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**First/Second Semester B.E. Degree Examination, June/July 2013**  
**Engineering Physics**

Time: 3 hrs.

Max. Marks:100

Note: 1. Answer any FIVE full questions, choosing at least two from each part.

2. Answer all objective type questions only on OMR sheet page 5 of the answer booklet.

3. Answer to objective type questions on sheets other than OMR will not be valued.

4. Physical Constants : Planck's constant,  $h = 6.63 \times 10^{-34}$  Js, Electron charge,  $e = 1.6 \times 10^{-19}$  C  
 Electron mass,  $m = 9.11 \times 10^{-31}$  kg, Velocity of light,  $C = 3 \times 10^8$  mS<sup>-1</sup>

**PART - A**

- 1 a. Choose the correct answers for the following : (04 Marks)
- If red and blue stars emits radiations of continuous wavelengths, then according to Wien's displacement law.
 

A) Blue star is hotter than red star	B) Red star is hotter than blue star
C) Both stars are at same temperature	D) Difficult to conclude.
  - The expression for de-Broglie wavelength for an electron under an accelerating potential V is,
 

A) $\frac{12.26}{\sqrt{V}}$ m	B) $\frac{12.26}{\sqrt{V}}$ A°	C) $\frac{12.26}{\sqrt{V}}$ nm	D) $\frac{12.26}{\sqrt{V}}$ μm
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  - A particle moves with velocity  $3 \times 10^6$  ms<sup>-1</sup>. The wavelength associated with it is 1 nm. Then group velocity of the particle is,
 

A) $3 \times 10^8$ mS <sup>-1</sup>	B) $3 \times 10^{10}$ mS <sup>-1</sup>	C) $3 \times 10^6$ mS <sup>-1</sup>	D) $1.5 \times 10^6$ mS <sup>-1</sup>
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  - According to the Compton effect, the wavelength of X-rays scattered at an angle greater than zero,
 

A) Decreases	B) Doesn't change	C) Increases	D) None of these
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- b. Derive an expression for group velocity on the basis of superposition of waves. Also obtain the relation between group velocity and phase velocity. (08 Marks)
- c. Show that Planck's law reduces to Wien's law and Rayleigh-Jeans law under certain conditions. (05 Marks)
- d. Calculate the de-Broglie wavelength associated with an electron of energy 1.5 eV. (03 Marks)
- 2 a. Choose the correct answers for the following : (04 Marks)
- The energy of the lowest state in one dimensional potential box of length  $a = 1$  unit is,
 

A) $\frac{h^2}{8m}$	B) zero	C) $\frac{h^2}{4ma^2}$	D) $\frac{h^2}{2ma^2}$
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  - For a particle which is not bound to any system and is free, the energy eigen value is,
 

A) zero	B) finite but not quantized
C) infinity	D) finite but quantized
  - If the uncertainty in the position of a particle is equal to its de-Broglie wavelength then uncertainty in its momentum will be,
 

A) $\Delta P \geq \frac{h}{4\pi}$	B) $\Delta P \geq \frac{h}{2\pi}$	C) $\Delta P \geq \frac{P}{4\pi}$	D) $\Delta P \geq \frac{h}{P}$
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  - For an electron to be present inside the nucleus of an atom the uncertainty in the position of the electron must be,
 

A) more than or equal to the radius of the nucleus
B) more than or equal to the diameter of the nucleus.
C) more than the diameter of the nucleus
D) less than or equal to the diameter of the nucleus.



- 2 b. Using time independent Schrodinger's wave equation, obtain the expression for the normalized wave function for a particle in one dimensional potential well of infinite height. (08 Marks)
- c. State Heisenberg's uncertainty principle. Write its physical significance. (04 Marks)
- d. A spectral line of wavelength  $5461 \text{ \AA}$  has a width of  $10^{-4} \text{ \AA}$ . Evaluate the minimum time spent by the electrons in the upper energy state. (04 Marks)
- 3 a. Choose the correct answers for the following : (04 Marks)
- i) In the following the ohm's law is,  
 A)  $J = \sigma E$                       B)  $J = \frac{\sigma}{E}$                       C)  $J = \sigma E^2$                       D)  $J = \frac{E}{\sigma}$
- ii) Mobility of electron is,  
 A) Reciprocal of conductivity  
 B) Average electrons drift velocity per unit electric field.  
 C) Flow of electrons per unit cross sectional area.  
 D) Reciprocal of resistivity
- iii) The dependence of mean free path  $\lambda$  on temperature T is,  
 A)  $\lambda \propto T$                       B)  $\lambda \propto \sqrt{T}$                       C)  $\lambda \propto \frac{1}{T}$                       D)  $\lambda \propto \frac{1}{\sqrt{T}}$
- iv) According to free electron theory, the free electrons are treated as,  
 A) Rigidity fixed lattice points                      B) Liquid molecules  
 C) Gas molecule                      D) None of these
- b. Define Fermi energy and Fermi factor. Discuss the variation of fermifactor with temperature and energy. (08 Marks)
- c. What is mean collision time? Using free electron theory in a metal, obtain an expression for electrical conductivity in terms of mean collision time. (06 Marks)
- d. State and explain Matthiessen's rule. (02 Marks)
- 4 a. Choose the correct answers for the following : (04 Marks)
- i) Electronic polarization,  
 A) Independent of temperature                      B) Increases with temperature  
 C) Decreases with temperature                      D) None of these
- ii) The correct relation among the following 4 equations is,  
 A)  $E = \epsilon_0 (\epsilon_r - 1)P$                       B)  $P = \epsilon_0 (\epsilon_r - 1)E$                       C)  $\epsilon_r = \chi - 1$                       D)  $D = \epsilon_0 (\epsilon_r - 1)E$
- iii) For Ferromagnetic substances, the Curie-Wiess law is given as,  
 A)  $\epsilon_r = \frac{C}{T}$                       B)  $\epsilon_r = \frac{T - \theta}{C}$                       C)  $\epsilon_r = \frac{C}{(T - \theta)}$                       D)  $\epsilon_r = \frac{C}{(T + \theta)}$
- iv) In the inverse piezoelectric effect,  
 A) Ultrasonic waves are produced                      B) Electromagnetic waves are produced  
 C) Microwaves are produced                      D) None of these
- b. What is internal field? Derive an expression for internal field in case of one dimensional array of atoms in dielectric solids. (08 Marks)
- c. Describe magnetic hysteresis in Ferromagnetic material. (05 Marks)
- d. Explain any three applications of piezoelectric material. (03 Marks)

