JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
[A GOVERNMENT AUTONOMOUS COLLEGE]
JGEC/B.TECH/ EE /MC-HU(EE) 301/ 2022-23
2022
ENVIRONMENTAL SCIENCES

Times: 3 Hours

Full Marks: 70

The figures in the margin indicate full marks.
Candidates are instructed to write the answers in their own words as far as practicable.

GROUP-A
[OBJECTIVE TYPE QUESTIONS]

5x2=10

Answer *all* questions
1. Write down the main components of environment.
2. Write down all the non-conventional resources.
3. What do you mean by the terms BOD and COD.
4. Which smog is oxidizing in nature and why?
5. What do you mean by temperature lapse rate?

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

4x15 = 60

Answer any *four* questions

6. i) What is the limitation of exponential growth model? How was the model modified? 2+1

ii) For logistic growth of population prove that, $r = \frac{1}{t_*} \ln\left(\frac{K}{N0} - 1\right)$ where the symbol has their usual meaning. What factor is responsible for changing exponential growth curve to logistic curve? 3+2

ii) What is the zero-population growth? Prove that in the case of similar growth and decay rates, the half-life time and doubling time become equal in exponential growth model? 2+3

iii) Assume a population of fish grows exponentially. A pond is stocked initially with 500 fish. After 6 months, there are 1000 fish in the pond. The owner will allow his friends and neighbors to fish on his pond after the fish population reaches 10,000. When will the owner's friends be allowed to fish? 2

7. i) What is eutrophication? Discuss the different types of eutrophication. What are affects of eutrophication? 2+2+3

ii) Derive the relation $BOD_t = C_0(1 - e^{-kt})$ where the terms indicate their usual meaning. 3

iii) What is Dissolved Oxygen? What is its importance as water quality parameter? Make a comparison between BOD and COD methods. 1+1+3

8. i) What are various processes involved in surface water treatment to make it potable? What will be the ratio of BOD_5 at 20° C, to that of $BOD_{2.5}$ at 35° C. 3+3

ii) A waste water sample has a BOD at 20° C equal to 200mg/l and ultimate BOD of 400 mg/l. Find the BOD_5 at 35° C. 3

iii) What is soil? Explain the term pedogenesis? How does soil get polluted? How can you control soil pollution? 1+1+2+2

9. i) How would you divide the structure of atmosphere on the basis of temperature? 4

ii) What is greenhouse effect? Name six greenhouse gases. Why do some gases behave as greenhouse gases and others do not? 2+1+4

iii) "Carbon dioxide, a non-pollutant, is perhaps the single most important environmental question facing us at present."- Discuss in term of Green House Effect. 4

10. i) What is global warming? Describe clearly how greenhouse gases cause global warming. What are the adverse effects of global warming? 2+3+2

ii) What is the importance of ozone layer for human beings? What is depletion of ozone layer? Give some examples of ozone depleting gases. 2+2+2

iii) Why is London smog called reducing smog? 2

11. Write short notes on any **three** of the following: i) Nature and scope of Environment Science and Engineering ii) Deforestation iii) Landslides iv) Electrostatic precipitator v) Acid rain and its harmful effects. vi) Catalytic converter. 3 ×5

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BIOLOGY

Full Marks: 70

Times: 3 Hours

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GROUP-A

Answer *all* questions. 5X2=10

1. Write two examples of basic amino acids.

2. What do you mean by exergonic reaction?

3. What do you mean by gram positive bacteria?

4. What is peptide bond?

5. What is nucleotide?

GROUP-B

Answer any *four* questions. 15X4=60

6. Classify carbohydrate with suitable examples. 15

7. Describe the di-hybrid cross experiment of Mendel. Define test cross with a suitable example. 10+5=15

8. Describe the Molecular Structure of DNA described by Watson and Crick. Write three differences between DNA and RNA. 12+3=15

