AISSMS College of Engineering, Pune

Department of Electrical Engineering

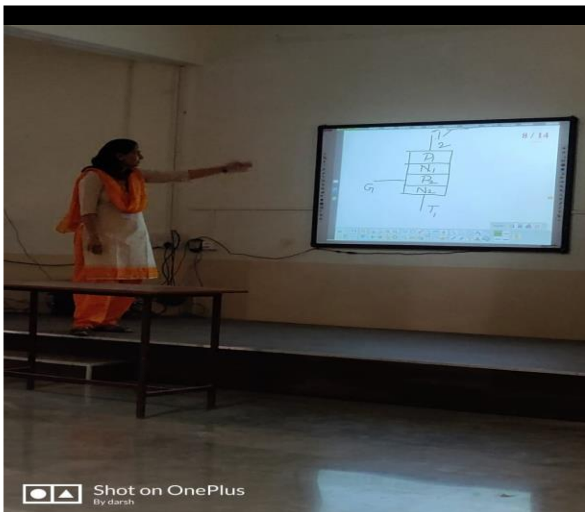
Academic year:2018-19 Term I

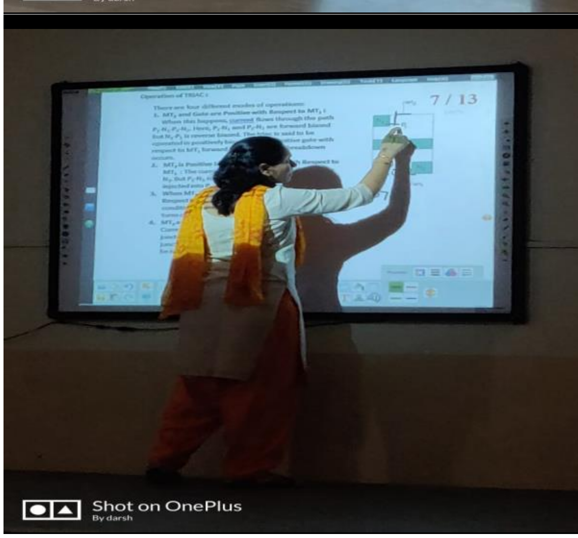
Subject: Power Electronics **Class: TE Electrical**

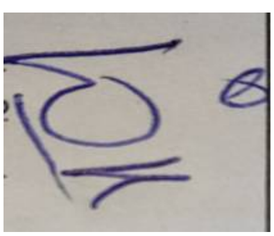
Date: 29/08/2018

Activity: Use Of ICT (Smart board & Presentation)

Smart Board is used to explain the construction and working of DIAC and TRIAC.







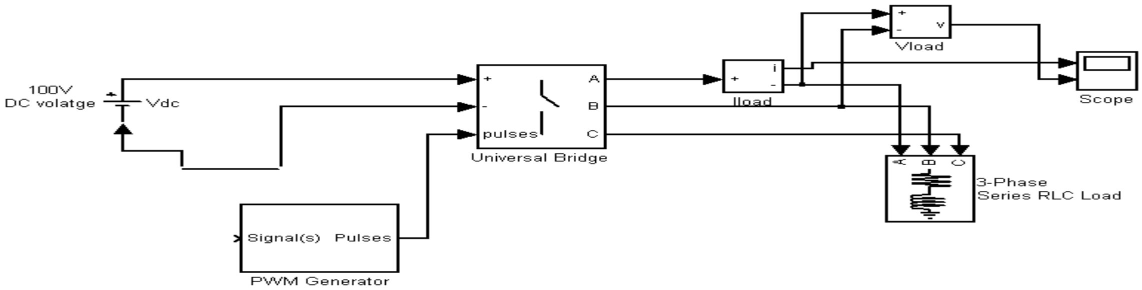
POWER ELECTRONICS (TE ELECTRICAL)
2008 COURSE
LEARNING BEYOND SYLLABUS

Title : **PWM BASED THREE PHASE INVERTER**

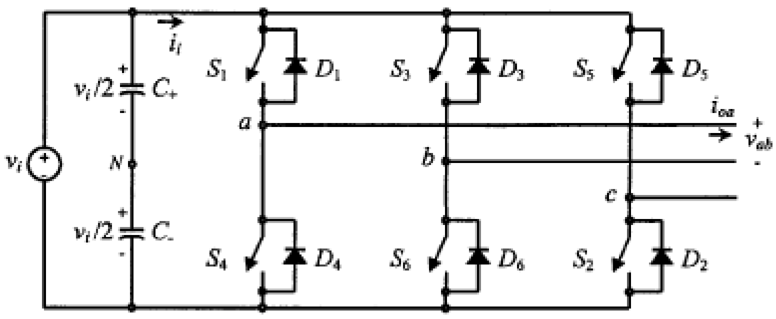
Aim : To design a three phase inverter based on sinusoidal pulse width modulation using MATLAB

Apparatus/ Components required: MATLAB software

Circuit diagram:



Theory:



Sinusoidal-Pulse-Width-Modulation (SPWM)

In sinusoidal pulse width modulation there are multiple pulses per half-cycle and the width of the each pulse is varied with respect to the sine wave magnitude corresponding to that duration. Fig 4(c) shows the gating signals and output voltage of SPWM with unipolar switching. In this scheme, the switches in the two legs of the full-bridge inverter are not switched simultaneously, as in the bi-polar scheme. In this unipolar scheme the legs R, Y and B of the full-bridge inverter are controlled separately by comparing carrier triangular wave v_{car} with the three control sinusoidal signals v_{c_R}, v_{c_Y} and v_{c_B} respectively which are displaced by 120^o. This SPWM is generally used in industrial applications. The number of pulses per half-cycle depends upon the ratio of the frequency of carrier signal (f_c) to the modulating sinusoidal signal. The frequency of control signal or the modulating signal sets the inverter output frequency f_o and the peak magnitude of control signal controls the modulation index m_a which in turn controls the rms output voltage.

The *amplitude modulation index* is defined as

$ma = Vc/Vcar$

where, Vc = peak magnitude of control signal (modulating sine wave).

