

Q.P. Code : **28529**

(OLD CORSE)
(2 Hours)

[Total Marks : 75

Note:

1. Q.1 is compulsory.
2. Answer any FOUR from the Q. 2 to Q.7
3. Symbols have their usual meanings.
4. Assume suitable data wherever necessary.

- Q.1 Attempt any FIVE of the following [03]
- a) Draw the following in cubic unit cell. [03]
1. $(1\bar{2}0)$ 2. $(1\bar{2}3)$ 3. $[101]$
- b) Define continuous X-ray spectra and characteristic X-ray Spectra. [03]
- c) Write the expression for Fermi level in n-type semiconductor and also mention the meaning of terms in it. [03]
- d) Define Hall effect and list some of its applications. [03]
- e) Define superconductivity, critical temperature and critical magnetic field. [03]
- f) State Sabine's formula and explain terms involved in it. [03]
- g) Define direct and inverse piezoelectric effect. [03]
- Q.2 A Draw BCC crystal structure with proper diagram and calculate atomic radius, Coordination number, Atomic Packaging Factor and Void space. [08]
- B A Copper specimen having length 1 meter, width 1 cm and thickness 1 mm is conducting 1 ampere current along its length and is applied with magnetic field of 1 tesla along its thickness. It experiences Hall effect and a Hall voltage of 0.074 micro Volts appear along its width. Calculate Hall coefficient and the mobility of electron in Copper. Conductivity of Copper is $\sigma = 5.8 \times 10^7 (\Omega m)^{-1}$. [07]
- Q.3 A Define superconductivity. Explain Type - II superconductors. [08]
- B Ni has FCC structure. Its lattice constant is 3.52 A.U., atomic weight is 58.71. Give Avogadro number is 6.023×10^{26} /Kg-mole. Calculate its radius, Atomic Packaging Factor and density. [07]
- Q.4 A Define Packing efficiency. Calculate atomic packing efficiency for Diamond unit cell. [05]
- B Draw the neat labelled energy band and Fermi level for intrinsic, n-type and p-type semiconductor. [05]
- C A Hall of volume $6000 m^3$ has a reverberation time 3 sec. if the absorbing surface of the hall has an area of $4000 m^2$. Calculate the average coefficient of absorption. [05]
- Q.5 A Silicon has the same structure as that of diamond. Its density is $2.3 \times 10^3 Kg/m^3$ and atomic weight 28.9. Calculate lattice constant and atomic radius of it. [05]
- B How a depletion region is formed in P-N junction diode explain with neat diagram. [05]
- C Explain construction and working of Magnetostriction oscillator with neat circuit diagram. [05]
- Q.6 A The Bragg angle corresponding to the first order reflection from (111) planes of a crystal is 30° . Wavelength of X-ray is 1.75A. Determine inter-planer spacing and lattice constant of the crystal. [05]
- B Describe Meissner effect. Show that superconductors are perfect diamagnetic below their critical temperature. [05]
- C Find the depth of sea water from a ship on the sea surface if the time interval of 2 seconds is required to receive the signal back. Given the temperature of sea water is $20^\circ C$ and salinity is 10 gm/lit. [05]
- Q.7 A Define liquid crystal and describe nematic phase. [05]
- B Calculate the thickness of quartz plate which is used to produce ultrasonic waves of 2MHz. [05]
- C Explain electrostatic focusing. [05]

Computer Programming-I

(OLD COURSE)

QP Code : 28533

(3 Hours)

[Total Marks : 100

- Note: 1) Question no. is 1 compulsory.
2) Answer any four from remaining.

Q1) Answer any four.

- Explain default constructor with example.
- What is function declaration?
- Explain destructor with example.
- WAP in c++ to find sum and average of digits in a given number.
- Explain the two features of OOP.

20

Q2a) WAP to generate output in following order. Use for loop.

```
1
121
12321
1234321
```

10

Q2b) Write a program in c++ to find roots of quadratic equation. Use switch statement.

10

Q3a) WAP in c++ to generate Fibonacci series using user defined function.

10

Q3b) Explain call by reference and call by value with example.

10

Q4a) Explain function overloading and write a program to perform sum of two integer, two float, two double. Using function overloading concept.

10

Q4b) Write a recursive program to find power of x^n .

10

Q5a) WAP in c++ to count number of characters, and space in a given string.

10

Q5b) Explain how to define functions inside and outside class with example.

10

Q6a) Explain multiple inheritance and write the program using concept of multiple inheritance.

10

Q6b) WAP to overload + operator to convert inches into feet and display total number of feet and inches.

10

Q7) write short note on (any four).

20

- Friend function
- static data member and member function
- pure virtual function
- copy constructor
- multipath inheritance.

