|  |  |
| --- | --- |
| **Course Title:** | **Stellar interior** |
| **Course Code:** | **ASTR 453** |
| **Program:** | **ASTR-MATH** |
| **Department:** | **Astronomy** |
| **College:** | **Science** |
| **Institution:** | **King AbdulAziz University** |

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# A. Course Identification

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **1. Credit hours:** | | | |  | | | | | | | | | | | | |
| **2. Course type** | | | | | | | | | | | | | | | | |
| **a.** | University | |  | | College | | |  | Department | | | | **✓** | Others |  |  |
| **b.** | | Required | | | |  | Elective | | | **✓** |  | | | | | |
| **3. Level/year at which this course is offered:** | | | | | | | | | | | | **8th Level / 4th Year** | | | | |
| **4. Pre-requisites for this course** (if any)**: ASTR352** | | | | | | | | | | | | | | | | |
| **5. Co-requisites for this course** (if any)**: None** | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |

## 6. Mode of Instruction (mark all that apply)

| **No** | **Mode of Instruction** | **Contact Hours** | **Percentage** |
| --- | --- | --- | --- |
| **1** | **Traditional classroom** | **2** | **100%** |
| **2** | **Blended** |  |  |
| **3** | **E-learning** |  |  |
| **4** | **Correspondence** |  |  |
| **5** | **Other** |  |  |

**7. Actual Learning Hours** (based on academic semester)

|  |  |  |
| --- | --- | --- |
| **No** | **Activity** | **Learning Hours** |
| **Contact Hours** | | |
| **1** | **Lecture** | **30** |
| **2** | **Laboratory/Studio** |  |
| **3** | **Tutorial** |  |
| **4** | **Others** (specify) |  |
|  | **Total** | **30** |
| **Other Learning Hours\*** | | |
| **1** | **Study** | **30 (minimum)** |
| **2** | **Assignments** | **15** |
| **3** | **Library** |  |
| **4** | **Projects/Research Essays/Theses** | **15** |
| **5** | **Others** |  |
|  | **Total** | **60** |

**\*** The length of time that a learner takes to complete learning activities that lead to achievement of course learning outcomes, such as study time, homework assignments, projects, preparing presentations, library times

# B. Course Objectives and Learning Outcomes

|  |
| --- |
| 1. Course Description This course contains the following subjects: Thermal hydrodynamic equilibrium in stellar interior. Instigated theories for solution of the elementary stellar interior equations. Determination of pressure, temperature, and density. Numerical solution for different stellar interior models. Nuclear reactions and energy generation in stellar interior. Different stages of stellar evolution. |
| 2. Course Main Objective The students should be understand   * What we can learn from observations. * The internal structure and physical characteristics of stars. * Stellar time scales. * The basic assumptions of stellar structure models. * The four fundamental differential equations of stellar structure. * The important physical processes in the stellar interior such as the equation of state, stellar opacity and the generation of energy by nuclear fusion. * Stellar model building. |
|  |

## 

## 3. Course Learning Outcomes

| **CLOs** | | **Aligned****PLOs** |
| --- | --- | --- |
| 1 | **Knowledge:** |  |
| 1.1 | List the various observed properties of stars. | K3 |
| 1.2 | State the stellar interior layers | K3, K11 |
| 1.3 | Memorize the four basic assumptions use in building stellar structure model. | K1, K6 |
| 1.4 | Define the dynamical, thermal, and nuclear timescales | K9, K11 |
| **2** | **Skills :** |  |
| 2.1 | Compare between the dynamical, thermal, and nuclear timescales. | S5, S11 |
| 2.2 | Interpret the spherical symmetry and static assumptions. | S5 |
| 2.3 | Explain the isolation and uniform initial composition assumptions. | S7, S11 |
| 2.4 | Derive mass conservation and hydrostatic equations. | S7, S11 |
| 2.5 | Explain the energy transport equation. | S11 |
| **3** | **Competence:** |  |
| 3.1 | Establish and manage a research project on the recent observations of active galaxies. | C2, C3, C4 |

