GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA in ME/MT**
PROGRAMME CODE	**04/05**
COURSE TITLE	**BASIC ELECTRONICS TECHNOLOGY**
COURSE CODE	**ET21201**
PREREQUISITE COURSE CODE & TITLE	**NA**
CLASS DECLARATION COURSE	**NO**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme												
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL &TSL				Based on SL		Total Marks
														Practical							
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA			
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min		
ET21201	BASIC ELECTRONICS ENGINEERING	AEC	2	--	2	--	4	2	--	--	--	--	--	25	10	25@	10	--	--	50	

Total IKS Hrs for Term: 0 Hrs

Abbreviations: CL-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA** - Formative Assessment**, SA** -Summative assessment, **IKS** – Indian Knowledge System, **SLA**- Self Learning Assessment

Legends: @-Internal Assessment, **#** - External Assessment,***#** - Online Examination,**@$** - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 15 marks each conducted during the semester.

1. If a candidate does not secure minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as **"Detained"** in that course.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as **'fail'** and will have to repeat and resubmit SLA work.
3. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.
6. *Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

Most consumer appliances are based on electronic circuits and devices in today's world. The foundation for working on a computer or any of its peripherals is based on electronics. This course has been designed to develop skills to understand and test simple electronic components and circuits. After studying this course, students will develop an insight to identify, build and troubleshoot simple electronic circuits.

III. COURSE-LEVEL LEARNING OUTCOMES (CO's)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented so that the student demonstrates the following industry-oriented COs associated with the competency mentioned below

CO1 – Use suitable electronic components for the given Mechanical Engineering application

CO2 – Plot characteristics of semiconductor diode and use them for a given application

CO3 – Plot characteristics of the transistor and use them for a given application

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT-I ELECTRONIC COMPONENTS AND SIGNALS (CL Hrs-08, Marks- Nil)				
1	TLO 1.1 Differentiate between the given active and passive components. TLO 1.2 Determine the value of the given resistor and capacitor using colour codes. TLO 1.3 Differentiate between an ideal and practical signal source TLO 1.4 Explain the given signal parameters with sketches. TLO 1.5 Identify the given type of ICs based on the IC number.	1.1 Electronic Components: Passive and Active components: Resistor, Capacitor, Inductor, symbols colour codes, specifications 1.2 Voltage and current sources (Ideal and Practical) 1.3 Signals: Waveform (Sinusoidal, triangular and square) 1.4 Time and frequency domain representation of signals. Amplitude, frequency, phase, wavelength 1.5 Integrated Circuits - Analog and Digital.	Improved Lecture Tutorial Assignment Demonstration Simulation	**CO1**
UNIT-II DIODES AND ITS APPLICATION (CL.Hrs-12, Marks- Nil)				
2	TLO 2.1: Differentiate between intrinsic and extrinsic semiconductor TLO 2.2: Plot VI characteristics of diode TLO2.3: Plot VI characteristics of Zener diode TLO 2.4: Describe the working principle of LED TLO 2.5 Describe the working of a given type of rectifier TLO 2.6: Describe the working of the DC-regulated power supply.	2.1. Semiconductor Theory- Intrinsic and Extrinsic Semiconductor 2.2 P-N junction diode: symbol, construction, forward and reverse biasing, VI characteristics of Diode 2.3 Zener diode: Symbol, Construction, Working, Avalanche and Zener Breakdown, VI Characteristics of Zener diode 2.4LED: symbol, construction, working 2.5 Rectifier: Definition, Classification of rectifier, half wave, Centre tapped full wave and bridge rectifier, working, input-output waveforms, comparison 2.6 Block diagram of Regulated power supply.	Improved Lecture Tutorial Assignment Demonstration Simulation	**CO2**

UNIT-III- TRANSISTORS (CL.Hrs-10, Marks -Nil)				
3	TLO 3.1 Identify terminals of the transistor. TLO 3.2: Plot input and output characteristics of transistor in CB configuration. TLO 3.3 Plot input and output characteristics of transistor in CE configuration. TLO3.4: Compare configurations of the transistor. TLO 3.5: Describe the working of BJT as a Switch. TLO 3.6: Describe the working of BJT as an amplifier.	3.1 Types: PNP and NPN transistor and their symbol. 3.2 Construction and Operating principle 3.3 Configurations: CB, CE and CC, input and output characteristics, Operating regions: Cut-off, saturation Active Region 3.4 Comparison of Transistor Configuration 3.4 Application: Transistor as a switch and amplifier	Improved Lecture Tutorial Assignment Demonstration Simulation	**CO3**

