	Universitas Negeri Surabaya Fakultas Matematika dan Ilmu Pengetahuan Alam Program Studi S1 Fisika	Kode Dokumen

RENCANA PEMBELAJARAN SEMESTER

MATA KULIAH (MK)	KODE	Rumpun MK	BOBOT (sks)			SEMESTER	Tgl Penyusunan
Fisika Matematik II	4520104071	Mata Kuliah Wajib Program Studi	T=4	P=0	ECTS=6.36	2	6 Januari 2024

OTORISASI	Pengembang RPS	Koordinator RMK	Koordinator Program Studi
	Nugrahani Primary Putri, M.Si.	.....	Prof. Dr. Munasir, S.Si., M.Si.

Model Pembelajaran	**Case Study**

Capaian Pembelajaran (CP)

CPL-PRODI yang dibebankan pada MK

CPL-5	Mampu mendemonstrasikan sebagai ilmuwan yang baik, kemampuan berpikir kritis dan inovasi dalam bidang penelitian dan profesional.
CPL-10	Menganalisis sistem fisik dengan menerapkan matematika dan alat komputasi / TIK.

Capaian Pembelajaran Mata Kuliah (CPMK)

CPMK - 1	Students are able to formulate simple physical systems related to mechanics and thermodynamics into mathematical model using relevant symbolic/numeric language.
CPMK - 2	Students are able to solve problems in simple physical systems related to mechanics and thermodynamics using mathematical physics and computational approach.
CPMK - 3	Students are able to analyze a simple physical system related to mechanics and thermodynamics using mathematical physics and computational approach.

Matrik CPL - CPMK

CPMK	CPL-5	CPL-10
CPMK-1		
CPMK-2		
CPMK-3		

Matrik CPMK pada Kemampuan akhir tiap tahapan belajar (Sub-CPMK)

CPMK	Minggu Ke															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
CPMK-1																
CPMK-2																
CPMK-3																

Deskripsi Singkat MK

This course examines infinite series, complex number, partial differential, ordinary differential equations, and vector analysis through active learning by combining the methods of discussion, questions and answers, also assignment using IT.

Pustaka

Utama :

1. Mary L. Boas. 2006. Mathematical Methods in the Physical Science . 3th edition. New York: John Wiley & Sons.

Pendukung :

1. Arfken, G. 1995. Mathematical Methods for Physicists. Academic Press.
2. Riley, K.F., Hobson, M.P., Bence, S.J. 2006. Mathematical Methods for Physics and Engineering, 3rd ed. Cambridge Univ. Press.
3. Hassani, Sadri. 2009. Mathematical Methods for Students of Physics and Related Fields, 2nd ed. Illinois: Springer.

Dosen Pengampu	Dr. Zainul Arifin Imam Supardi, M.Si. SUPARDIYONO Prof. Dr. Munasir, S.Si., M.Si. Dzulkiflih, S.Si., M.T. Nugrahani Primary Putri, S.Si., M.Si. Dr. Eng. Evi Suaebah, M.Si., M.Sc. Dr. Fitriana, S.Si.