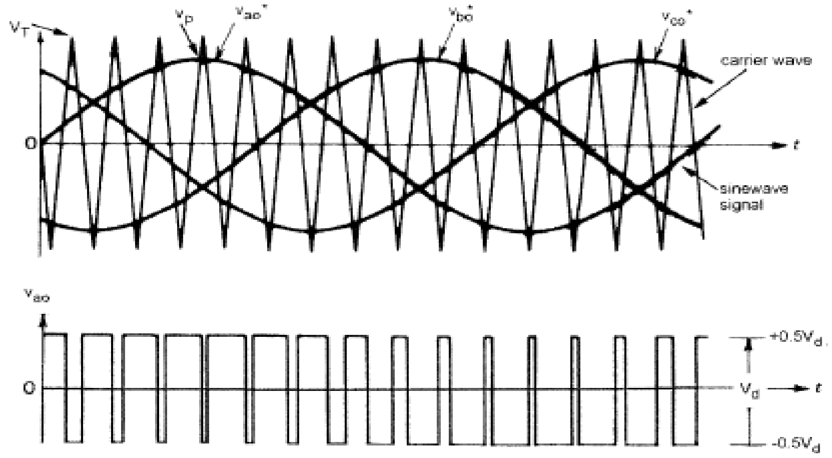
$Vcar$ = peak magnitude of carrier signal (triangular signal).

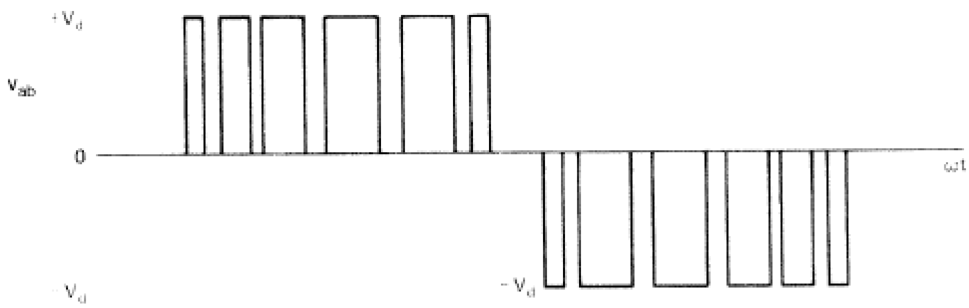
The *frequency modulation ratio* is defined as

$mf = fcar/fc$

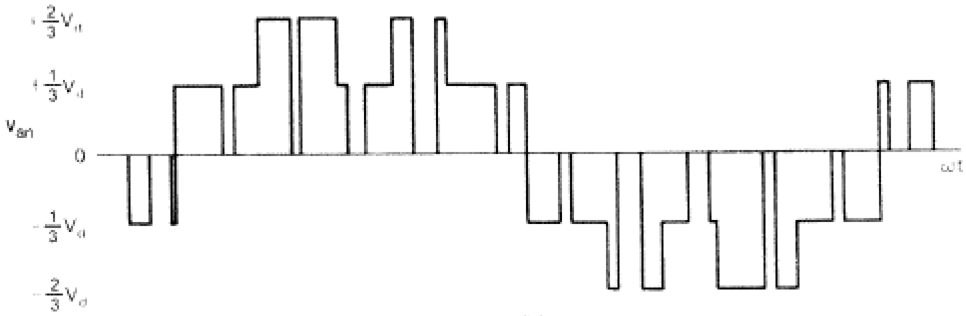
where, fc = frequency of control signal (sine signal).

$fcar$ = frequency of carrier signal (triangular signal).