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL /TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1	LLO 1.1: Identify various active electronic components in a given circuit.	*Passive Electronic component	2	CO1
2	LLO 2.1: Calculate series resistance and measures its value using a Multimeter LLO 2.2: Calculate Parallel resistance and measure its value using a Multimeter	*Connection of resistors in series and parallel on breadboard	2	CO1
3	LLO 3.1: Connect the capacitors in series combination on a breadboard to measure their value using a Multimeter. LLO 3.2: Connect the capacitors in parallel combination on bread board to measure their value using a Multimeter.	Connection of Capacitors in Series and Parallel	2	CO1
4	LLO 4.1: Use an LCR meter to measure inductance and capacitance	*Measure the value of the inductor and capacitor using an LCR meter	2	CO1
5	LLO 5.1: Use a Multimeter to measure the value of the given resistor	*Calculate the values of different resistors by the colour-coding method	2	CO1
6	LLO 6.1: Identifies various active electronic components in a given circuit.	Active Components	2	CO2
7	LLO 7.1: Plot the V-I characteristics of the PN junction diode and determine the cut-in voltage. LLO 7.2: Calculate the static and Dynamic resistance of the diode.	*Test the performance of the P-N junction diode	2	CO2

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
8	LLO 8.1: Plot V-I characteristics of the Zener Diode and determine Zener breakdown voltage	Test the performance of the Zener diode	2	CO2
9	LLO 9.1: Build the circuit for the Half Wave Rectifier using PN junction Diode LLO 9.2 Plot Output Waveform for sinusoidal input. And Measure the DC output voltage	*Construct and test Half wave rectifier	2	CO2
10	LLO 10.1: Build the circuit for centre tapped Full Wave Rectifier using the P-N junction Diode LLO 10.2: Plot Output Waveform for sinusoidal input And Measure DC output voltage	*Construct and test Centre tapped Full wave rectifier	2	CO2
11	LLO 11.1: Build the circuit for the Bridge Rectifier using the P-N junction Diode LLO 11.2: Plot Output Waveform for sinusoidal input. And Measure the DC output voltage	Construct and test the Bridge Rectifier	2	CO2
12	LLO 12.1: Identify terminals of transistor	Transistor identification	3	CO3
13	LLO 13.1: Plot input and output characteristics of BJT in common base configuration	Input and output characteristics of transistor in CB configuration	3	CO3
14	LLO 14.1: Plot input and output characteristics of BJT in common emitter configuration	*Input and output characteristics of transistor in CE configuration.	3	CO3
15	LLO 15.1: Plot input and output characteristics of BJT in common collector configuration	Input and output characteristics of transistor in CC configuration.	3	CO3
16	LLO 16.1: Identify Cutoff and saturation regions	Transistor as a switch	3	CO3
17	LLO 17.1: Build a single-stage Common emitter amplifier. LLO 17.2: Plot frequency response for Common emitter amplifier.	*Common Emitter Transistor amplifier	3	CO3
18	LLO 18.1: Identify different blocks of the Instrumentation System	*Block schematic of instrumentation system	3	CO3

A minimum of 12 for 2 LL Hrs./Week or 24 for 4 LL hrs./Week are to be performed.
'*' Marked Practicals (LLOs) Are Mandatory
A judicial mix of LLOs is to be performed to complete the minimum requirement of 12 / 24 as applicable.

VI. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Analog Multimeter& Digital Multimeter	All
2	CRO 20/30/100 MHz Frequency Dual Channel External Trigger CT mode facility or any other better specifications	9,10,11,16
3	Function Generator 0-2 MHz with Sine, square and triangular output with variable frequency and amplitude	All
4	Variable DC Power supply 0-30V with display for voltage and current, 2Amp SC protection	All
5	Different types of cables and connectors	All

VII. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
1. Term Work	1. End Term Exam

VIII. SUGGESTED COS- POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes *(PSOs)	
	PO-1 Basic and Discipline-Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO1	1	2	2	2	-	-	-	-	-
CO2	1	2	3	2	-	-	-	-	-
CO3	1	2	3	2	-	-	-	-	-

Legends:-High:03, **Medium:**02, **Low:**01, **No Mapping: -**
*PSOs are to be formulated at the institute level