**PART – B**

5 a. Choose the correct answers for the following : (04 Marks)

i) The pumping action in diode laser is by,  
A) Optical pumping B) Electrical discharge C) Reverse bias D) Forward bias

ii) The expression for energy density in terms of Einstein's coefficients,

$$A) U_{\gamma} = \frac{B}{A} \left[ \frac{1}{e^{hy/KT} - 1} \right]$$

$$B) U_{\gamma} = \frac{A}{B} \left[ \frac{1}{1 - e^{hy/KT}} \right]$$

$$C) U_{\gamma} = \frac{A}{B} \left[ \frac{1}{e^{hy/KT} - 1} \right]$$

$$D) U_{\gamma} = \frac{A}{B} \left[ e^{hy/KT} - 1 \right]$$

iii) In order to see the image of an object recorded by holography.

A) It is enough if we just have the hologram.

B) We need the hologram and the reference beam.

C) We need the hologram, the reference beam and the object beam.

D) We need the hologram, the reference beam and the object beam as well as the object.

iv) In a laser system when the energy difference between two energy levels is  $2 \times 10^{-19}$  J, the average power output of laser beam is found to be 4 mw. Then number of Photons emitted per second is,

A)  $2 \times 10^{16}$

B)  $2 \times 10^{-16}$

C)  $0.5 \times 10^{16}$

D)  $2 \times 10^{19}$

b. Describe the construction of He-Ne laser and explain its working with the help of energy level diagram and mention few applications. (08 Marks)

c. Explain the terms spontaneous emission and stimulated emission. (04 Marks)

d. Explain laser welding and cutting process with diagrams. (04 Marks)

6 a. Choose the correct answers for the following : (04 Marks)

i) Superconductors are

A) Ferromagnetic B) Paramagnetic C) Antiferromagnetic D) Diamagnetic

ii) All high temperature superconductors are different types of oxides of,

A) Mercury B) Lead C) Copper D) Tin

iii) The quantum of magnetic flux is given by,

A)  $\frac{2e}{h}$

B)  $\frac{h}{2e}$

C)  $\frac{he}{2}$

D)  $\frac{2h}{e}$

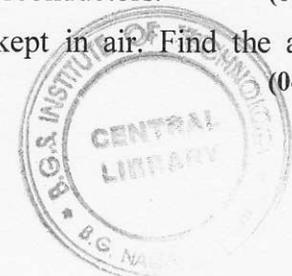
iv) Numerical aperture of an optical fiber depends on,

A) Acceptance angle B) Diameter of the fiber C) Critical angle D) None of these

b. Discuss point to point optical fiber communication system and mention its advantages over the conventional communication systems. (06 Marks)

c. Define superconductivity and explain Type I and Type II superconductors. (06 Marks)

d. The angle of acceptance of an optical fiber is  $30^\circ$  when kept in air. Find the angle of acceptance when it is in a medium of refractive index 1.33. (04 Marks)



7 a. Choose the correct answers for the following : (04 Marks)

- i) A crystal of hexagonal lattice has unit cell with sides,  
 A)  $a \neq b \neq c, \alpha = \beta = 90^\circ, \gamma = 120^\circ$       B)  $a = b = c, \alpha = \beta = 90^\circ, \gamma = 120^\circ$   
 C)  $a \neq b = c, \alpha = \beta = \gamma = 90^\circ$       D)  $a = b \neq c, \alpha = \beta = 90^\circ, \gamma = 120^\circ$
- ii) In Bragg's spectrometer, for every rotation  $\theta$  of the turn table, the detector turns by an angle,  
 A)  $\theta$       B)  $4\theta$       C)  $2\theta$       D)  $\frac{\theta}{2}$
- iii) The interatomic distance between the sodium and chlorine atoms in sodium crystal is,  
 A) 5.68 Å      B) 2.81 Å      C) 6.62 Å      D) 5.51 Å
- iv) The interplanar spacing in a crystal is 1 Å and the glancing angle is  $35^\circ$ . For the first order Bragg reflection to take place, the wavelength of X-rays is,  
 A) 1.147 Å      B) 0.573 Å      C) 1.638 Å      D) 0.819 Å

b. What are Miller indices? Explain the procedure to find Miller indices with an example. (05 Marks)

c. Obtain the expression for interplanar spacing in terms of 'a' for a cubic lattice. (05 Marks)

d. Calculate the atomic packing factor for SC, FCC and BCC lattices. (06 Marks)

8 a. Choose the correct answers for the following : (04 Marks)

- i) An acoustic grating can be made by,  
 A) Drawing lines on a glass plate  
 B) Subjecting an optical grating to pressure waves of ultrasonic frequency  
 C) It is only theoretical concept.  
 D) Setting up a standing waves pattern in a liquid using ultrasonic.
- ii) The velocity of ultrasonic wave through the liquid increases as,  
 A) Bulk modulus decreases      B) Density decreases  
 C) Bulk modulus increases      D) Volume increases
- iii) The minimum size of matter below which the properties becomes size dependent is called,  
 A) Pico size      B) Nano size      C) Micro size      D) Macro size
- iv) The number of carbon atoms present in  $C_{60}$  molecule is,  
 A) 60      B) 32      C) 20      D) 12

b. Describe with simple illustrations, the two methods of preparation of nano materials. (06 Marks)

c. Describe a method of measuring velocity of ultrasonic waves in solids. Using this how you can find the rigidity modulus of the solid. (06 Marks)

d. Explain quantum structures. (04 Marks)

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## First/Second Semester B.E. Degree Examination, June/July 2013

## Engineering Mathematics – I

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing at least two from each part.

