Q. No. | Questions | M.M.
---|---|---
1(a) | Obtain the equilibrium points and determine their steady state stability when motor and load torques are: \[ T = -1 - 2\omega_m \quad \text{and} \quad T_l = -3\sqrt{\omega_m} \] | [06]
1(b) | A motor operates on a periodic duty cycle in which it is clutched to its load for 10 minutes and declutched to run on no load for 20 minutes. Minimum temperature rise is 40°C. Heating and cooling time constants are equal and have a value of 60 minutes. When the load is declutched continuously the temperature rise is 15°C. Determine:
   i. Maximum temperature during duty cycle
   ii. Temperature when the load is clutched continuously.
   OR
1'(a) | Find the expression of overloading factor K of a motor for short time duty loads. | [06]
1'(b) | A constant speed drive has the following duty cycle:
   i. Load rising from 0 to 400 kW for 5 minutes
   ii. Uniform load of 500 kW for 5 minutes
   iii. Regenerative power of 400 kW returned to the supply for 4 minutes
   iv. Remains idle for 2 minutes
   Estimate power rating of the motor. Assume losses to be proportional to \((\text{power})^2\). | [06]
2(a) | Explain the regenerative braking characteristics of a separately excited motor. | [06]
2(b) | A 220 V, 970 rpm, 100 A dc separately excited motor has an armature resistance of 0.05 Ω. It is braked by plugging from an initial speed of 1000 rpm. Calculate:
   i. Resistance to be placed in armature circuit to limit braking current to twice the full load value.
   ii. Torque when the speed has fallen to zero.
   OR
2' | A 200 V, 875 rpm, 150 A separately excited dc motor has an armature resistance of 0.06 Ω. It is fed from a single phase fully controlled rectifier with an ac source voltage of 220 V, 50 Hz. Assuming continuous conduction, calculate:
   i. Firing angle for rated motor torque and 750 rpm.
   ii. Firing angle for rated motor torque and (-500 rpm).
   iii. Motor speed for \(\alpha = 160°\) and rated torque.
Briefly explain the following related to closed loop control of drives:

i. Current limit control

ii. Closed loop torque control

iii. Closed loop speed control

A 2.8 kW, 400 V, 50 Hz, 4 pole, 1370 rpm, delta connected squirrel-cage induction motor has following parameters referred to the stator:

\[ R_s = 2 \, \Omega, \quad R'_r = 5 \, \Omega, \quad X_s = X'_r = 5 \, \Omega, \quad X_m = 80 \, \Omega \]

Motor speed is controlled by stator voltage control. When driving a fan load it runs at rated speed at rated voltage. Calculate:

i. Motor terminal voltage, current and torque at 1200 rpm

ii. Motor speed, current and torque for the terminal voltage of 300 V.

OR

For variable frequency control of induction motor explain the following points:

i. For speeds below base speed \((V/f)\) ratio is maintained constant, why?

ii. For speeds above base speed, the terminal voltage is maintained constant, why?

iii. At very low value of frequency the maximum torque during motoring is reduced, why?

5(a) Explain the closed loop speed control with static rotor resistance control of three phase slip ring induction motor

5(b) A 440 V, 50 Hz, 970 rpm, 6 pole, Y-connected, 3-phase wound rotor induction motor has following parameters referred to stator:

\[ R_s = 0.1 \, \Omega, \quad R'_r = 0.08 \, \Omega, \quad X_s = 0.3 \, \Omega, \quad X'_r = 0.4 \, \Omega \]

The stator to rotor turns ratio is 2. Motor speed is controlled by static Scherbius drive. Drive is designed for a speed range of 25% below the synchronous speed. Maximum value of firing angle is 165°. Calculate the transformer turns ratio.
Maximum Marks: 60
Credits: 04
Duration: Two Hour

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

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<th>Q.No.</th>
<th>Questions</th>
<th>M.M. 60</th>
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<tr>
<td>1.(a)</td>
<td>Define (a) Beam radiation, (b) Diffused radiation and (c) Global radiation. What are the different options by which the solar radiation data of a particular location can be obtained?</td>
<td>[6]</td>
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<tr>
<td>1.(b)</td>
<td>Explain the construction and principle of operation of pyranometer in brief.</td>
<td>[6]</td>
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<tr>
<td>1'.(a)</td>
<td>Define declination angle, hour angle, zenith angle, solar azimuth angle and angle of incidence.</td>
<td>[6]</td>
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<td>1'.(b)</td>
<td>Calculate the angle made by beam radiation with the normal to a flat-plate collector, tilted at 30° from the horizontal, pointing due south, located at New Delhi, at 11:00h (IST), on 1st June. The latitude and longitude of New Delhi are 28°35’N and 77°12’E respectively. The standard longitude of IST is 81°44’E. Assume the value of time correction for 1st June to be +2.5 minutes.</td>
<td>[6]</td>
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<tr>
<td>2.(a)</td>
<td>Define performance indices for a solar collector. Discuss in brief the effect of various parameters on the performance of flat plate collectors?</td>
<td>[6]</td>
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<tr>
<td>2.(b)</td>
<td>With the help of schematic diagram explain the working of passive solar water heating system.</td>
<td>[6]</td>
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<tr>
<td>3.(a)</td>
<td>Discuss in brief various strategies used for operation of an MPPT in an SPV system.</td>
<td>[6]</td>
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<td>3.(b)</td>
<td>A PV system feeds a dc motor to produce 1 hp power at the shaft. The motor efficiency is 85%. Each module has 36 multi-crystalline silicon solar cells arranged in a 9x4 matrix. The cell size is 125mm x 125mm and the cell efficiency is 12%. Calculate the number of modules required in the PV array. Assume global radiation incident normally to the panel is 1kW/m².</td>
<td>[6]</td>
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<tr>
<td>3'.(a)</td>
<td>Discuss the effect of shadowing of a cell in a module.</td>
<td>[6]</td>
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<tr>
<td>3'.(b)</td>
<td>A PV source having I-V characteristics as shown in Fig. 1 is supplying power to a load whose line intersects the characteristics at (10 V, 5 A). Determine the</td>
<td>[6]</td>
</tr>
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</table>
additional power gained if an MPPT is interposed between the source and the load. If cost of the MPPT is Rs. 4000/- for how long does the system needs to operate in order to recover cost of MPPT? The cost of electricity may be assumed as Rs. 3.00 per kWhr. Consider MPPT efficiency to be 95%.