9. Describe the classification of Bacteria. 15

10. Describe the microbial growth curve. Describe various types of enzyme inhibition. 5+10=15

11. Describe the different types of Protein structure.

12. Describe different theories of Enzyme action. Enumerate various types of Enzyme Inhibition. 10+5=15

MATHEMATICS-III

Times: 3 Hours

Full Marks: 70

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GROUP-A
[OBJECTIVE TYPE QUESTIONS]

5x2=10

Answer **all** questions

1. Prove that $\delta = \Delta E^{1/2}$
2. Show , $x^6 - 3x + 1 = 0$ has a root α, in the interval $[0,1]$ and has a root β in the interval
3. Define nth order divided difference of $f(x_0, x_1 \ldots\ldots\ldots x_n)$.
4. State sufficient condition for convergence of Gauss-Seidel method
5. Write two advantage of N-R method.

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

4x15=60

5+5+5

Answer any **four** questions

6. i) Find the value of $(\Delta^2/E)x^3$.
   ii) Find a positive real root of the following equation, $2x - 3\sin x - 5 = 0$ using bisection method .
   iii) Construct a iterative formula of $K^{1/n}$ also find the value of $125^{1/7}$.

7. i) Determine the value of $f(102.2)$ using Lagrange's interpolation formula. Where values of x and   5+5+5
   f(x) are given in the following table:

X :	93	96.2	100	104.2	108.7
f(x) :	11.38	12.8	14.7	17.07	19.91

   ii) Find a real root of the equation $e^x - 3x = 0$ using $Newton - raphson\ mehod$, correct to five decimal places.
   iii) State and proved ' Bayes ' theorem.

8. i)Solve the system of equations by L-U decomposition method.   7+8
   $8x - 3y + 2z = 20$, $4x + 11y - z = 33$, $6x + 3y + 12z = 36$.
   ii)Solve the following equations by Gauss-Seidel iteration method
   $3x + y + 5z = 13$, $5x - 2y + z = 4$, $x + 6 y - 2z = -1$.

9.   5+5+5
   i). Solve the equation using Gausses elimination method
   $5x - y + z = 10$, $2x + 4y = 12$, $x + y + 5z = -1$.
   ii). Find a real root of the equation, $x \log_{10} x - 1.2 = 0$ correct unto four significant figure by Regula Falsi method.
   iii). Find by Taylor's series method, the values of y at $x=1.2$ and $x=1.3$ to five decimals from
   $dy/dx = x + y/x - y$, $y(1.1) = 5$.

10. i) The probability density of a continuous distribution is given by $f(x) = 3x(2-x)/4$, $0 < x < 2$. Compute   5+5+5
   Mean and variance.
   ii) State and proved Simpson's 3/8 rule.
   iii) Four dice are thrown. Find the probability that the of the numbers will be 14.

11. i). Evaluate $\int_0^{\Pi/2} \sqrt{(\sin x)} \, dx$ by Simpson's 1/3 rule ,with 8 subintervals.

ii). Solve by Euler's modified method the following differential equation for x=0.02 by taking length h=0.01. $\frac{dy}{dx} = x^2+y$, initially y (0) = 1.

iii).Use Runge-Kutta method of 4th order method to evaluate y(1.2) with h =0.1, given $\frac{dy}{dx} = x^2+y^2$, and y(1) = 0.

12. i)The length of bolts produced by a machine is normally distributed with mean 4 and s.d. 0.5. A bolt is defective if its length does not lie in the interval (3.8,4.3). Find the percentage of defective bolts produced by the machine. *Given that* $(1/\sqrt{2\Pi}) \int_{-\infty}^{0.6} e^{-t^2} dt = 0.7257$ $(1/\sqrt{2\Pi}) \int_{-\infty}^{0.4} e^{-t^2} dt = 0.6554$.

ii)If X has Binomial Distribution with parameters n and p then (a) its mean is np (b) its variance npq where q=1-p.

iii) Find the Z transform of the sequence {0,2,4,6,8 ....}

Full Marks: 70

ENGINEERING MECHANICS

Times: 3 Hours

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GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer *all* questions   5x2=10

1. What is angle of friction?
2. Explain free body diagram with an example
3. What is order of tensor?
4. Define strength of a shaft.
5. What is radius of gyration?