2. Answer all objective type questions only on OMR sheet page 5 of the answer booklet.

3. Answer to objective type questions on sheets other than OMR will not be valued.

## PART – A

- 1 a. Choose your answers for the following: (04 Marks)
- If  $y = 3^{5x}$  then  $y_n$  is A)  $(3 \log 5)^n e^{5x}$  B)  $(5 \log 3)^n e^{5x}$  C)  $(5 \log 3)^{-n} e^{5x}$  D)  $(5 \log 3)^n e^{-5x}$
  - If  $y = \cos^2 x$  then  $y_n$  is  
A)  $2^{n+1} \cos(n\pi/2 + 2x)$  B)  $2^{n-1} \cos(n\pi/2 + 2x)$  C)  $2^{n-1} \cos(n\pi/2 - 2x)$  D)  $2^{n+1} \cos(n\pi/2 - 2x)$
  - The Lagrange's mean value theorem for the function  $f(x) = e^x$  in the interval  $[0, 1]$  is  
A)  $C = 0.5413$  B)  $C = 2.3$  C)  $0.3$  D) None of these
  - Expansion of  $\log(1 + e^x)$  in powers of  $x$  is \_\_\_\_\_.  
A)  $\log 2 - x/2 + x^2/8 + x^4/192 + \dots$   
B)  $\log 2 + x/2 + x^2/8 - x^4/192 + \dots$  C)  $\log 2 + x/2 + x^2/8 + x^4/192 + \dots$  D)  $\log 2 - \frac{x}{2} - \frac{x^2}{8} - \frac{x^4}{192} + \dots$
- b. If  $y^m + y^{-m} = 2x$  prove that  $(x^2 - 1)y_{n+2} + (2n + 1)xy_{n+1} + (n^2 - m^2)y_n = 0$ . (06 Marks)
- c. Verify the Rolle's theorem for the functions:  $f(x) = e^x(\sin x - \cos x)$  in  $(\pi/4, 5\pi/4)$ . (06 Marks)
- d. By using Maclaurin's theorem expand  $\log \sec x$  up to the term containing  $x^6$ . (04 Marks)
- 2 a. Choose your answers for the following: (04 Marks)
- The indeterminate form of  $\lim_{x \rightarrow 0} \frac{a^x - b^x}{x}$  is A)  $\log(b/a)$  B)  $\log(a/b)$  C) 1 D) -1
  - The angle between the radius vector and the tangent for the curves  $r = a(1 - \cos \theta)$  is  
A)  $\theta/2$  B)  $-\theta/2$  C)  $\pi/2 + \theta$  D)  $\pi/2 - \theta/2$ .
  - The polar form of a curve is \_\_\_\_\_. A)  $r = f(\theta)$  B)  $\theta = f(y)$  C)  $r = f(x)$  D) None of these
  - The rate at which the curve is bending called \_\_\_\_\_. A) Radius of curvature; B) Curvature; C) Circle of curvature; D) Evaluate.
- b. Evaluate  $\lim_{x \rightarrow 0} \left( \frac{\sin x}{x} \right)^{1/x^2}$ . (06 Marks)
- c. Find the angles of intersection of the following pairs of curves,  $r = a\theta/(1 + \theta)$ ;  $r = a/(1 + \theta^2)$ . (06 Marks)
- d. Find the radius of curvature at  $(3a/2, 3a/2)$  on  $x^3 + y^3 = 3axy$ . (04 Marks)
- 3 a. Choose your answers for the following: (04 Marks)
- If  $u = x^2 + y^2$  then  $(\partial^2 u)/(\partial x \partial y)$  is equal to A) 2 B) 0 C)  $2x$  D)  $2y$
  - If  $z = f(x, y)$  where  $x = u - v$  and  $y = uv$  then  $(u + v)(\partial z / \partial x)$  is  
A)  $u(\partial z / \partial u) - v(\partial z / \partial v)$  B)  $u(\partial z / \partial u) + v(\partial z / \partial v)$  C)  $\partial z / \partial u + \partial z / \partial v$  D)  $\partial z / \partial u - \partial z / \partial v$
  - If  $x = r \cos \theta$ ,  $y = r \sin \theta$  then  $[\partial(r, \theta)]/[\partial(x, y)]$  is A)  $r$  B)  $1/r$  C) 1 D) -1
  - In errors and approximations  $\partial x/x$ ,  $\partial y/y$ ,  $\partial f/f$  are called  
A) relative error B) percentage error C) error in  $x, y$  and  $f$  D) none of these
- b. If  $x^x y^y z^z = c$ , show that  $\partial^2 z / \partial x \partial y = -[x \log ex]^{-1}$ , when  $x = y = z$ . (06 Marks)
- c. Obtain the Jacobian of  $\partial(x, y, z)/\partial(r, \theta, \phi)$  for change of coordinate from three dimensional Cartesian coordinates to spherical polar coordinates. (06 Marks)
- d. In estimating the cost of a pile of bricks measured as  $2m \times 15m \times 1.2m$ , the tape is stretched +1% beyond the standard length. If the count is 450 bricks to 1 cu.cm and bricks cost of 530 per 1000, find the approximate error in the cost. (04 Marks)
- 4 a. Choose your answers for the following: (04 Marks)
- If  $\vec{R} = xi + yj + zk$  then  $\text{div } \vec{R}$  A) 0 B) 3 C) -3 D) 2
  - If  $\vec{F} = 3x^2i - xyj + (a - 3)zk$  is Solenoidal then  $a$  is equal to \_\_\_\_\_. A) 0 B) -2 C) 2 D) 3
  - If  $\vec{F} = (x + y + 1)i + j - (x + y)k$  then  $\vec{F} \cdot \text{curl } \vec{F}$  is \_\_\_\_\_. A) 0 B)  $x + y$  C)  $x + y + z$  D)  $x - y$
  - The scale factors for cylindrical coordinate system  $(\rho, \phi, z)$  are given by  
A)  $(\rho, 1, 1)$  B)  $(1, \rho, 1)$  C)  $(1, 1, \rho)$  D) none of these
- b. Prove that  $\text{curl } \vec{A} = g \text{ rad}(\text{div } \vec{A}) - \nabla^2 \vec{A}$ . (06 Marks)
- c. Find the constants  $a, b, c$  such that the vector  $\vec{F} = (x + y + az)i + (bx + 2y - z)j + (x + cy + 2z)k$  is irrotational. (06 Marks)
- d. Derive an expression for  $\nabla \cdot \vec{A}$  in orthogonal curvilinear coordinates. Deduce  $\nabla \cdot \vec{A}$  is rectangular coordinates. (04 Marks)

