IT5412 - ADVANCED DATA STRUCTURES
Mini Project Report

AUTOMATIC EXAM TIMETABLE SCHEDULER

DONE BY

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AIM:

To develop a automatic exam timetable scheduler using graph coloring method in C++ programming language.

PROBLEM STATEMENT:

PROBLEM:

- Exam time table scheduling problem
- Every education system faces this problem.
- Due to vast number of students in offered courses.
- Graph colouring approach is used to solve this problem.

SOLUTION:

For solving this problem, we make vertices of total number of subject, and assign every vertex to one subject. Then we make edge between all subject of every semester.

KEY FUNCTIONS OF THE PROJECT:

displayColors()

This function is used to display all the allocated slots with their respective subject names and codes. It's return type is void.

Display()

This function used to display the colors given to vertices(subjects) explicitly for better understanding. It's return type is void.

satisfyConstraints()

This function used to check whether the color is assigned and whether it has an edge or not. It's return type is bool.

m_Coloring_Helper()

This function is used to help the m_Coloring function by allocating colors to each vertex and check whether it is valid or not. It’s return type is bool.

m_Coloring()

This function is used to color all the vertices(subjects). It’s return type is bool.

displayMatrix()

This function is used to display the adjacency matrix. It’s return type is void.

add_edge()

This function is used to add edge between vertices(subjects) by manipulating adjacency matrix. It’s return type is void.

getInpput()(Member Function of Class Subjects)

This function is used to get the all the details of a course/Subject. It’s return type is void.

CLASSES USED IN THE PROJECT:

Subjects

- ➢ Data Members
  - ■ Subject_name(stores subject name)
  - ■ Subject_code(stores subject code)
  - ■ Semester(stores the semesters in which the subject appears)
- ➢ Member functions
  - ■ getInpput()

FUNCTIONALITY OF THE PROJECT:

Add course

This functionality of the project is used to add various subjects along with their information so that the program can schedule the subjects with the given information.

View schedule

This functionality of the project is used to view the scheduled time table for the given subjects with the set of information provided.

View Course

This functionality of the project is used to view the set of information provided so that user can verify.

Exit

This functionality of the project is to exit the application.

DATA STRUCTURES AND THEIR USE IN THE PROJECT:

◆ DATA STRUCTURES USED:

Graphs

- Use in the project:
  - We have used undirected graph in this project, each vertex of the graph represents each subject entered by the user. Each edge of the graph between two vertices depicts the fact that those two subjects cannot be slotted together.
  - Adjacency matrix of the graph is created and with the help of the adjacency matrix coloring of vertices is done and the timetable is scheduled.

SOURCE CODE:

```
#include <bits/stdc++.h>
#include<vector>
#include<conio.h>
using namespace std;

vector<vector<bool> > Adj_matrix;

class Subjects{
    public:
    string subject_name,subject_code;
    vector<int> semester;
    void getInpput()
    {
        int sem,semesterCount;
        cout<<"\n\n\t\t\t\t\t\t\tEnter number of semesters this course
appears:";
        cin>>semesterCount;
        cout<<"\n";
        for(int i=0;i<semesterCount;i++){
            cout<<"\t\t\t\t\t\t\tSemester Appearance "<<i+1<<":";
            cin>>sem;
            semester.push_back(sem);
        }

                cout<<"\n\t\t\t\t\t\t\tSubject name:";
        cin.ignore();
        getline(cin,subject_name);

                cout<<"\n\t\t\t\t\t\t\tSubject code:";
        cin>>subject_code;
    }
};

vector<Subjects> allSubject;
```

```
void displayColors(int color[])
{
 vector<vector<int> > cls;
 for(int i=0;i<Adj_matrix.size();i++)
 {
  vector<int> temp;
  for(int j=0;j<Adj_matrix.size();j++)
  {
   if(color[j]==(i+1))
   {
    temp.push_back(j);
   }
  }
  cls.push_back(temp);
 }
 cout<<endl;
 for(int i=0;i<Adj_matrix.size();i++)
 {
  if(!cls[i].empty())
  {
   cout<<"\t\t\t\t\t\t\t\t==================";
   cout<<"\n\t\t\t\t\t\t\t\tSlot-->"<<i+1<<endl;
   cout<<"\t\t\t\t\t\t\t\t==================\n";
   cout<<"\n\t\t\t\t\t\t\t";
   cout<<setw(35);
   cout<<"Subject Name:";
   cout<<setw(35);
   cout<<"\tSubject Code:\n ";
   for(int j=0;j<cls[i].size();j++)
   {
    cout<<"\t\t\t\t\t\t\t\t";
   cout<<setw(30);
    cout<<allSubject[cls[i][j]].subject_name;
   cout<<setw(30);
    cout<<allSubject[cls[i][j]].subject_code<<"\n";
   }
```

```
    }
  }
}

void Display(int color[]) {
  cout << "\n\n\t\t\t\t\t\t\tThe colors given to vertices are:\n" << endl;
  for (int i = 0; i < Adj_matrix.size(); i++)
    cout << "\t\t\t\t\t\t\tVertex " << i + 1 << " is given color:" << color[i]
<< endl;
  cout << endl;
}

bool satisfyConstraints(int v, vector<vector<bool> > Adj_matrix, int
color[], int c)
{
  for (int i = 0; i < Adj_matrix.size(); i++) {
    if (Adj_matrix[v][i] && c == color[i])
      return false;
  }
  return true;
}

bool m_Coloring_Helper(vector<vector<bool> > Adj_matrix, int m, int
color[], int v) {

  if (v == Adj_matrix.size())
    return true;

  for (int c = 1; c <= m; c++) {

    if (satisfyConstraints(v, Adj_matrix, color, c)) {
      color[v] = c;

      if (m_Coloring_Helper(Adj_matrix, m, color, v + 1) == true)
        return true;
      color[v] = 0;
    }
  }

  return false;
}

bool m_Coloring(vector<vector<bool> > Adj_matrix, int m) {

  int color[Adj_matrix.size()];
  for (int i = 0; i < Adj_matrix.size(); i++) {
    color[i] = 0;
  }
  if (m_Coloring_Helper(Adj_matrix, m, color, 0) == false) {
    cout << "\t\t\t\t\t\t\t\tNo such arrangement exists!!";
    return false;
  }

  Display(color);
  displayColors(color);
  return true;
}

void displayMatrix() {
   int i, j;
   cout<<"\n\n";
   for(i = 0; i < Adj_matrix.size(); i++) {
      cout<<"\t\t\t\t\t\t\t\t\t";
          for(j = 0; j < Adj_matrix.size(); j++) {
         cout<< Adj_matrix[i][j] << " ";
      }
      cout << endl;
   }
}
void add_edge(int u, int v) {
   Adj_matrix[u][v] = 1;
   Adj_matrix[v][u] = 1;
}
```