Mg Ke-	**Kemampuan akhir tiap tahapan belajar (Sub-CPMK)**	**Penilaian**		**Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]**		**Materi Pembelajaran [Pustaka]**	**Bobot Penilaian (%)**
		Indikator	**Kriteria & Bentuk**	**Luring (*offline*)**	**Daring (*online*)**		
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
1	1.Students are able to formulate simple physical system related to mechanics and thermodynamics into mathematical model using infinite series 2.Students are able to solve problems of simple physical system related to mechanics and thermodynamics into mathematical model using infinite series and computational tools 3.Students are able to analyze problems of simple physical system related to mechanics and thermodynamics into mathematical model using infinite series and computational tools.	1.1. Students are able to undertake convergence test of a series. 2.2. Students are able to analyze a function into power series. 3.3. Students are able to solve mechanics and thermodynamics problems using series concept.	**Kriteria:** Students will get full marks if they meet the assessment indicators **Bentuk Penilaian** : Aktifitas Partisipasif, Penilaian Portofolio	Lecture and discussion 4 x 50 menit	Lecture and discussion 4 x 50	**Materi:** 1. Definition and notation 2. Convergence test of infinite series 3. Alternating series 4. Power series 5. Convergence interval of power series 6. Taylor Analysis of a function **Pustaka:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science . 3th edition. New York: John Wiley & Sons.*	2%
2	1.Students are able to formulate simple physical system related to mechanics and thermodynamics into mathematical model using infinite series 2.Students are able to solve problems of simple physical system related to mechanics and thermodynamics into mathematical model using infinite series and computational tools 3.Students are able to analyze problems of simple physical system related to mechanics and thermodynamics into mathematical model using infinite series and computational tools.	1.1. Students are able to undertake convergence test of a series. 2.2. Students are able to analyze a function into power series. 3.3. Students are able to solve mechanics and thermodynamics problems using series concept.	**Kriteria:** Students will get full marks if they meet the assessment indicators **Bentuk Penilaian** : Aktifitas Partisipasif, Penilaian Portofolio	Lecture and discussion 4 x 50 menit	Lecture and discussion 4 x 50	**Materi:** 1. Definition and notation 2. Convergence test of infinite series 3. Alternating series 4. Power series 5. Convergence interval of power series 6. Taylor Analysis of a function **Pustaka:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science . 3th edition. New York: John Wiley & Sons.*	2%

3	1.Students are able to formulate simple physical system related to mechanics and thermodynamics into mathematical model using infinite series 2.Students are able to solve problems of simple physical system related to mechanics and thermodynamics into mathematical model using infinite series and computational tools 3.Students are able to analyze problems of simple physical system related to mechanics and thermodynamics into mathematical model using infinite series and computational tools.	1.1. Students are able to undertake convergence test of a series. 2.2. Students are able to analyze a function into power series. 3.3. Students are able to solve mechanics and thermodynamics problems using series concept.	**Kriteria:** Students will get full marks if they meet the assessment indicators **Bentuk Penilaian** : Aktifitas Partisipasif, Penilaian Portofolio	Lecture and discussion 4 x 50 menit	Lecture and discussion 4 x 50	**Materi:** 1. Definition and notation 2. Convergence test of infinite series 3. Alternating series 4. Power series 5. Convergence interval of power series 6. Taylor Analysis of a function **Pustaka:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science . 3th edition. New York: John Wiley & Sons.*	5%
4	1.Students are able to formulate simple physical system related to mechanics and thermodynamics into mathematical model using complex number 2.Students are able to solve problems of simple physical system related to mechanics and thermodynamics into mathematical model using complex number and computational tools 3.Students are able to analyze problems of simple physical system related to mechanics and thermodynamics into mathematical model using complex number and computational tools.	1.1. Students are able to perform complex algebraic operations 2.2. Students are able to solve problems related to complex series, exponential functions, logarithms, trigonometry, and hyperbolic complexes. 3.3. Students are able to apply complex numbers to solve physics problems	**Kriteria:** Students will get full marks if they meet the assessment indicators **Bentuk Penilaian** : Aktifitas Partisipasif, Penilaian Portofolio	Lecture and discussion. 4 x 50 menit	Lecture and discussion 4 x 50	**Materi:** 1. Real and imaginary parts of complex numbers 2. Complex number algebra 3. Complex field 4. Complex equations 5. Complex series 6. Complex power series 7. Exponential functions and Euler's formula 8. Complex logarithmic functions 9. Complex powers and roots 10. Trigonometric and hyperbolic functions 11. Application of complex numbers in physics **Pustaka:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science . 3th edition. New York: John Wiley & Sons.*	2%