# C. Course Content

|  |  |  |
| --- | --- | --- |
| **No** | **List of Topics** | **Contact Hours** |
| 1 | Chapter 1: The observed properties of stars. | 6 |
| 2 | Chapter 2: Basic assumptions and stellar timescales | 6 |
| 3 | Chapter 3: Equations of Stellar Structure | 6 |
| 4 | Chapter 4: Equations of state and Stellar Model building | 6 |
| 5 | Chapter 5: Application (STATSTAR, A stellar structure code) | 6 |
| **Total** | | **30** |

# D. Teaching and Assessment

## 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| **Code** | **Course Learning Outcomes** | **Teaching Strategies** | **Assessment Methods** |
| --- | --- | --- | --- |
| **1.0** | **Knowledge** | | |
| 1.1 | List the various observed properties of stars. | Lectures & in class discussion | Exams & Homework |
| 1.2 | State the four differential equations use in building stellar structure model. |
| 1.3 | Memorize the four basic assumptions use in building stellar structure model. |
| 1.4 | Define the dynamical, thermal, and nuclear timescales |
| **2.0** | **Skills** | | |
| 2.1 | Compare between the dynamical, thermal, and nuclear timescales. | Lectures & in class discussion | Exams & Homework |
| 2.2 | Interpret the spherical symmetry and static assumptions. |
| 2.3 | Explain the isolation and uniform initial composition assumptions. |
| 2.4 | Derive mass conservation and hydrostatic equations. |
| 2.5 | Explain the energy transport equation. |
| **3.0** | **Competence** | | |
| 3.1 | Establish and manage a stellar structure model. | In class discussion | Project reports & student presentation |

## 

## 2. Assessment Tasks for Students

| **#** | **Assessment task\*** | **Week Due** | **Percentage of Total Assessment Score** |
| --- | --- | --- | --- |
| **1** | Exams I | 6th | 15% |
| **2** | Exams II | 11th | 15% |
| **4** | Homework | Each two weeks | 15% |
| **5** | Report + Student’s presentation | 4th, 7th, 11th | 10% |
| **6** | Project + Student’s presentation | 13th | 15% |
| **7** | Final Exam | 15th | 30% |

**\*Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

# E. Student Academic Counseling and Support

|  |
| --- |
| **Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :** |
| Office hours: 2 hours per week |

# F. Learning Resources and Facilities

## 1.Learning Resources

|  |  |
| --- | --- |
| **Required Textbooks** | * Stellar interiors, Hanson, Klawer, 1994, Springer. * Stellar structure and evolution, Kippenhahn, 1994, Springer. * The physics of stars, S.A. Kaplan-John Wiley and Sons, 1981 |
| **Essential References Materials** | * Lecture notes |
| **Electronic Materials** |  |
| **Other Learning Materials** |  |

## 2. Facilities Required

| **Item** | **Resources** |
| --- | --- |
| **Accommodation**  (Classrooms, laboratories, demonstration rooms/labs, etc.) | * Lecture’s room with 10 seats * Internet connection * Library |
| **Technology Resources**  (AV, data show, Smart Board, software, etc.) | Data show |
| **Other Resources**  (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list) |  |

# G. Course Quality Evaluation

| **Evaluation**  **Areas/Issues** | **Evaluators** | **Evaluation Methods** |
| --- | --- | --- |
| Course contents | Students | Course evaluation questionnaire (Direct) |
| Learning resources and equipment | Students | Student experience questionnaire (Direct) |
| Effectiveness of teaching and assessment | Students | Student experience questionnaire (Direct) |
| Course contents and materials | Faculty members | By department council discussion (Indirect) |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)

**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

**Assessment Methods** (Direct, Indirect)

# H. Specification Approval Data

|  |  |
| --- | --- |
| **Council / Committee** |  |
| **Reference No.** |  |
| **Date** | September 2017 |