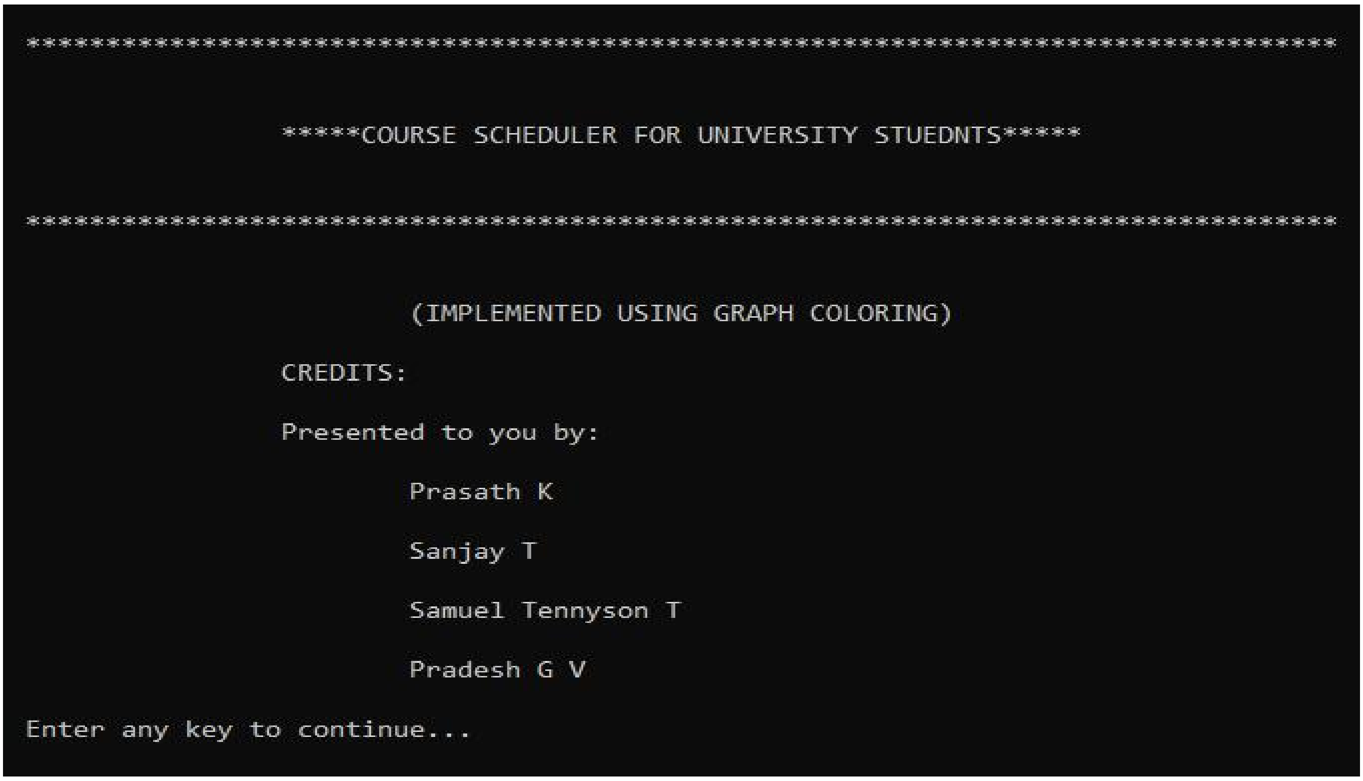
```
int main() {
        system("cls");
        cout<<"\n\n\n\n\n\t\t\t\t\t\t**********************************
**************************************************\n\n";
        cout<<"\n\t\t\t\t\t\t\t*****COURSE SCHEDULER FOR
UNIVERSITY
STUEDNTS*****\n\n\n\t\t\t\t\t********************************
****************************************************\n\n\n\t\t
\t\t\t\t\t\t\t(IMPLEMENTED USING GRAPH
COLORING)\n\n\t\t\t\t\t\t\tCREDITS:\n\n\t\t\t\t\t\t\tPresented to you
by:\n\n\t\t\t\t\t\t\t\t\tPrasath K\n\n\t\t\t\t\t\t\t\t\tSanjay
T\n\n\t\t\t\t\t\t\t\t\tSamuel Tennyson T\n\n\t\t\t\t\t\t\t\t\tPradesh G V\n\n";

    int choice;
    cout<<"\t\t\t\t\t\tEnter any key to continue...";
    getch();
    do{
        system("cls");
        Subjects S;

cout<<"\n\n\t\t\t\t\t******************************************
******************************************\n\n";
                cout<<"\n\n\t\t\t\t\t\t\t\tYOUR CHOICES ARE:\n\n";
        cout<<"\n\t\t\t\t\t\t\t\t1.Add course\n\n\t\t\t\t\t\t\t\t2.View
Schedule\n\n\t\t\t\t\t\t\t\t3.View Courses\n\n\t\t\t\t\t\t\t\t4.Exit\n";
        cout<<"\n\n\n\n\t\t\t\t\t\t\tEnter your preferred choice:";
        cin>>choice;
        switch(choice)
        {
            case 1:
                S.getInpput();
                allSubject.push_back(S);
                cout<<"\t\t\t\t\t\tEnter any key to continue...";
                getch();
                system("cls");
                break;
            case 2:
```

```
        Adj_matrix.clear();
        for(int i=0;i<allSubject.size();i++)
        {
         vector<bool> temp;
         for(int j=0;j<allSubject.size();j++)
         {
          temp.push_back(0);
         }
         Adj_matrix.push_back(temp);
        }

        for(int i=0;i<allSubject.size();i++)
        {
          for(int j=0;j<allSubject.size();j++)
          {
            if(i!=j)
            {
              for(int k=0;k<allSubject[i].semester.size();k++)
              {
                for(int l=0;l<allSubject[j].semester.size();l++)
                {

if(allSubject[i].semester[k]==allSubject[j].semester[l])
                  {
                    add_edge(i,j);
                  }
                }
              }
            }
          }
        }
        displayMatrix();
        m_Coloring(Adj_matrix,allSubject.size());
        cout<<"\n\t\t\t\t\t\tEnter any key to continue...";
        getch();
        system("cls");
        break;
```

```
      case 3:
       cout<<setw(35);
       cout<<"\n\t\t\t\t\t\t\t\tSubject Name";
       cout<<setw(35);
       cout<<"\tSubject Code\n";
       for(int i=0;i<allSubject.size();i++)
       {
         cout<<"\n\t\t\t\t\t\t\t\t";
         cout<<setw(30);
         cout<<allSubject[i].subject_name;
         cout<<setw(30);
         cout<<allSubject[i].subject_code;
       }
        cout<<"\n\t\t\t\t\t\tEnter any key to continue...";
        getch();
        system("cls");
       break;
      case 4:
        system("cls");
        cout<<"\n--Thank you--\n";
        exit(0);
    }
  }while(1);
 return 0;
}
```

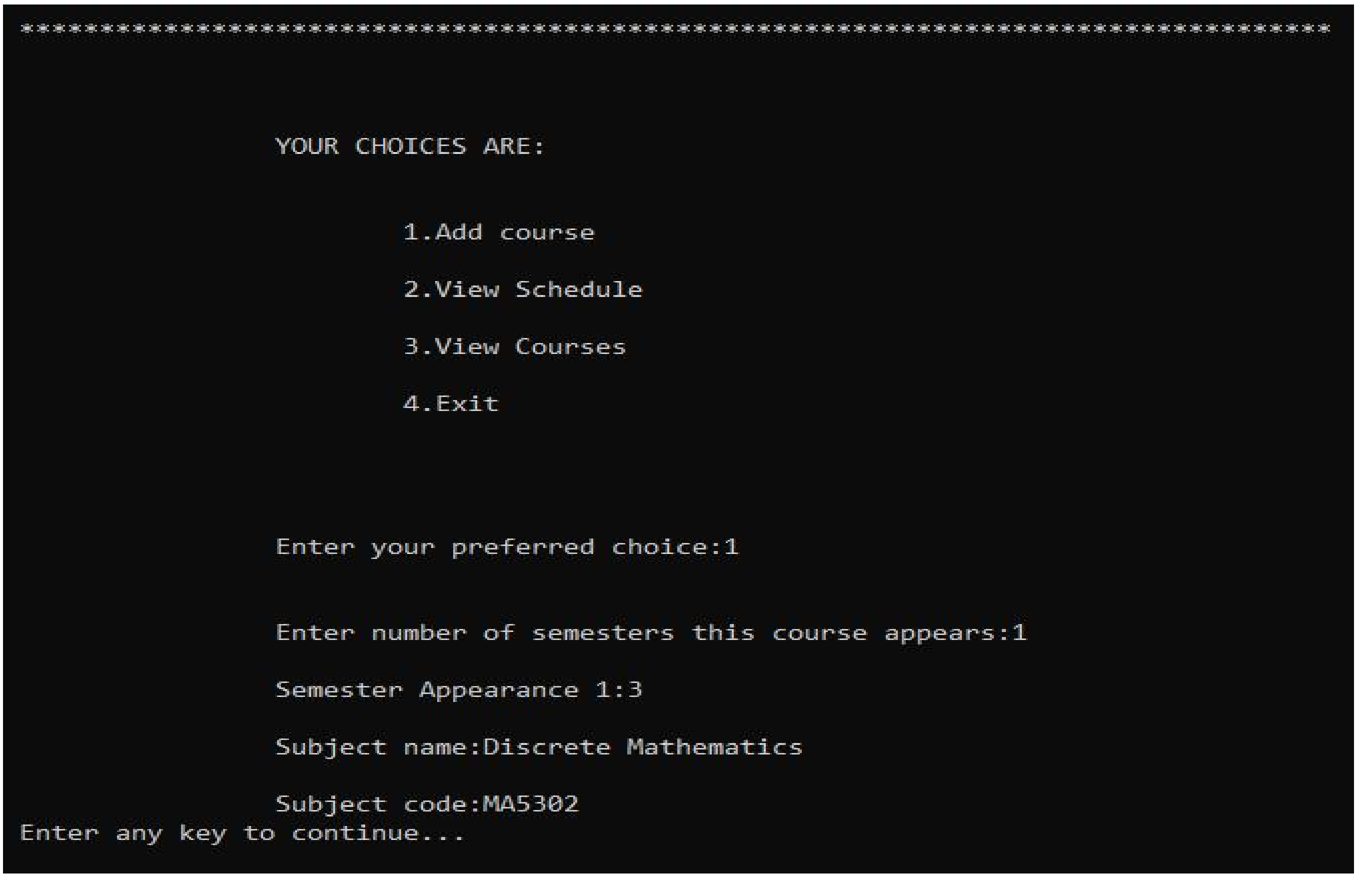
SCREENSHOTS:

