L-1/T-1/ME **Date : 08/08/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2015-2016

Sub : **EEE 159** (Fundamental of Electrical Engineering)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE** questions.

1. (a) Find the unknown reactive circuit component in Fig. 1(a) which makes the power factor of the load unity. Assume the source frequency to be 50 Hz. **(15)**

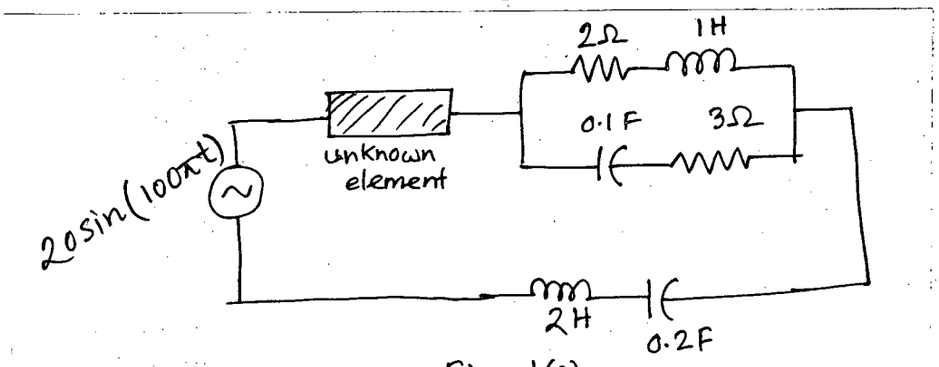

Fig. 1(a)

(b) Two single phase AC motors are connected in parallel. Motor 1 takes 250 A (rms) at 0.8 lagging power factor while motor 2 absorbs 50 KW at 0.5 leading power factor. What is the power factor of the combined load? What is the total current absorbed by the two motors? Assume the line voltage is 220 V (rms). **(20)**

2. (a) Find the current $i_0(t)$ in Fig. 2(a). **(20)**

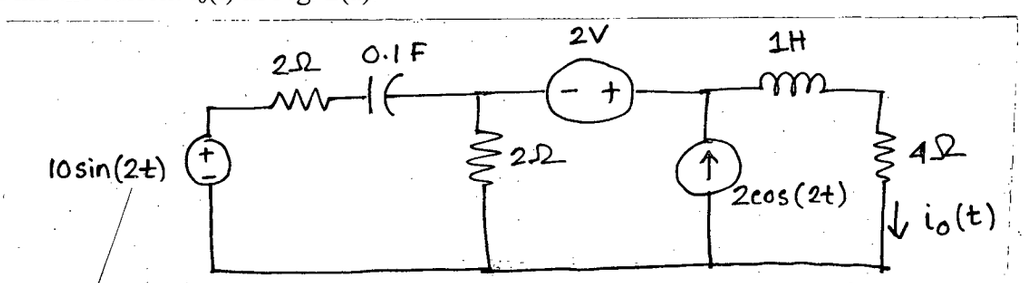

Fig. 2(a)

(b) Determine the value of resistor R_L in Fig. 2(b) so that it will absorb maximum average power. Also find the maximum average power absorbed by R_L. **(15)**

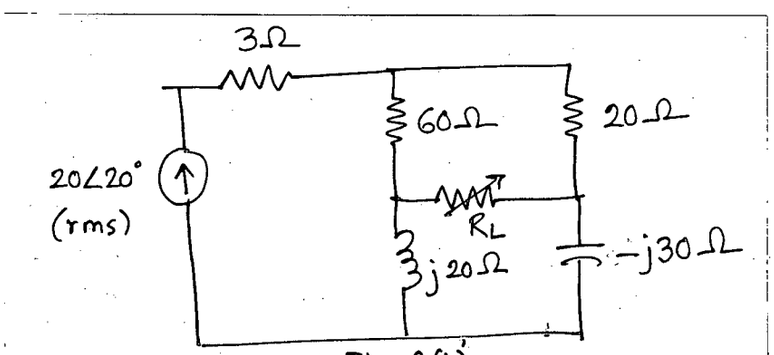

Fig. 2(b)

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3. (a) Prove that total instantaneous power in a balanced three-phase system is independent of time. **(10)**