5 a. Choose your answers for the following :

i) The value of  $\int_0^{\infty} e^{-ax} dx$  is \_\_\_\_\_ A)  $1/e$  B)  $-1/e$  C)  $1/\alpha$  D)  $-1/\alpha$

ii) The value of the integral  $\int_0^{\pi/2} \sin^7 x dx$  is A)  $35/16$  B)  $16/35$  C)  $-16/35$  D)  $18/35$

iii) The volume generated by revolving the cardioid  $r = a(1 + \cos \theta)$  about the initial line is  
A)  $(3\pi a^2)/8$  B)  $(3\pi a^3)/8$  C)  $(2\pi a^2)/9$  D) None

iv) The area of the loop of the curve  $r = a \sin 3\theta$  is \_\_\_\_\_ A)  $a^2/12$  ; B)  $\pi/12$  ; C)  $\pi a^2/12$  ; D) None

b. By applying differential under the integral sign evaluate  $\int_0^{\pi/2} \frac{\log(1 + y \sin^2 x)}{\sin^2 x} dx$ . (06 Marks)

c. Evaluate of  $\int_0^{\pi/2} \sin^n x dx$  where n is any integer. (06 Marks)

d. Find the length of the arch of the cycloid  $x = a(\theta - \sin \theta)$ ;  $y = a(1 - \cos \theta)$ ;  $0 < \theta \leq 2\pi$ . (04 Marks)

6 a. Choose your answers for the following :

(04 Marks)

i) The general solution of the differential equation  $(dy/dx) = (y/x) + \tan(y/x)$  is

A)  $\sin(y/x) = c$  B)  $\sin(y/x) = cx$  C)  $\cos(y/x) = cx$  D)  $\cos(y/x) = c$

ii) An integrating factor for  $ydx - xdy = 0$  is A)  $x/y$  B)  $y/x$  C)  $1/(x^2y^2)$  D)  $1/(x^2+y^2)$

iii) The differential equation satisfying the relation  $x = A \cos(mt - \alpha)$  is

A)  $(dx/dt) = 1 - x^2$  B)  $(d^2x/dt^2) = -\alpha^2 x$  C)  $(d^2x/dt^2) = -m^2 x$  D)  $(dx/dt) = -m^2 x$

iv) The orthogonal trajectories of the system given by  $r = a\theta$  is

A)  $r^2 = ke^\theta$  B)  $r = ke^\theta$  C)  $r^2 e^{-\theta^2} = k$  D)  $r^2 = k e^{-\theta^2}$

b. Solve  $(x \cos(y/x) + y \sin(y/x))y - (y \sin(y/x) - x \cos(y/x))x(dy/dx) = 0$ . (06 Marks)

c. Solve  $(1 + y^2) + (x - e^{\tan^{-1}y})dy/dx = 0$ . (06 Marks)

d. Prove that the system of parabola  $y^2 = 4a(x + a)$  is self orthogonal. (04 Marks)

7 a. Choose your answers for the following :

(04 Marks)

i) Find the rank of  $\begin{bmatrix} 3 & -1 & 2 \\ -6 & 2 & 4 \\ -3 & 1 & 2 \end{bmatrix}$ ; A) 3 B) 2 C) 4 D) 1

ii) The exact solution of the system of equation  $10x + y + z = 12$ ,  $x + 10y + z = 12$ ,  $x + y + 10z = 12$  by inspection is equal to A)  $(-1, 1, 1)$  ; B)  $(1, 1, 1)$  ; C)  $(-1, -1, -1)$  ; D) None

iii) If the given system of linear equations in 'n' variables is consistent then the number of linearly independent - solution is given by A) n ; B)  $n-1$  ; C)  $r-n$  ; D)  $n-r$

iv) The trivial solution for the given system of equations  $9x - y + 4z = 0$ ,  $4x - 2y + 3z = 0$ ,  $5x + y - 6z = 0$  is  
A)  $(1, 2, 0)$  B)  $(0, 4, 1)$  C)  $(0, 0, 0)$  D)  $(1, -5, 0)$ .

b. Using elementary transformation reduce each of following matrices to the normal form,  $\begin{bmatrix} 1 & 1 & 1 & 6 \\ 1 & -1 & 2 & 5 \\ 3 & 1 & 1 & 8 \\ 2 & -2 & 3 & 7 \end{bmatrix}$ . (06 Marks)

c. Test for consistency and solve the system,  $2x + y + z = 10$ ,  $3x + 2y + 3z = 18$ ,  $x + 4y + 9z = 16$ . (06 Marks)

d. Apply Gauss-Jordan method to solve the system of equations,  $2x + 5y + 7z = 52$ ,  $2x + y - z = 0$ ,  $x + y + z = 9$  (04 Marks)

8 a. Choose your answers for the following :

(04 Marks)

i) A square matrix A is called orthogonal if, A)  $A = A^2$  B)  $A = A^{-1}$  C)  $AA^{-1} = I$  D) None

ii) The eigen values of the matrix,  $\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$  are A) 2, 3, 8 B) 2, 3, 9 C) 2, 2, 8 D) None

iii) The eigen vector X of the matrix A corresponding to eigen value  $\lambda$  and satisfy the equation,

A)  $AX = \lambda X$  B)  $\lambda(A - X) = 0$  C)  $XA - A\lambda = 0$  D)  $|A - \lambda|X = 0$

iv) Two square matrices A and B are similar if, A)  $A = B$ ; B)  $B = P^{-1}AP$ ; C)  $A' = B'$ ; D)  $A^{-1} = B^{-1}$

b. Show that the transformation,  $y_1 = 2x_1 - 2x_2 - x_3$ ,  $y_2 = -4x_1 + 5x_2 + 3x_3$ ,  $y_3 = x_1 - x_2 - x_3$  is, regular and find the inverse transformations. (06 Marks)

c. Diagonalize the matrix,  $A = \begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$ . (06 Marks)

d. Reduce the quadratic form,  $x_1^2 + 2x_2^2 - 7x_3^2 - 4x_1x_2 + 8x_2x_3$  into sum of squares. (04 Marks)

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**First/Second Semester B.E. Degree Examination, June/July 2013**  
**Elements of Civil Engineering and Engineering Mechanics**

Time: 3 hrs.

Max. Marks:100

- Note:** 1. Answer any FIVE full questions, choosing at least two from each part.  
 2. Answer all objective type questions only on OMR sheet page 5 of the answer booklet.  
 3. Answer to objective type questions on sheets other than OMR will not be valued.  
 4. Assume missing data suitably.

