

FE (C/M/E) Sem-I, A.T.K.T, 23/06/2015.  
Applied Chemistry-I

Bharatiya Vidya Bhavan's

**SARDAR PATEL COLLEGE OF ENGINEERING**

(An Autonomous Institution Affiliated to University of Mumbai)

Duration :

APPLIED CHEMISTRY – I  
(50 MARKS)

FE (C/M/E) SEM I  
KT-exam 2015

- Question No. 1 is compulsory.
- Attempt any four questions out of remaining.
- Assume any other data needed suitably if not given; but justify the same.
- Illustrate your answers with neat diagram.

- Q.1 (a) Explain desalination of brackish water with reverse osmosis. 05  
(b) Describe in detail rechargeable lithium ion batteries. 05
- Q.2 (a) Give the point of differences between cold and hot lime soda process. 05  
(b) Explain in detail applications of fullerenes. 05
- Q.3 (a) Describe in detail acid value calculation in lubricants. 05  
(b) 0.30 g of  $\text{CaCO}_3$  was dissolved in minimum quantity of hydrochloric acid and the solution is made up to 1 liter with distilled water. 100 mL of above std. solution required 25 mL of EDTA solution. 100 mL of hard water sample required 35 mL of EDTA solution. After boiling, filtering and cooling of this hard water, 100 ml of this solution on titration required 15 ml of EDTA solution. Calculate each type of hardness present in given water sample. 05
- Q.4 (a) Describe in detail semisolid lubricants. 05  
(b) 0.20 g of  $\text{CaCO}_3$  was dissolved in minimum quantity of hydrochloric acid and the solution is made up to 1 liter with distilled water. 100 mL of above std. solution required 20 mL of EDTA solution. 100 mL of hard water sample required 35 mL of EDTA solution. After boiling, filtering and cooling of this hard water, 100 ml of this solution on titration required 10 ml of EDTA solution. Calculate each type of hardness present in given water sample. 05
- Q.5 (a) Explain the terms: Viscosity, Saponification value, Acid value, Flash point and Fire point. 05  
(b) Describe in detail Biomass energy. 05
- Q.6 (a) Give the point of differences between BOD and COD. 05  
(b) 25 mL lubricating oil was dissolved in alcohol. Solution was treated with 0.02 N KOH solution. At the end point, burette reading was found to be 2.5 mL. Calculate the acid value of the given oil. (density of oil = 0.85 g/mL) 05
- Q.7 (a) Explain in detail carbon nano tubes. 05  
(b) A 35 mL of sewage water was refluxed with 10 mL of 0.25N  $\text{K}_2\text{Cr}_2\text{O}_7$  solution in presence of dil.  $\text{H}_2\text{SO}_4$ ,  $\text{Ag}_2\text{SO}_4$  and  $\text{HgSO}_4$ . The unreacted dichromate required 8.5 mL of 0.1N FAS. 10 mL of the  $\text{K}_2\text{Cr}_2\text{O}_7$  and 35mL of distilled water, under the same condition as the sample, required 30 mL of 0.1 N FAS. Calculate the COD of the sewage water sample. 05

**SARDAR PATEL COLLEGE OF ENGINEERING**

(An Autonomous Institution Affiliated to University of Mumbai)

**APPLIED CHEMISTRY - I**

Duration :

**(75 MARKS)**

FE (C/M/E):2014-15  
SEM-I/KT- exam

- **Question No. 1 is compulsory.**
- Attempt any four questions out of remaining.
- Assume any other data needed suitably if not given; but justify the same.
- Illustrate your answers with neat diagram.

*Master*

- Q.1 (a) Explain in detail carbon nano tubes. 05
- (b) Explain in detail acid value calculation in lubricants. 05
- (c) Describe in detail rechargeable Lithium ion batteries. 05
- Q.2 (a) The hardness of 10,000 liters of hard water sample was completely removed by passing it through a zeolite softener. The zeolite softener required 5000 liters of NaCl solution containing 1170 mg of NaCl/L. Determine the hardness of water sample. 05
- (b) Explain in detail Hydrogen as fuel. 05
- (c) Give the point of differences between BOD and COD. 05
- Q.3 (a) Explain in detail continuous cold Lime -soda process. 05
- (b) 2.5 g of vegetable oil was mixed with 50 mL of 0.4 N KOH solution and heated for 01 hour. The mixture required 26.4 mL of 0.4 N HCl. The blank titration reading was 49.0 mL. Find the Saponification value of oil. 05
- (c) Explain conducting polymers with its detail classification. 05
- Q.4 (a) Define plain carbon steels and give any three drawbacks of plain carbon steels. 05
- (b) 150 mL of sample contains 1250 ppm of dissolved oxygen. After 5 days, the dissolved oxygen value becomes 550 ppm after the sample has been diluted to 250 mL. Calculate the BOD of sample. 05
- (c) Give the point of differences between cold and hot lime soda process. 05
- Q.5 (a) Explain desalination of brackish water with reverse osmosis. 05
- (b) 25 mL of a sewage water sample was refluxed with 10 mL of 0.25 N  $K_2Cr_2O_7$  solution in presence of dilute  $H_2SO_4$ ,  $Ag_2SO_4$  and  $HgSO_4$ . The unreacted dichromate required 6.5 mL of 0.25 N FAS. 10 mL of same  $K_2Cr_2O_7$  solution with 25 mL of distilled water, under same conditions as the sample, required 31 mL of FAS. Calculate the COD of the sewage water sample. 05
- (c) Describe in detail Graphite. 05

Applied Chemistry - I

- Q.6 (a) 25 mL lubricating oil was dissolved in alcohol. Solution was treated with 0.02 N KOH solution. At the end point, burette reading was found to be 2.5 mL. Calculate the acid value of the given oil. (density of oil = 0.85 g/mL) 05
- (b) Describe in detail Fullerenes with their application. 05
- (c) Explain in detail zeolite or permutit process for water softening. 05
- Q.7 (a) State and explain: Saponification value, Cloud point, Pour point, Flash and Fire point. 05
- (b) 50 mL std. hard water (1.1 mg of  $\text{CaCO}_3/\text{mL}$ ) requires 38 mL of disodium EDTA. 100 mL of water sample consumes 21 mL of EDTA during titration. Find the degree of hardness of water. 05
- (c) Explain the detail Biomass energy.

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**SARDAR PATEL COLLEGE OF ENGINEERING**  
(An Autonomous Institution Affiliated to University of Mumbai)  
A.T.K.T.