   (b) A balanced three phase system consists of Y connected source and a Δ connected load. Derive the relationship between phase and line currents. Draw necessary phasor diagrams. **(10)**

   (c) A balanced three phase Y connected source with $V_{an} = 120\angle 0$ (rms) is connected with a Δ connected load with $Z_{an} = 51 + 45j$ ohms through transmission lines with $Z_{line} = 0.4 + 1.2j$ ohms.. Find the total average power absorbed by the load. **(15)**

4. (a) Current i(t) shown in Fig. 4(a) flows through a resistor, R = 5 ohms. Find I_{rms} and I_{avg} of i(t). Also find the average power absorbed by the resistor R. **(15)**

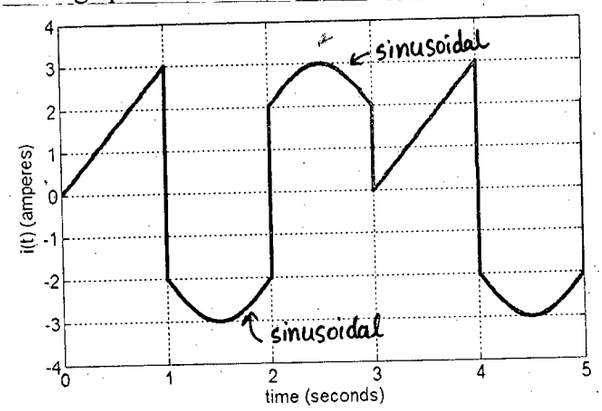
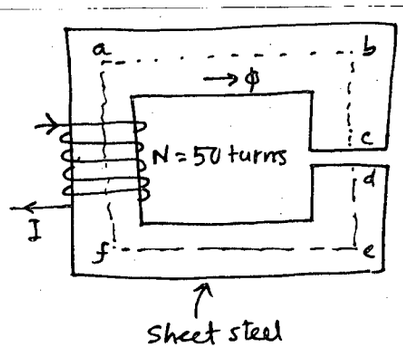


Fig. 4(a)

   (b) Find the current I required to produce a flux, $\Phi = 2.4 \times 10^{-4}$ Wb in the magnetic circuit shown in Fig. 4(b). **(20)**



Area (throughout) $= 2 \times 10^{-4}\ m^2$

$l_{ab} = l_{ef} = 0.05\ m$

$l_{af} = l_{be} = 0.02\ m$

$l_{bc} = l_{de}$

$l_{cd} = 0.003\ m$

Fig. 4(b)

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE** questions.

5. (a) For the series-parallel network of Fig. for Q. 5(a), find: **(20)**

   (i) the currents I, I_3, I_8 and I_9.

   (ii) the voltage V_{ab}.

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Contd … Q. No. 5(a)

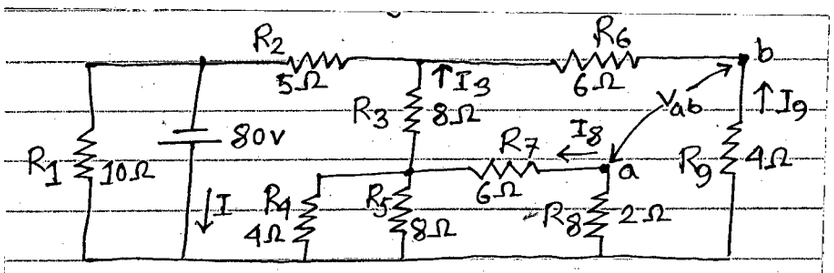

Fig. for Q. 5(a)

(b) Use the mesh-current method to find the total power developed in the circuit of Fig. for Q. 5(b). **(15)**

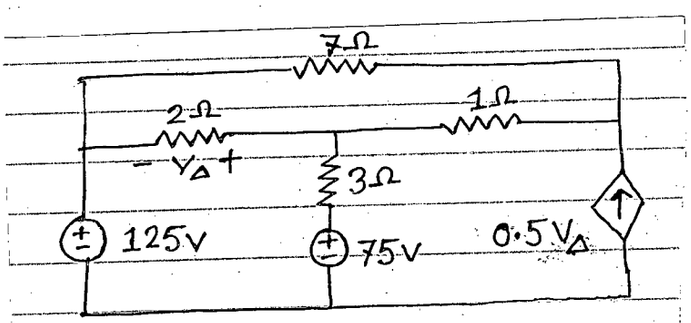

Fig. for Q. 5(b)