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any *four* questions   4x15=60

6. i)   Derive the expression of strength of solid and hollow shaft.   8

    ii) A hollow shaft is to transmit 200 kW at 80 RPM. If the shear stress of the shaft material is not to exceed   7
         60 Mpa and internal diameter is 0.6 of the external diameter, find the diameter of the shaft.

7. i)   Define Area moment of inertia and Mass moment of inertia.   6
    ii) Determine moment of inertia of a rectangular area of height h and base b with respect to its base and   9
         centroidal axis respectively.

8. i)   Distinguish between static friction and Dynamic friction   2
    ii) Correlate angle of friction and coefficient of friction numerically.   3
    iii) Two blocks A and B of weights 1 kN and 2 kN respectively are in equilibrium position as shown in below   10
         figure. If the coefficient of friction between the two blocks as well as the block B and the floor is 0.3, find
         the force (P) required to move the block B.
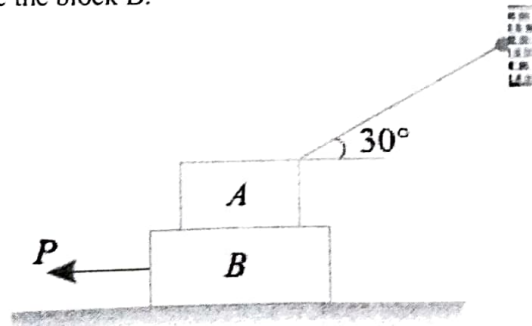
9. i)   Define overhang beam.   2
    ii) Define point of contra flexure   2

iii) A simply supported beam 6 m long is carrying a uniformly distributed load of 5 kN/m over a length of 3   11
m from the right end as shown in fig. below. Draw the S.F. and B.M. diagrams for the beam and also
calculate the maximum B.M. on the section.
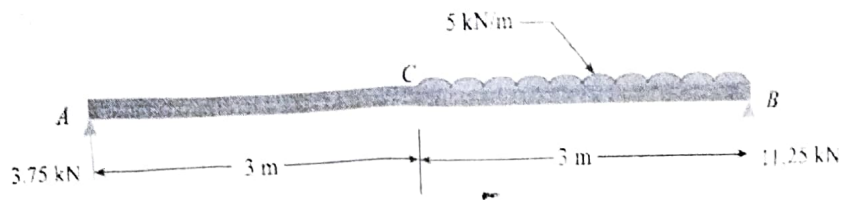
10. i) Derive the equation of projectile path. What is range of a projectile?   7
    ii) A projectile has a horizontal range S. If Y_1 and Y_2 are the greatest height in the two paths possible, show 8
       that $S = 4\sqrt{Y_1 Y_2}$.

11. i) Describe scalar, vector and tensor.   5

    ii) Write short notes on Euler angle of rotation.   10

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JGEC/B.TECH/ EE/ PC-EE-301/ 2022-23
2022
Analog Electronics Circuit

Full Marks: 70

Times: 3 Hours

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GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer *all* questions

5x2=10

1. Prove that the relation between current gain α and β is $\beta=\alpha/(1-\alpha)$ — 2
2. Write down the advantages of FET over BJT. — 2
3. Define input offset current in case of an Ideal Op-Amp. — 2
4. Draw the V-I characteristic graph of a p-n junction diode and show the Break down voltage in it. — 2
5. Give the relationship between pinch-off voltage, saturation voltage and gate-source voltage for op-amp. — 2

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any *four* questions

4x15 = 60

6. i) What is thermal runway in BJT? How can it be avoided? — 2

   ii) Ripple factor of a Full-wave rectifier is 0.482. Prove the above statement. — 5

   iii) Draw the circuit diagram of a full wave bridge rectifier and explain its operation. — 5

   iv) In case of P-N junction semiconductor define the following term a) Knee Voltage b) Maximum Forward Current c) Peak Inverse voltage. — 3

7. Write short note on any two of the following: — 7.5×2
   i) Colpitt's Oscillator;   ii) Zener Diode;   iii) Precision Rectifier;   iv) Wien Bridge Oscillator.