JUNE 2015  
Duration : 3 Hours

Total Marks : 100

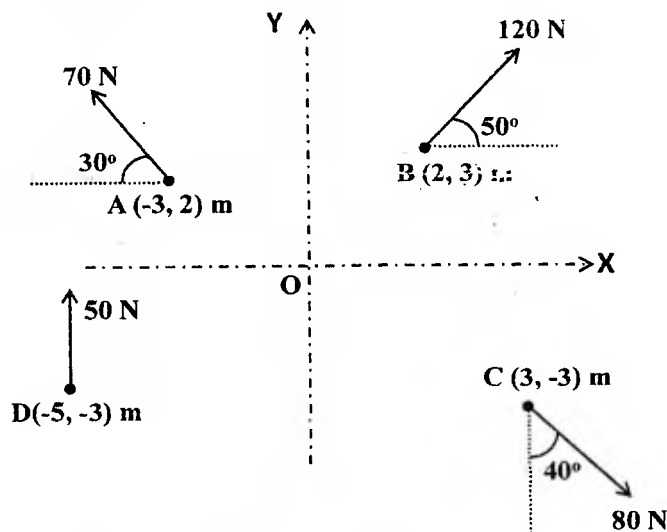
CLASS/SEM : FE (C/E/M) SEM I

SUBJECT : ENGINEERING MECHANICS - I

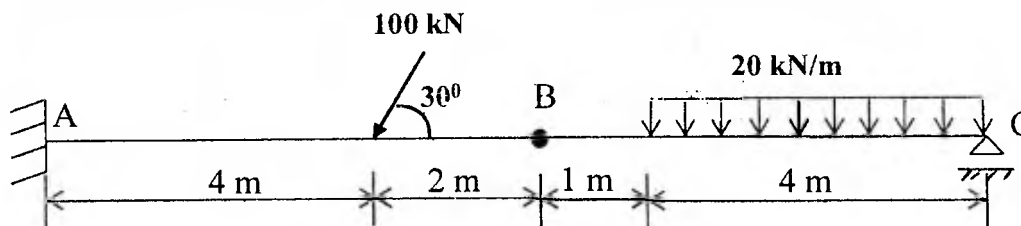
- Attempt any FIVE questions out of SEVEN questions.
- If there are sub questions, answers to all sub questions should be grouped together.
- Figures to the right indicate full marks.
- Assume suitable data if necessary and state the same clearly.

*Master*  
*10/06/15*

- Q.1 (a) Replace the system of forces shown in figure below by a single resultant force. (10)  
Find the x and y intercepts of the resultant force with respect to the origin O. The values in the bracket are the coordinates of the point of application of the respective force/moment.

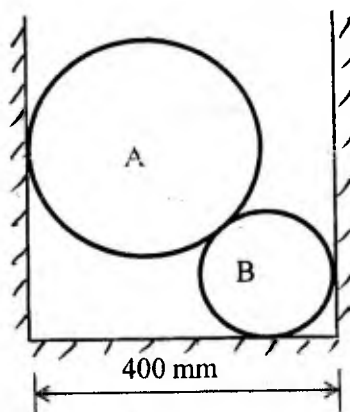


- Q.1 (b) A beam is supported and loaded as shown in figure below. Find the reactions at the supports using equations of equilibrium only. B is an internal hinge. (10)

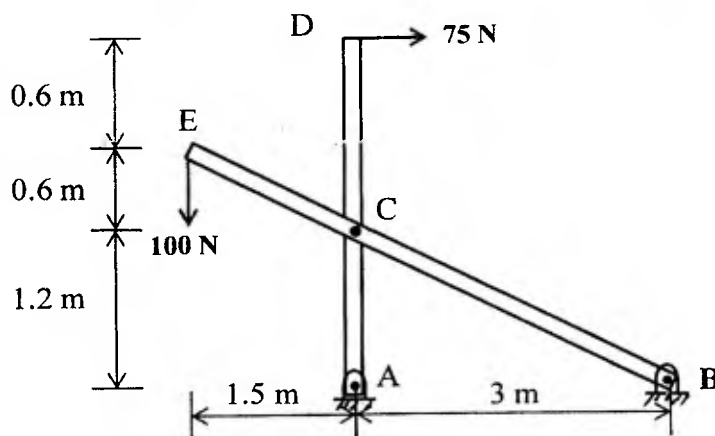


Engineering Mechanics-I

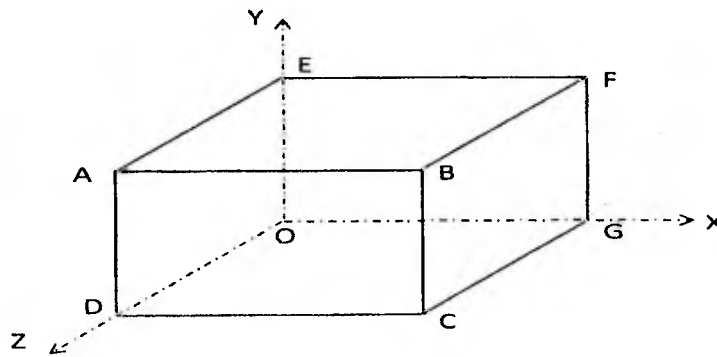
- Q.2 (a) Two cylinders A and B rest in a channel of bottom width 400 mm as shown in figure below. The cylinder A has a mass of 50 kg and a radius of 150 mm. The cylinder B has a mass of 12 kg and a radius of 100 mm. Determine the reactions at all contact points. Neglect friction. (12)



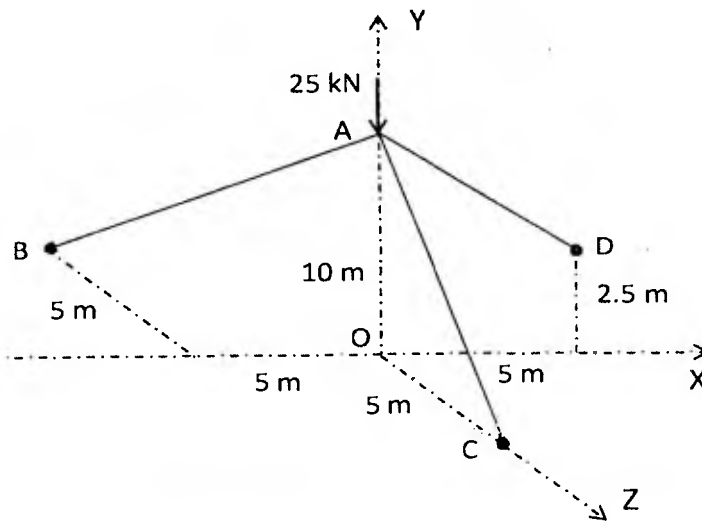
- Q.2 (b) Determine the reactions at supports A and B and pin C for the frame loaded as shown in figure below. (08)



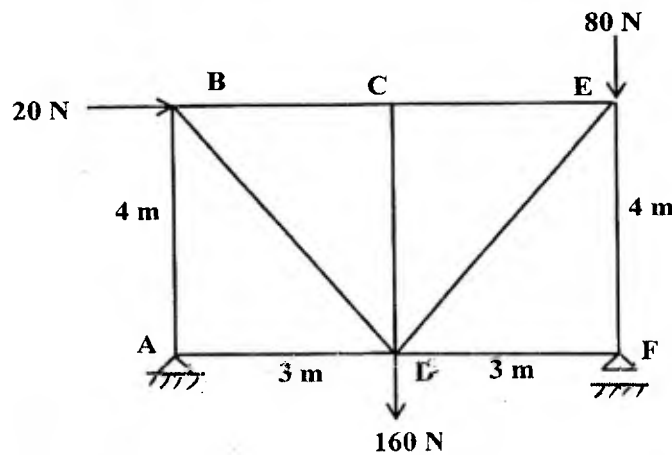
- Q.3 (a) The sides of a rectangular block shown in figure below are  $AB = 6\text{m}$ ,  $BC = 3\text{m}$  and  $BF = 4\text{m}$ . The following forces act on this block  
 $F_1 = 40\text{ kN}$  along BF  
 $F_2 = 50\text{ kN}$  along AG  
 $F_3 = 30\text{ kN}$  along CE  
 Find the resultant force and resultant moment of these forces acting at O. (10)



Q.3 (b) A vertical load of 25 kN is supported by three bars of a tripod as shown in figure (10) below. Find the forces in each bar. Note that points B and C lie in XZ plane.



