

Duration : 3 Hours

Marks: 80

N.B .1) Question No. 1 is compulsory .

2) Attempt any three questions out of the remaining five questions .

3) Figures to the right indicate full marks .

- Q.1** a) Find the Laplace transform of $f(t) = 2\alpha(1 + te^{-t})^2 \cdot e^{-2t}$ where α is real constant. 5
- b) Find the Fourier series for $f(x) = x$ in $(-3,3)$ 5
- c) In what direction is the directional derivative of $\phi(x, y, z) = 2x^2y^2(8z^4)$ at $(1,-1,-2)$ is maximum ? Find its magnitude . 5
- d) Determined the constants A,B,C,D,E & F if $f(z) = (Ax^3 - Bxy^2 + \sin 6x \cdot \cosh 6y + C \cdot x) + i(Dyx^2 - 9y^3 + \cos Ex \sinh Fy + 101y)$ is analytic . 5
- Q.2** a) Prove that $J_{1/2}(x) = \sqrt{\frac{2}{\pi x}} \sin x$. 6
- b) Evaluate $\int_0^\infty e^{-8t} \left\{ \int_0^t \int_0^t \int_0^t x \cdot \sin 4x \cdot \cos 4x \cdot (dx)^3 \right\} \cdot dt$ 6
- c) Obtain half range cosine series for $f(x) = x$, $0 < x < 1$ and hence prove that the value of $\frac{\pi^4}{96} = \sum_{n=1}^\infty \frac{1}{(2n-1)^4}$ using Parseval's identity . 8
- Q.3** a) If $\vec{F} = (x + 2y + 2Lz)i + (4Mx - 3y - z)j + (4x + Ny + 2z)k$ is irrotational .Find the constants L, M, N .Show that \vec{F} can be expressed as the gradient of the scalar function . 6
- b) Find Fourier series for the following function 6
- $$f(x) = \begin{cases} (x - \pi)^2 & 0 \leq x \leq \pi \\ 0 & \pi \leq x \leq 2\pi \end{cases}$$
- c) Solve using Laplace transform $(D^2 + 25)y = (K + 6) \cdot t$,if $y(0) = 0, y'(0) = 0$ and find the value of the constant K if $y(\pi) = 1$. 8
- Q.4** a) Find the translation transformation using cross ratio property, which maps the points $\infty, -1, 1$ of Z-plane onto the points $\infty, 3, 2$ of W-plane . 6

b) By using Stokes theorem evaluate $\int_C \vec{F} \cdot \vec{dr}$ where $\vec{F} = (x^2 + 2y^2)i + (2x^2 - y^2)j$ and C is the boundary of the region enclosed by circle $x^2 + y^2 = 9$, $x^2 + y^2 = 36$. 6

c) Find Inverse Laplace transform of 8

i) $\left\{ \frac{s+\alpha}{s^2+16} \right\}$ and find the constant α , if $f\left(\frac{\pi}{8}\right) = 1$ ii) $\left\{ \frac{s+6}{(s-5)^2+121} \right\}$

Q.5 a) Define Orthogonal set of functions on (a,b). If $f(x) = P_1f_1(x) + P_2f_2(x) + P_3f_3(x)$, where P_1, P_2, P_3 are constants and $f_1(x), f_2(x), f_3(x)$ are orthogonal functions on (a,b), Then show that $\int_a^b [f(x)]^2 \cdot dx = P_1^2R_1 + P_2^2R_2 + P_3^2R_3$ where R_i ' are non zero for $i = 1,2,3$. 6

b) Find the analytic function $f(z) = u + iv$ in terms of Z if $u - 3v = x^2 - y^2 - 5x + y + 2$. 6

c) Verify Green's theorem for $\int_C (x^2)dx - (xy)dy$, C is a triangle whose vertices are A(0,2), B(2,0), C(4,2) in the XY-plane. 8

Q.6 a) Find the image of the real axis of the Z-plane under the transformation $w = \frac{1}{z+i}$ onto the W-plane. 6

b) Find Laplace transform of $f(t) = e^{-4t} \cdot \cos 4t \cdot \sin 4t \cdot H\left(t - \frac{\pi}{2}\right)$ 6

c) Obtain Complex form of Fourier series for $f(x) = \cosh 2x + \sinh 2x$ in $(-2,2)$. 8



(3 Hours)

(Total Marks : 80)

- N.B. : 1) Question No.1 is compulsory.
 2) Attempt any three questions from the rest.
 3) Make any suitable assumption wherever required.