5	1.Students are able to formulate simple physical system related to mechanics and thermodynamics into mathematical model using complex number 2.Students are able to solve problems of simple physical system related to mechanics and thermodynamics into mathematical model using complex number and computational tools 3.Students are able to analyze problems of simple physical system related to mechanics and thermodynamics into mathematical model using complex number and computational tools.	1.1. Students are able to perform complex algebraic operations 2.2. Students are able to solve problems related to complex series, exponential functions, logarithms, trigonometry, and hyperbolic complexes. 3.3. Students are able to apply complex numbers to solve physics problems	**Bentuk Penilaian** : Aktifitas Partisipasif, Penilaian Portofolio	Lecture and discussion. 4 x 50 menit	Lecture and discussion 4 x 50	**Materi:** 1. Real and imaginary parts of complex numbers 2. Complex number algebra 3. Complex field 4. Complex equations 5. Complex series 6. Complex power series 7. Exponential functions and Euler's formula 8. Complex logarithmic functions 9. Complex powers and roots 10. Trigonometric and hyperbolic functions 11. Application of complex numbers in physics **Pustaka:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science . 3th edition. New York: John Wiley & Sons.*	5%
6	1.Students are able to formulate simple physical system related to mechanics and thermodynamics into mathematical model using complex number 2.Students are able to solve problems of simple physical system related to mechanics and thermodynamics into mathematical model using complex number and computational tools 3.Students are able to analyze problems of simple physical system related to mechanics and thermodynamics into mathematical model using complex number and computational tools.	1.1. Students are able to perform complex algebraic operations 2.2. Students are able to solve problems related to complex series, exponential functions, logarithms, trigonometry, and hyperbolic complexes. 3.3. Students are able to apply complex numbers to solve physics problems	**Kriteria:** Students will get full marks if they meet the assessment indicators **Bentuk Penilaian** : Aktifitas Partisipasif, Penilaian Portofolio	Lecture and discussion. 4 x 50 menit	Lecture and discussion 4 x 50	**Materi:** 1. Real and imaginary parts of complex numbers 2. Complex number algebra 3. Complex field 4. Complex equations 5. Complex series 6. Complex power series 7. Exponential functions and Euler's formula 8. Complex logarithmic functions 9. Complex powers and roots 10. Trigonometric and hyperbolic functions 11. Application of complex numbers in physics **Pustaka:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science . 3th edition. New York: John Wiley & Sons.*	5%

7	1.Students are able to formulate simple physical system related to mechanics and thermodynamics into mathematical model using complex number 2.Students are able to solve problems of simple physical system related to mechanics and thermodynamics into mathematical model using complex number and computational tools 3.Students are able to analyze problems of simple physical system related to mechanics and thermodynamics into mathematical model using complex number and computational tools.	1.1. Students are able to perform complex algebraic operations 2.2. Students are able to solve problems related to complex series, exponential functions, logarithms, trigonometry, and hyperbolic complexes. 3.3. Students are able to apply complex numbers to solve physics problems	**Kriteria:** Students will get full marks if they meet the assessment indicators **Bentuk Penilaian** : Aktifitas Partisipasif, Penilaian Portofolio	Lecture and discussion. 4 x 50 menit	Lecture and discussion 4 x 50	**Materi:** 1. Real and imaginary parts of complex numbers 2. Complex number algebra 3. Complex field 4. Complex equations 5. Complex series 6. Complex power series 7. Exponential functions and Euler's formula 8. Complex logarithmic functions 9. Complex powers and roots 10. Trigonometric and hyperbolic functions 11. Application of complex numbers in physics **Pustaka:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science . 3th edition. New York: John Wiley & Sons.*	5%
8	Students are able to solve physics and mathematics problems using the concepts of infinite series and complex numbers		**Kriteria:** Students will get full marks if they meet the assessment indicators **Bentuk Penilaian** : Tes	Mid-term examination 2 x 50	UTS 2 x 50	**Materi:** Ch 1 and 2 **Pustaka:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science . 3th edition. New York: John Wiley & Sons.*	20%