(a) Line voltage

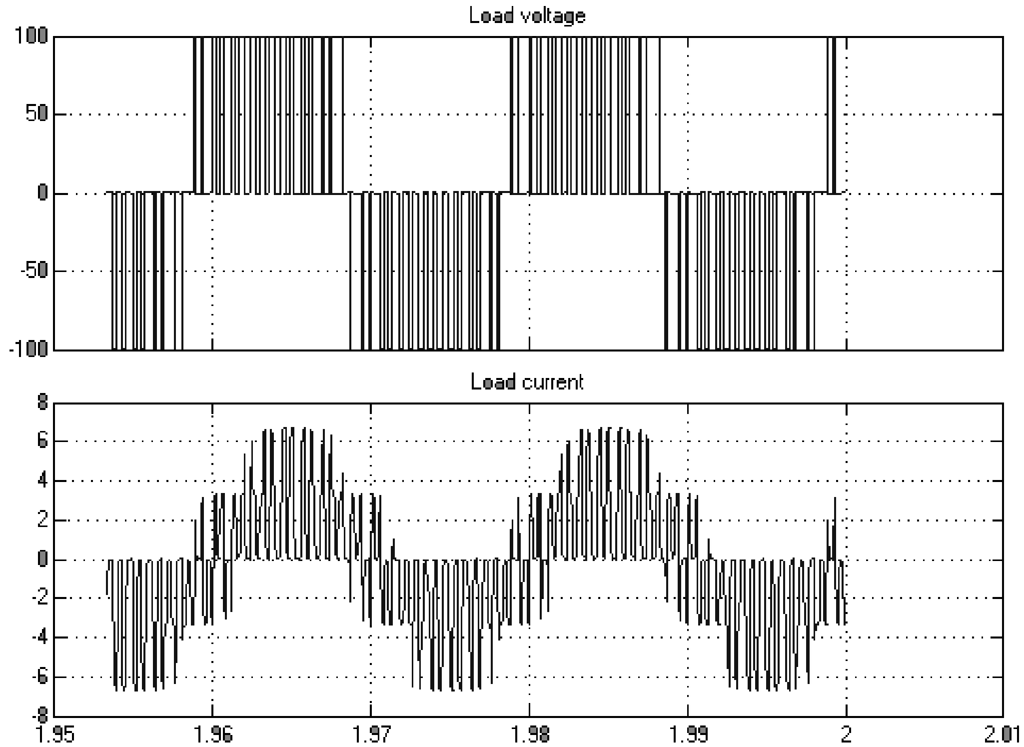


(b) Phase voltage

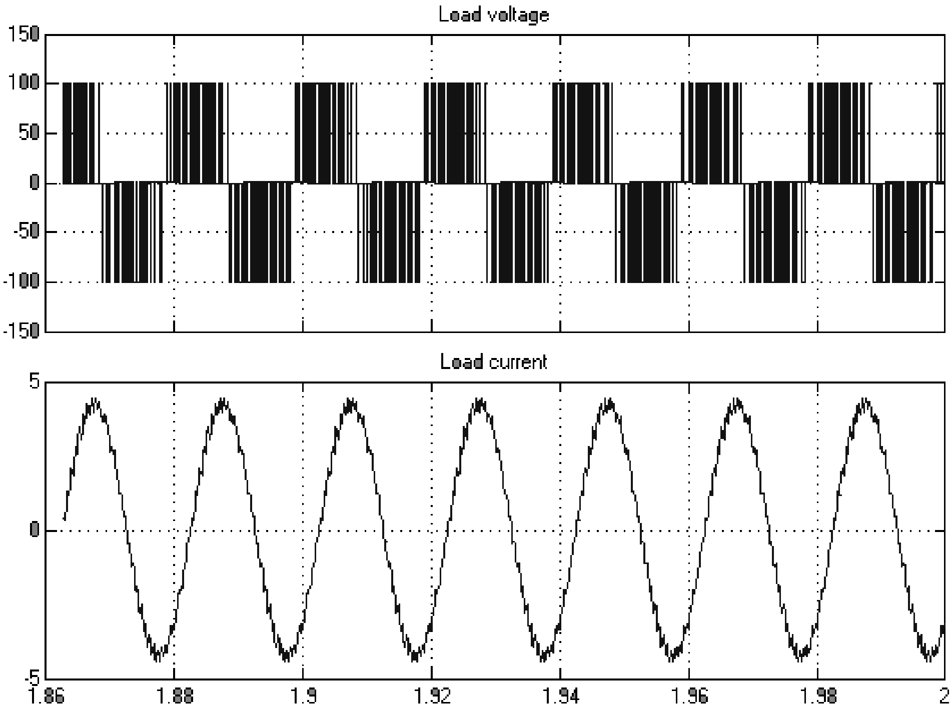
Procedure:

1) Open MATLAB 6.5 and go to simulink library browser.
2) Open new model file.
3) Go to Simpower system blockset in simulink browser.
4) In that, go to power electronic library.
5) Drag universal bridge in model file. Open universal bridge block and set the ABC as output.
6) Connect DC source (from sources library) to universal bridge and set DC voltage to 100V.
7) Connect series RLC load (from elements library) to output of universal bridge and set voltage to 100V rms, frequency to 50Hz, active power to 1000W, inductive reactive power to 10 VAR. And capacitive reactive power to 0 VAR.
8) Connect one voltage measurement block and current measurement block (from measurement block) to measure the line voltage and line current.
9) Connect output of voltage and current measurement to scope. Scope is available in simulink-sinks. Set the number of axis is equal to 2.
10) Set simulation parameter as stop time = 2.00
    Solver option = ode 15s stiff/NDF.
11) Start the simulation and observe the waveforms.
12) Increase the inductive load from 10 Var to 1000 Var and see effect on waveforms.

Model graphs: **When Load is 1000W and 10 VAr**



\When Load is 1000W and 1000 VAr



Conclusion:

References:

1. Power Electronics by M.H. Rashid, Prentice Hall of India.
2..Power Electronics by M.D.Singh and Khanchandani
3.Power Electronics by Ned Mohan

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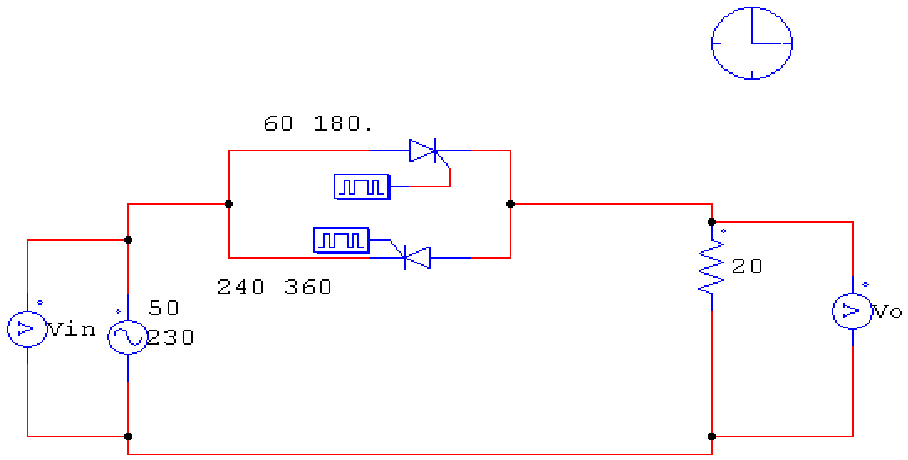
POWER ELECTRONICS (TE ELECTRICAL)
LEARNING BEYOND SYLLABUS

Title : **1 PHASE AC VOLTAGE CONTROLLER**

Aim : To design a single phase AC Voltage Controller using PSIM/MATLAB

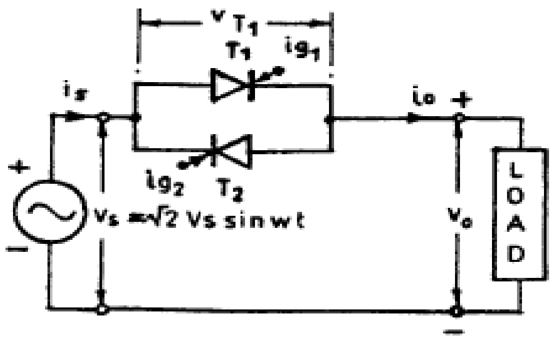
Apparatus/ Components required: PSIM /MATLAB software