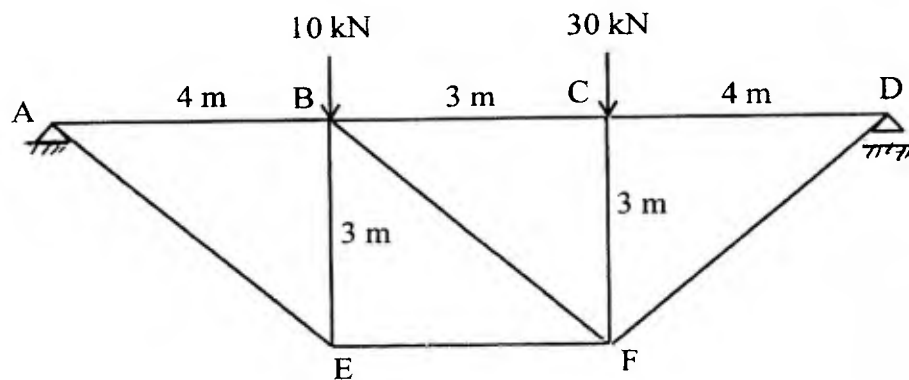
Q.4 (a) Find the forces in all the members of the truss loaded as shown in figure below. (12)



Q.4 (b) A truss is loaded as shown in figure below. Find force in members BC and EF of (08) the truss by **method of sections only**.

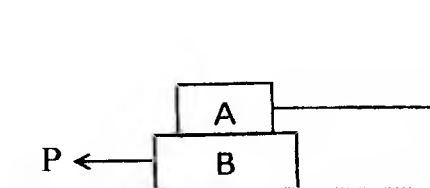


Engineering Mechanics-I

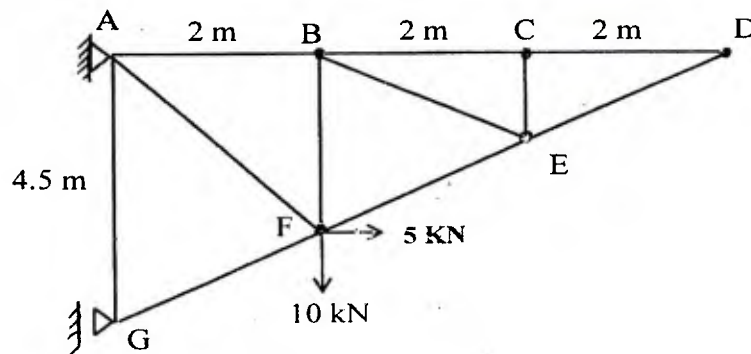


Q.5 (a) A 3 m long ladder weighing 500 N rests against a vertical wall. It makes an angle of  $50^\circ$  with the horizontal floor. In addition to the self weight, the ladder has to support a man weighing 700 N at its top end. Find the force P required to be applied horizontally at the lower end of the ladder so as to prevent the slipping of the ladder. The co-efficient of friction between all the contact surfaces is 0.2. (10)

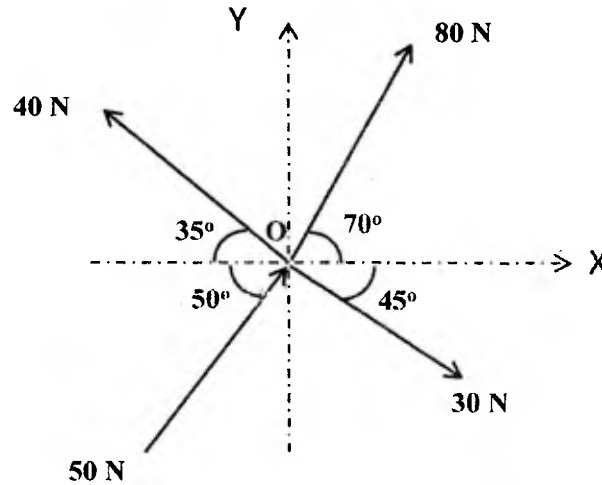
Q.5 (b) A block B of mass 50 kg rests on a horizontal surface and supports another block A of mass 20 kg on the top of it as shown in figure below. Block A is connected to a light horizontal cord which is attached to a vertical wall. Find the force P required to produce the impending motion of the blocks. The coefficient of friction between the blocks A and B is 0.2 and that between block B and the horizontal plane is 0.35. (10)



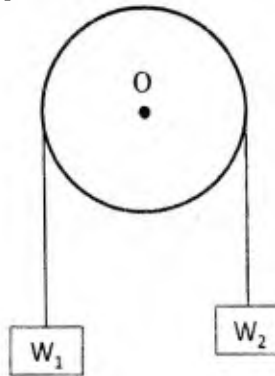
Q.6 (a) Find zero force members of the truss loaded as shown in figure below. (06)



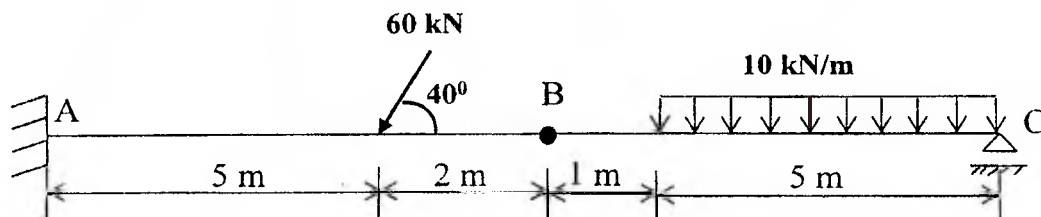
Q.6 (b) Determine the resultant of the force system shown in figure below. (08)



Q.6 (c) A belt supports two weights  $W_1$  and  $W_2$  over a pulley as shown in figure below. (06)  
If  $W_1 = 1500$  N, find the minimum and maximum weight of  $W_2$  to keep  $W_1$  in equilibrium. Assume that the pulley is locked and  $\mu = 0.25$ .