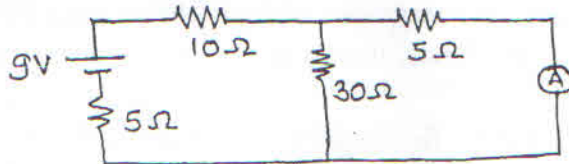
QP Code : 28518

(3 Hours)

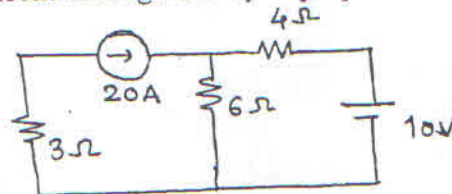
[Total Marks : 100

- N. B. : (1) Question No. 1 is compulsory.
 (2) Attempt any four out of the remaining.

1. (a) Determine current drawn by the ammeter shown in figure

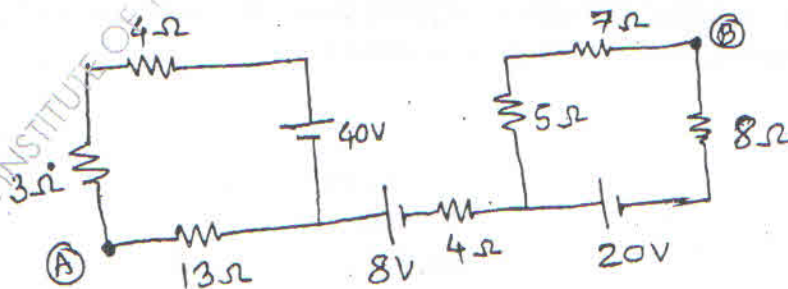


- (b) Find current through 6Ω by superposition theorem



- (c) A voltage of $v = 200 \sin(314t + 20^\circ)$ is being applied to pure inductor of value 50mH. Find instantaneous wave equation of current through the circuit.
- (d) A series resonant circuit has an impedance of 500Ω at resonant frequency. The cut off frequencies are 10KHz & 100Hz. Find inductance of the circuit.
- (e) Write voltage & current relationship between phase & line quantities in three phase star circuit.
- (f) What are the losses in transformer. Explain any one type of loss.
- (g) A three phase IM has 4 poles & runs at 1460 rpm. If frequency is 50Hz. Find slip.
- (h) Define rectification efficiency.

2. (a)

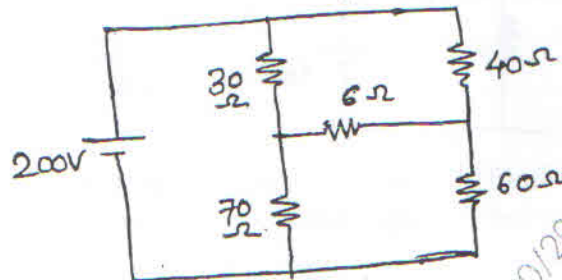


Find voltage across point A & B.

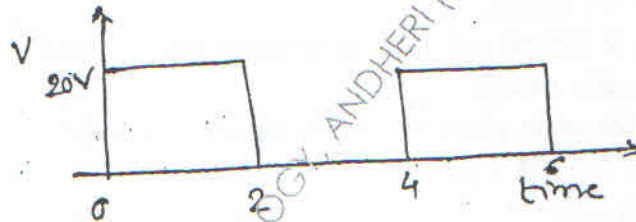
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- (b) A resistor of 20Ω is in series with a capacitor of $50\mu\text{F}$. A voltage of $200\angle 20^\circ\text{V}$ is being applied to it. Find impedance of circuit, current and power in the circuit. 6
- (c) Draw the phasor diagram of a transformer leading pf load. 8
3. (a) Three identical impedances are connected in star to a 400V , 50Hz supply. Each impedance has a resistance of 20Ω & inductance of 20mH in series. Find phase impedance, line & phase current & total power absorbed by the circuit. 8
- (b) Explain short circuit test to find equivalent circuit parameters of a transformer. 4
- (c) Explain double field revolving theory in single phase induction motor. 8

4. (a)

Find current in 6Ω by thevenin's theorem.