6. (a) Using nodal analysis find the voltages v_1, v_2 and v_3 in the circuit of Fig. for Q. 6(a). **(17)**

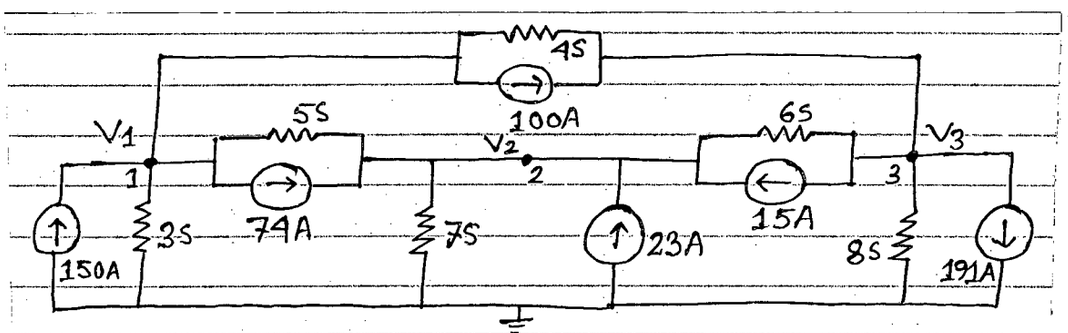

Fig. for Q. 6(a)

(b) In the circuit of Fig. for Q. 6(b), what resistor R_L will absorb maximum power and what is this power? **(18)**

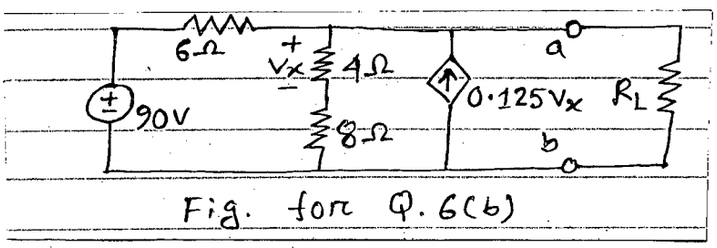

Fig. for Q. 6(b)

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7. (a) Determine the Norton equivalent of the circuit of Fig. for Q. 7(a). **(20)**

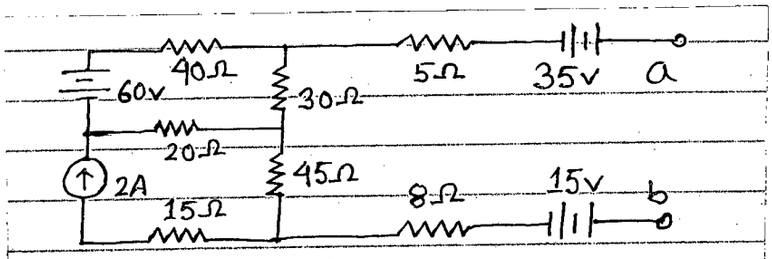

Fig. for Q. 7(a)

(b) Find the current, i_0 in Fig. for Q. 7(b) using superposition principle. **(15)**

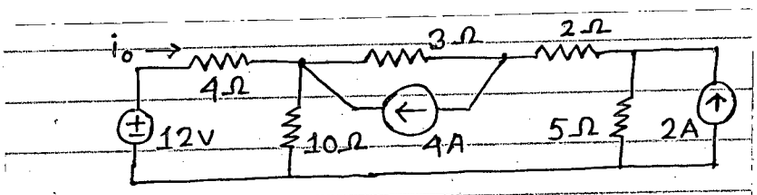

Fig. for Q. 7(b)

8. (a) Find the reading of the voltmeter in the Fig. for Q. 8(a) using source transformation. **(15)**