Circuit Diagram:

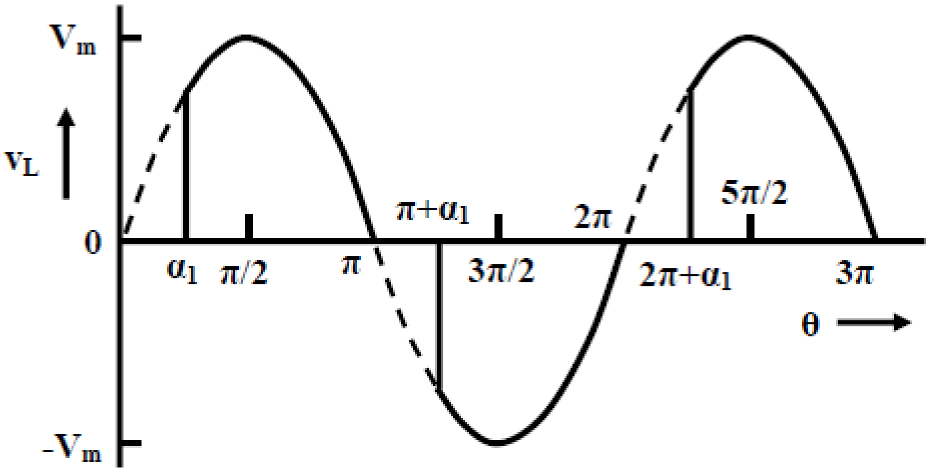


Theory: The basic power circuit of a single-phase ac-ac voltage controller is composed of a pair ofSCRs connected back-to-back (also known as inverse-parallel or antiparallel) between the ac supply and the load. This connection provides a bidirectional full-wave symmetrical control and the SCR pair can be replaced by a Triac With phase control, the switches conduct the load current for a chosen period of each input cycle of voltage and with on/off control the switches connect the load either for a few cycles of input voltage and disconnect it for the next few cycles (integral cycle control) or the switches are turned on and off several times within alternate half-cycles of input voltage (ac chopper or PWM ac voltage controller).

For a full-wave, symmetrical phase control, the SCRs T1 and T2 are gated at α and (Π +α) respectively, from the zero crossing of the input voltage and by varying α, the power flow to the load is controlled through voltage control in alternate half-cycles. As long as one SCR is carrying current, the other SCR remains reverse-biased by the voltage drop across the conducting SCR. The principle of operation in each half-cycle is similar to that of the controlled half-wave rectifier.



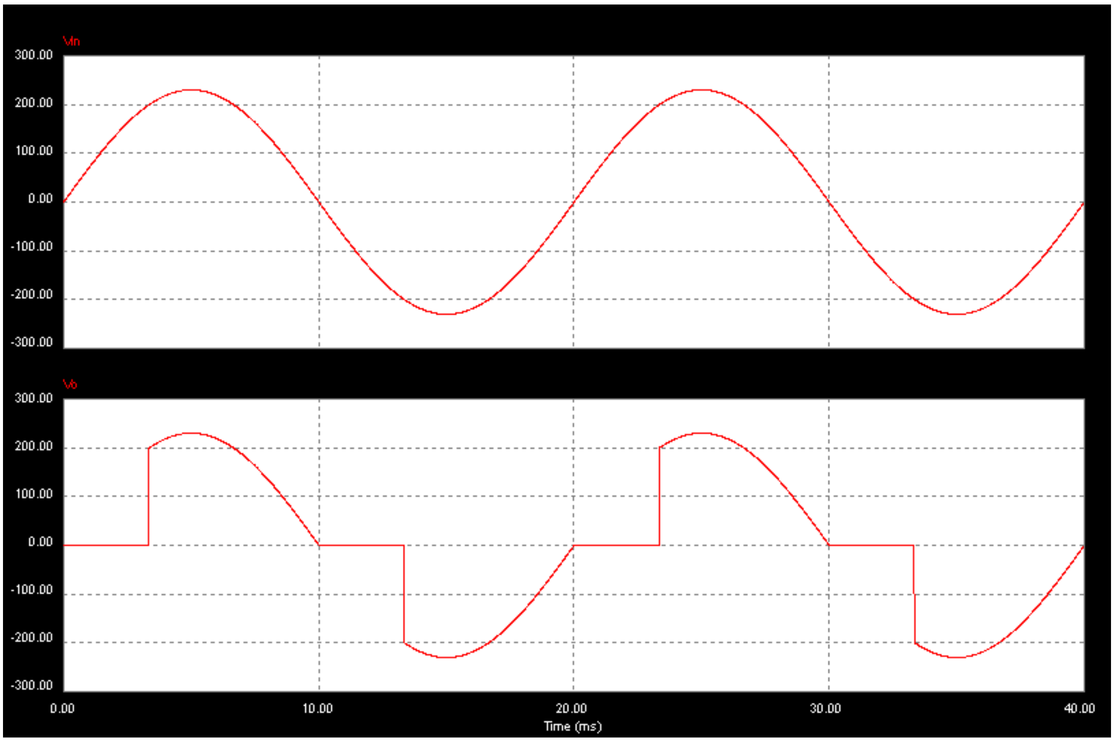
Model Graph:



Procedure:

1. Open the PSIM/MATLAB and built a new file in it.
2. By using SCRs/MOSFETs /IGBTs construct a single phase AC Voltage Controller as shown in the figure.
3. Give pulse sequence to both the switches.
4. Run the simulation and see the results in SimView/Scope window.

Waveforms



Conclusion:

References:

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Experiment No. 1: Computer Program for 1D bar using linear elements. Show the Variation of Stress and Strain.