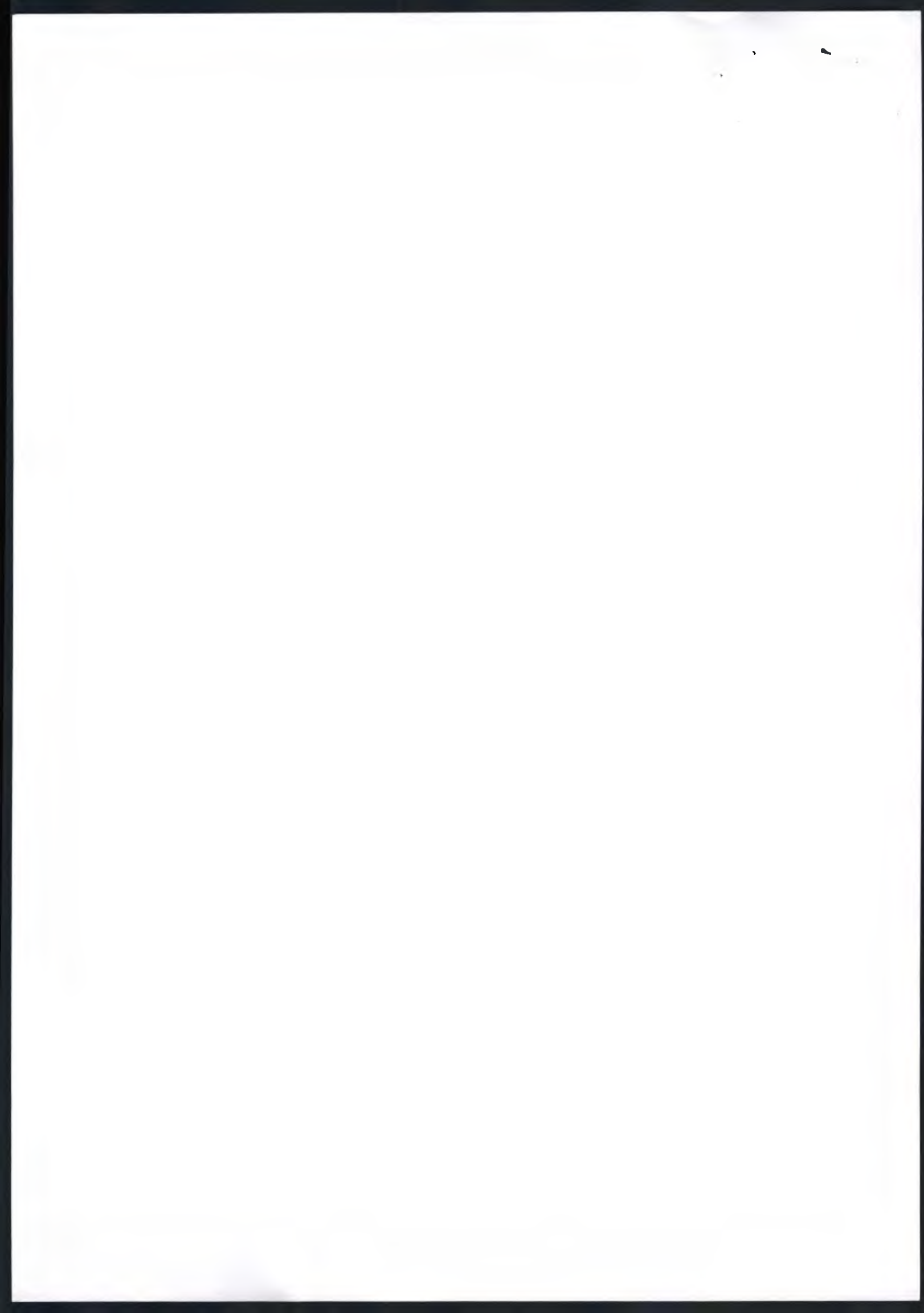
Q.7 (a) A beam is supported and loaded as shown in figure below. Using the principle of virtual work find the reactions at the supports. Note that there is an internal hinge at B. (10)



(b) State and explain Varignon's theorem. (05)

(c) What are the assumptions made in the analysis of a truss? (05)





FE (C/M/E), Sem-I, Re-exam, 23/06/2015, (old),  
Applied Physics-I.

lib  
23/06/15

Bharatiyavidyabhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

[ An autonomous institution Affiliated to university of Mumbai ]

RE-EXAMINATION FOR F.E.(C/M/E) MAY 2015

Total marks : 75

old

duration : 3 hr

Subject : Applied Physics(Sem-I) CFE (C/M/E) Sem-I, A.T.K.T.

- Question No. 1 is compulsory.
- Attempt any **Four** out of remaining **Six** questions.
- Draw diagrams and assume suitable data wherever necessary.
- Figure to right indicates full marks.

Master.

Q1.

[5\*3=15]

- a) Write down the expression for intensity for diffraction through double slit and hence draw intensity distribution curve for diffraction through double slit considering value of  $b=2a$ .
- b) Why De-Broglie waves are insignificant in the case of macro bodies? Explain with the suitable example.
- c) Write a short note on three level and four level pumping schemes.
- d) Explain the properties of wedge shaped interference pattern with explanation.

Answer any four

Q2

[9+6]

- a) What do you understand by normalization? Derive time independent schrodinger's equation.
- b) A 0.1 W laser beam with an aperture of 5.00 mm emits a light of wavelength 694 nm. Calculate the areal spread and intensity of the image when the beam is focused with a lens having focal length 100 mm.

page - ①

FEC (MIE), Sem-I, Re-exam, 23/06/2015. (Old),  
Applied Physics-I

Q3.

[9+6]

- a) Describe construction and working of He-Ne LASER ?
- b) A light ray enters from air to fiber. The refractive index of air is 1.0. The fiber has refractive index of core is equal to 1.5 and that of cladding is 1.48. Find the critical angle, the fractional refractive index, the acceptance angle and numerical aperture.

Q4

[9+6]

- a) Derive the expression for intensity in Fraunhofer diffraction through a single slit. Obtain the condition for principal maximum, secondary maxima and minima and hence draw the diffraction curve.
- b) In Newton's rings experiment, the diameters of the 4<sup>th</sup> and 12<sup>th</sup> dark rings were 0.004m and 0.007m respectively. Deduce the diameter of 20<sup>th</sup> dark ring and hence deduce the diameter of 20<sup>th</sup> dark ring if the system is submerged in a liquid of RI 1.33.

Q5

[9+6]

- a) What are anti-reflecting coating and dielectric mirrors? Derive the condition for minimum thickness and the refractive index of the coating for both.
- b) State energy momentum uncertainty.

Compute the first two permitted energy values for an electron in a box of width 0.4nm.

Q6

[9+6]

- a) What is critical angle of propagation? Derive an expression for numerical aperture and acceptance angle and hence define acceptance cone.
- b) A parallel beam of light from He-Ne laser is incident perpendicularly on a slit width of 0.1mm. Calculate angular width and linear width of central maximum form on the screen 100 cm away.

Q7

[5\*3=15]

- a) Differentiate between step index fiber and graded index fiber.
- b) What is attenuation in optical fiber? A signal of power 0.005mW exists just inside the entrance of 0.1 km. Calculate the absorption coefficient of the fiber if the power inside the fiber be 0.001mW.
- c) Derive a relationship between group and phase velocity of matter waves.