Title screen:



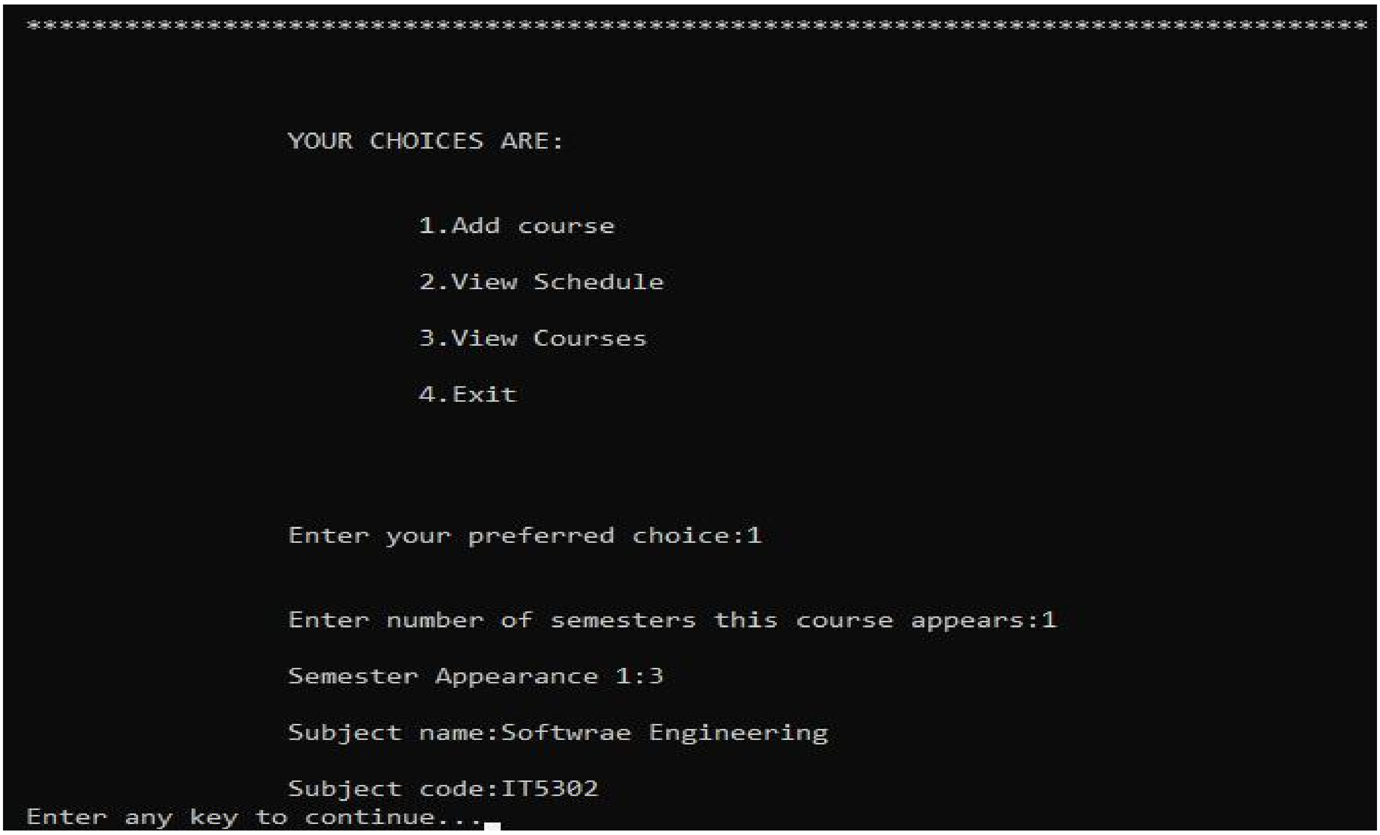
```
************************************************************************************

                *****COURSE SCHEDULER FOR UNIVERSITY STUEDNTS*****

************************************************************************************

                        (IMPLEMENTED USING GRAPH COLORING)

                CREDITS:

                Presented to you by:

                        Prasath K

                        Sanjay T

                        Samuel Tennyson T

                        Pradesh G V

Enter any key to continue...
```

Main menu:

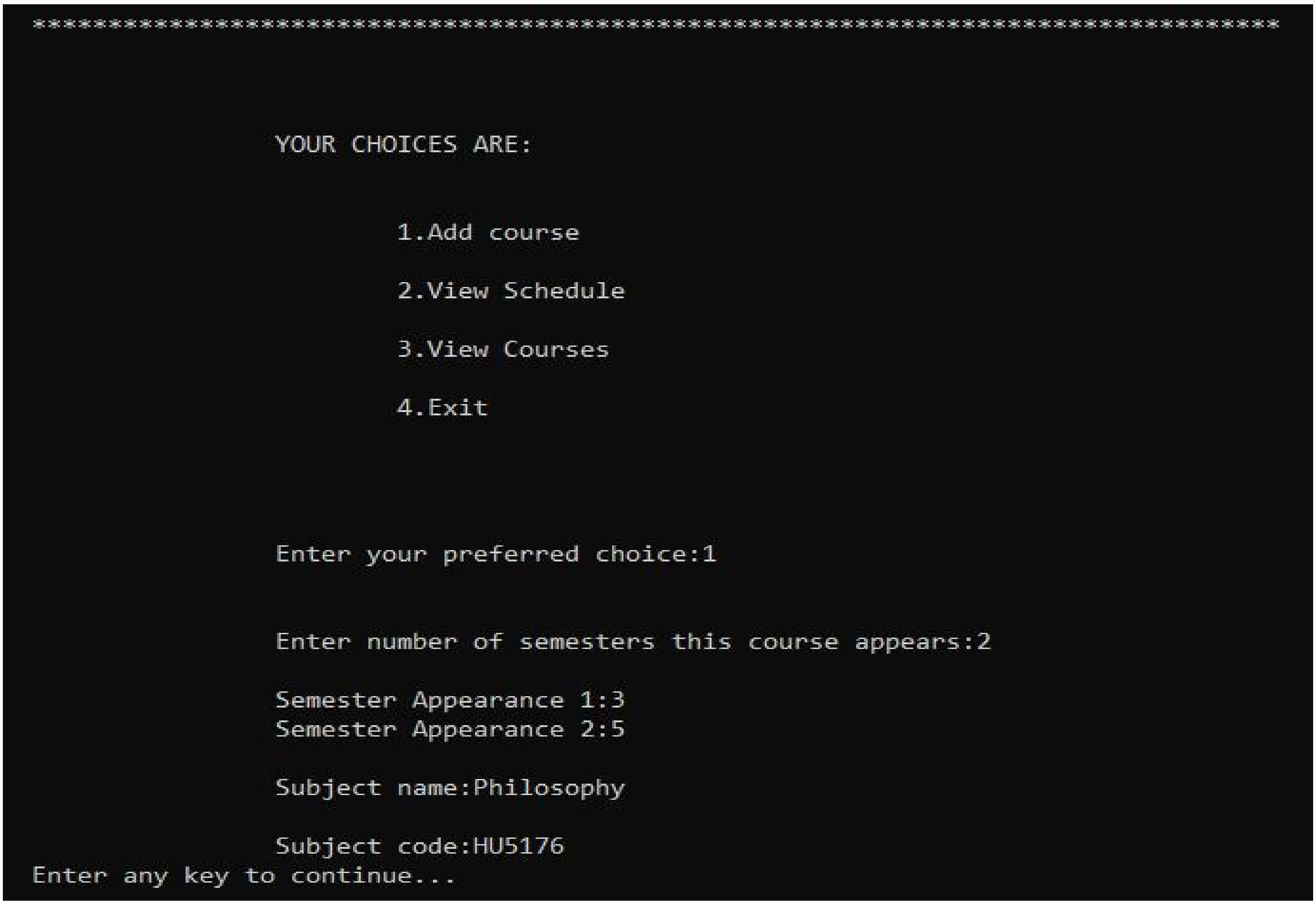


```
************************************************************************************


                YOUR CHOICES ARE:

                        1.Add course

                        2.View Schedule

                        3.View Courses

                        4.Exit



                Enter your preferred choice:1


                Enter number of semesters this course appears:1

                Semester Appearance 1:3

                Subject name:Discrete Mathematics

                Subject code:MA5302
Enter any key to continue...
```