IX. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	Author	Title	Publisher
1.	Albert Malvino	Basic Electronics	Tata McGraw Hill, 2015 ISBN10: 1259200116
2.	J.S.Katre	Basic Electronics	Techmax Publishers ISBN-10: 9350779641
3.	V.K. Mehta	Principles of Electronics	S.Chand New Delhi, edition-2008, ISBN-13: 978- 8121927833
4.	Sedha, R.S.	A Textbook of Applied Electronics	S.Chand (G/L) & Company Ltd ISBN-13 978-8121904209

X. LEARNING WEBSITES & PORTALS

Sr.No	Link/Portal	Description
1.	https://nptel.ac.in/courses	Basic Electronics and Lab, IIT Madras Prof. T.S. Natarajan 2
2.	https://archive.nptel.ac.in/courses	Basic Electronics, IIT Bombay 3 4
3.	https://learn.sparkfun.com/tutorials/transistors	Transistor basics
4.	https://www.multisim.com	Online multi-sim software

Name & Signature: **Smt. V.G.Mahendra** Lecturer in Electronics and Telecommunication **(Course Experts)**	
Name & Signature: **Smt.N.S.Kadam** (Programme Head)	Name & Signature: **Shri.S.B.Kulkarni** (CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN CE/EE/ET/ME/MT/CM/IT/DDGM**
PROGRAMME CODE	**01/02/03/04/05/06/07/08**
COURSE TITLE	**INDIAN CONSTITUTION: CORE CONCEPTS AND VALUES**
COURSE CODE	**HU21203**
PREREQUISITE COURSE CODE & TITLE	**NA**
CLASS DECLARATION COURSE	**NO**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory Practical				Based on LL & TSL Practical				Based on SL		Total Marks
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
HU21203	INDIAN CONSTITUTION: CORE CONCEPTS AND VALUES	VEC	1	--	--	1	2	1	--	--	--	--	--	--	--	--	--	50	20	50

Total IKS Hrs for Term: 0 Hrs

Abbreviations: CL-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA** - Formative Assessment**, SA** -Summative assessment, **IKS** – Indian Knowledge System, **SLA**- Self Learning Assessment

Legends: @-Internal Assessment, # - External Assessment,***#** - Online Examination,**@$** - Internal Online Examination

Note:

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5. * Self-learning hours shall not be reflected in the Timetable.
6. * Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

Introducing a course on the Indian Constitution can provide students with a comprehensive understanding of the country's legal framework and democratic principles. Such a course could cover the historical context of its creation, the structure and functions of the government it establishes, and the fundamental rights and duties of citizens. It could also explore the significant amendments and judicial interpretations that have shaped its evolution over time. This foundational knowledge is not only for fostering informed and engaged citizens who can contribute to the nation's democratic processes but also enriches the educational experience by fostering a sense of national identity and ethical responsibility among future engineers. Furthermore, embedding Electoral Literacy and Voter Education in diploma engineering programs strategically empowers these future professionals with an awareness of their electoral privileges and the workings of democracy.

III. COURSE-LEVEL LEARNING OUTCOMES (CO's):

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO1: Foster comprehension of the fundamental principles and goals embedded in the Indian constitution.
CO2: Elaborate on the core rights and duties conferred upon Indian citizens by the Constitution.
CO3: Comprehend the distribution of legislative, executive, and financial powers between the Union and the States.
CO4: Understand the functioning of Indian democracy, encompassing its frameworks and mechanisms at local, state, and national levels.
CO5: Cultivate the skills and perspectives required for active participation in electoral processes, the conscientious exercise of voting rights, and the promotion of informed democratic participation within society.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT-I INTRODUCTION TO INDIAN CONSTITUTION(CL Hrs-03, Marks-NIL)				
1	**TLO 1.1** Understand the historical context and events leading to the drafting of the Indian Constitution. **TLO 1.2** Comprehend the essential features and understand the significance of the Indian Constitution in shaping India's democratic governance and societal ethos. **TLO 1.3** Analyze the vision and ideals articulated in the Preamble and their relevance in contemporary Indian society.	1.1 Historical background and making of the Indian Constitution 1.2 Salient features and significance of the Indian Constitution 1.3 Preamble: Vision and Ideals of the Indian Constitution	Presentations Case Studies and Analysis Role-Playing and Simulations Project-Based Learning	**CO1**
UNIT - II FUNDAMENTAL RIGHTS, FUNDAMENTAL DUTIES AND DIRECTIVE PRINCIPLES (CL Hrs-04, Marks-NIL)				
2	**TLO2.1** Understand the introduction and structure of Fundamental Rights in Part Ill of the Indian Constitution. **TLO2.2** Understand the principles of the Right to Equality, Right to Freedom, and Right to Life.	**2.1** Fundamental Rights: Introduction & its Scheme under Part -III **2.2** Right to Equality (Article 14-18) **2.3** Right to Freedom (Article 19-22) **2.4** Right to Life (Article 21) **2.5** Fundamental Duties and their Significance under Part IV-A **2.6** Directive Principles of State Policy under Part – IV: importance and	Presentations Case Studies and Analysis Role-Playing and Simulations Project-Based Learning	**CO2**