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**SARDAR PATEL COLLEGE OF ENGINEERING**

[ An autonomous institution Affiliated to university of Mumbai ]

**KT-EXAMINATION FOR F.E.(C/M/E)\_june2015**

Total marks :50

duration : 1 hr 30 min

Subject : Applied Physics(Sem-1) A.T.K.T

- **Question No. 1** is compulsory.
- Attempt any **Four** out of remaining **Six** questions.
- Draw diagrams and assume suitable data wherever necessary.
- Figure to right indicates full marks.
- **GOOD LUCK**

*Master*

Q1. Answer any two.

[5\*2=10]

- a) Compute the first two permitted energy values for an electron in a box of width 0.4nm?
- b) Write a short note on three level and four level pumping schemes?
- c) Explain giving the necessary theory, the phenomenon of fraunhofer diffraction through single slit?

Answer any four

Q2

[6+4]

- a) Derive the condition for path difference for interference in thin parallel film due to reflected light? And hence write condition for brightness?
- b) An optical signal has lost 85% of its power after traversing 500m in an optical fiber .what is the loss in dB/km?

Q3.

[6+4]

- a) Describe working of ND-YAG LASER ?
- b) In plane transmission, grating the angle of diffraction for second order maxima for wavelength  $5 \times 10^{-5}$ cm is  $30^\circ$  .calculate the number of lines in one centimeter of grating surface?

FE (CUMIE), Sem-I, A.T.K.T, 23/6/15.  
Applied physics-I

Q4 [6+4]

- a) Write a note on losses of optical fiber?
- b) Write down condition for constant interference of light waves?

Q5 [6+4]

- a) State and prove De Broglie's hypothesis? And hence derive De Broglie's justification of Bohr's postulate?
- b) Write down full form of LASER?  
In ruby laser which ions gives rise to laser action?

Q6 [6+4]

- a) Define resolving power? What is the resolving power of a plane transmission grating?
- b) Newton's rings are formed using light of wavelength 589nm in reflected light with a liquid placed between plane and curved surface. The diameter of 7<sup>th</sup> bright fringes is 0.4 cm and the radius of curvature is 1m. Evaluate the refractive index of liquid?

Q7 [6+4]

- a) Derive time independent Schrodinger's equation?
- b) For an optical fiber, refractive index of the core is 1.5 and fractional refractive index change is 1.8% estimate

1) Numerical aperture.

2) Acceptance angle.

FEC(CIMIE), Sem I, A.T.K.T.  
Communication Skills

Lib  
24/06/15

BHARATIYA VIDYA BHAVAN'S  
SARDAR PATEL COLLEGE OF ENGINEERING  
MUNSHI NAGAR, ANDHERI WEST  
MUMBAI 400058  
(Government- Aided Autonomous Institute)

A.T.K.T.

TIME: 3 HOURS

COMMUNICATION SKILLS

TOTAL MARKS: 100

FEC(CIMIE). Sem I.  
Reexamination 2015 June

Instruction: Candidates should read carefully the instructions printed on the question paper and on the cover of the Answer Book, which is provided for their use.

NB:

- 1) Question No.1 is compulsory.
- 2) Out of remaining questions, attempt any 4 .
- 3) In all 5 questions to be attempted.
- 4) All questions carry equal marks. (20)
- 5) Answer to each new question to be started on a fresh page.
- 6) Figures on the right hand side indicate full marks.

Master

- Q.1. a. Comment on the statement that communication is a two-way process, what role does feedback play in this process? Illustrate your answer with the help of a diagram -10-
- b. Explain merits and demerits of oral communication -04-
- c. Write short notes on any One:- -03-
- i. Techniques to improve public speaking
  - ii. Role played by Eye-Contact in nonverbal communication
- d. State true or false:- - 03-
- i. Acting is a form of communication
  - ii. The meaning of message is not in words
  - iii. Jargons are considered as linguistics barrier
- Q.2. a. What are the causes of poor listening? What steps would you take in order to ensure good listening? -10-
- b. Define the following terms:- -05-
- i. E-Mail
  - ii. Thermometer
  - iii. Paralanguage
  - iv. Hammer
  - v. Proxemics
- c. Given below is a situation, identify the components of communication interms od Sender, Receiver, Medium, Channel, Message and Feedback. -05-
- i. The artist displays his painting about peace at an exhibition and is awarded the first prize.
- Q.3. a. You are the Head of the Computer Department in your college and you need some new updates equipments for your computer laboratory. Write a letter of Enquiry to Compuware Services Private Limited, Chennai, and give full details of your requirements. (Use Complete Block form) -12-
- b. Write short notes on any Two:- -05-
- i. Semi Block form of letter writing
  - ii. Two physical barriers to Communication

page 10



iii Clarity as principle of correspondence

iv. Encoding and Decoding

c. Give one word substitute:-

i. Communication by touch H \_\_\_\_\_ 07

ii. The way one sits or stands P \_\_\_\_\_ 07

iii. Similar sounding words H \_\_\_\_\_ 08

-03-

Q.4. a. Describe any one of the object with the help of a diagram.

i. Calculator                      ii. A Torch

-10-

b. Write a complete set of effective instructions for welding two pieces of Metal together. (Illustrate wherever necessary)

-08-

c. Fill in the blanks:-

-02-

i. \_\_\_\_\_ is the first stage in the process of communication

ii. The principle of \_\_\_\_\_ implies concern for the needs of the reader

Q.5. a. As the purchase manager of your company you had ordered 20 laptops from Dell Company, when the consignment arrived you found five of the pieces in a damaged condition. Write a letter to Sales Manager claiming suitable adjustment. Decide what form of compensation/ adjustment you want. (Use modified block form)

-12-

b. Revise the following sentences as directed:-

-04-

i. It is impossible to deliver the refrigerator tomorrow. (Make it positive).

ii. We acknowledge with thanks the receipt of your communication dated 15<sup>th</sup> June, 2015.

( Remove Jargon)

c. Explain in brief any Two Socio-Psychological Barriers.

-04-

Q.6. a. Distinguish between:-

-04-

i. Semi-block form and Modified block form

ii. Solicited Enquiry and Unsolicited Enquiry

b. "Reading maketh a Man perfect". Explain the Eye-training and Mind training (SQ3R) techniques to improve reading skills.

-06-

c. Explain Objectives of Communication.

-05-

d. How silence can be effective way of communication?

-05-

Q.7. a. Read the passage and answer the following questions:-

From the ever-evolving computer industry to the introduction and widespread popularity of the internet, from the various electronic gadgets cars to spacecrafts, the world of technology is seemingly endless. Technology is a powerful tool in this modern era, and it has the capability to influence society for its betterment, as well as destruction.