**PART - A**

- 1 a. Choose the correct answers for the following : (04 Marks)
- Geotechnical engineering involves the study of,  
 A) Water                      B) Soil                      C) Air                      D) All of these
  - By-pass road is constructed,  
 A) Inside the city                      B) Over the main road  
 C) Around the city                      D) None of these
  - The part of civil engineering which deals with waste water and solid waste is called,  
 A) Water supply engineering                      B) Geotechnical engineering  
 C) Sanitary engineering                      D) Structural engineering
  - A bascule bridge is a,  
 A) Floating bridge      B) Arch bridge      C) Suspension bridge      D) Movable bridge
- b. Write a note on role of civil engineer in infrastructural development. (10 Marks)
- c. Name the different types of roads as per Nagpur plan. (06 Marks)
- 2 a. Choose the correct answers for the following : (04 Marks)
- Moment of a force can be defined as the product of force and \_\_\_\_\_ distance from the line of action of force to the moment center.  
 A) Least                      B) Maximum                      C) Any                      D) None of these
  - Effect of force on a body depends on,  
 A) Direction                      B) Magnitude                      C) Position                      D) All of these
  - The forces which meet at one point have their line of action in different plane are called,  
 A) Coplanar concurrent forces                      B) Non coplanar concurrent forces  
 C) Non coplanar non concurrent forces                      D) None of these
  - Couple means two forces acting parallel,  
 A) Equal in magnitude and in the same direction.  
 B) Not equal in magnitude but in the same direction.  
 C) Equal in magnitude but opposite in direction.  
 D) None of these
- b. Define force and state its characteristics. (06 Marks)
- c. Determine the magnitude and direction of the resultant for the system of forces shown in Fig. Q2 (c). Use classical method. (10 Marks)

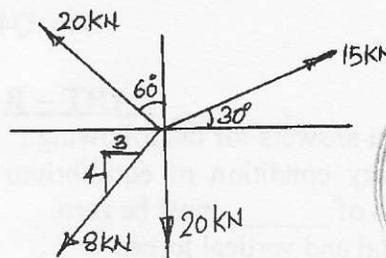


Fig. Q2 (c)  
1 of 4



- 3 a. Choose the correct answers for the following : (04 Marks)
- The technology of finding the resultant of a system of forces is called,
    - Resultant
    - Resolution
    - Composition
    - None of these
  - Equilibrant in nothing but a resultant,
    - Equal in magnitude and in the same direction.
    - Equal in magnitude but opposite in direction.
    - Not equal in magnitude but in the same direction.
    - Not equal in magnitude and opposite in direction.
  - If two forces P and Q ( $P > Q$ ) act on the same straight line but in opposite direction their resultant is
    - $P + Q$
    - $P/Q$
    - $Q - P$
    - $P - Q$
  - In coplanar concurrent force system if  $\sum H = 0$  then the resultant is
    - Horizontal
    - Vertical
    - Moment
    - None of these
- b. State and prove Varignon's theorem of the moments. (06 Marks)
- c. Two spheres each of radius 100mm and weight 5kN is in a rectangular box as shown in Fig. Q3 (c). Calculate the reactions at the point of contacts. (10 Marks)

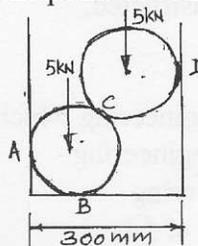


Fig. Q3 (c)

- 4 a. Choose the correct answers for the following : (04 Marks)
- Moment of total area about its centroidal axis is
    - Twice the area
    - Three times the area
    - Zero
    - None of these
  - The centroid of a semicircle of radius R about its centroidal axis parallel to its diametric axis is
    - $3R/4\pi$
    - $3R/8\pi$
    - $4R/\pi$
    - $4R/3\pi$
  - An axis over which one half of the plane figure is just mirror of the other half which is
    - Bottom most axis of the figure
    - Axis of symmetry
    - Unsymmetrical axis
    - None of these
  - Centroid of a rectangle of base width b and depth d is
    - $b/3$  and  $d/3$
    - $b/2$  and  $d/2$
    - $b/4$  and  $d/4$
    - None of these.
- b. Determine the centroid of a triangle by the method of integration. (06 Marks)
- c. Locate the centroid of the lamina shown in Fig. Q4 (c) with respect to point O. (10 Marks)

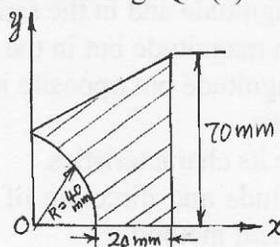


Fig. Q4 (c)

**PART - B**

- 5 a. Choose the correct answers for the following : (04 Marks)
- The necessary condition of equilibrium of a coplanar concurrent force system is algebraic sum of \_\_\_\_\_ must be zero.
    - Horizontal and vertical forces
    - Moment of forces
    - Horizontal, vertical and moment of forces
    - None of these

7 a. Choose the correct answers for the following :

- i) Angle of friction is angle between
  - A) the incline and horizontal
  - B) the normal reaction and friction force
  - C) the weight of the body and the friction force
  - D) Normal reaction and the resultant.
- ii) The force of friction developed at the contact surface is always
  - A) Parallel to the plane and along the direction of the applied force
  - B) Perpendicular to the plane
  - C) Parallel to the plane and opposite to the direction of the motion
  - D) All of these.
- iii) The maximum inclination of the plane on which the body free from external forces can repose is called
  - A) Cone of friction
  - B) Angle of friction
  - C) Angle of repose
  - D) None of these
- iv) The force of friction depends on
  - A) Area of contact
  - B) Roughness of the surface
  - C) Both area of contact and roughness of the surface
  - D) None of these.

b. State the laws of static friction. (04 Marks)

c. A uniform ladder of length 15m and weight 750N rests against a vertical wall making an angle of  $60^\circ$  with the horizontal. Co-efficient of friction between the wall and the ladder is 0.3 and between the ground and the ladder is 0.25. A man weighing 500N ascends the ladder. How long will he be able to go before the ladder slips? (12 Marks)

8 a. Choose the correct answers for the following :

(04 Marks)