AIM:

To determine stress and displacement in bar

Hardware required:

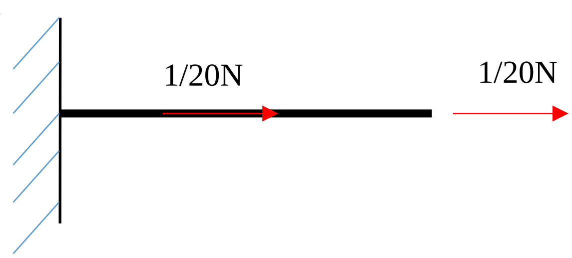
1. I5 Intel processor.
2. 4 GB RAM.
3. VGA color monitor.
4. Color printer

Software required:

1. ANSYS APDL
2. MATLAB

Problem Statement:

Find the Stresses developed in a component with cross section area of $1cm^2$ and length of 1 cm. Consider 20 elements and a force of 1/20N is being applied axially on each element.

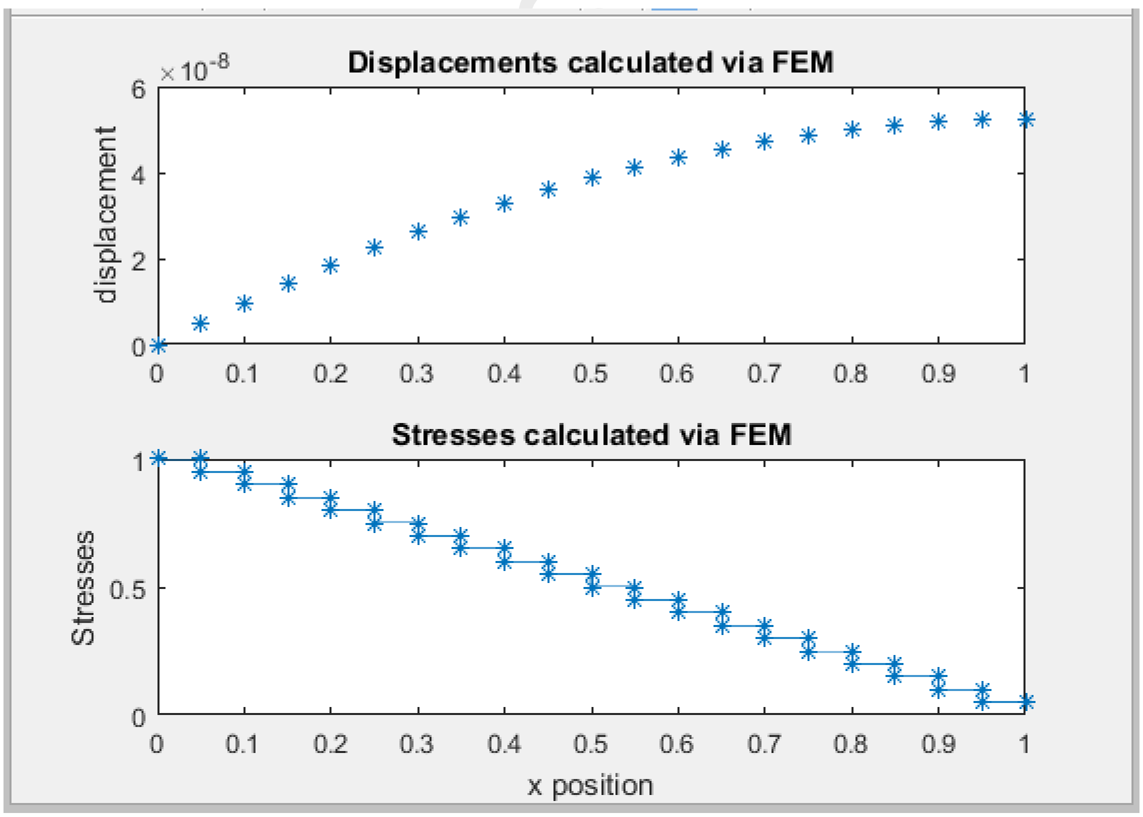


MATLAB Code:

```
% One dimensional finite element program
% Simulation and Modeling 345
% INPUT DATA
% this data automatically describes a line of 2-node elements
% with support conditions at both ends and a uniform load; the
% number of elements can be varied by changing numele

clear;
clc;
close all;                          %closes all open Figure windows
disp('This is a general Matlab code for a 1D rod.');
disp('This program can be edited to solve a number of suitable problems');
numele=20;                           % number of elements
numnod=numele+1;                    % number of nodes (special case for 1D
problem)
x= 0:1/numele:1;                    % x-coordinates of nodes
node= [1:numele; 2:numele+1];       % node stores the nodes of all elements
area=[1*ones(1,numele)];            % area of each element
young=[1E7*ones(1,numele)];         % Young's modulus of each element
% support conditions, ifix(i)=1 if node i is fixed, else zero
ifix=[1,zeros(1,numele)];
ifix(numnod)=0;                     %change the BC on last node; 1 = fixed, 0 =
free
force=[1/numele*ones(1,numnod)];% applied external forces on nodes
%
% BELOW IS THE MACHINERY OF THE FEM METHOD
% DO NOT CHANGE - SKIP TO THE PLOTTING PART
bigk=[zeros(numnod,numnod)];        % zero bigk matrix to prepare for assembly
%
for e=1:numele                              % loop over elements
    length=x(node(2,e))-x(node(1,e));       % compute element length
    c=young(e)*area(e)/length;              % "spring stiffness" for each rod
    ke=[c,-c;-c,c];                         % compute element stiffness%
    % now assemble ke into bigk
    bigk(node(1,e),node(1,e))=bigk(node(1,e),node(1,e))+ke(1,1);
    bigk(node(1,e),node(2,e))=bigk(node(1,e),node(2,e))+ke(1,2);
    bigk(node(2,e),node(1,e))=bigk(node(2,e),node(1,e))+ke(2,1);
    bigk(node(2,e),node(2,e))=bigk(node(2,e),node(2,e))+ke(2,2);
end

% support conditions (boundary conditions)
for n=1:numnod
    if (ifix(n) == 1)
        bigk(n,n)=1E+30;                    % math trick to account for fixed BC
        force(n)=0;
    end
end
%
disp=force/bigk;                            % SOLVE [F]=[K][D] FOR THE NODAL
DISPLACEMENTS
%
subplot(211), plot(x,disp,'*')              % plot displacements
title('Displacements calculated via FEM');
```

```
ylabel('displacement')

% compute stresses

for e=1:numele                                % this loops over the number of
elements
    length=x(node(2,e))-x(node(1,e));         % compute element length
    elong=disp(node(2,e))-disp(node(1,e)); % elongation of each element
    stress(2*e-1)=young(e)*elong/length;      % to plot, calculate the "stress"
at each node
    stress(2*e)=stress(2*e-1);                % stress in each element is
uniform
    xx(2*e-1)=x(node(1,e));
    xx(2*e)=x(node(2,e));
end

subplot(212)
plot(xx,stress,'*-')  % plot the FEM stresses (constant stress element)

title('Stresses calculated via FEM');
xlabel('x position')
ylabel('Stresses')
```