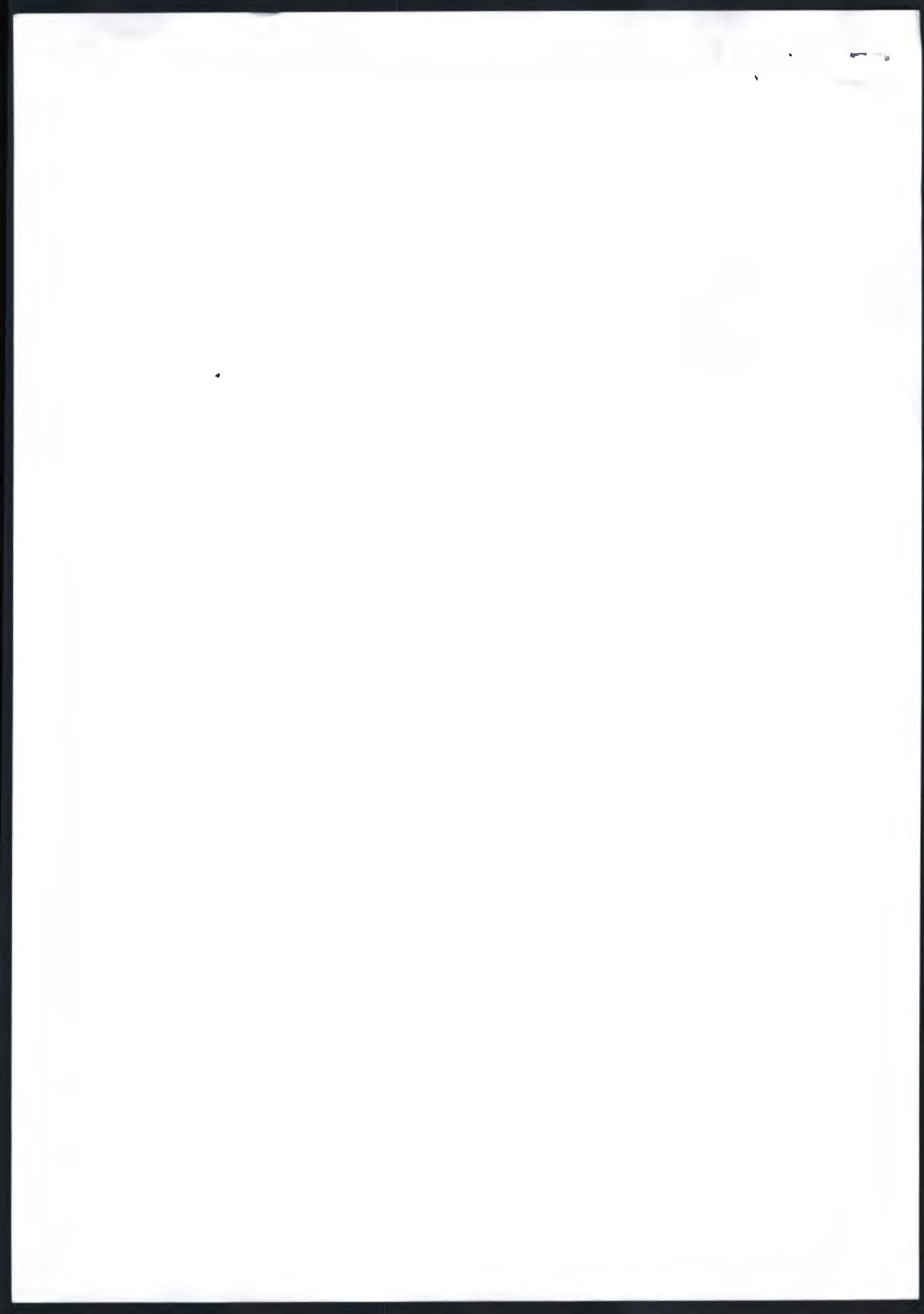
Terrorism, by far, is the worst reason for which technology can be utilized: unfortunately, however, technology has helped terrorism to grow by leaps and bounds. It has helped terrorism in both actual and cyber terrorism. It takes only a glance at the complex making and build-up of an explosive or bomb to realize that yes; technology has had a worldwide impact on terrorism.

Thus we know that on one hand, in the long run, terrorism nowadays is based mainly on different types of technology, manufacturing hi-tech gadgets illegally, that too on a daily basis, using the internet as hub to meet, discuss and plan attacks with fellow terrorists breaking (hacking) into government data systems to wreak havoc are only some of the ways in which terrorists utilize technology. Even now, every Indian shudders when the thought of the 26/11 attacks come to mind, when the whole of Mumbai lost many of her loved ones, including army personnel, police officers, women and children. One question, keeps staring at us in the face – “How did a bunch of young boys keep an entire city under siege?” The answer lies only in one word – technology. By using sophisticated weapons and gadgets, even a dozen young boys were able to terrorize us. Another example is of the train blasts that happened in Mumbai few years back. News reports state that the bomb inside the train was activated using a cell phone.

Conversely, if advancing technology supports the growth of terrorism, it also means that the government has better ways to defend the country/state against terrorism. Hi-end security measures, such as CCTV cameras, infrared detection, video messages regarding solely for the purpose of reporting unidentified / suspicious objects, are all ways in which government can defend the country and combat terrorist by foiling their plans, Bomb-squads, Bullet-proof jackets are many other ways for police and law enforcement officers to fight terrorism effectively.

Whether technology affects the future of terrorism in both the aforementioned ways, is quite clear. As technology advanced, it will propel the ways and means of terrorism. Nevertheless, it will also enable the government to take better, stringent measures to protect the people against terrorist. It simply is the question of who will prevail first. And that, in its entirety, is a very scary thought

1. Why is technology described as a powerful tool in the passage? (02)
  2. How has technology helped terrorism? (02)
  3. How do terrorists utilize technology? (02)
  4. What are the good uses of technology? (02)
  5. Give one word for: (02)
    - i) Extensively far-reaching
    - ii) Confusion and destruction
  6. Write a summary of the above passage in 170 words. (06)
  7. Give a Diagrammatic representation of the parts of a letter in Semi-block form. (04)
-



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Total Marks : 100

KT June 2015

Duration: 3 Hours

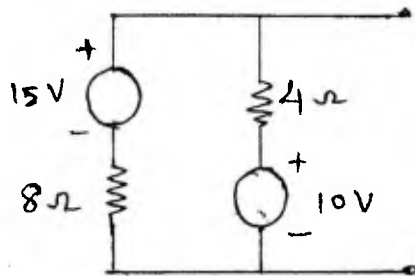
CLASS/SEM: C/M/E/ I SEM/ FE

SUBJECT: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING I

- Attempt any FIVE questions out of SEVEN questions
- Answers to all sub questions should be grouped together
- Figures to the right indicates full marks

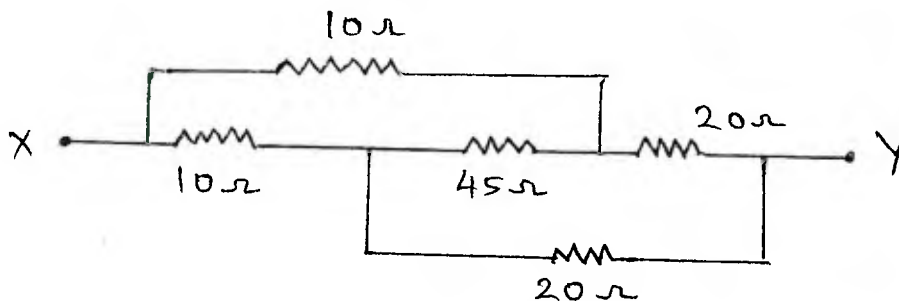
Master.