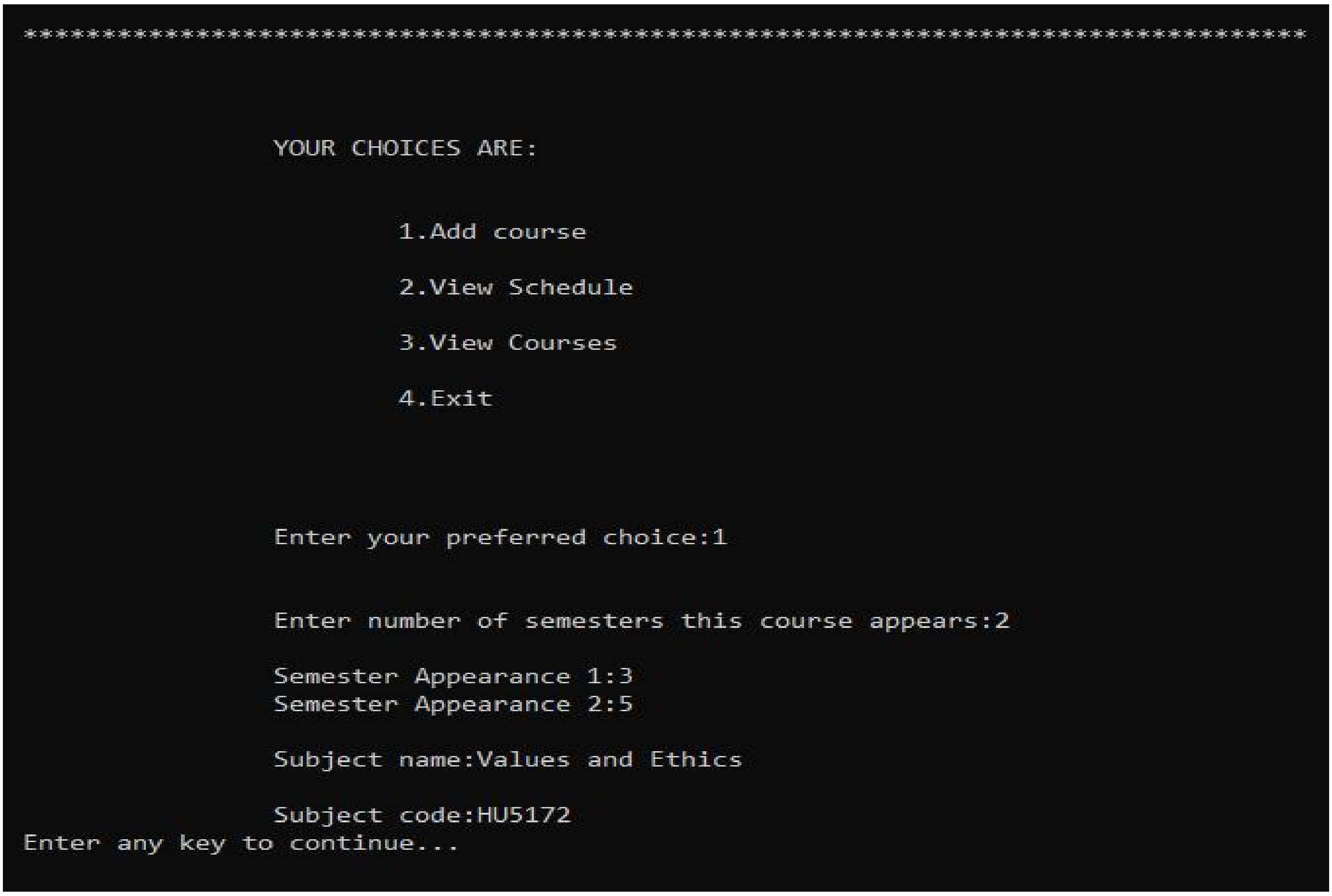
Subject Insertion:



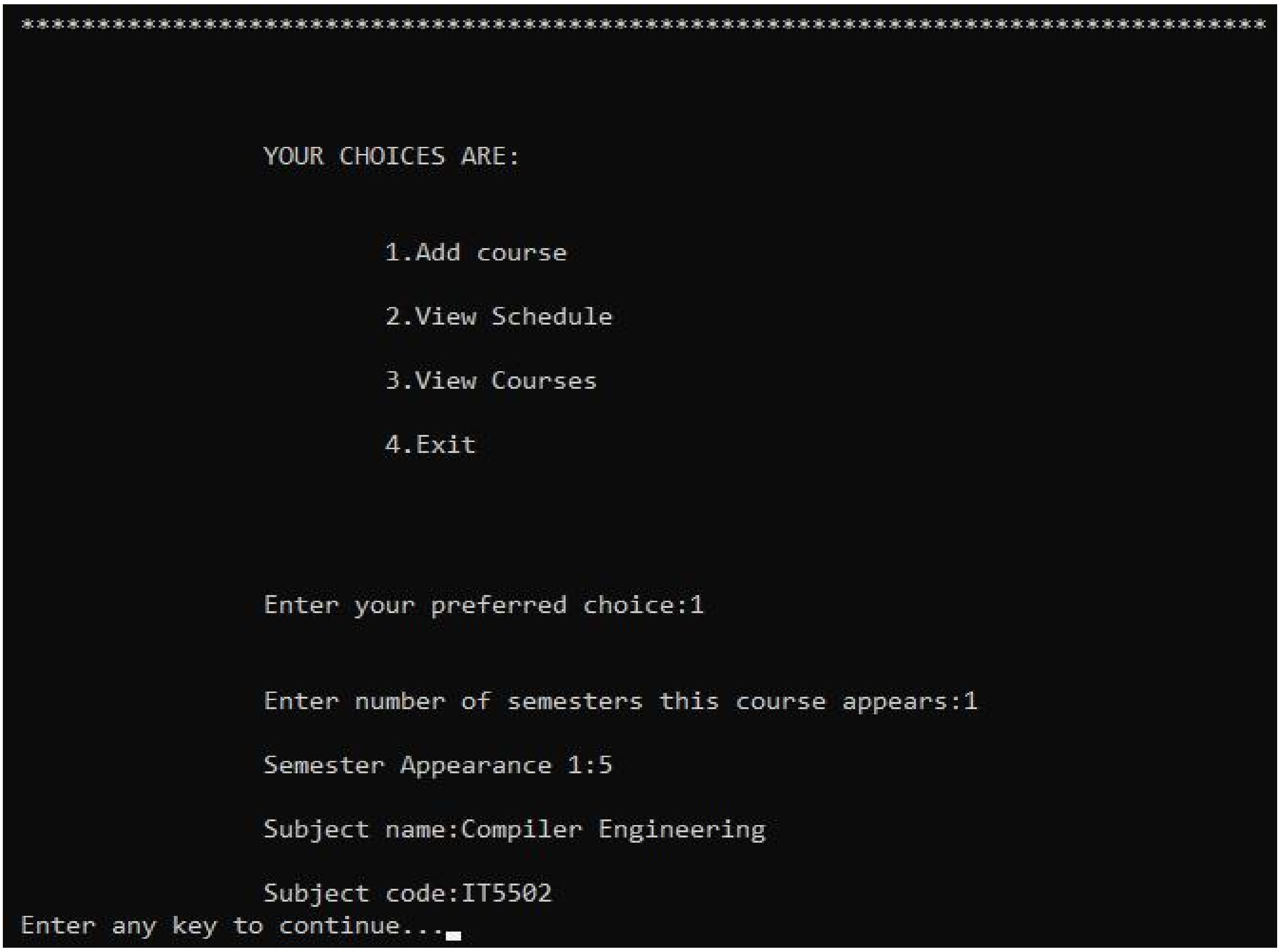
```
 ****************************************************************************************


                YOUR CHOICES ARE:


                        1.Add course

                        2.View Schedule

                        3.View Courses

                        4.Exit



                Enter your preferred choice:1


                Enter number of semesters this course appears:1

                Semester Appearance 1:3

                Subject name:Softwrae Engineering

                Subject code:IT5302
 Enter any key to continue...
```