MATLAB Result:



Result from Ansys:

Displacement:

```
***** POST1 NODAL DEGREE OF FREEDOM LISTING *****

LOAD STEP=     1  SUBSTEP=     1
 TIME=    1.0000      LOAD CASE=   0

THE FOLLOWING DEGREE OF FREEDOM RESULTS ARE IN THE GLOBAL COORDINATE SYSTEM

  NODE      UX
     1   0.0000
     2  0.52500E-07
     3  0.50000E-08
     4  0.97500E-08
     5  0.14250E-07
     6  0.18500E-07
     7  0.22500E-07
     8  0.26250E-07
     9  0.29750E-07
    10  0.33000E-07
    11  0.36000E-07
    12  0.38750E-07
    13  0.41250E-07
    14  0.43500E-07
    15  0.45500E-07
    16  0.47250E-07
    17  0.48750E-07
    18  0.50000E-07
    19  0.51000E-07
    20  0.51750E-07
    21  0.52250E-07

MAXIMUM ABSOLUTE VALUES
NODE          2
VALUE   0.52500E-07
```


Stress:

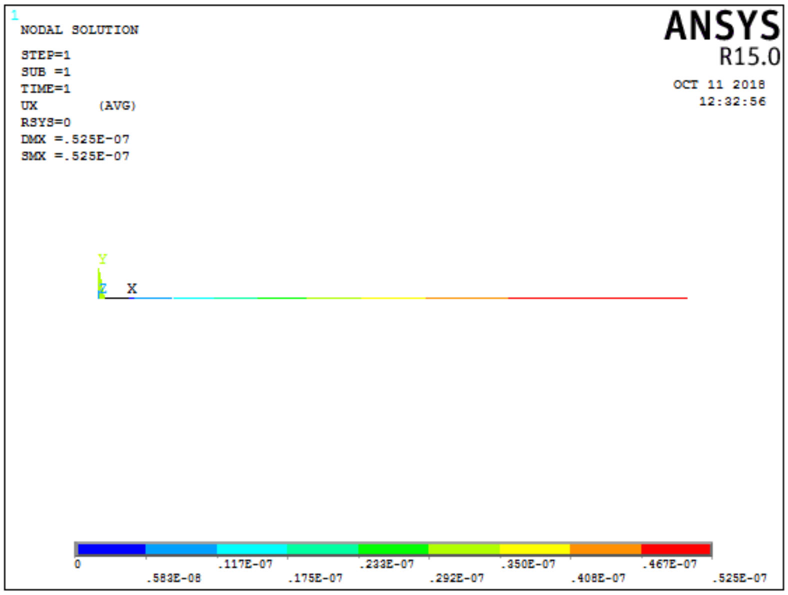
```
***** POST1 ELEMENT NODAL STRESS LISTING *****

  LOAD STEP=     1  SUBSTEP=     1
   TIME=    1.0000      LOAD CASE=   0

  THE FOLLOWING X,Y,Z VALUES ARE IN GLOBAL COORDINATES


  ELEMENT=       1        LINK180
    NODE    SX           SY           SZ           SXY          SYZ          SXZ
       1   1.0000       0.0000       0.0000       0.0000       0.0000       0.0000
       3   1.0000       0.0000       0.0000       0.0000       0.0000       0.0000

  ELEMENT=       2        LINK180
    NODE    SX           SY           SZ           SXY          SYZ          SXZ
       3  0.95000       0.0000       0.0000       0.0000       0.0000       0.0000
       4  0.95000       0.0000       0.0000       0.0000       0.0000       0.0000

  ELEMENT=       3        LINK180
```

```
  NODE    SX          SY          SZ          SXY         SYZ         SXZ
     4  0.90000      0.0000      0.0000      0.0000      0.0000      0.0000
     5  0.90000      0.0000      0.0000      0.0000      0.0000      0.0000

 ELEMENT=       4         LINK180
  NODE    SX          SY          SZ          SXY         SYZ         SXZ
     5  0.85000      0.0000      0.0000      0.0000      0.0000      0.0000
     6  0.85000      0.0000      0.0000      0.0000      0.0000      0.0000

 ELEMENT=       5         LINK180
  NODE    SX          SY          SZ          SXY         SYZ         SXZ
     6  0.80000      0.0000      0.0000      0.0000      0.0000      0.0000
     7  0.80000      0.0000      0.0000      0.0000      0.0000      0.0000

 ELEMENT=       6         LINK180
  NODE    SX          SY          SZ          SXY         SYZ         SXZ
     7  0.75000      0.0000      0.0000      0.0000      0.0000      0.0000
     8  0.75000      0.0000      0.0000      0.0000      0.0000      0.0000

 ELEMENT=       7         LINK180
  NODE    SX          SY          SZ          SXY         SYZ         SXZ
     8  0.70000      0.0000      0.0000      0.0000      0.0000      0.0000
     9  0.70000      0.0000      0.0000      0.0000      0.0000      0.0000

***** POST1 ELEMENT NODAL STRESS LISTING *****

 LOAD STEP=     1  SUBSTEP=     1
  TIME=    1.0000      LOAD CASE=   0

 THE FOLLOWING X,Y,Z VALUES ARE IN GLOBAL COORDINATES


 ELEMENT=       8         LINK180
  NODE    SX          SY          SZ          SXY         SYZ         SXZ
     9  0.65000      0.0000      0.0000      0.0000      0.0000      0.0000
    10  0.65000      0.0000      0.0000      0.0000      0.0000      0.0000

 ELEMENT=       9         LINK180
  NODE    SX          SY          SZ          SXY         SYZ         SXZ
    10  0.60000      0.0000      0.0000      0.0000      0.0000      0.0000
    11  0.60000      0.0000      0.0000      0.0000      0.0000      0.0000

 ELEMENT=      10         LINK180
  NODE    SX          SY          SZ          SXY         SYZ         SXZ
    11  0.55000      0.0000      0.0000      0.0000      0.0000      0.0000
    12  0.55000      0.0000      0.0000      0.0000      0.0000      0.0000

 ELEMENT=      11         LINK180
  NODE    SX          SY          SZ          SXY         SYZ         SXZ
    12  0.50000      0.0000      0.0000      0.0000      0.0000      0.0000
    13  0.50000      0.0000      0.0000      0.0000      0.0000      0.0000

 ELEMENT=      12         LINK180
  NODE    SX          SY          SZ          SXY         SYZ         SXZ
    13  0.45000      0.0000      0.0000      0.0000      0.0000      0.0000
    14  0.45000      0.0000      0.0000      0.0000      0.0000      0.0000

 ELEMENT=      13         LINK180
  NODE    SX          SY          SZ          SXY         SYZ         SXZ
    14  0.40000      0.0000      0.0000      0.0000      0.0000      0.0000
    15  0.40000      0.0000      0.0000      0.0000      0.0000      0.0000
```

