axes of dumpy level. Explain their inter-relationship for a perfect instrument. **[06]**

(C) Write a brief note on EDM. **[04]**

OR

Q.6) (A) Define Contour. Draw the typical contours for the following features with RLs : **[01+05=06]**

(1) Hill

(2) Uniformly Sloping Ground

(3) Steeply Sloping Ground

(4) Vertical Cliff

(5) Over-hanging Cliff

(B) Briefly explain the following instruments :

(1) Digital Theodolite

(2) Digital Planimeter [03+03=06]

(C) Following readings were taken during a levelling work. Work out the entries in a level page of field book, using Rise and Fall Method. Apply usual checks. The first reading was taken on a B.M. of R.L. 100m. The instrument was shifted after 4th and 7th reading

1.450, 1.980, 0.675, 2.315, 1.900, 1.310, 3.865, 0.985, 1.230. [06]

SECTION - II

Q.7) (A) Explain following terms and give uses of : [06]

(1) Plain Cement Concrete (PCC)

(2) Prestressed Concrete (PSC)

(3) Reinforced Cement Concrete (RCC)

(B) State any four functions of Foundation. [04]

(C) What is a Load Bearing Structure ? What are its disadvantages ? [04]

(D) State the purpose of the following : [02]

(1) Openings in a Building

(2) Walls

OR

Q.8) (A) Write short notes on : [06]

(1) Classification of Stones

(2) Types of Steel Reinforcement

(B) Explain with sketches : [04]

(1) Isolated Footing

(2) Combined Footing

(C) Differentiate clearly between the Load Bearing Structure and Framed Structure w.r.t any 4 aspects / points. [04]

(D) State two conditions under which Cantilever Footing is used. [02]

Q.9) (A) State eight factors influencing Site Selection for a Factory Building. [04]

(B) What is Prospect ? Draw sketches to show how prospect can be achieved ? [04]

(C) On a plot measuring 1000 m^2, a G + 1 building is constructed on a plinth area of 425 m^2. How much terrace area can be enjoyed by the occupants above ground floor and first floor, if F.S.I. is 0.8 ? [04]

(D) What are the objectives of Land Acquisition Act, 1894 ? [04]

OR

Q.10) (A) Explain with sketches how privacy is achieved in the building ? [04]

(B) What is Grouping and Circulation ? How they are related ? [04]

(C) A building is to be constructed with G + 2 storeys and built up area on each floor is to be 600 m^2. A rectangular plot is purchased for this building, having width along road, one third of the longer side at right angles to the road. Find the dimensions of the plot, if FSI allowed is 1.50. [04]

(D) What are the objectives of Environmental Protection Act, 1986 ? [04]

Q.11) (A) Write short notes on : [03+03=06]

(1) Biotic and Abiotic Factors

(2) Requirement of Site for Producing Wind Energy

(B) List out various Non-conventional Energy Sources. Explain their advantages and disadvantages. [04]

(C) What are the effects of air pollution on man, vegetation and materials and structures ? [04]

(D) Explain procedure for 'Harnessing Energy from Biogas'. [04]

OR

Q.12) (A) Describe briefly : [03+03=06]

(1) Impact of Harnessing Energy on Environment

(2) Acid Rain

(B) State uses, advantages and limitations of Wind Energy. [04]

(C) Explain Noise Pollution and its ill effects. [04]

(D) State effects and control of Water Pollution. [04]