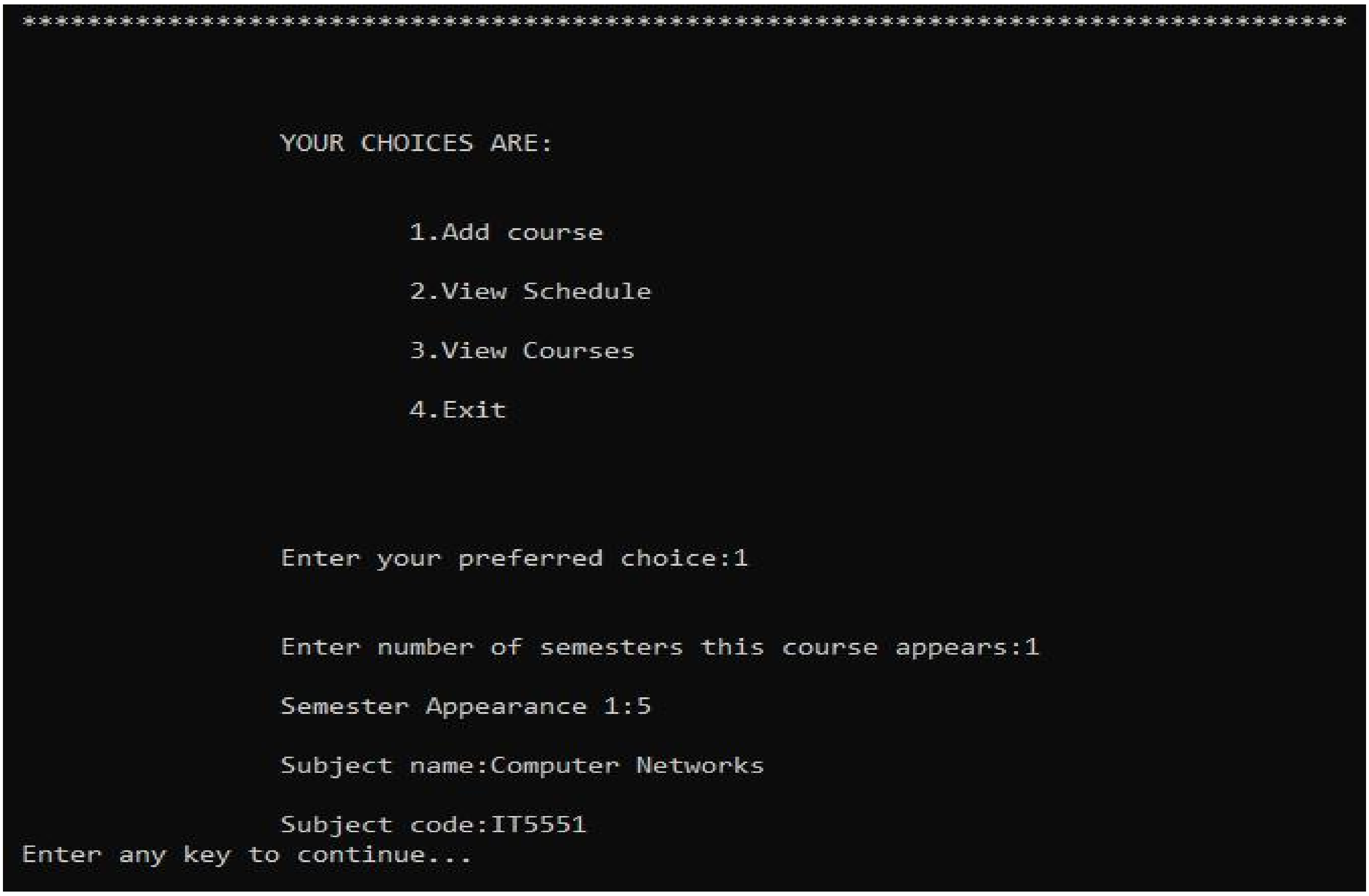
```
 ****************************************************************************************


                YOUR CHOICES ARE:


                        1.Add course

                        2.View Schedule

                        3.View Courses

                        4.Exit



                Enter your preferred choice:1


                Enter number of semesters this course appears:2

                Semester Appearance 1:3
                Semester Appearance 2:5

                Subject name:Philosophy

                Subject code:HU5176
 Enter any key to continue...
```



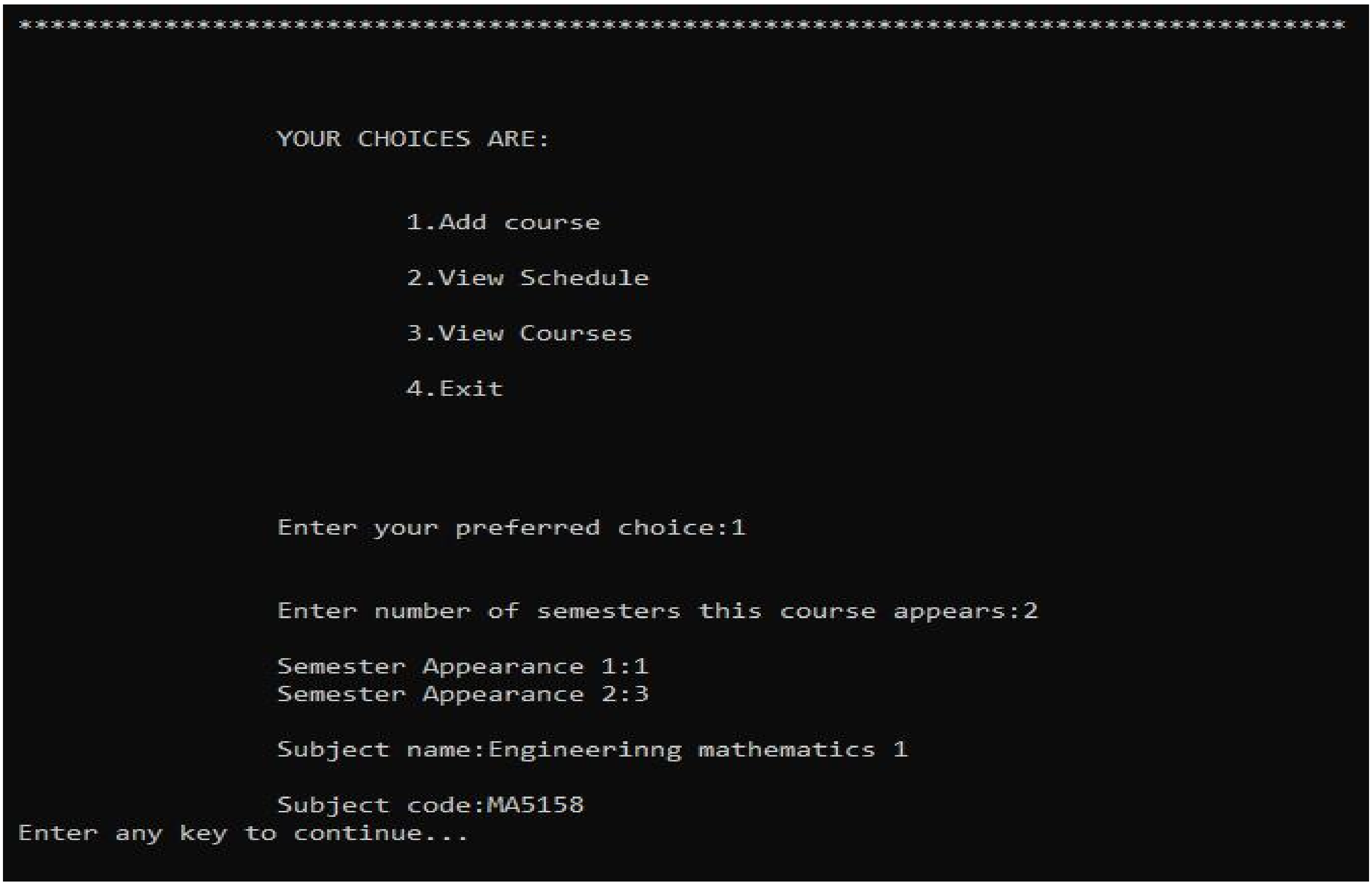
```
************************************************************************************



                YOUR CHOICES ARE:


                        1.Add course

                        2.View Schedule

                        3.View Courses

                        4.Exit




                Enter your preferred choice:1


                Enter number of semesters this course appears:2

                Semester Appearance 1:3
                Semester Appearance 2:5

                Subject name:Values and Ethics

                Subject code:HU5172
Enter any key to continue...
```