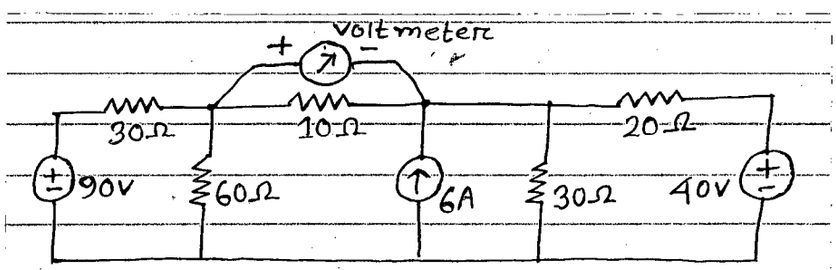

Fig. for Q. 8(a)

(b) Find the equivalent resistance, R_{eq} in the circuit of Fig. for Q. 8(b) for the following cases. **(20)**

(i) If $R_X = R_Y = \infty$.

(ii) If $R_X = R_Y = 0\ \Omega$.

(iii) If $R_X = 4\ \Omega$, $R_Y = 1\ \Omega$.

(iv) If $R_{eq} = 10\ \Omega$, $R_Y = \infty$, then find the value of R_X.

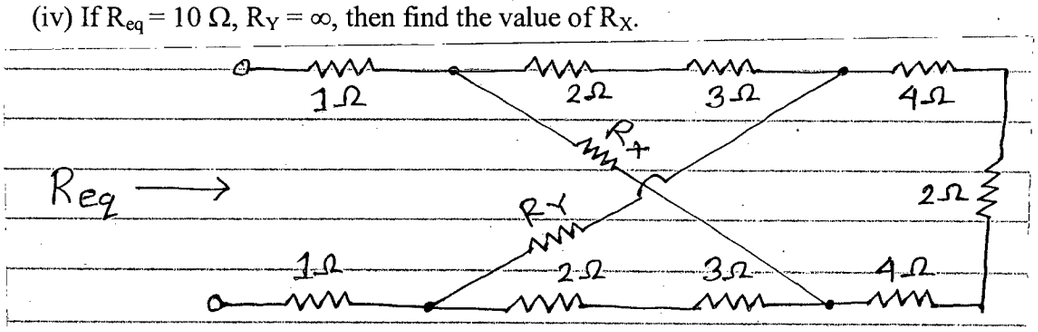

Fig: for Q. 8(b)