	TLO2.3 Identify fundamental duties in general and in particular with the engineering field. **TLO2.4**: Grasp the significance and practical application of Directive Principles of State Policy outlined in Part IV of the Indian Constitution.	implementation.		
UNIT- III UNION AND STATE EXECUTIVE(CL Hrs-03, Marks-NIL)				
3	**TLO 3.1** 3.1: Gain insight into the structure and functions of the Union executives and the jurisdiction of the Supreme Court. **TLO 3.2** 3.2: Understand the organization and responsibilities of the State Executives and the functions of the State Judiciary(High Courts).	**3.1** Union Government, Union Legislature (Parliament), Lok Sabha and Rajya Sabha (with Powers and Functions), Union Executive, President of India (with Powers and Functions), Prime Minister of India (with Powers and Functions), Union Judiciary (Supreme Court), Jurisdiction of the Supreme Court. **3.2** State Government, State Legislature (Legislative Assembly/ Vidhan Sabha, Legislative Council / Vidhan Parishad), Powers and Functions of the State Legislature, State Executive, Governor Of the State (with Powers and Functions), The Chief Minister Of the State (With Powers and Functions) State Judiciary (High Courts).	Presentations Case Studies and Analysis Role-Playing and Simulations Project-Based Learning	**CO3**
UNIT-IV AMENDMENTS AND EMERGENCY PROVISIONS(CL Hrs-03, Marks-NIL)				
4	**TLO 4.1** Comprehend the meaning and significance of constitutional amendments, as well as the procedural rules detailed in Article 368 of the Indian Constitution. **TLO 4.2** Recognize the roles of various branches of government in the amendment process, **TLO 4.3** Examine the significant procedures and historical context of major constitutional amendments	**4.1 Introduction to Constitutional Amendments:** Definition and significance of constitutional amendments. Constitutional provisions governing the amendment procedure (Article 368). **4.2 Types of Amendments:** Simple majority amendments, Special majority amendments, Amendments requiring ratification by states. **4.3 Role of the Executives Amendments**: Role of Parliament: Lok Sabha and Rajya Sabha, Role of President: Assent to amendments, Role of State Legislatures: Ratification of certain amendments. **4.4 Major Constitutional**	Presentations Case Studies and Analysis Role-Playing and Simulations Project-Based Learning	**CO4**

		Amendment procedures: Major Constitutional Amendment procedures - 1st, 7th,42nd, 44th, 73rd & 74th, 76th, 86th, 52nd & 91st, 102nd		
UNIT –V ELECTORAL LITERACY (CL Hrs-02, Marks-NIL)				
5	**TLO5.** Electoral Literacy: Develop understanding and proficiency in electoral processes, voter registration, rights and responsibilities of voters, electoral reforms, and initiatives promoting electoral literacy.	**5.1 Understanding the Electoral Process :** Overview of the electoral process: registration, voting, counting, and declaration of results, Role and functions of the Election Commission of India Types of elections: Lok Sabha, Rajya Sabha, State Legislative Assembly, Local Body elections **5.2 Voter Registration and Electoral Rolls:** Importance of voter registration Eligibility criteria for voter registration Process of voter registration: online, offline, and special drives Checking and updating voter details in electoral rolls **5.3 Rights and Responsibilities of Voters:** Understanding fundamental rights related to elections Responsibilities of voters towards ensuring free and fair elections Consequences of electoral malpractices and non-participation **5.4 Electoral Reforms and Initiatives:** Overview of electoral reforms aimed at enhancing transparency, inclusivity, and integrity of elections Role of technology in improving electoral processes: Voter Verifiable Paper Audit Trail (VVPAT), Online voter registration, e-voting Initiatives by the Election Commission and civil society organizations to promote electoral literacy	Presentations Case Studies and Analysis Role-Playing and Simulations Project-Based Learning	**CO5**

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/ TUTORIAL EXPERIENCES.