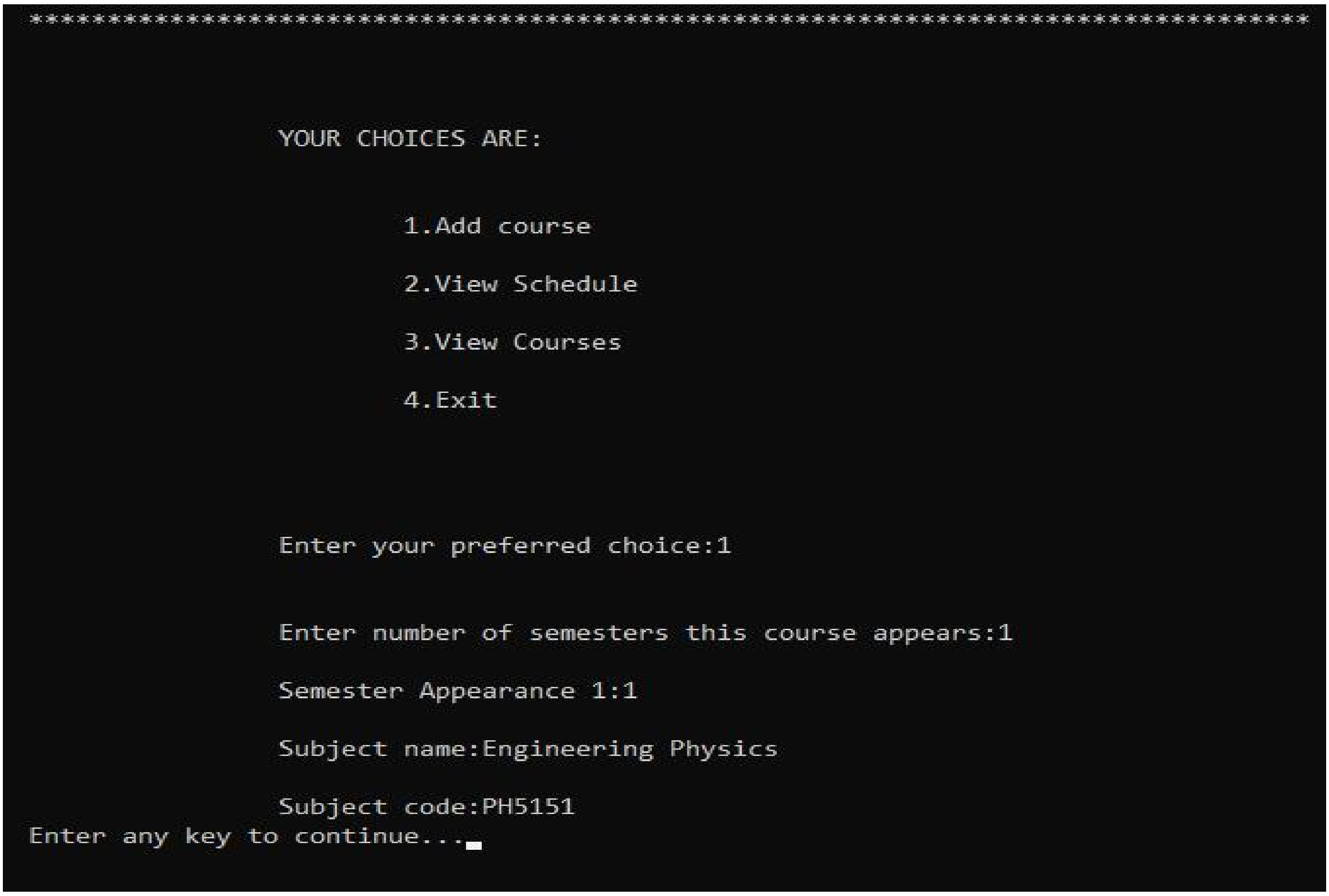
```
************************************************************************************



                YOUR CHOICES ARE:


                        1.Add course

                        2.View Schedule

                        3.View Courses

                        4.Exit




                Enter your preferred choice:1


                Enter number of semesters this course appears:1

                Semester Appearance 1:5

                Subject name:Compiler Engineering

                Subject code:IT5502
Enter any key to continue...
```



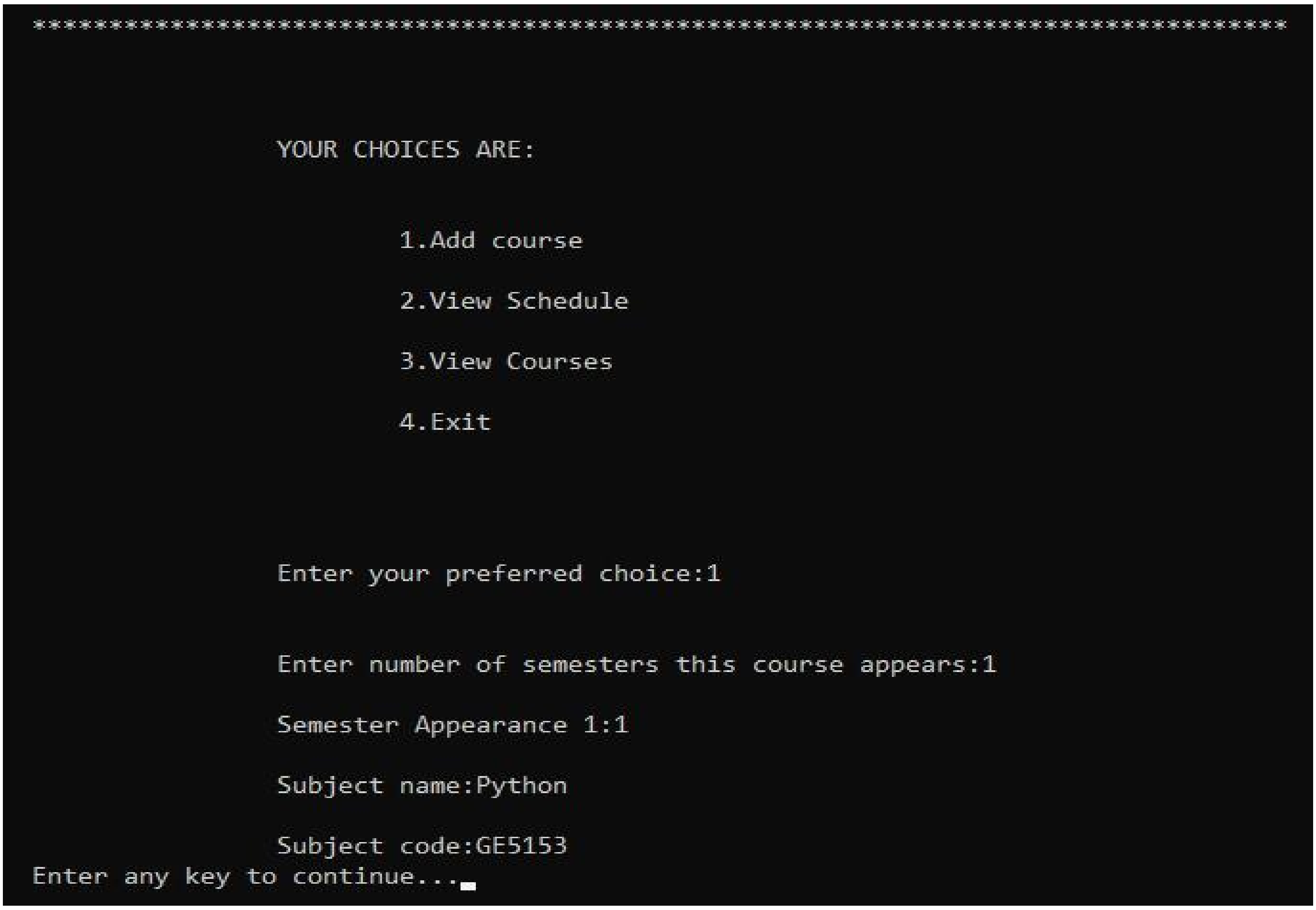
```
***********************************************************************************



                YOUR CHOICES ARE:


                        1.Add course

                        2.View Schedule

                        3.View Courses

                        4.Exit




                Enter your preferred choice:1


                Enter number of semesters this course appears:1

                Semester Appearance 1:5

                Subject name:Computer Networks

                Subject code:IT5551
Enter any key to continue...
```



```
***********************************************************************************



                YOUR CHOICES ARE:


                        1.Add course

                        2.View Schedule

                        3.View Courses

                        4.Exit




                Enter your preferred choice:1


                Enter number of semesters this course appears:2

                Semester Appearance 1:1
                Semester Appearance 2:3

                Subject name:Engineerinng mathematics 1

                Subject code:MA5158
Enter any key to continue...
```