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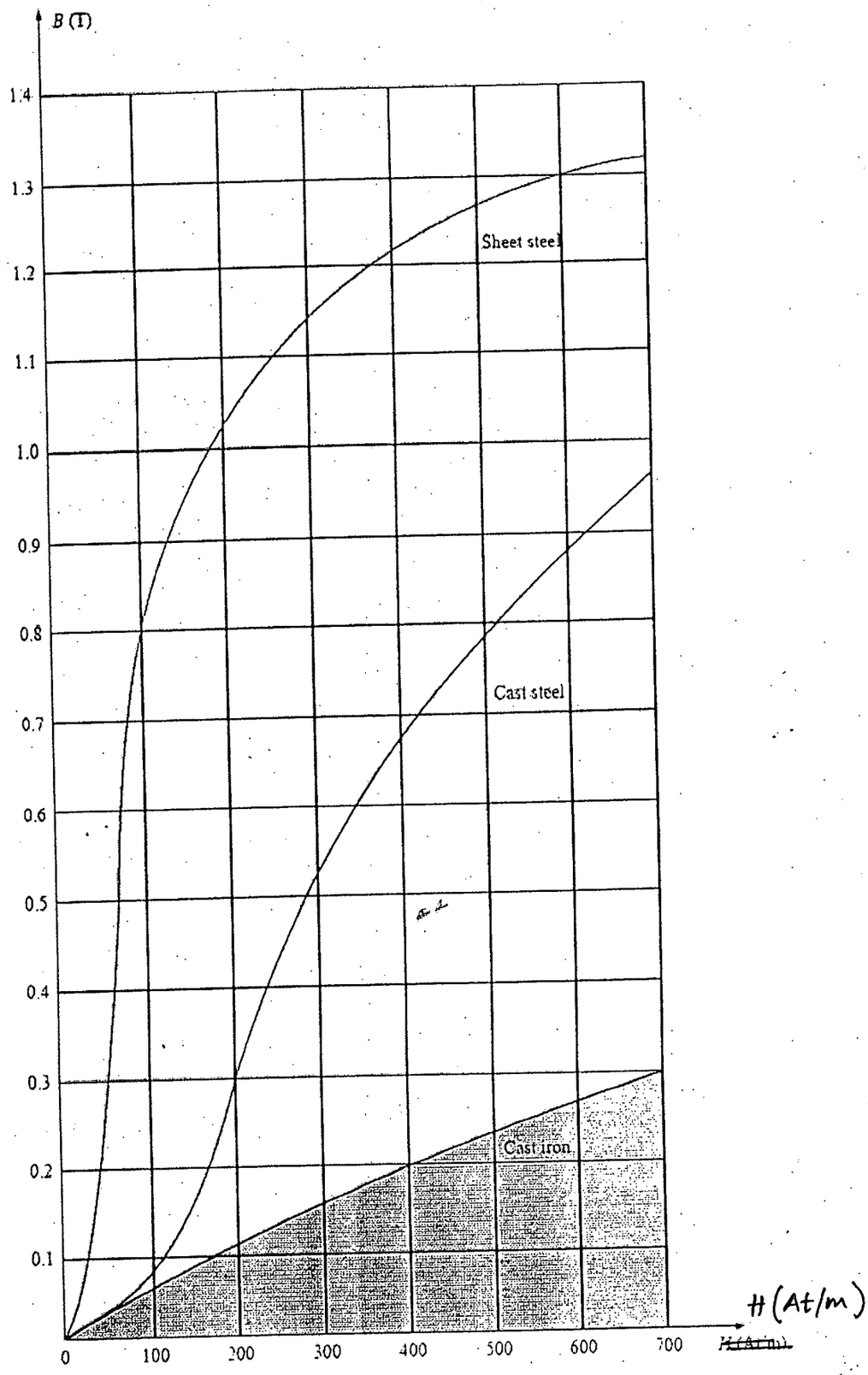
=5=

B-H curve



L-1/T-1/ME **Date : 18/07/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2015-2016

Sub : **MATH 161** (Differential Calculus, Three Dimensional Geometry and Vectors)

Full Marks : 280 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) If $y=\left(cos^{-1}x\right)^2$, prove that $\left(1-x^2\right)y_{n+2}-(2n+1)xy_{n+1}-n^2y_n=0$. **(15)**

   (b) If $u=ln\left(x^2+y^2+z^2\right)$, then show that $x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y}+z\frac{\partial u}{\partial z}=2$. **(15)**

   (c) If $y=(sin\,x)^{(sin\,x)^{(sin\,x)^{\cdots\cdots\infty}}}$, then prove that $\frac{dy}{dx}=\frac{y^2\,cot\,x}{1-y\,ln(sin\,x)}$. **(16⅔)**

2. (a) Evaluate : (i) $\lim\limits_{x\to 0}(cos\,x)^{cosec^2x}$ **(20)**

   (ii) $\lim\limits_{x\to 0}\frac{sin\,x-ln\left(e^x\,cos\,x\right)}{x\,sin\,x}$.

   (b) Verify Mean value theorem for $f(x)=3+2x-x^2$ in the interval (0, 1). **(10⅔)**

   (c) Expand $f(x)=ln\,x$ in powers of $(x-1)$. Also find Lagrange and Cauchy's form of remainder. **(16)**

3. (a) Prove that $x^2\,ln\left(\frac{1}{x}\right)$ is a maximum when $x=e^{-1/2}$. **(15)**

   (b) If $y=\frac{1}{x^2+16}$, find y_n. **(15)**

   (c) If the normal to the curve $x^{2/3}+y^{2/3}=a^{2/3}$ makes an angle φ with the axis of x, show that it's equation is $y\,cos\,\varphi-x\,sin\,\varphi=a\,cos\,2\varphi$. **(16⅔)**

4. (a) Find all the asymptotes of $x^3-2y^3+2x^2y-xy^2+xy-y+1=0$ **(15)**

   (b) Find the envelope of the family of circles $x^2+y^2-2ax\,cos\,\alpha-2ay\,sin\,\alpha=c^2$, where α = parameter. Also interpret the result. **(16⅔)**