- 1 Answer any four.
- | | | |
|-----|---|----|
| (a) | Explain the construction and working of Schottky diode. | 5M |
| (b) | What do you understand by 'Pinch off voltage' and 'cut off voltage' as applied to FET. | 5M |
| (c) | Explain in brief the r_e model in BJT. | 5M |
| (d) | What is the effect of Negative feedback on bandwidth and overall gain? | 5M |
| (e) | Find frequency of oscillations for Colpitt's oscillator with $C_1 = 0.01\mu\text{F}$, $C_2 = 0.001\mu\text{F}$ & $L = 5\text{ mH}$ | 5M |
- 2 (a) Derive the expression for ripple factor for Full Wave Bridge Rectifier with LC filter. 10M
 (b) Compare different biasing methods of BJT and calculate the values of I_{BQ} , I_{CQ} & V_{CEQ} for the following fig. 1 shown of silicon transistor with $\beta = 100$. 10M

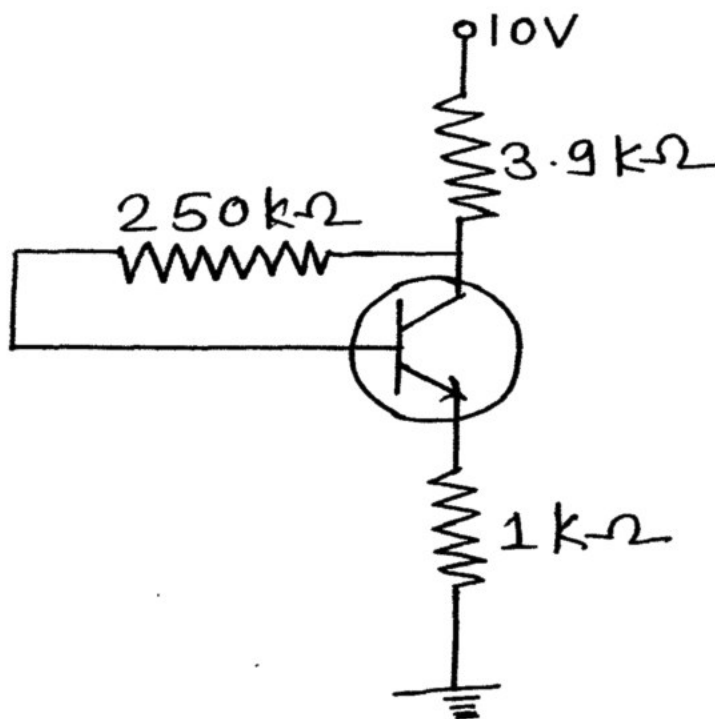


Fig .1

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- 3 (a) Draw & explain E-type MOSFET in detail with its input & output characteristic. 10M
- (b) For the circuit shown in fig.2 determine voltage gain, input impedance and output impedance. FET has $I_{DSS} = 10\text{mA}$ and $V_P = -4.5\text{V}$.

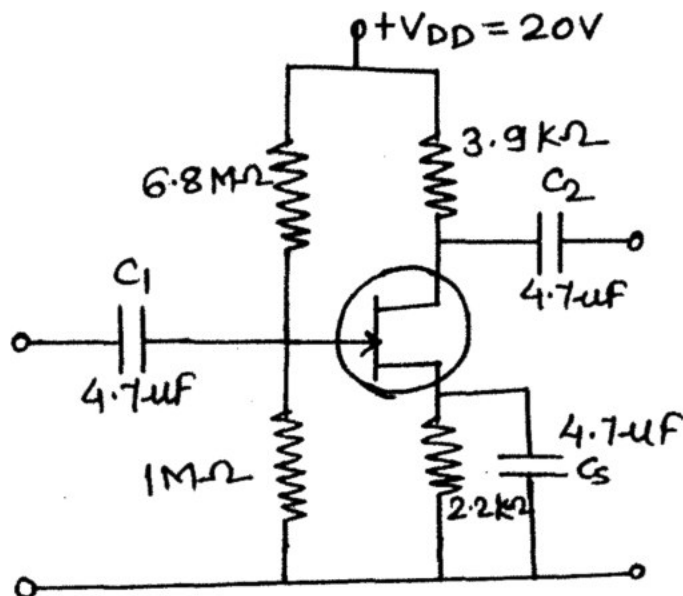


Fig. 2

- 4 (a) Draw and explain Hartley oscillator and derive an expression for its frequency of oscillation. 10M
- (b) What are the advantages of negative feedback? 5M
- (c) Explain in brief various types of negative feedback amplifiers. 5M
- 5 (a) Explain the features of multistage RC coupled amplifier. Draw and explain two stage RC coupled transistor amplifier 10M
- (b) Derive the expression for stability factor (S) for voltage divider biasing in transistor. 10M
- 6 (a) Write short note on frequency response of BJT amplifier. 10M
- (b) Write short note on different types of filter circuits used to remove the ripple in rectifier output. Derive the ripple factors for each. 10M

[Time: 3 Hours]

[Marks:80]

Please check whether you have got the right question paper.