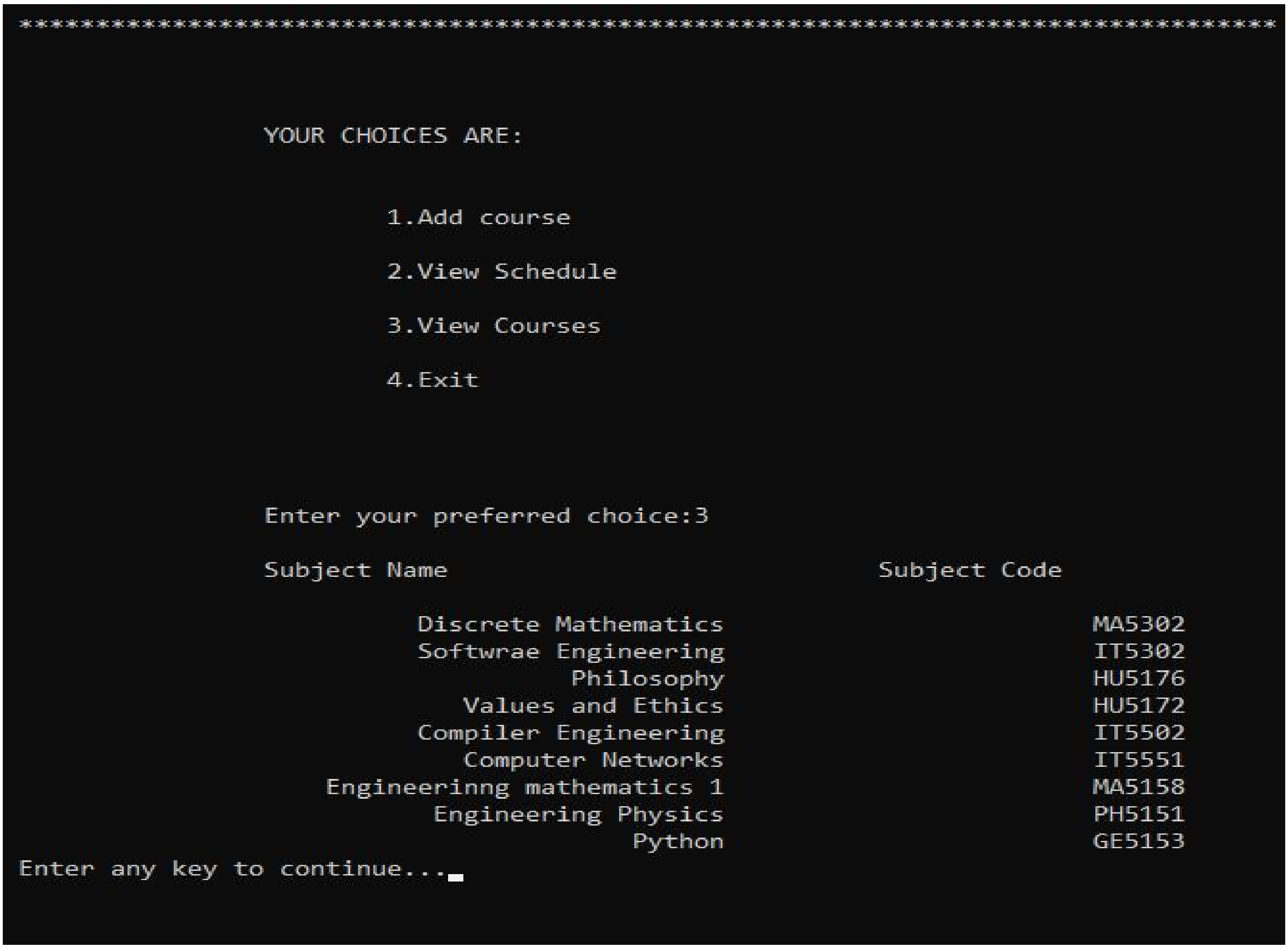


```
**********************************************************************************



                YOUR CHOICES ARE:


                        1.Add course

                        2.View Schedule

                        3.View Courses

                        4.Exit




                Enter your preferred choice:1


                Enter number of semesters this course appears:1

                Semester Appearance 1:1

                Subject name:Engineering Physics

                Subject code:PH5151
Enter any key to continue...
```



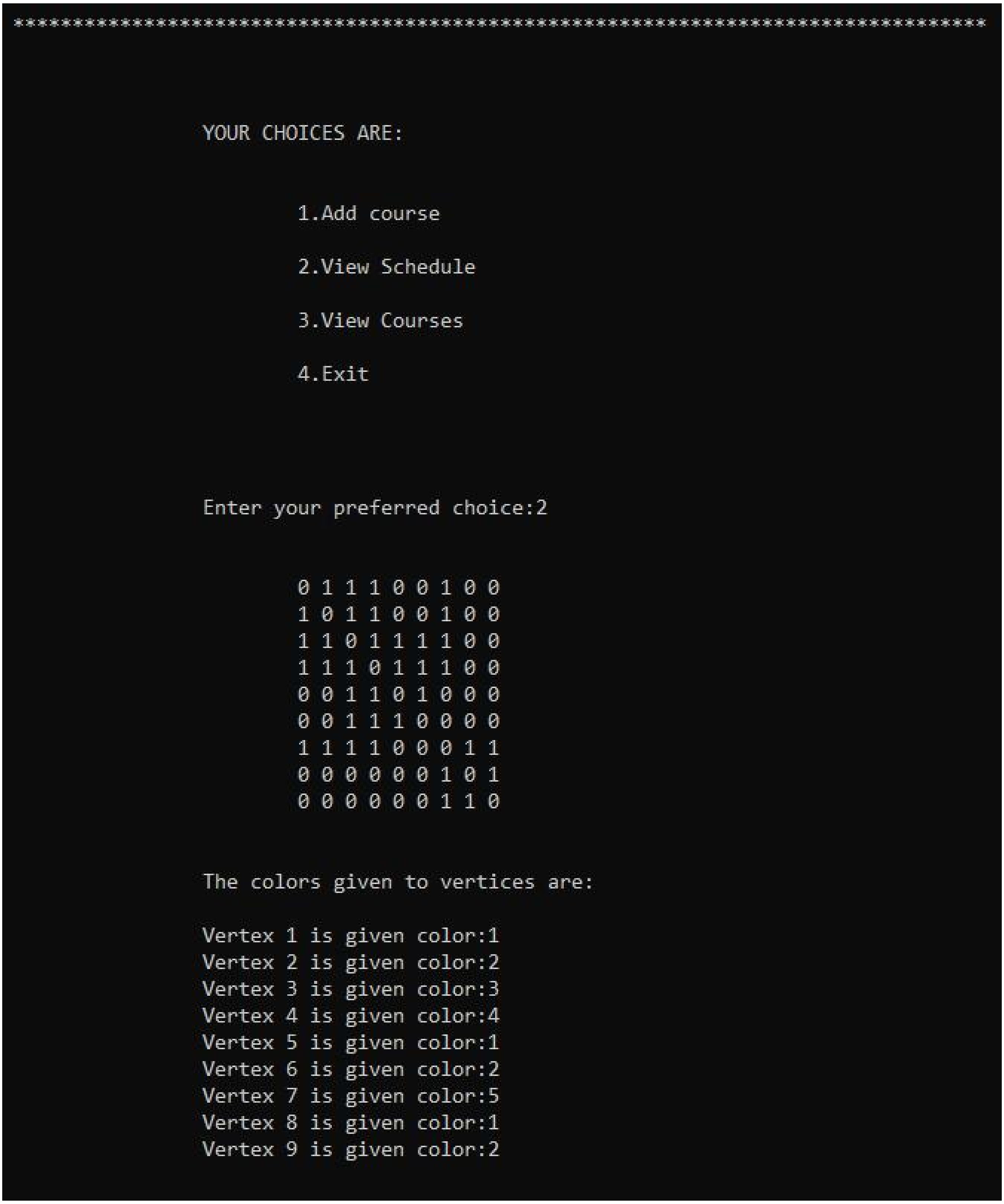
```
**********************************************************************************



                YOUR CHOICES ARE:


                        1.Add course

                        2.View Schedule

                        3.View Courses

                        4.Exit




                Enter your preferred choice:1


                Enter number of semesters this course appears:1

                Semester Appearance 1:1

                Subject name:Python

                Subject code:GE5153
Enter any key to continue...
```