   (c) Find the center of curvature at any point (x, y) on the curve $y^2=4ax$. **(15)**

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MATH 161

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) If l_1, m_1, n_1 and l_2, m_2, n_2 are the direction cosines of two mutually perpendicular straight lines, show that the direction cosines of the line perpendicular to both of them are $m_1 n_2 - m_2 n_1,\ n_1 l_2 - n_2 l_1,\ l_1 m_2 - l_2 m_1$ **(15)**

(b) A line makes angles α, β, γ, δ with the diagonals of a cube. Find the value of $\cos^2\alpha + \cos^2\beta \cos^2\gamma + \cos^2\delta$. **(16⅔)**

(c) A variable plane is at a constant distance p from the origin O and meets the axes in A, B and C. Find the locus of the centroid of the tetrahedron OABC. **(15)**

6. (a) Find the equation of the planes through the points (0, 4, –3) and (6, –4, 3) which cuts off from the axes intercepts whose sum is zero. **(15)**

(b) Find the length and the equation of the shortest distance between the two lines $\frac{x+3}{-4} = \frac{y-6}{3} = \frac{z}{2}$ and $\frac{x+2}{-4} = \frac{y}{1} = \frac{z-7}{1}$. Also find the points where it intersects the lines. **(16⅔)**

(c) Find the distance of the point (2, - 3, 6) from the plane $2x + 3y + 4z = 25$ measured parallel to the line $\frac{x}{2} = \frac{y}{3} = \frac{z}{-5}$. **(15)**

7. (a) Examine whether the vectors $\overline{v_1} = \hat{i} + 2\hat{j} + \hat{k}, \overline{v_2} = 3\hat{k}, \overline{v_3} = 2\hat{i} + 4\hat{j}$ are linearly dependent or independent. Also show that the terminals points of these vectors are not collinear. **(16⅔)**

(b) Prove that $(\bar{a} \times \bar{b}) \times (\bar{c} \times \bar{d}) = [\bar{a}\,\bar{b}\,\bar{d}]\,\bar{c} - [\bar{a}\,\bar{b}\,\bar{c}]\,\bar{d}$. **(15)**

(c) Prove that the sides about the equal angles of equilateral triangles are proportional. **(15)**

8. (a) If $\bar{a}, \bar{b}, \bar{c}$ and $\bar{a}', \bar{b}', \bar{c}'$ are reciprocal system of vectors prove that **(18⅔)**

(i) $\bar{a} \cdot \bar{a}' + \bar{b} \cdot \bar{b}' + \bar{c} \cdot \bar{c}' = 3$.

(ii) $\bar{a}' \times \bar{b}' + \bar{b}' \times \bar{c}' + \bar{c}' \times \bar{a}' = \frac{\bar{a} + \bar{b} + \bar{c}}{[\bar{a}\,\bar{b}\,\bar{c}]}$.

(b) Solve for $\bar{x}$, the vector equation $\bar{x} + \bar{x} \times \bar{a} = \bar{b}$. **(14)**

(c) Show that $\bar{a} \times (\bar{b} \times \bar{c}) = (\bar{a} \times \bar{b}) \times \bar{c}$ if and only if either $\bar{b} = 0$ or $\bar{c}$ is collinear with $\bar{a}$ or $\bar{b}$ is perpendicular to both $\bar{a}$ and $\bar{c}$. **(14)**

L-1/T-1/ME **Date : 03/08/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2015-2016

Sub : **ME 101** (Introduction to Mechanical Engineering)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Symbols have their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE** questions.

Assume any missing data.