- i) The unit of radius of Gyration is
  - A) mm
  - B)  $\text{mm}^2$
  - C)  $\text{mm}^3$
  - D)  $\text{mm}^4$
- ii) The moment of inertia of an area about an axis which is in a plane perpendicular to the area is called
  - A) Radius of Gyration
  - B) Polar moment of inertia
  - C) Second moment of area
  - D) None of these
- iii) The moment of inertia of a circle with 'd' as its diameter about its centroidal axis
  - A)  $\frac{\pi D^2}{32}$
  - B)  $\frac{\pi D^2}{64}$
  - C)  $\frac{\pi D^4}{32}$
  - D)  $\frac{\pi D^4}{64}$
- iv) The moment of inertia of a square of side 'b' about an axis through its centroid is
  - A)  $\frac{b^4}{12}$
  - B)  $\frac{b^4}{8}$
  - C)  $\frac{b^4}{36}$
  - D)  $\frac{b^3}{12}$

b. State and prove parallel axis theorem. (06 Marks)

c. Find the moment of inertia of the region shown in Fig. Q8 (c) about horizontal axis AB and also find the radius of Gyration about the same axis. (10 Marks)

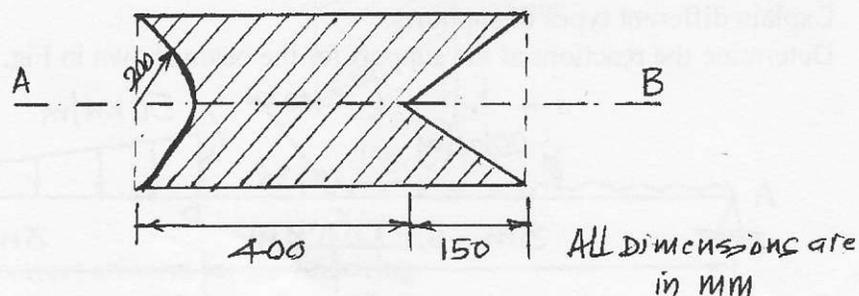


Fig. Q8 (c)

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40W11M6003

10EME14/24

**First/Second Semester B.E. Degree Examination, June/July 2013**  
**Elements of Mechanical Engineering**

Time: 3 hrs.

Max. Marks:100

- Note:** 1. Answer any FIVE full questions, choosing at least two from each part.  
 2. Answer all objective type questions only on OMR sheet page 5 of the answer booklet.  
 3. Answer to objective type questions on sheets other than OMR will not be valued.

**PART – A**

- 1 a. Choose the correct answers for the following : (04 Marks)
- i) Lunar is \_\_\_\_\_ form of energy
- A) Stored B) Transitional  
 C) Celestial D) Capital
- ii) Enthalpy is also called as \_\_\_\_\_
- A) Sufficient heat B) Insufficient heat  
 C) Total heat D) Incomplete heat
- iii) Steam pressure is \_\_\_\_\_ in water tube boilers
- A) Low B) High  
 C) Medium D) Absolute
- iv) Feed check valve is a boiler mounting for \_\_\_\_\_
- A) Safety B) Operation  
 C) Testing D) Security
- b. Compare and contrast renewable and non renewable energy sources. (06 Marks)
- c. Enumerate the advantages and disadvantages of superheated steam. (04 Marks)
- d. Explain briefly air preheater, superheater and Chimney with respect to boilers. (06 Marks)
- 2 a. Choose the correct answers for the following : (04 Marks)
- i) An example for a reaction turbine is
- A) Laval turbine B) Curtis turbine  
 C) Zoelly turbine D) Parson's turbine
- ii) The weight to power ratio of a gas turbine is
- A) High B) Less  
 C) Moderate D) Equal
- iii) Draft tube is a \_\_\_\_\_ steel pipe
- A) Closed B) Open  
 C) Converging D) Diverging
- iv) Kaplan turbine is a \_\_\_\_\_ head turbine
- A) High B) Low  
 C) Medium D) Simple
- b. With a neat sketch, explain the working principle of an impulse turbine. (06 Marks)
- c. List any four differences between closed cycle and open cycle gas turbines. (04 Marks)
- d. Define radial flow, axial flow and mixed flow with respect to water turbine. (06 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.



3 a. Choose the correct answers for the following : (04 Marks)

- i) Flywheel is used as an energy \_\_\_\_\_
- |             |               |
|-------------|---------------|
| A) Receiver | B) Reservoir  |
| C) Mixer    | D) Multiplier |
- ii) Mechanical efficiency of a four-stroke engine is
- |           |             |
|-----------|-------------|
| A) Medium | B) High     |
| C) Low    | D) Balanced |
- iii) The output shaft in IC engines is
- |                 |                |
|-----------------|----------------|
| A) Camshaft     | B) Crankshaft  |
| C) Rotary shaft | D) Axial shaft |
- iv) In C.I. engines, charge means
- |                  |              |
|------------------|--------------|
| A) Air and fuel  | B) Only fuel |
| C) Air and water | D) Only air  |

b. List any four differences between two-stroke and four-stroke engines. (04 Marks)

c. A six cylinder 4-stroke I.C. engine develops 50 kW of indicated power at mep of 700 kPa. The bore and stroke length are 70mm and 100mm respectively. If the engine speed is 3700 rpm, find the average misfires per unit time. (06 Marks)

d. Draw a schematic diagram of I.C. engines and name the parts. (06 Marks)

4 a. Choose the correct answers for the following : (04 Marks)

- i) Brine is an example for
- |              |                |
|--------------|----------------|
| A) Coolant   | B) Effluent    |
| C) Deodorant | D) Refrigerant |
- ii) The value of COP is greater than
- |             |            |
|-------------|------------|
| A) Infinity | B) Ten     |
| C) Unity    | D) Hundred |
- iii) A thermostat in A.C. is used to control
- |             |                |
|-------------|----------------|
| A) Pressure | B) Temperature |
| C) Volume   | D) Efficiency  |
- iv) The viscosity of an ideal refrigerant should be
- |             |          |
|-------------|----------|
| A) Low      | B) High  |
| C) Moderate | D) Unity |

b. Mention the uses of any four refrigerants. (04 Marks)

c. With a neat sketch, explain the working of a vapour absorption refrigerator. (06 Marks)

d. List the differences between vapour compression refrigeration and vapour absorption refrigeration. (06 Marks)

## PART – B

5 a. Choose the correct answers for the following : (04 Marks)

- i) Compound side swiveling method is used to produce  
 A) Hole B) Threads  
 C) Knurl D) Taper
- ii) Lathe Dog is  
 A) A part B) A component  
 C) An accessory D) An assembly
- iii) \_\_\_\_\_ is an operation to produce a conical surface at the end of a predrilled hole  
 A) Counter Boring B) Counter sinking  
 C) Tapping D) Reaming
- iv) The supporting section (core) of a drill is called  
 A) Web B) Tang  
 C) Land D) Margin

b. With a neat sketch, explain the principle and operation to produce a 'taper' on lathe by tail stock set over method. (06 Marks)

c. Differentiate between cross slide and compound slide. (04 Marks)

d. With a neat sketch, explain the operation of a radial drilling machine. (06 Marks)