View courses:



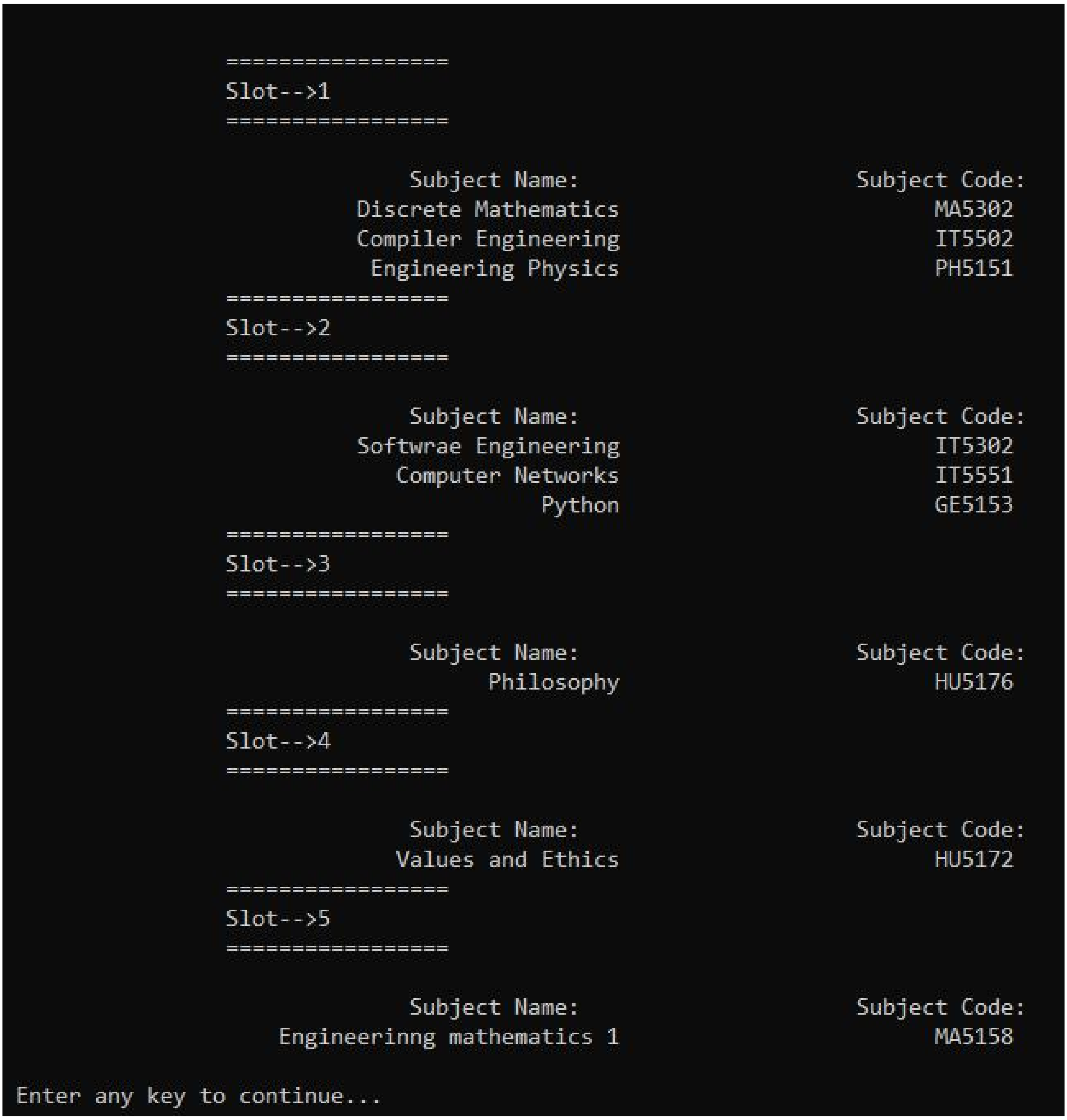
```
**********************************************************************************



                YOUR CHOICES ARE:


                        1.Add course

                        2.View Schedule

                        3.View Courses

                        4.Exit




                Enter your preferred choice:3

                Subject Name                        Subject Code

                          Discrete Mathematics                        MA5302
                          Softwrae Engineering                        IT5302
                                    Philosophy                        HU5176
                             Values and Ethics                        HU5172
                          Compiler Engineering                        IT5502
                             Computer Networks                        IT5551
                    Engineerinng mathematics 1                        MA5158
                           Engineering Physics                        PH5151
                                        Python                        GE5153
Enter any key to continue...
```

Graph coloring and Adjacency matrix:



```
**********************************************************************************



                YOUR CHOICES ARE:


                        1.Add course

                        2.View Schedule

                        3.View Courses

                        4.Exit




                Enter your preferred choice:2


                        0 1 1 1 0 0 1 0 0
                        1 0 1 1 0 0 1 0 0
                        1 1 0 1 1 1 1 0 0
                        1 1 1 0 1 1 1 0 0
                        0 0 1 1 0 1 0 0 0
                        0 0 1 1 1 0 0 0 0
                        1 1 1 1 0 0 0 1 1
                        0 0 0 0 0 0 1 0 1
                        0 0 0 0 0 0 1 1 0


                The colors given to vertices are:

                Vertex 1 is given color:1
                Vertex 2 is given color:2
                Vertex 3 is given color:3
                Vertex 4 is given color:4
                Vertex 5 is given color:1
                Vertex 6 is given color:2
                Vertex 7 is given color:5
                Vertex 8 is given color:1
                Vertex 9 is given color:2
```

Scheduled Timetable:



```
                =================
                Slot-->1
                =================

                             Subject Name:                              Subject Code:
                         Discrete Mathematics                                 MA5302
                         Compiler Engineering                                 IT5502
                          Engineering Physics                                 PH5151
                =================
                Slot-->2
                =================

                             Subject Name:                              Subject Code:
                         Softwrae Engineering                                 IT5302
                            Computer Networks                                 IT5551
                                       Python                                 GE5153
                =================
                Slot-->3
                =================

                             Subject Name:                              Subject Code:
                                   Philosophy                                 HU5176
                =================
                Slot-->4
                =================

                             Subject Name:                              Subject Code:
                            Values and Ethics                                 HU5172
                =================
                Slot-->5
                =================

                             Subject Name:                              Subject Code:
                    Engineerinng mathematics 1                                MA5158

Enter any key to continue...
```

Result:

In this project we are studied a exam timetable scheduling problem where graph coloring methods were applied and a complete solution provided and it also satisfies important constraints.

Thus by using graph coloring we are able to solve this scheduling problem easily.