8. i) A half wave rectifier uses a diode with a forward resistance of 100 ohm. If the input voltage is 220V(rms) and the load resistance is of 2k ohm then determine a) I_{max}, I_{dc} and I_{rms} b) Peak inverse voltage c) Ripple factor d) Transformer utilization factor, when the diode is ideal. — 5

   ii) What are the advantages and disadvantages of Bridge rectifier over Centre-tap rectifier? — 2

   iii) In case of common emitter configuration of BJT prove that $I_c = I_B+(1+\beta)I_{CBO}$ — 5

   iv) Write down the properties of an Ideal Op-Amp. — 3

9. i) Draw the drain characteristics of depletion type MOSFET and explain different operating regions in the characteristics with proper reason. — 6

   ii) Draw the schematic diagram of an adder using op-amp and explain its working. — 6

   iii) Define CMRR and Slew Rate of a differential amplifier. — 3

10. i) Show that the stability factor of voltage divider circuit of transistor is $S=1+ \beta/[1+\beta(R_E/R_{TH}+R_E)]$ — 5

    ii) What is the effect of negative feedback on the impedance of a transistor amplifier? — 4

    iii) In case of Inverting amplifier configuration of closed loop Op-Amp show that the closed loop gain (A_F) is simply the ratio of two resistor R_1 & R_2 i.e. $A_F = - (R_2/R_1)$ — 6

11. i) A differential amplifier has a typical common mode gain of 35dB and CMRR of 72dB. Find out the output voltage (V_0) when input voltages are 0.16mV and 0.18mV. — 2

    ii) Explain how does an oscillator operate without an input signal? — 3

    iii) Draw the different topological connection used in Feedback amplifier with practical circuits as an example. — 5

    iv) Explain the fixed bias technique of BJT. — 5

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JGEC/B.TECH/ EE/ PC-EE-303/ 2022-23
2022
ELECTRICAL CIRCUIT ANALYSIS

Full Marks: 70

Times: 3 Hours

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GROUP-A
### [OBJECTIVE TYPE QUESTIONS]

Answer *all* questions

5x2=10

1. State the condition for maximum power transfer for an ac network. 2

2. A tie-set matrix has 3 rows and 7 branches. What will be the number of twigs? 2

3. The Z matrix of a 2-port network is given by $\begin{bmatrix} 0.9 & 0.2 \\ 0.2 & 0.6 \end{bmatrix}$. Find out the element Y_{22} of the corresponding Y matrix of the same network. 2

4. What will be the final value of f(t) whose Laplace transform is : $\dfrac{2s+1}{s^4 + 8s^3 + 16s^2 + s}$ 2

5. A voltage V (t) = $12t^2$ is applied across a 1H inductor for t ≥ 0, with initial current through it being zero. Find the current through the inductor for t ≥ 0. 2
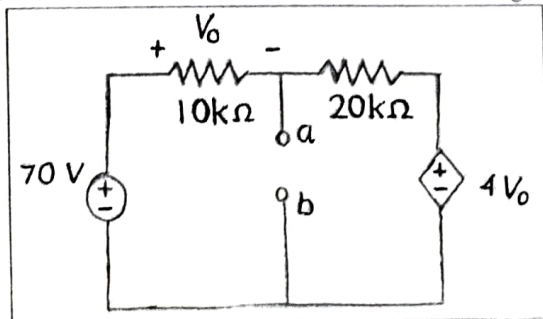
GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any *five* questions