1. (a) Classify "Electro-Mechanical" systems and briefly mention their salient features. **(10)**

   (b) Mention some important practical applications of "MEMS" in our daily life. **(5)**

   (c) With net sketch, briefly explain how Micro Capacitive Accelerometer works. **(10)**

   (d) Why Monocrystalline Sillicon is so popular for MEMS fabrication? **(5)**

   (e) What is LASER? Write down some important industrial applications of LASER. **(5)**

2. (a) Define "Mechatronics". Mention some advantage and disadvantages of mechatronic system over conventional system. **(10)**

   (b) With a neat sketch, briefly describe the basic elements of a Robot. **(10)**

   (c) Briefly explain the term 6DoF. **(5)**

   (d) Describe with examples, how different mechanical engineering branches contribute to Biomedical Engineering. **(10)**

3. (a) What is Gear Train? Classify them. Mention the advantage of Gear Transmission over other Mechanical Power Transmission systems. **(10)**

   (b) Why bearing is used in mechanical systems? Briefly describe different types of bearing used in various mechanical systems. **(10)**

   (c) Define Beam and Column. Classify them along with suitable sketches. **(10)**

   (d) Mention some desirable properties of bearing material. **(5)**

4. (a) With the help of a simple schematic, explain the working principle and important features of a Cochran boiler. **(15)**

   (b) Write down the function of the following components of a boiler: **(6)**

   (i) Fusible plug (ii) Feed check valve and (iii) Economizer

   (c) What is the importance of engineering standards and codes? Write down the name of any five standard development organizations. **(8)**

   (d) Define engineering ethics. Write down any three fundamental canons of the Code of Ethics for Engineers. **(6)**

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ME 101

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE** questions.

5. (a) Why Mechanical Engineering is called " The Mother of Engineering"? How long the need for Mechanical Engineering will remain? What does a Mechanical Engineer do? Mention 5 key activities associated with Mechanical Engineers. **(10)**

(b) What is meant by "Calorific Value" of a fuel? What is the difference between Gross Calorific value and Net Calorific Value? **(5)**

(c) How nuclear energy is available from U_{235}? With a schematic diagram show how electricity is produced from a nuclear reactor. **(10)**

(d) What is a 'p-n' junction? With a simple sketch show how a P-V cell is connected to variable resistance. Draw the I-V characteristic curve for a typical silicon P-V cell showing I_{sc}, V_{oc} and P_{max} points (symbols have their usual meaning). **(10)**

6. (a) Define power coefficient, tip speed ratio and solidity of a wind turbine. Theoretically what is the maximum value of power coefficient? With simple sketches show the difference between: (i) HAWT and VAWT, (ii) Upwind and downwind wind turbines. **(10)**

(b) Draw typical C_p–λ characteristic curves for low and high solidity wind turbines. **(5)**

(c) Distinguish between primary and secondary air pollution produced from internal combustion engines. What are the health problems associated with particulate matter and NOx? What is meant by CFCs and how it contributes to ozone layer depletion? **(10)**

(d) A motor bike engine has its bore equal to its stroke. Its clearance volume is 12.5 cc and compression ratio is 9. Determine its engine volume, bore and crank radius. **(10)**

7. (a) Draw and label the coil ignition system for a 4-stroke cycle 4-cylinder SI engine. **(10)**

(b) Write down the two missing words 'A' and 'B' of the following sentences (do not write sentences): **(5)**

(i) The loud pulsating noise heard within the engine cylinder is known as 'A'. It is caused due to the propagation of a high speed pressure wave created by the auto-ignition of end portion of unburnt fuel.

(ii) The scientists all over the world, have concentrated on the design of their IC engines, so that the burnt gases are completely exhausted from the cylinder before the suction starts. The process of removing burnt gases from the combustion chamber of the engine cylinder is known as 'B'.

(c) Draw a neat sketch to show how valves of a 4-stroke cycle IC engine operate and mention the name of the components involved in this operation in sequence. **(10)**

(d) Draw the block diagram, P-V and T-s diagrams for a close cycle gas turbine plant employing two stage expansion (turbine) with a reheater. **(10)**

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ME 101

8. (a) Draw and label a centrifugal pump. Draw the typical performance curves for a centrifugal pump at constant speed. **(10)**

(b) Define a fan, a blower and a compressor in terms of pressure ratio. **(5)**

(c) What are the 4 main components of a refrigeration system? Show them in a simple sketch in sequence as they are connected. Show the ideal vapor-compression system in T-s diagram. **(10)**

(d) What is meant by air conditioning? Define comfort zone for a human being. Briefly explain the differences between "Window type" and "Split type" air conditioning systems. **(10)**