- N.B:
1. Question No.1 is Compulsory.
 2. Answer any three out of remaining five questions
 3. Assume any suitable data wherever required but justified the same
 4. Illustrate answer with sketches wherever required

- Q.1** Attempt any **four**
- a. How you will illustrate the comparison between base load plant and peak load plant. **05**
 - b. Pertaining to the operation of the various types of nuclear power plants, explain **05**
 - c. the role played by the Moderator and Coolant **05**
 - d. Illustrate the principle of operation of Gas turbine power plant. **05**
 - e. Illustrate the Rankine cycle with reference to thermal power plant operation **05**
 - f. Illustrate the principle of operation of Fuel cell. **05**
- Q.2**
- a. Name and explain the essential elements of a hydroelectric power plant **10**
 - b. Illustrate in brief ash handling plant in steam power station **05**
 - c. What is the significance of Super heater towards enhancement of performance of thermal power plant? **05**
- Q.3**
- a. Explain BWR type nuclear reactor with neat sketch. Give its advantages and disadvantages. **10**
 - b. Illustrate the induced draught fan and forced draught fan in a thermal power plant. **10**
- Q.4**
- a. A power plant has following annual factors: **10**
 Load Factor = 0.6
 Plant Use Factor = 0.45
 Plant Capacity Factor = 0.4
 If Maximum demand is 30MW, find the following:-
 i) Annual energy consumed in 365 days in a year
 ii) Reserve capacity of plant
 iii) No. of ms. per year during which the plant is not working
 - b) Draw and illustrate the operation of Diesel power, plant **10**
- Q.5**
- a. Illustrate horizontal axis and vertical axis wind turbine power plant **10**
 - b. Describe the operation of Solar pond power plant. **10**
- Q.6** Write short note on **20**
- i) Surge Tank
 - ii) Tidal Power Plant
 - iii) Solar Concentrators
 - iv) Pelton Turbine

(3 Hours)

[Total marks : 80]

Note: 1) Question No.1 is compulsory.

2) Attempt any three questions out of remaining five question.

3) Assume suitable data if required.

1 Solve any four

- A. Explain galvanometer used as a detector in d.c. bridge. 5
- B. Write short note on Extension range of ammeter 5
- C. Explain resolution and sensitivity of digital meters. 5
- D. How digital meters are advantageous over analog meters? 5
- E. Differentiate between active and passive transducers. 5

2 (A) Write short note on Production of controlling torque through spring control method. 10

(B) Why synchroscope is required? Explain with neat diagram westone type synchroscope. 10

3 (A) Describe construction and working principle of moving iron instrument and hence derive the torque equation. 10

(B) Explain with block diagram ramp type digital voltmeter. 10

4 (A) Explain a suitable bridge to measure Low Resistance. 10

(B) Explain with phasor diagram how schering bridge can be used to measure unknown capacitor 10

5 (A) Draw circuit diagram and explain Maxwell's bridge. 10

(B) Explain the construction and working of thermocouple.also mention the advantages and disadvantages 10

6 (A) Explain how Crompton's type potentiometer can be used for calibration of voltmeter . 10

(B) Explain Anderson bridge for measuring self inductance. Draw neat circuit diagram and phasor diagram. 10

[Time: 3 Hours]

[Marks:80]

Please check whether you have got the right question paper.

- N.B: 1. Questions No.1 is compulsory.
 2. Solve three questions from remaining questions.
 3. All questions carry equal marks.
 4. Assume suitable data if required.

- Q.1** a) Explain the use of commutation in DC motor. **20**
 b) Explain armature reaction in DC machine.
 c) Explain difference between electric circuit & magnetic circuit.
 d) Explain the principle of energy conversion and develop the model of an electromechanical energy conversion device.
 e) Write the application of stepper motor.
- Q.2** a) Explain the concept of singly excited machines and derive the expression for the electromagnetic torque. **20**
 b) Explain the electrical braking methods for DC motor.
- Q.3** a) A 230 V shunt motor running on no load and at normal speed takes an armature current of 2.5 A from 230 V supply mains .the field circuit resistance is 230 ohm and the armature circuit resistance is 0.3 ohm .calculate the motor output and efficiency when total current taken from mains is 35 A. if the motor is used as a 230 v shunt generator. Find the efficiency and the input power for an output current of 35 A. **20**
 b) Write a short notes on doubly excited magnetic field.
- Q.4** a) Explain the construction and working of permanent magnet stepper motor. **20**
 b) With the help of neat circuit diagram explain the Swinburns test.
- Q.5** a) Explain the methods of speed control of DC motor. **20**
 b) The Hopkinson's test on two shunt machines gave the following result for full load .line voltage =250V , current taken from supply system excluding filed current =50A, motor armature current =380 A, filed current =5 A, and 4.2 A. Calculate the efficiency of the machine working as a generator .armature resistance of each machine is 0.02 ohm.
- Q.6** a) Explain four point starter. **20**
 b) Write down the application of DC shunt and series motor.