6 a. Choose the correct answers for the following : (04 Marks)

- i) Conventional milling is also called  
 A) End milling B) Climb milling  
 C) Peripheral milling D) Up milling
- ii) The milling process used to produce V – blocks is called  
 A) Form milling B) Slot milling  
 C) Angular milling D) Slab milling
- iii) Flint is an example for a \_\_\_\_\_ abrasive  
 A) Artificial B) Natural  
 C) Strong D) Weak
- iv) The bond used for manufacturing elastic grinding wheels is called  
 A) Shellac B) Vitrified  
 C) Resinoid D) Oxy – chloride

b. Differentiate between up milling and down milling. (06 Marks)

c. List any four differences between horizontal milling machine and vertical milling machine (04 Marks)

d. With a neat sketch, explain the principle of centreless cylindrical grinding. (06 Marks)



7 a. Choose correct answers for the following :

(04 Marks)

- i) Spelter is used in,  
 A) Welding  
 C) Soldering  
 B) Brazing  
 D) Electroplating
- ii) \_\_\_\_\_ is used as flux in welding,  
 A) Sodium phosphate  
 C) Sodium silicate  
 B) Sodium carbonate  
 D) Sodium chloride
- iii) A good lubricant should be,  
 A) Highly volatile  
 C) Less volatile  
 B) Non-volatile  
 D) Moderately volatile
- iv) Collar bearing is an example for,  
 A) Radial bearing  
 C) Thrust bearing  
 B) Journal bearing  
 D) Sleeve bearing

b. With a neat sketch explain a foot step bearing.

(06 Marks)

c. Explain splash lubrication with a neat sketch.

(06 Marks)

d. Differentiate between welding and brazing.

(04 Marks)

8 a. Choose correct answers for the following :

(04 Marks)

- i) V-belts are,  
 A) Repairable  
 C) Quickly repairable  
 B) Not repairable  
 D) Easily repairable
- ii) Belts transmit motion by \_\_\_\_\_,  
 A) Friction  
 C) Suction  
 B) Abrasion  
 D) Expulsion
- iii) The surface of the tooth below the pitch circle is called \_\_\_\_\_,  
 A) Clearance  
 C) Backlash  
 B) Flank  
 D) Face
- iv) Module indicates the \_\_\_\_\_ of the pitch,  
 A) Whole  
 C) Total  
 B) Fraction  
 D) Integration

b. Differentiate between an open belt drive and cross belt drive.

(04 Marks)

c. Enumerate the advantages and disadvantages of gear drives.

(06 Marks)

d. A V-belt drive transmits 10 kW power at 240 rpm. The grooved pulley has a mean diameter of 1.2 m and groove angle of  $45^\circ$ . Taking  $\mu = 0.3$  and angle of lap equal to  $\pi$  radians, determine the tensions on each side of the belt.

(06 Marks)

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**First/Second Semester B.E. Degree Examination, June/July 2013**  
**Basic Electrical Engineering**

Time: 3 hrs.

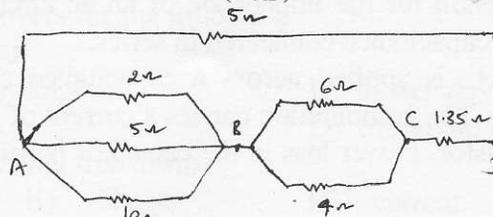
Max. Marks:100

- Note:** 1. Answer any FIVE full questions, choosing at least two from each part.  
 2. Answer all objective type questions only on OMR sheet page 5 of the answer booklet.  
 3. Answer to objective type questions on sheets other than OMR will not be valued.

**PART - A**

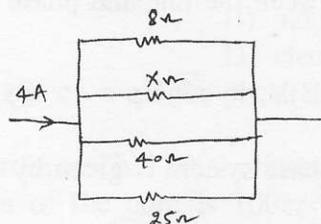
- 1 a. Choose the correct answers for the following : (04 Marks)
- The condition for the validity under Ohm's law is that the
    - temperature should remain constant
    - current should be proportional to voltage
    - resistance must be wire wound type
    - all of the above.
  - A linear resistor is one which obeys
    - Ampere's law
    - Lenz's law
    - ohms law
    - Kirchhoff's law
  - The resistance of a conductor having length  $\ell$ , area of cross section  $a$  and resistivity  $\rho$  is given as
    - $R = \frac{\rho a}{\ell}$
    - $R = \frac{\rho \ell}{a}$
    - $R = \rho \ell a$
    - $R = \frac{\ell}{\rho a}$
  - Resistance of a wire always increases if
    - temperature is reduced
    - temperature is increased
    - number of free electrons available become less
    - number of free electrons available become more.
- b. Find the resistance of the circuit shown ( $R_{AD}$ ). (05 Marks)

Fig.Q1(b)



- c. State and explain Kirchoff's laws. (05 Marks)
- d. In the parallel arrangement of resistors shown the current flowing in the  $8\Omega$  resistor is 2.5 amperes. Find i) current in other resistors ii) resistor X iii) the equivalent resistance. Refer fig. Q1(d). (06 Marks)

Fig.Q1(d)