12x5 = 60

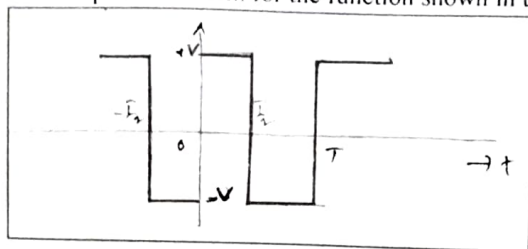6. a. Find the value of V_x in the following circuit: 6
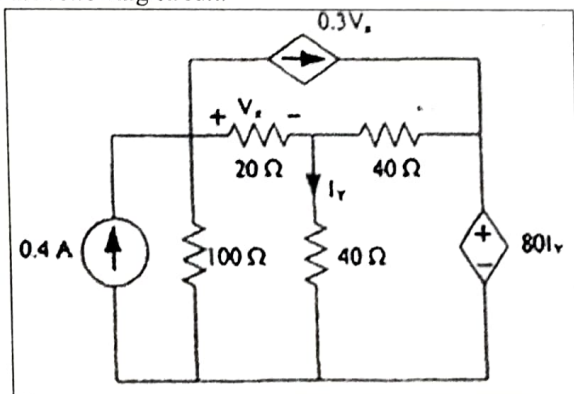
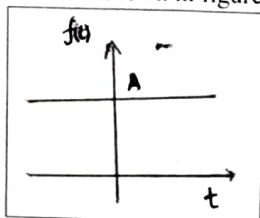b. Find the Thevenin's equivalent network at terminals a-b of the circuit in figure below 6

7. a. Determine the Fourier series in exponential form for the function shown in the figure

b. Find out the Fourier Transform of a constant as shown in figure

6

8. a. A certain function V(t), a train of rectangular pulses of amplitude V_0 and duration τ, is recurring 8 periodically every T seconds as shown in the figure. Find the exponential Fourier series of V(t) and draw the corresponding line spectrum.
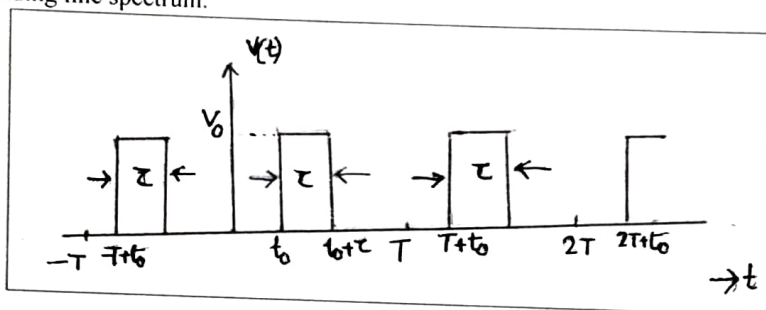

b. State and prove final value theorem.