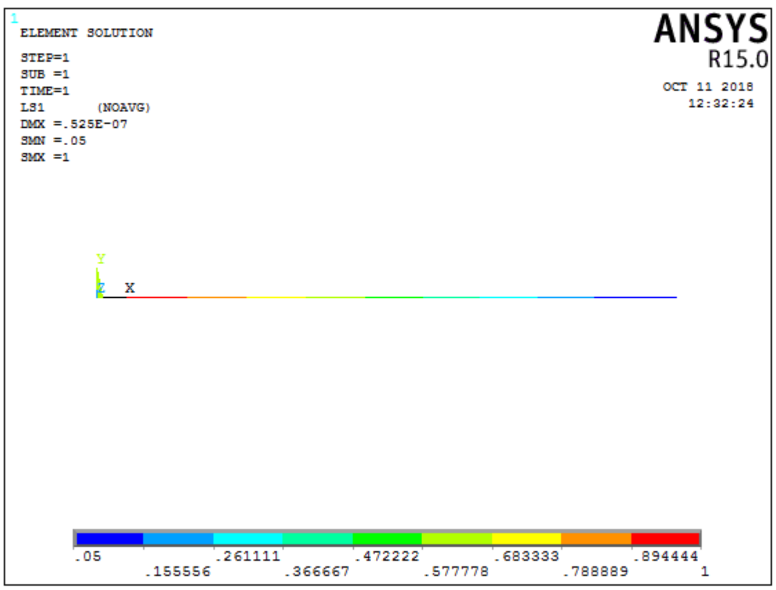
```
 ELEMENT=      14        LINK180
   NODE    SX           SY           SZ           SXY          SYZ          SXZ
     15  0.35000      0.0000       0.0000       0.0000       0.0000       0.0000
     16  0.35000      0.0000       0.0000       0.0000       0.0000       0.0000

***** POST1 ELEMENT NODAL STRESS LISTING *****

 LOAD STEP=     1  SUBSTEP=     1
  TIME=    1.0000      LOAD CASE=   0

 THE FOLLOWING X,Y,Z VALUES ARE IN GLOBAL COORDINATES


 ELEMENT=      15        LINK180
   NODE    SX           SY           SZ           SXY          SYZ          SXZ
     16  0.30000      0.0000       0.0000       0.0000       0.0000       0.0000
     17  0.30000      0.0000       0.0000       0.0000       0.0000       0.0000

 ELEMENT=      16        LINK180
   NODE    SX           SY           SZ           SXY          SYZ          SXZ
     17  0.25000      0.0000       0.0000       0.0000       0.0000       0.0000
     18  0.25000      0.0000       0.0000       0.0000       0.0000       0.0000

 ELEMENT=      17        LINK180
   NODE    SX           SY           SZ           SXY          SYZ          SXZ
     18  0.20000      0.0000       0.0000       0.0000       0.0000       0.0000
     19  0.20000      0.0000       0.0000       0.0000       0.0000       0.0000

 ELEMENT=      18        LINK180
   NODE    SX           SY           SZ           SXY          SYZ          SXZ
     19  0.15000      0.0000       0.0000       0.0000       0.0000       0.0000
     20  0.15000      0.0000       0.0000       0.0000       0.0000       0.0000

 ELEMENT=      19        LINK180
   NODE    SX           SY           SZ           SXY          SYZ          SXZ
     20  0.10000      0.0000       0.0000       0.0000       0.0000       0.0000
     21  0.10000      0.0000       0.0000       0.0000       0.0000       0.0000

 ELEMENT=      20        LINK180
   NODE    SX           SY           SZ           SXY          SYZ          SXZ
     21  0.50000E-01  0.0000       0.0000       0.0000       0.0000       0.0000
      2  0.50000E-01  0.0000       0.0000       0.0000       0.0000       0.0000
```

Ansys Plot:

Displacement:



Stress:



Conclusion:

MATLAB code developed successfully and its results are verified using ANSYS analysis software.