9	1. Students are able to formulate simple physical system related to mechanics and thermodynamics into mathematical model using partial differentiation 2. Students are able to solve problems of simple physical system related to mechanics and thermodynamics into mathematical model using partial differentiation and computational tools. 3. Students are able to analyze problems of simple physical system related to mechanics and thermodynamics into mathematical model using partial differentiation and computational tools.	1. 1. Students are able to execute partial differential using chain rules. 2. 2. Students are able to execute implicit differentiation, change variable and limit requirement 3. 3. Students are able to look for minimum and maximum value of a function 4. 4. Students are able to solve mechanics and thermodynamics problems using partial differential concept	**Kriteria:** Students will get full marks if they meet the assessment indicators **Bentuk Penilaian** : Aktifitas Partisipasif, Penilaian Portofolio	Lecture and discussion 4 x 50	Lecture and discussion 4 x 50	**Materi:** Ch 4 **Pustaka:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science . 3th edition. New York: John Wiley & Sons.*	5%
10	1. Students are able to formulate simple physical system related to mechanics and thermodynamics into mathematical model using partial differentiation 2. Students are able to solve problems of simple physical system related to mechanics and thermodynamics into mathematical model using partial differentiation and computational tools. 3. Students are able to analyze problems of simple physical system related to mechanics and thermodynamics into mathematical model using partial differentiation and computational tools.	1. 1. Students are able to execute partial differential using chain rules. 2. 2. Students are able to execute implicit differentiation, change variable and limit requirement 3. 3. Students are able to look for minimum and maximum value of a function 4. 4. Students are able to solve mechanics and thermodynamics problems using partial differential concept	**Kriteria:** Students will get full marks if they meet the assessment indicators **Bentuk Penilaian** : Aktifitas Partisipasif	Lecture and discussion 4 x 50	Lecture and discussion 4 x 50	**Materi:** Ch 4 **Pustaka:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science . 3th edition. New York: John Wiley & Sons.*	5%

11	1. Students are able to formulate simple physical system related to mechanics and thermodynamics into mathematical model using ordinary differential equations 2. Students are able to solve problems of simple physical system related to mechanics and thermodynamics into mathematical model using ordinary differential equations and computational tools. 3. Students are able to analyze problems of simple physical system related to mechanics and thermodynamics into mathematical model using ordinary differential equations and computational tools.	1. 1. Students are able to identify first and second order differential equations related to physics concept particularly mechanics and thermodynamics. 2. 2. Students are able to solve first order differential equation. 3. 3. Students are able to find solutions for first order differential equation in physics problems.	**Kriteria:** Students will get full marks if they meet the assessment indicators **Bentuk Penilaian** : Aktifitas Partisipasif, Penilaian Portofolio	Lecture and discussion 4 x 50	Lecture and discussion 4 x 50	**Materi:** Ch 8 **Pustaka:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science . 3th edition. New York: John Wiley & Sons.*	2%
12	1. Students are able to formulate simple physical system related to mechanics and thermodynamics into mathematical model using ordinary differential equations 2. Students are able to solve problems of simple physical system related to mechanics and thermodynamics into mathematical model using ordinary differential equations and computational tools. 3. Students are able to analyze problems of simple physical system related to mechanics and thermodynamics into mathematical model using ordinary differential equations and computational tools.	1. 1. Students are able to solve second order differential equation. 2. 2. Students are able to find solutions for second order differential equation in physics problems. 3. 3. Students are able to apply ordinary differential equation to solve physics problems in accordance with the concept of mechanics and thermodynamics.	**Kriteria:** Students will get full marks if they meet the assessment indicators **Bentuk Penilaian** : Aktifitas Partisipasif, Penilaian Portofolio	Lecture and discussion 4 x 50	Lecture and discussion 4 x 50	**Materi:** Ch 8 **Pustaka:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science . 3th edition. New York: John Wiley & Sons.*	3%