- 1a. Using source transformation convert the circuit given below to a single voltage source 4 in series with a resistor.



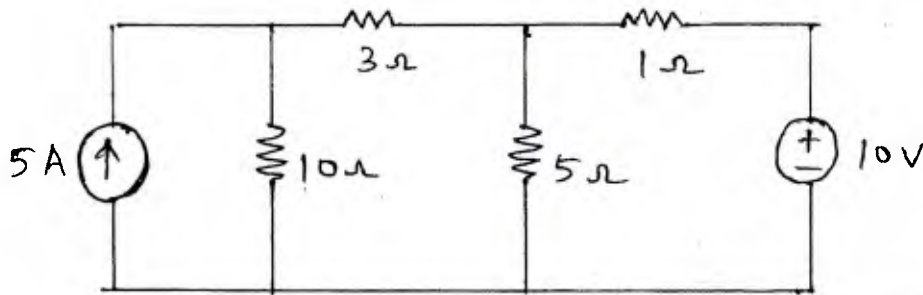
- b. Write voltage, current and power relation in a balanced delta connected load. 4  
c. What is power triangle? 4  
d. Derive the condition for maximum power transfer through a network. 4  
e. What are the losses in a transformer? Why a transformer is rated in KVA and not in KW? 4

- 2a. Calculate  $R_{XY}$  for the given circuits. 6



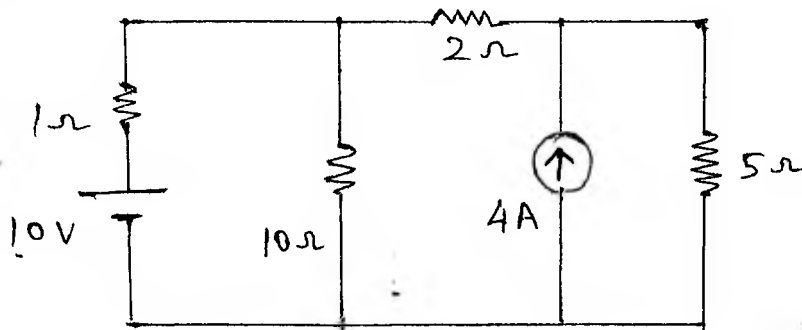
- b. Find the current through the 3 ohm resistor using nodal analysis.,

7



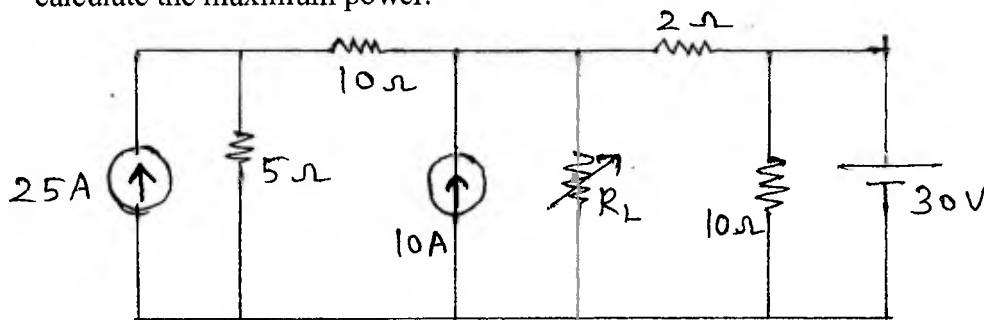
- c. Determine the current through the 10 ohm resistor using superposition theorem.

7



- 3a. For the circuit given below determine  $R_L$  for maximum power transfer. Also calculate the maximum power.

8



- b. The input power of a three phase motor was measured by two wattmeter method. The reading of two wattmeters are 5.2KW and -1.7KW and the line voltage is 415V. Calculate the active power, power factor and the line current.

7

- c. What are the advantages of a three phase system over single phase system?

5

- 4a. When a resistance and coil are connected to a 240 v supply current of 3A flows lagging  $37^\circ$  behind the supply voltage while the voltage across the coil is 171V. Find the resistance of the resistor, resistance and reactance of the coil.

8

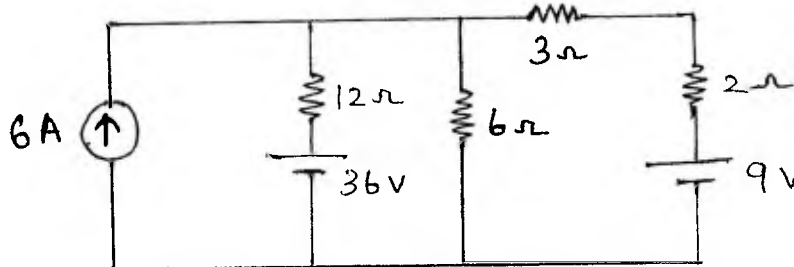
- b. Explain two wattmeter method of power measurement in three phase circuit with neat phasor diagrams.