Head of Department
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ICT Tools You Tube and NPTEL Link

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College of Engineering
ICT USAGE
Department: Mechanical Engineering

Sr. No	Name of Faculty	Subject	ICT Tool	Link/URL
1	Dr. Bhanudas Dattatraya Bachchhav	Manufacturing Engineering Manufacturing Processes	CDs Videos	Borrowed through British Library Mumbai Encouraged students to see NPTEL videos
11	Mr. Dinesh Yashwant Dhande	**Computer Aided Machine Drawing**	**YouTube**	https://www.youtube.com/watch?v=jgrI4JHmT0g https://www.youtube.com/watch?v=S9fshEGLmtA https://www.youtube.com/watch?v=t4wwBBdcM2o https://www.youtube.com/watch?v=CMyFYlgtK7A https://www.youtube.com/watch?v=hpy38OBIbBI https://www.youtube.com/watch?v=wvVd8XR3AdE https://www.youtube.com/watch?v=c_WcrGhJK9g https://www.youtube.com/watch?v=nMXgcWrgMfQ https://www.youtube.com/watch?v=1u4Hmeg-EtY&t=10s https://www.youtube.com/watch?v=WcV_zIgi7Ak https://www.youtube.com/watch?v=kB15AxYIe1M&t=82s https://www.youtube.com/watch?v=DTiw9OT5Isk https://www.youtube.com/watch?v=llDpXrhFiIU&t=1s https://www.youtube.com/watch?v=-kK5v4Z4mXE&t=156s https://www.youtube.com/watch?v=Zg0Y_5F-U7M https://www.youtube.com/watch?v=JUTGmwMWciY https://www.youtube.com/watch?v=JPJ2WXOCvyM https://www.youtube.com/watch?v=sv-miFmurO4 https://www.youtube.com/watch?v=1DSJ795_3i0 https://www.youtube.com/watch?v=e2cAWcWPUyw https://www.youtube.com/watch?v=bv21QTKISuc
18	Ms. Ashwini Tanaji Thombare (Tonde)	Theory of Machine II	YouTube	https://www.youtube.com/watch?v=K4JhruinbWc
19	Ms. Margi Pritesh Shah (Chokshi)	CAD/CAM and Automation	Slide share	1.https://www.slideshare.net/MargiChokshi/automation-83102238?qid=f8057617-89b0-4ffb-baa1-ab55ae12f968&v=&b=&from_search=1 2.https://www.slideshare.net/MargiChokshi/roboticampautomation?qid=f8057617-89b0-4ffb-baa1-ab55ae12f968&v=&b=&from_search=2
20				
21	Mr. Yogesh Balwant Karandikar	Machine Design	NPTEL Video / PDF	http://nptel.ac.in/courses/112105124/ http://nptel.ac.in/downloads/112105125/ http://nptel.ac.in/courses/112106137/ http://www.nptelvideos.in/2012/12/design-of-machine-elements.html http://web.iitd.ac.in/~hirani/MEL311.pdf
27	Mr. Ganesh Bhoju Narkhede	Strength of Materials	YouTube	https://www.youtube.com/watch?v=GkFgysZC4Vc http://nptel.ac.in/courses/112107147/1 http://nptel.ac.in/courses/112107147/2 http://nptel.ac.in/courses/112106180/13 http://nptel.ac.in/courses/112106180/14 http://nptel.ac.in/courses/112107147/35 http://nptel.ac.in/courses/112107147/23 http://nptel.ac.in/courses/112101095/3 http://nptel.ac.in/courses/112101095/7
28	Mr. Vipin Suresh Wagare	Numerical Methods & Optimization	NPTEL video & pdf	1. http://nptel.ac.in/courses/122102009/ - Numerical Methods & Computation Videos 2. http://www.iitg.ac.in/kartha/CE601/LectureSlides.htm - IIT Guwahati Useful PDF for Numerical Method
29	Ms. Sujata Laxman Patekar	Applied Computer aided Engineering	Slide Share	https://www.slideshare.net/SujataPatekarJadhav/rapid-prototyping-82095894?qid=f59c7f7b-740b-4ce6-81b8-743e80bafa1e&v=&b=&from_search=1
33	Mr. Girishkumar Nagnath Jagdale	Design of Simple Machine Elements – I	NPTEL	http://nptel.ac.in/courses/112105124/18 http://nptel.ac.in/courses/112105124/19 http://nptel.ac.in/courses/112105124/20 http://nptel.ac.in/courses/112105124/21 http://nptel.ac.in/courses/112105124/27 http://nptel.ac.in/courses/112105124/28 http://nptel.ac.in/courses/112105124/29 http://nptel.ac.in/courses/112105124/23 http://nptel.ac.in/courses/112105124/24 http://nptel.ac.in/courses/112105124/35 http://nptel.ac.in/courses/112105124/36 https://www.youtube.com/watch?v=qUr4qZ4gD_w https://www.youtube.com/watch?v=SLqkITQfN1I
34	Ms. Sonali Shrikant Patil			
35	Mr. Sumit Madhukar Sakhare-Chougule			https://onlinecourses.nptel.ac.in/noc17_me22/unit?unit=43&lesson=48 https://onlinecourses.nptel.ac.in/noc17_me22/unit?unit=52&lesson=54 https://onlinecourses.nptel.ac.in/noc17_me22/unit?unit=14&lesson=16 https://onlinecourses.nptel.ac.in/noc17_me22/unit?unit=59&lesson=63 https://onlinecourses.nptel.ac.in/noc17_me22/unit?unit=52&lesson=55 www.me.udel.edu/~prasad/meeg331/labs/jet.pd https://onlinecourses.nptel.ac.in/noc17_me22/unit?unit=59&lesson=64 https://onlinecourses.nptel.ac.in/noc17_me22/unit?unit=43&lesson=46 https://onlinecourses.nptel.ac.in/noc17_me22/unit?unit=59&lesson=65 https://onlinecourses.nptel.ac.in/noc17_me22/unit?unit=68&lesson=71 https://onlinecourses.nptel.ac.in/noc17_me22/unit?unit=68&lesson=72 https://onlinecourses.nptel.ac.in/noc17_me22/unit?unit=59&lesson=62 https://onlinecourses.nptel.ac.in/noc17_me22/unit?unit=59&lesson=65 https://onlinecourses.nptel.ac.in/noc17_me22/unit?unit=68&lesson=70 https://onlinecourses.nptel.ac.in/noc17_me22/unit?unit=14&lesson=17

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