13	1. Students are able to formulate simple physical system related to mechanics and thermodynamics into mathematical model using ordinary differential equations 2. Students are able to solve problems of simple physical system related to mechanics and thermodynamics into mathematical model using ordinary differential equations and computational tools. 3. Students are able to analyze problems of simple physical system related to mechanics and thermodynamics into mathematical model using ordinary differential equations and computational tools.	1. 1. Students are able to solve second order differential equation. 2. 2. Students are able to find solutions for second order differential equation in physics problems. 3. 3. Students are able to apply ordinary differential equation to solve physics problems in accordance with the concept of mechanics and thermodynamics.	**Kriteria:** Students will get full marks if they meet the assessment indicators **Bentuk Penilaian** : Aktifitas Partisipasif, Penilaian Portofolio	Lecture and discussion 4 x 50	Lecture and discussion 4 x 50	**Materi:** Ch 8 **Pustaka:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science . 3th edition. New York: John Wiley & Sons.*	3%
14	1. Students are able to formulate simple physical system related to mechanics and thermodynamics into mathematical model using vector analysis 2. Students are able to solve problems of physical system related to mechanics and thermodynamics into mathematical model using vector analysis and computational tools. 3. Students are able to analyze problems of simple physical system related to mechanics and thermodynamics into mathematical model using vector analysis and computational tools.	1. 1. Students are able to hold vector multiplication and vector differentiation, also formulate simple physical system using vector multiplication and vector 2. 2. Students are able to use vector operator in cartesian coordinate, gradient, divergence and curl in simple physical model. 3. 3. Students are able to understand Green Theorem, divergence theorem and Stokes theorem.	**Bentuk Penilaian** : Aktifitas Partisipasif	Lecture and discussion 4 x 50	Lecture and discussion 4 x 50	**Materi:** Ch 6 **Pustaka:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science . 3th edition. New York: John Wiley & Sons.*	1%

15	1.Students are able to formulate simple physical system related to mechanics and thermodynamics into mathematical model using vector analysis 2.Students are able to solve problems of physical system related to mechanics and thermodynamics into mathematical model using vector analysis and computational tools. 3.Students are able to analyze problems of simple physical system related to mechanics and thermodynamics into mathematical model using vector analysis and computational tools.	1.1. Students are able to hold vector multiplication and vector differentiation, also formulate simple physical system using vector multiplication and vector 2.2. Students are able to use vector operator in cartesian coordinate, gradient, divergence and curl in simple physical model. 3.3. Students are able to understand Green Theorem, divergence theorem and Stokes theorem.	**Bentuk Penilaian** : Aktifitas Partisipasif	Lecture and discussion 4 x 50	Lecture and discussion 4 x 50	**Materi:** Ch 6 **Pustaka:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science . 3th edition. New York: John Wiley & Sons.*	5%
16	Students are able to solve physics and mathematics problems using partial differential concepts, ordinary differential equations and vector analysis	Students are able to solve physics and mathematics problems using partial differential concepts, ordinary differential equations and vector analysis.	**Kriteria:** Students will get full marks if they meet the assessment indicators **Bentuk Penilaian** : Tes	final exam 2 x 50	UAS 2 x 50	**Materi:** Ch 4, 8 dan 6 **Pustaka:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science . 3th edition. New York: John Wiley & Sons.*	30%

Rekap Persentase Evaluasi : Case Study

No	Evaluasi	Persentase
1.	Aktifitas Partisipasif	30.5%
2.	Penilaian Portofolio	19.5%
3.	Tes	50%
		100%

Catatan

1. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.
2. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, ketrampulan umum, ketrampilan khusus dan pengetahuan.
3. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.
4. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.
5. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.
6. **Kreteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kreteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kreteria dapat berupa kuantitatif ataupun kualitatif.
7. **Bentuk penilaian:** tes dan non-tes.
8. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.
9. **Metode Pembelajaran:** Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning, dan metode lainnya yg setara.
10. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.
11. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.
12. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.

RPS ini telah divalidasi pada tanggal 18 April 2024

Koordinator Program Studi S1 Fisika

Prof. Dr. Munasir, S.Si., M.Si.
NIDN 0017116901

UPM Program Studi S1 Fisika

Diah Hari Kusumawati, S.Si., M.Si.
NIDN 0018047302

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