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

Q.No. | Question                                                                                                                                  | M.M.
-----|------------------------------------------------------------------------------------------------------------------------------------------|------
1.(a) | What problem is imposed by a fluctuating load of high value on the supply system? Explain how the load can be equalized by placing a flywheel on the motor shaft. | [08] |
1(b)  | Explain the disadvantages of selecting a motor which has a power rating much higher than the load demand. What will be the drawbacks if the motor rating is less than the load demand? | [04] |
2(a)  | What are the different methods of electric braking of dc motors? Explain the least efficient method of braking for a separately excited dc motor. | [08] |

OR

2'(a) | Compare armature voltage control and field control methods of speed control of a dc motor. Draw and explain power and torque capability curves of armature voltage controlled and field controlled drives. | [08] |
2(b)  | A 220 V, 1500 rpm, 10 A, separately excited dc motor has an armature resistance of 2 Ω. It is fed from a single-phase fully-controlled rectifier with an ac source voltage of 230 V, 50 Hz. Assuming continuous conduction, calculate firing angle if the motor has to produce half the rated torque at 500 rpm. | [04] |
3(a)  | Draw a chopper circuit that can be used both for motoring and braking operation of a dc separately excited motor. Briefly explain its operation. | [06] |
3'(b) | A 220 V, 1000 rpm, 24 A, separately excited dc motor has an armature resistance of 2 Ω. It is controlled by a chopper with frequency of 500 Hz and source voltage of 230 V. Calculate the duty ratio for 1.2 times the rated torque and 500 rpm. Draw the waveforms of armature voltage and current. Assume continuous conduction. | [06] |
4. Explain why the voltage applied to an induction motor has to be reduced as the frequency is decreased to decrease its speed. With the help of block diagrams explain the various schemes for implementing frequency control method.

OR

4(a) Explain the voltage control method of speed control of an induction motor. What are the drawbacks of this method?

4(b) A 3-phase, 400 V, 4-pole, 1370 rpm, 50 Hz star-connected induction motor has the following circuit parameters:

\[ R_s = 2 \Omega, \quad R_r' = 3 \Omega, \quad X_s = X_r' = 3.5 \Omega \]

The motor speed is controlled by varying the frequency from 10 Hz to 50 Hz, keeping V/f constant. Calculate the starting torque and starting current if the motor is started with the lowest frequency. Neglect magnetizing current.

5. Draw schematic diagram of a static Kramer's drive and explain its working. What modification is required in the scheme if speed control is required from zero to about synchronous speed?

OR

5' With the help of a schematic diagram explain the speed control of a wound rotor induction motor by static rotor resistance control method. Show that the effective external resistance connected in each phase of the rotor is given by

\[ R_{ext} = 0.5 R (1 - \delta) \Omega \]

Where R is the resistance used in the circuit and \( \delta \) is the duty ratio of the transistor switch.
2016-17
B. TECH (WINTER SEMESTER) EXAMINATION
ELECTRICAL ENGINEERING
POWER SEMICONDUCTOR CONTROLLERS
EE 422

Maximum Marks: 60
Credits 04
Duration: Two Hours

Assume suitable data if missing
Notations used have their usual meaning
Be specific in your answer
Answer all questions

Q.No.

1(a)
Draw the circuit diagram and suitable waveforms for the continuous conduction mode of operation of a flyback converter.

1(b)
A switch mode power supply is to be designed with the following specifications

\[ V_d = 48 \text{ V} \pm 10\%, \ V_o = 5 \text{ V}, \ f = 100 \text{ kHz}, \ P_{\text{load}} = 15-50 \text{ W} \]

A forward converter operating in a continuous mode with a demagnetizing winding \((N_1/N_3)\) is chosen. Assume all components to be ideal except for the presence of transformer magnetizing inductance

a. Calculate \(N_2/N_1\) if the turns ratio is desired to be as small as possible.
b. Calculate the minimum value of the filter inductance.

OR

1(b')
The forward converter has the following parameters: \(V_s = 48 \text{ V}, \ R = 10 \Omega, \ L_x = 0.4 \text{ mH}, \ L_m = 5 \text{ mH}, \ C = 100 \mu\text{F}, \ f = 35 \text{ kHz}, \ N_1/N_2 = 1.5, \ N_1/N_3 = 1, \ D = 0.4\)

(a) Determine the output voltage, the maximum and minimum currents in \(L_x\), and the output voltage ripple. (b) Determine the peak current in the transformer primary winding. Verify that the magnetizing current is reset to zero during each switching period. Assume all components are ideal.