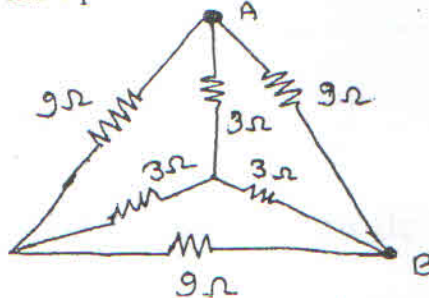
- (b) Find average value of following waveform 4



- (c) Comment on how readings of two wattmeter changes with change in power factor angle e.g. 0° , 60° to 90° , 90° , where wattmeter are connected to measure three phase power in a three phase circuit. 4
- (d) Explain working of half wave rectifier 5

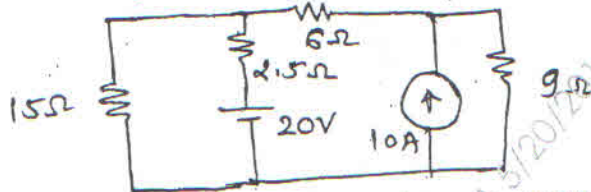
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5. (a) Find equivalent resistance between A & B



- (b) In a RLC series circuit voltage across resistor, voltage across inductor & voltage across capacitor are 1V, 15V, 10V respectively. Find magnitude of supply voltage.
- (c) A 10kVA, 450V/120V, 50Hz, single phase transformer gave following results.
- | | | | |
|---------|-------|-------|-------------------|
| OC test | 120V | 4.2A | 80w (HV open) |
| SC test | 9.65V | 22.2A | 120w (LV shorted) |
- Find equivalent circuit constants referred to primary.

6. (a) Calculate power dissipated in 9Ω by superposition theorem.



- (b) A series RLC circuit has resistance of 10Ω , inductance of 20mH & capacitance of $50\mu\text{F}$. Find resonant frequency, quality factor and bandwidth.
- (c) Prove that two wattmeter method can measure power in three phase star connected circuit.
7. (a) For $v = 200 \sin(314t - 20^\circ)$. Find amplitude, frequency & phase angle of the wave.
- (b) An impedance contains a resistance of 10Ω & inductance of 20mH in series. Find admittance & its components of circuit.
- (c) Find all day efficiency of a 500 kVA transformer having full load copper loss is 4.5kw & iron loss is 3.5 kw. It is loaded during 24 hours as follows:
- | | | |
|-------|--------|----------|
| 400kw | 0.8pf | 6 hours |
| 300kw | 0.75pf | 10 hours |
| 100kw | 0.8pf | 4 hours |
| 0kw | - | 4 hours |
- (d) Derive an expression for emf induced in DC motor
- (e) Describe experimental setup to obtain input & output characteristics of CE configuration of BJT.

QP Code : 28521

Total Marks : 75

Duration : 2 hrs

- N.B.** (1) Question no. I is compulsory.
(2) Attempt any four questions from remaining six.
(3) Figures to the right indicate full marks.
(4) Assume suitable data if necessary.

(At.wt: Mg= 24, H=1, C=12, O=16, Ca=40, Cl=35.5, S=32, N=14, Na= 23,
Al=27, Fe = 56).

1. Attempt any 5.

15

- Explain condensation polymerization with an example.
- Define BOD and COD and give their significance.
- What are solid lubricants? Where are they used?
- Write a note on plain carbon steels.
- How are nanomaterials different from conventional materials?
- Differentiate between conventional and non conventional energy sources.
- Find the acid value of a used oil sample whose 7ml required 3.8ml of N/20 KOH during titration (Density of oil = 0.88). State whether oil is proper for lubrication or not.

2. a) Calculate lime (90%) and soda (80%) pure required for softening one million litres of water containing following impurities-

- $\text{Mg}(\text{HCO}_3)_2 = 14.6 \text{ mg/litre}$
- $\text{Mg}(\text{NO}_3)_2 = 29.6 \text{ mg/litre}$
- $\text{Ca}(\text{HCO}_3)_2 = 8.1 \text{ mg/litre}$
- $\text{HCl} = 3.65 \text{ mg/litre}$
- $\text{Na}_2\text{SO}_4 = 4.5 \text{ mg/litre}$

6

b) What is compounding of plastics? Give the different additives of plastics with examples.

5

c) Write a note on solar flat plate collector.

4

3. a) Give the preparation, properties and uses of PMMA and Buna-S.

6

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- b) What are blended oils? With examples explain how they are superior to vegetable and mineral oils? 5
- c) What are fullerenes? Explain their structure and applications. 4
4. a) What is the mechanism of lubrication applicable to a journal bearing? Explain with diagram and state the type of lubricant suitable for it. 6
- b) What are special steels? Give the special properties imparted to steels by Cobalt, Manganese, Nickel. 5
- c) 50ml of standard hard water (2gm CaCO_3 /litre) requires 30ml of EDTA solution. 100ml of a water sample consumes 15ml EDTA. 100ml of boiled and filtered water sample consumes 8ml EDTA solution. Calculate temporary hardness of the given water sample. 4
5. a) Draw the phase diagram of a one component system and derive all possible degrees of freedom. 6
- b) With the help of a flow chart explain activated sludge system of waste water treatment. 5
- c) Explain the process of vulcanization of natural rubber. Compare the properties of the natural and vulcanized rubber. 4
6. a) What are the different methods of synthesizing carbon nanotubes? Explain any one. 6
- b) Describe the demineralization process of water treatment with respect to the following: i) Principle ii) Diagram iii) Process iv) Advantages. 5
- c) Explain the construction and working of photovoltaic cell. 4
7. a) Name the different fabrication techniques for moulding of polymers. Explain injection moulding with a neat diagram. 6
- b) Write a note on any one: i) Reverse osmosis process ii) Permutit process 5
- c) Define and give the significance of the following properties of lubricants: i) Viscosity index ii) Flash point and fire point. 4

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Q.P. Code : 28505

(3 Hours)

[Total Marks : 100

- N.B. : (1) Question No. 1 is compulsory.
 (2) Attempt any four out of remaining six questions.