12

Basic Electrical and Electronics Engineering, -I

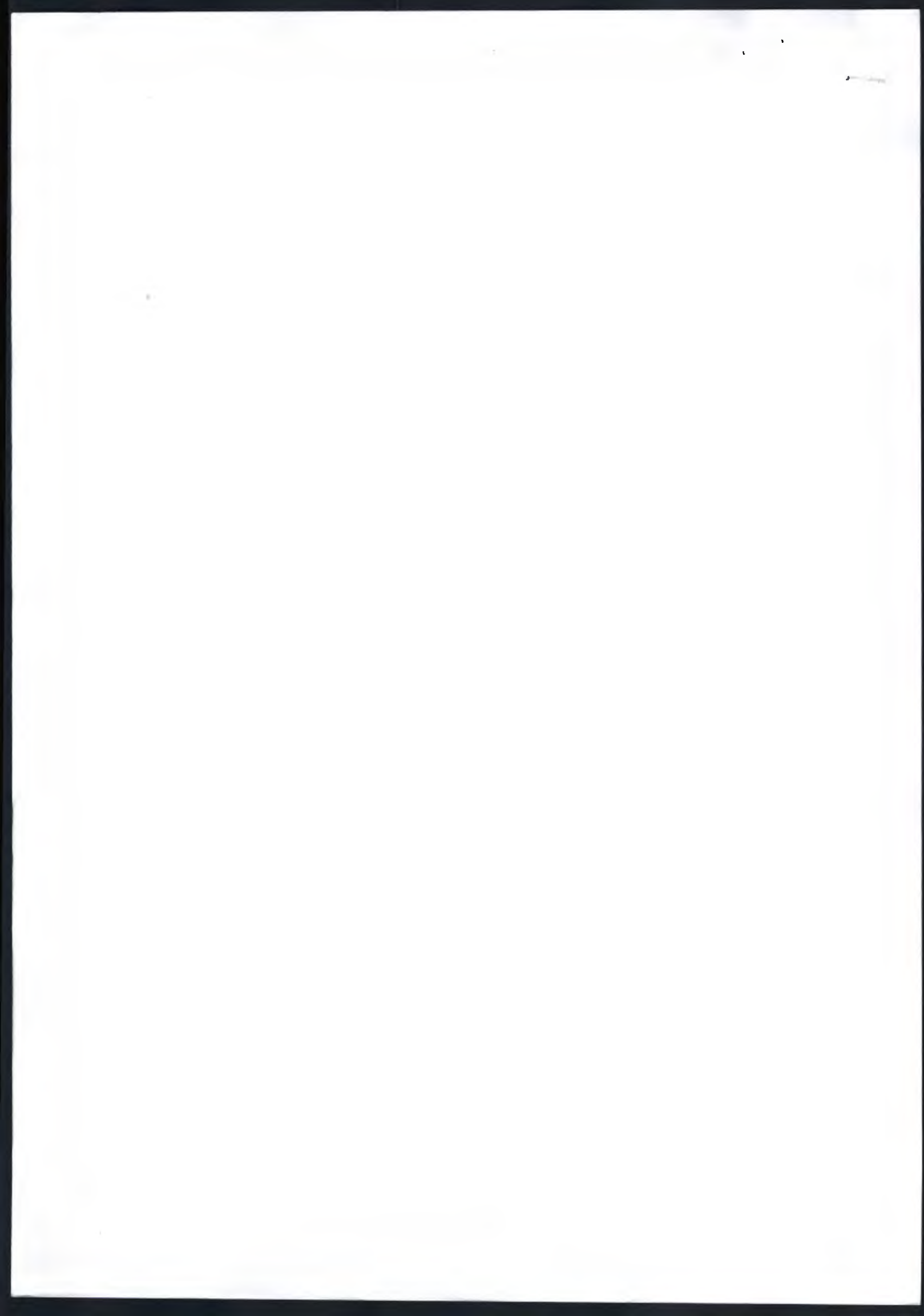
- 5a. With neat circuit diagrams explain the open circuit and short circuit test of a single phase transformer. 10
- b. Explain double field revolving theory in single phase induction motors. 10
- 6a. Explain the working principle of a single phase transformer and derive the emf equation for the same. 8
- b. Explain slip in three phase induction motors? 4
- c. When a 240V, 50Hz supply is fed to a 15 ohm resistor in parallel with an inductor the total current is 22.1A. What value must the frequency have for the total current to be 34A? 8

- 7a. Find the current through the 2 ohm resistor using mesh analysis 8



- b. What is back emf. State its significance in dc motors. 6
- c. Draw the phasor diagram of a transformer for resistive load and inductive load. 6





Bharatiya Vidya Bhavan's  
**SARDAR PATEL COLLEGE OF ENGINEERING**

(An Autonomous Institution Affiliated to University of Mumbai)

APKT / Old.

June 2015

Total Marks: 100

Duration: 3 Hours

CLASS/SEM: F.E (C/M/E)/I

SUBJECT: APPLIED MATHEMATICS I

- Attempt any FIVE questions out of SEVEN questions.
- Answers to all sub questions should be grouped together.
- Figures to the right indicate full marks.

*Master*

- Q.1 (a) Show that  $(4n)$  th power of  $\frac{1+7i}{(2-i)^2}$  is equal to  $(-4)^n$  where n is a positive integer. 6
- (b) Find the  $n^{\text{th}}$  derivative of  $y = \frac{x}{x^2 - a^2}$  6
- (c) In usual notations prove that  $\text{Divgrad } r^n = n(n+1)r^{n-2}$  8
- Q.2 (a) Prove that  $16 \cosh^5 x = \cosh 5x + 5 \cosh 3x + 10 \cosh x$  6
- (b) If  $U = \frac{x^3 + y^3}{y\sqrt{x}} + \frac{1}{x^7} \sin^{-1} \left( \frac{x^2 + y^2}{x^2 + 2xy} \right)$  find the value of  $x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} + x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y}$  at  $x=1, y=2$  6
- (c) Separate into real and imaginary parts  $\sin^{-1} (3i/4)$  8
- Q.3 (a) If  $i^{\alpha+ib} = \alpha + i\beta$  (or  $i^{i \dots \alpha} = \alpha + i\beta$ ) Prove that  $\alpha^2 + \beta^2 = e^{-(4n+1)\pi\beta}$  where n is any positive integer. 6
- (b) Prove that  $\log(1 + \sin x) = x - \frac{x^2}{2} + \frac{x^3}{6} + \dots$  6
- (c) If  $y = \sin \log(x^2 + 2x + 1)$  prove that  $(x+1)^2 y_{n+2} + (2n+1)(x+1) y_{n+1} + (n^2 + 4) y_n = 0$  8
- Q.4 (a) If  $u = \frac{e^{x+y+z}}{e^x + e^y + e^z}$  prove that  $u_x + u_y + u_z = 2u$  6

(b) Prove that  $\nabla \times \left( \frac{\vec{a} \times \vec{r}}{r^n} \right) = \frac{(2-n)\vec{a}}{r^n} + \frac{n(\vec{a} \cdot \vec{r})\vec{r}}{r^{n+2}}$  6

(c) If  $\alpha = 1+i$ ,  $\beta = 1-i$  and  $\cos \theta = x+1$ , prove that  $(x+\alpha)^n - (x+\beta)^n = (\alpha-\beta) \sin n\theta \operatorname{cosec}^n \theta$  8

Q.5 (a) If  $U = \tan^{-1} \left[ \frac{x^2 + y^2}{x-y} \right]$  prove that  $x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = -\sin^3 u \cos u$  6

(b) Find the maximum and minimum value of  $x^3 + 3xy^2 - 3x^2 - 3y^2 + 4$  6

(c) Show that  $\tan 7\theta = \frac{7 \tan \theta - 35 \tan^3 \theta + 21 \tan^5 \theta - \tan^7 \theta}{1 - 21 \tan^2 \theta + 35 \tan^4 \theta - 7 \tan^6 \theta}$  8

6(a) Expand  $f(x) = 7x^6 - 3x^5 + x^2 + 2x$  in powers of  $(x-1)$  6

(b) If  $\vec{a}$  is a constant vector and  $\vec{r} = xi + yj + zk$  prove that  $\operatorname{curl}(\vec{a} \times \vec{r}) = 2\vec{a}$  6

(c) The focal length of a mirror is found from the formula  $\frac{2}{f} = \frac{1}{v} - \frac{1}{u}$ . Find the percentage error in  $f$  if  $u$  and  $v$  are both in error by 1% each 8

7(a) Solve,  $x^5 + 1 = 0$  6

(b) Find the angle between the surfaces  $x^2 + y^2 + z^2 = 9$  &  $z = x^2 + y^2 - 3$  at the point  $(2, -1, 2)$  6

(c) Find the values of  $a$  &  $b$  such that  $\frac{a \sinh x + b \sin x}{x^3} = \frac{5}{3}$  8