4.(a) With the help of schematic diagram explain the working of stand-alone type SPV system.

4.(b) Enumerate the Balance of System (BoS) components of solar PV system. Discuss commonly used set points and their behaviour in charge controllers.

**OR**

4'(b) Discuss different criterion that should be incorporated while designing precise solar PV systems.

5. (a) What are thin films, multi-crystalline and amorphous solar cell technologies?

5. (b) Write short notes on emerging solar cell technologies.

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**Useful Data:**

\[ \delta = 23.45 \times \sin \left( \frac{360}{365} \left( 284 + n \right) \right) \text{ degrees} \]

\[ \text{LAT} = \text{Standard time} + 4 \times (L_{st} - L_{loc}) + E \]

\[ \cos \theta_i = \sin \phi \left( \sin \delta \cos \beta + \cos \delta \cos \gamma \cos \omega \sin \beta \right) + \cos \phi \left( \cos \delta \cos \omega \cos \beta - \sin \delta \cos \gamma \sin \beta \right) + \cos \delta \sin \gamma \sin \omega \sin \beta \]
B.E. (VIII SEMESTER) EXAMINATION
DIGITAL SIGNAL PROCESSING
EEE-482N

Maximum Marks: 60
Credits: 04
Duration: Two Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

1(a)

a) What is aliasing

b) Consider the analog signal

\[ x_a(t) = 6\cos 200\pi t \]

Determine the minimum sampling rate to avoid aliasing.

c) If the signal is sampled at the rate \( Fs = 150 \text{ Hz} \), what is the discrete time signal obtained after sampling.

What is the frequency \( 0 < F < Fs/2 \) of sinusoid that yield samples identical to those obtained in part (c)

1(b)

Explain the following conversion in digital signal processing mentioning all the stages along with their block diagrams.

1. analog to digital
2. digital to analog

2(a)

Consider the system in figure below with \( h(n) = a^n u(n), \quad -1 < a < 1 \). Determine the response \( y(n) \) of the system to the excitation \( x(n) = u(n + 5) - u(n - 10) \)

\[ y(n) = x(n) * h(n) \]

\( OR \)

2(a)

Briefly explain correlation, auto correlation and cross correlation. Also mention their practical applications in digital signal processing.

2(b)

Determine the response of the relaxed system characterized by the impulse response

\[ h(n) = \left( \frac{1}{2} \right)^n u(n) \]

to the input signal \( x(n) = \frac{1}{0}, \quad 0 \leq n < 10 \)

\( otherwise \)

\( \text{contd...} \)
2(b)' Compute and sketch the step response of the system

\[ y(n) = \frac{1}{M} \sum_{k=0}^{M-1} x(n-k) \]

3(a) A discrete system is given by the following difference equation:

\[ y(n) - 5y(n-1) = x(n) + 4x(n-1) \]

Where \( x(n) \) is the input and \( y(n) \) is the output. Determine its magnitude and phase response using Fourier transform.

3(b) Determine the output sequence from the output spectrum

\[ Y(\omega) = \frac{1}{4} \frac{e^{j2\omega} + 1 + e^{-j2\omega}}{1 - ae^{-j\omega}} \]

OR

3(b)' Let \( i(t) = 2e^t u(-t) A \). Find the total energy carried by \( i(t) \) and the percentage of the \( 1 \Omega \) energy in the frequency range of \(-5 < \omega < 5 \text{ rad/s}.\)

4(a) Find the convolution of the sequences using Z transform.

\[ x_1(n) = \{2,1,0,-1,3\}; \quad x_2(n) = \{1,-3,2\} \]

OR

4(a)' Find the Z transform of the following sequence.

\[ x(n) = a^{n-2} u(n-2) \]

4(b) Find the inverse Z-transform of the following function

\[ X(z) = \frac{2z^3 - 5z^2 - z - 4}{(z-1)(z-2)}; \quad \text{ROC}; \quad |z| < 1 \]

5. Describe briefly about (ANY TWO) of the following in context of digital signal processing.
   a) FIR filters.
   b) Butterworth filters
   c) Chebyshev filters
   d) IIR filters