1. (a) If $\sin \psi = i \tan \theta$, prove that $\cos \theta + i \sin \theta = \tan \left(\frac{\psi}{2} + \frac{\pi}{4} \right)$ 5
- (b) If $u = (1 - 2xy + y^2)^{-1/2}$, prove that $x \frac{\partial u}{\partial x} - y \frac{\partial u}{\partial y} = y^2 u^3$. 5
- (c) Prove that $\nabla f(r) = f'(r) \frac{\vec{r}}{r}$ and hence find $f(r)$ if $\nabla f(r) = 3r^5 \vec{r}$ 5
- (d) If $f(x)$ and $g(x)$ are respectively \sqrt{x} and $\frac{1}{\sqrt{x}}$ then prove that c of Cauchy's Mean value Theorem is the Geometric mean between a and b , $a > 0$, $b > 0$. 5
2. (a) Show that $32 \sin^4 \theta \cos^2 \theta = \cos 6\theta - 2 \cos 4\theta - \cos 2\theta + 2$. 6
- (b) Find the directional derivative of $f(x, y, z) = 4e^{2x-y+z}$ at the point $(1, 1, -1)$ in the direction toward the point $(-3, 5, 6)$ 7
- (c) If $u = A e^{-gx} \sin(nt - gx)$ satisfies the equation $\frac{\partial u}{\partial t} = \mu \frac{\partial^2 u}{\partial x^2}$; prove that $n = 2g^2 \mu$ 7
3. (a) Find the equation whose roots are $2 \cos \frac{\pi}{7}$, $2 \cos \frac{3\pi}{7}$, $2 \cos \frac{5\pi}{7}$. 6
- (b) If $z = f_1(x+ct) + f_2(x-ct)$, prove that $\frac{\partial^2 z}{\partial t^2} = c^2 \frac{\partial^2 z}{\partial x^2}$ 7
- (c) If a vector field is given by $\vec{F} = (x^2 + xy^2) \vec{i} + (y^2 + x^2y) \vec{j}$. Show that \vec{F} is irrotational and find its scalar potential. 7
4. (a) Test for convergence of the series $1 + \frac{2}{5}x + \frac{6}{9}x^2 + \frac{14}{17}x^3 + \dots (x > 0)$ 6
- (b) Find the values of a, b, c so that $\lim_{x \rightarrow 0} \frac{ae^x - b \cos x + ce^{-x}}{x \sin x} = 2$ 7
- (c) If $y = \frac{\log x}{x}$ prove that $y_5 = \frac{5!}{x^6} \left[1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5} - \log x \right]$ 7

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- 5 (a) Find the stationary values of $3x^2 - y^2 + x^3$ 6
 (b) If $\sin(\theta + i\phi) = \cos \alpha + i \sin \alpha$, prove that $\cos^4 \theta = \sin^2 \alpha = \sinh^4 \phi$ 7
 (c) Prove that $\frac{b-a}{\sqrt{1-a^2}} < \sin^{-1} b - \sin^{-1} a < \frac{b-a}{\sqrt{1-b^2}}$
- 6 (a) Prove that $\cos \left[i \log \left(\frac{a-ib}{a+ib} \right) \right] = \frac{a^2 - b^2}{a^2 + b^2}$ 6
 (b) Expand $\log(1+x+x^2+x^3)$ upto x^4 7
 (c) If $x = \tan(\log y)$, prove that $(1+x^2)y_{n+1} + (2nx-1)y_n + n(n-1)y_{n-1} = 0$ 7
- 7 (a) If $i^{\alpha+i\beta} = \alpha+i\beta$, prove that $\alpha^2 + \beta^2 = e^{-(4n+1)\beta\pi}$ where n is any positive integer. 6
 (b) If $u = \tan^{-1} \left[\frac{x^3 + y^3}{2x + 3y} \right]$, prove that 7

$$x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = \sin 4u - \sin 2u$$

 (c) If $y^{1/m} - y^{-1/m} = 2x$, prove that 7

$$y = 1 + mx + \frac{m^2}{2!} x^2 + \frac{m^2(m^2+1)}{3!} x^3 + \dots$$