4

9. a. Determine the Laplace Transform of the periodic rectified half-wave waveform as shown in the figure   6
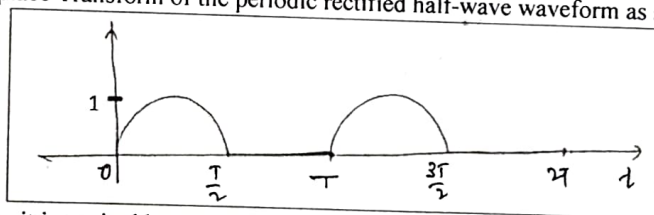
b. A parallel R-L circuit is excited by a current source 10u(t) A as shown in the figure. At t=0 sec, the circuit is energized by closing the switch S, and after t=0.5sec the switch is opened again. Derive the expressions for the current flowing through the inductor.
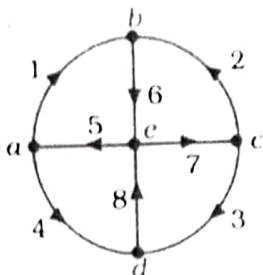
6
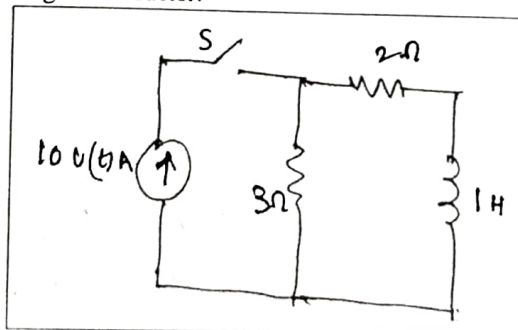
10. a. Derive the conditions with h-parameter for a network to be reciprocal and symmetrical. 4
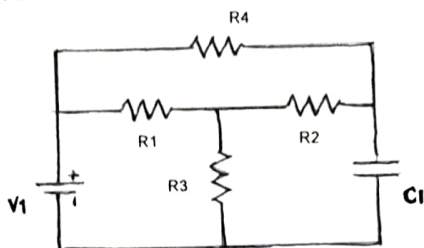   b. Find the Z- parameter and ABCD parameter of circuit given below in the figure 8
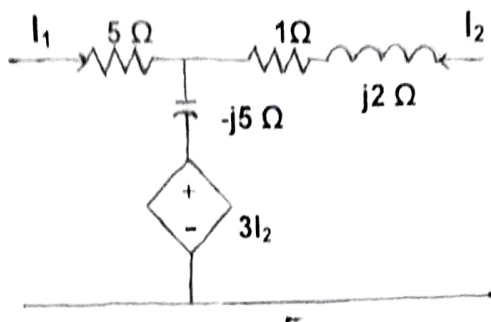
11. a. Find out the fundamental cut-set matrix and fundamental tie-set matrix of the graph shown below 6
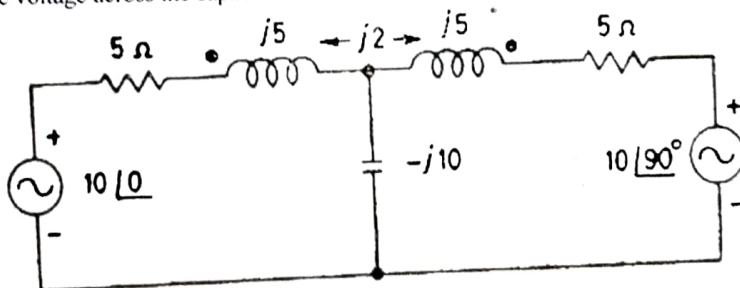

    b. Draw the oriented graph of the circuit shown in the figure and find the incidence matrix. 6

12. a. Determine the voltage across the capacitor in the circuit in figure 6

    b. Draw the circuit diagram of a first order high pass filter and find out the expression of the cut-off 6
       frequency.

13. a. Prove that AD-BC=1 for a reciprocal network. 4
    b. Define Fourier transform. How does Fourier Transform differ from Laplace transform? 4
    c. The response of a network to an impulse is 4

$$h(t) = 0 \cdot 18 \left(e^{-0 \cdot 3t} - e^{-2 \cdot 1t} \right).$$

Find the response of the network to a unit-step function using convolution theorem.

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JGEC/B.TECH/EE/PC-EE302/2022-23
2022
ELECTRICAL MACHINES-I

Full Marks: 70

Times: 3 Hours

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GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer **all** questions

5x2=10

1. Calculate the line transformation ratio of Yd11 transformer when phase transformation ratio is 'a'.
2. Show that line to line voltage of delta connected winding of a 3-ph transformer is always free from 3rd harmonic voltages.
3. Stator of two 3-phase Machine has 27 and 32 slots. Which of them suitable for 4-pole winding?
4. What is the advantage of 4-point starter over 3-point starter?
5. Why is the Swinburne Test not done for Dc Series Motor?