M.M.

4
8

2

With the help of circuit diagram, switching diagram and waveforms explain the various modes of operation of a series loaded resonant dc-dc converter.

OR

2'
The full wave zero current switching quasi resonant buck converter has an input voltage of 12 V. The values of the resonant inductor, \(L_r\), and resonant capacitor, \(C_r\), are 2 \(\mu\text{H}\) and 79 nF, respectively. The average output voltage is 9 V across a 9 \(\Omega\) resistor. The output inductor and output capacitor are 10 mH and 100 \(\mu\text{F}\), respectively. Determine

a. The switching frequency, \(f_s\)
b. The duration that the resonant inductor is being charged
c. The peak current in the resonant inductor
d. The peak voltage across the resonant capacitor.

M.M.

12
12

cont'd.... 2.
3(a) Write a program to simulate a flyback converter. The program should plot the instantaneous output voltage and the current through the magnetizing inductance. Assume the load to be purely resistive.

OR

3(a') Develop the mathematical model for a buck converter. Also write a program to simulate the current through inductor.

3(b) Solve the system of differential equations using RK4 method

\[
\frac{dy}{dx} = y - t \\
\frac{dy}{dx} = x + t
\]

With \( x = 1, y = 1 \) when \( t = 0 \), taking \( \Delta t = h = 0.1 \)

4(a) Draw the protection scheme for a power diode.

4(b) Describe the structure and the equivalent circuit of a MOS controlled thyristor (MCT). Also draw the dynamic switching waveform.

5(a) Draw an off grid and a grid connected topology of a converter for a solar PV system. Explain the importance of Charge controller and MPPT.

5(b) Classify the Multi-Level converter topologies? Write one advantage and one disadvantage of each.
2016-17
B.TECH EXAMINATION (WINTER SEMESTER)
DEPARTMENTAL ELECTIVE
SOLAR ENERGY AND ITS APPLICATION
EE-423

Maximum Marks: 60  
Credits: 04  
Duration: Two Hours

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

Q. No.  
1(a) Give the main reasons for moving towards renewable sources of energy from fossil fuel based energy sources.  

1(b) Explain the following terms:  
a. AM0  
b. AM1.5  
c. Solar Constant

1(c) Differentiate between solar irradiance and solar insolation.

2(a) Write in brief about the operation of a rooftop solar water heating system
2(b) Explain the operation of solar air conditioning and refrigeration system.

3(a) Write a program to implement Perturb and Observe method for maximum power point tracking in a solar PV system

OR

3(a') Write a program to implement incremental conductance method for maximum power point tracking in a solar PV system

3(b) What are the various types of charge controllers? Discuss any two of them with their advantages.

OR

3(b') Write a program to simulate a solar PV cell at SRC.

4(a) The relationship between the output voltage and current for a PV array is defined by the data in the table. The PV array is connected to a resistive load of 50 ohms through flyback converter operating in CCM. The turns ratio \( \frac{N_1}{N_2} = 2 \). Determine the duty cycle of the interfacing converter required to operate the PV array at MPP.

<table>
<thead>
<tr>
<th>( V_{pv} ) (Volts)</th>
<th>52.8</th>
<th>53.6</th>
<th>54.2</th>
<th>55.2</th>
<th>56.16</th>
<th>56.26</th>
<th>56.36</th>
<th>56.48</th>
<th>56.58</th>
<th>56.7</th>
</tr>
</thead>
<tbody>
<tr>
<td>( I_{pv} ) (A)</td>
<td>3.44</td>
<td>3.42</td>
<td>3.4</td>
<td>3.38</td>
<td>3.34</td>
<td>3.28</td>
<td>3.24</td>
<td>3.18</td>
<td>3.14</td>
<td>3.08</td>
</tr>
</tbody>
</table>

4(b) Classify various types of hybrid PV system and with the help of block diagram explain PV-
Wind hybrid system.

4′(a) Design a solar PV system (PV Panels, Batteries, Inverter, Solar charge controller for a house with following load requirements.

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Load</th>
<th>Numbers</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lights (50W each)</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>Refrigerator (500W)</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>Ceiling fans (45W each)</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>Washer (1000 W)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Television (200 W)</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

System is powered by 12 Vde with 110 Wp PV module.

4′(b) Mention four issues related to hybrid solar PV system operation.

5 Compare the features of a thin film, single-crystalline, multi-crystalline and amorphous PV cell technology.

OR

5′(a) Write in brief the emerging technologies in solar cell.

5′(b) Explain in brief the working of a concentrator PV cell.