- 2 a. Choose the correct answers for the following : (04 Marks)
- The law that finds application in electrolysis  
A) Faraday's law B) Coulomb's law C) Ohm's law D) Lenz's law
  - According to Faraday's law of electro magnetic induction an emf is induced in a conductor whenever it  
A) lies in a magnetic field B) lies perpendicular to the magnetic field  
C) cuts the magnetic flux  
D) moves parallel to the direction of magnetic field.
  - "In all cases of electromagnetic induction, an induced voltage will cause a current to flow in a closed circuit in such a direction that the magnetic field which is caused by that current will oppose the change that produces the current" is the original statement of  
A) Lenz's law B) Faraday's law of magnetic induction  
C) Fleming's law of induction D) Ampere's law
  - Which law is synonymous to the occurrence of diamagnetism  
A) Ampere's law B) Maxwell's law C) Coulomb's law D) Lenz's law.
- b. State and explain Faraday's laws of electromagnetic induction. (08 Marks)
- c. Derive the expression for energy stored in an inductor. (08 Marks)
- 3 a. Choose the correct answers for the following : (04 Marks)
- The form factor is the ratio of  
A) average value to rms value B) rms value to average value  
C) peak value to average value D) peak value to rms value
  - In an R – L series circuit the pf is  
A) leading B) lagging C) zero D) unity
  - The power factor of an ac circuit is equal to  
A) cosine of the angle B) sine of the phase angle  
C) unity for a resistive circuit D) unity for a reactive circuit
  - In a pure capacitive circuit, the current will  
A) lag behind the voltage by  $90^\circ$  B) lead the voltage by  $90^\circ$   
C) remain in phase with voltage D) None of these
- b. Derive an expression for the impedance of an ac circuit consisting of a resistance an inductance and a capacitance connected in series. (10 Marks)
- c. 125 volts at 60Hz is applied across a capacitance connected in series with a non inductive resistor. The combination carries a current of 2.2A and causes a power loss of 96.8 w in the resistor. Power loss in the capacitor is negligible. Calculate the resistance and capacitance. (06 Marks)
- 4 a. Choose the correct answers for the following : (04 Marks)
- In a 3 phase balanced star – connected load, neutral current is equal to  
A) Zero B)  $I_P$  C)  $I_L$  D) Unpredictable
  - The relationship between the line and phase voltage of a delta connected circuit is given by  
A)  $V_L = V_P$  B)  $V_L = \sqrt{3} V_P$  C)  $V_L = \frac{V_P}{\sqrt{2}}$  D)  $V_L = \frac{2}{\pi} V_P$
  - The power in a 3 phase system is given by  $\sqrt{3} V_L I_L \cos \phi$ , where  $\phi$  is the phase angle between  
A) line voltage and line current B) phase voltage and phase current  
C) line voltage and phase current D) phase voltage and line current

- iv) Three equal impedances are first connected in delta across a 3 - phase balanced supply. If the same impedances are connected in star across the same supply  
 A) phase currents will be one - third      B) line currents will be one - third  
 C) power consumed will be one - third      D) None of these
- b. Derive the relationship between a line current and a phase current and a line voltage and phase voltage related to a star connected load. **(07 Marks)**
- c. Mention different types of wiring used in domestic dwellings. **(03 Marks)**
- d. Explain construction and working principle of induction type single phase energy meter. **(06 Marks)**

**PART - B**

- 5 a. Choose the correct answers for the following : **(04 Marks)**
- i) The emf generated in a dc generator depends upon  
 A) brush contact drop      B) commutation  
 C) number of parallel paths      D) terminal voltage
- ii) The dc generator having residual magnetism gives zero induced emf, the speed will be  
 A) zero      B) very small      C) rated one      D) any
- iii) The field coils of a dc machine are made of  
 A) carbon      B) copper      C) mica      D) steel
- iv) The rotating part of a dc machine is called the  
 A) rotor      B) field      C) armature      D) stator
- b. The emf generated in the armature of a shunt generator is 625 volts, when delivering its full load current of 400 A to the external circuit. The field current is 6 amp and the armature resistance is  $0.06\Omega$ . What is the terminal voltage? **(08 Marks)**
- c. A 220 volts series motor is taking a current of 40 amperes. Resistance of armature  $0.5\Omega$ , resistance of series field is  $0.25\Omega$ . Calculate i) Voltage at the brushes ii) Back emf iii) Power wasted in armature iv) Power wasted in series field. **(08 Marks)**
- 6 a. Choose the correct answers for the following : **(04 Marks)**
- i) Transformer is used  
 A) to step up the voltage      B) to step down the voltage  
 C) on dc      D) to step up or step down the voltage
- ii) A transformer does not transform  
 A) power      B) voltage      C) current      D) impedance
- iii) In a transformer, electrical power is transferred from primary to secondary  
 A) through air      B) by magnetic flux  
 C) through insulating medium      D) none of these
- iv) The two windings of a transformer are  
 A) conductively linked      B) inductively linked  
 C) not linked at all      D) electrically linked
- b. Explain principle of operation of a single phase transformer and derive the EMF equation. **(08 Marks)**
- c. A single phase, 20 KVA transformer has 1000 primary turns and 2500 secondary turns. The net cross sectional area of the core is  $100\text{cm}^2$ . When the primary winding is connected to 500V , 50Hz supply, calculate i) the maximum value of the flux density in the core ii) the voltage induced in the secondary winding and iii) the primary and secondary full load currents. **(08 Marks)**

- 7 a. Choose correct answers for the following : (04 Marks)
- In a synchronous machine, the stator frame is made of,
    - Stain steel
    - CRC<sub>0</sub>GS
    - Cast iron or welded steel plates
    - Laminated silicon steel
  - The stator core of a synchronous machine is laminated so as to reduce,
    - Eddy current loss
    - Hysteresis
    - Both eddy current and hysteresis loss
    - The size and weight of the machine
  - The stator slot insulations in synchronous made of,
    - Mica cloth
    - Fibre glass
    - Polister sheets
    - Any of these
  - The machine that supplies dc to the rotor is called the,
    - Rectifier
    - Exciter
    - Convertor
    - Invertor
- b. Derive EMF equation of an alternator. (08 Marks)
- c. Explain construction and working principle of synchronous generator. (08 Marks)
- 8 a. Choose the correct answers for the following : (04 Marks)
- If a single phase induction motor runs at a speed lower than the rated one, the most likely defect is,
    - improper size fuses
    - Worn-out bearings or low voltage or over load
    - Open-circuit in the winding
    - Short-circuit in the winding
  - If the starting winding of a single phase induction motor is left in the circuit,
    - the motor will run faster
    - the motor will run slower
    - there will be undue sparking
    - the auxillary winding will get over-heated due to continuous flow of current and may get damaged.
  - Which of the following types of motors are not single phase ac motors?
    - Induction type motors
    - Commutator type motors
    - Synchronous type motors
    - Schrage motors
  - Which of the following types of motors are not the induction motors?
    - Repulsion motors
    - Split phase motors
    - Shaded pole motors
    - Repulsion start induction motors
- b. Explain construction and working principle of star-delta starter. (08 Marks)
- c. What is meant by the slip of the induction motor? Under what circumstances the slip is i) unity and ii) zero. (08 Marks)

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