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any *five/four* questions

12x5=60

6. (a) A silicon iron ring of cross-sectional area 5 cm2 has a radial air gap of 2 mm cut into it. If the mean length of the silicon iron path is 40 cm, calculate the current required in the coil wound over the ring to produce a flux of 0.7 mWb. The permeability of silicon iron, $\mu_r = 675$ and $\mu_0 = 4\pi \times 10^{-7}$. Number of turns of the coil is 100. — 6

 (b) Estimate the force experienced per unit length by each of the two infinitely long parallel conductors carrying current in: i) same direction, and ii) opposite direction. — 6

7. (a) If P1 and P2 be the iron and copper losses of a transformer on full load, find the ration P1 to P2 such that maximum efficiency occurs at 75% of full load. — 3

 (b) Why is the middle limb of a 3-phase shell type transformer wounded just the opposite to that of the other two outer limbs? — 4

 (c) Show that Group-III and Group-IV 3-ph transformers can be connected in parallel with a small change in external connection. — 5

8. (a) What is Oscillating Neutral? How is it avoided? — 3

 (b) How is the Single ph to neutral load of a Yy0 3-ph transformer equalized by tertiary winding? — 2

 (c) Which winding of the transformer is suitable for providing tap- changer and why? — 2

 (d) Show that the primary currents of a Scott connected transformer balanced when load at secondary side is also balanced. — 5

9. (a) Which type of Armature winding suitable for DC Machine with high current rating and low voltage rating? — 2

 (b) What is Equalizer ring? Where is it used? — 3

 (c) The stator of a 3-ph ac machine has 24 slots. Draw the R-ph winding for that machine if it has 4-poles and the winding is short-pitched by one slot. — 7

(a) Two single phase transformers, each of rating 200kVA, 11/0.4kV, 50Hz, are connected at open   3+3
delta.

(i) Determine the load kVA that can be delivered by his connection scheme without overloading either of the transformers.

(ii) This connection scheme supplies a 3-ph balanced load of 200kVA a 400V, 0.866 lagging power factor. Determine the currents at high voltage side of the transformers and their operating power factors.

(b) A four-pole DC shunt generator with a wave wound armature having 390 conductors has to   6
supply a load of 500 lamps each of 100 W at 250 V. Allowing 10 V for the voltage drop in the connecting leads between the generator and the load and brush drop of 2 V. Calculate the speed at which the generator should be driven. The flux per pole is 30 m Wb and the value of Ra = 0·05 Ω and Rsh = 65 Ω

11. (a) What is Demagnetising Effect of Armature Reaction of DC machine? What are the problems   3
associated with it?

(b) How is the interpole winding connected to armature of the dc machine and why?   2

(c) The armature of a four-pole DC shunt generator has 378 wave connected conductors. The   7
armature and shunt winding resistance of the generator is 1 ohm and 100 ohm respectively. The flux per pole is 0.02 Wb. If a load resistance of 10 ohm is connected across the armature terminals and the generator is driven at 1000 rpm, calculate the power absorbed by the load.

12. (a) Draw the toque-speed characteristics of DC Series Motor. On the same diagram, draw the said   4
characteristics with (1) the demagnetization effect of armature reaction and (2) saturation of field.

(b) A 250 V shunt motor has an armature current of 20 A when running at 1000 rpm against full load   8
torque. The armature resistance is 0.5 Ω. What resistance must be inserted in series with the armature to reduce the speed to 800 rpm at the same torque, and what will be the speed if the load torque is halved with this resistance in the circuit. Assume the flux to remain constant throughout and neglect brush contact drop.

13 (a) Calculate the resistance steps for the starter of a shunt motor if
    No. of studs =4   6
    Armature resistance =1 Ω
    Maximum current= 40A
    Minimum current=10A

(b) A 5 kW, 250V dc shunt motor takes a no-load current of 4A at rated voltage and runs at 1200   6
rpm. The armature resistance is 0.4 Ω and field resistance is 250 Ω. At rated load and voltage, the motor takes 26A and armature reaction weakens the field flux by 3%.Calculate the full-load speed and corresponding electromagnetic torque of the motor.