NOT APPLICABLE

VI. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

i) **Case Study Analysis:** Select a few landmark Supreme Court cases related to Fundamental Rights (e.g., Kesavananda Bharati v. State of Kerala, Maneka Gandhi v. Union of India) and analyze the court's interpretation and impact on these rights.

ii) **Comparative Analysis**: Compare the provisions of the Right to Equality under Articles 14-18 with similar provisions in the constitutions of other countries. Highlight similarities, differences, and the reasoning behind them.

iii) **Public Awareness Campaign**: Design a public awareness campaign to educate citizens about their Fundamental Rights and Duties. Create informative posters, social media content, and interactive workshops to engage people in discussions about constitutional rights and responsibilities.

iv) Write a reflective essay discussing the historical context and debates surrounding the inclusion of Fundamental Rights in the Indian Constitution.

v) Create a visual timeline depicting the evolution of laws related to equality in India, from independence to the present day. Include major legislative reforms and judicial decisions.

vi) Conduct a comparative analysis of the implementation of Directive Principles in different states of India, identifying successful initiatives and areas needing improvement.

vii) **Case Study Analysis:** Choose a recent constitutional or political issue that has been debated in Parliament. Analyze the roles played by the Loksabha and Rajya Sabha in addressing the issue and the impact of their decisions.

viii) Case Study Analysis: Analyze a landmark constitutional amendment in India (e.g., the 42nd Amendment) and its impact on governance, fundamental rights, and the balance of power between different branches of government.

ix) **Infographic Creation:** Create an infographic illustrating the process of amending the Indian Constitution as outlined in Article 368. Highlight key steps and requirements for different types of amendments.

x**) Timeline Project:** Create a timeline highlighting major constitutional amendments in India, such as the 1st, 7th, 42nd, 44th, 73rd & 74th, 76th, 86th, 52nd & 91st, and 102nd amendments. Include key provisions and the political context surrounding each amendment.

xi) **Debate:** Organize a debate on the topic "Should the President have the power to refuse assent to constitutional amendments?" Encourage students to research and present arguments from legal, political, and ethical perspectives.

xi**) Campaign Design:** Design a social media campaign to raise awareness about the importance of voter participation and responsible voting. Create visually engaging posters, infographics, and videos highlighting the consequences of electoral malpractices and non-participation.

xii) **Online Tutorial:** Create a step-by-step tutorial video or guide demonstrating the voter registration process, both online and offline. Include instructions for checking and updating voter details in electoral rolls.

xiii**) Survey Project:** Conduct a survey to assess the awareness and accessibility of voter registration

facilities among different demographic groups in your locality. Analyze the results and propose strategies to improve voter registration rates.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

NOT APPLICABLE

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

NOT APPLICABLE

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Assignment, Self-learning and Terms work Seminar/Presentation	—

X. SUGGESTED COS- POS MATRIX FORM

Course Outcomes (Cos)	Programme Outcomes(Pos)							Programme Specific Outcomes *(PSOs)	
	PO-1 Basic and Discipline-Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO1	--	--	--	--	2	--	2		
CO2	--	--	--	--	3	--	2		
CO3	--	--	--	--	3	--	2		
CO4	--	--	--	--	3	--	2		
CO5	--	--	--	--	3	--	2		

Legends:- High:03, **Medium:**02, **Low:**01, **No Mapping:** -
*PSOs are to be formulated at the institute level

XI. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	Author	Title	Publisher
1	M. Laxmikanth	"Indian Polity"	McGraw Hill Education: ISBN-13: 978-9352603633
2	D. D. Basu	Introduction to the Constitution of India	LexisNexis: ISBN-13: 978-8180386477
3	Subhash C. Kashyap	Our Constitution: An Introduction to India's Constitution and Constitutional Law	National Book Trust, India ISBN-13: 78-8123748462
4	Arun K. Thiruvengadam	The Constitution of India: A Contextual Analysis	Oxford University Press ISBN-1 3:978-0199467078
5	Oxford University Press	The Making of India's Constitution	Oxford University Press Oxford University Press

XI. LEARNING WEBSITES & PORTALS

Sr.No.	Link/Portal	Description
1	https://prsindia.org/.	In-depth analysis of parliamentary affairs, legislative processes, and policy Issues in India.
2	https://awmin.gov.in	Official repository providing access to the full text of the Indian Constitution.
3	https://constitution.org.in	Interactive platform offering the text of the Constitution along with annotations and historical context.
4	https://indiankanoon.org	Legal search engine offering a vast database of Indian case law, including constitutional judgments.
5	https://nptel.ac.in	Offers video lectures and course materials on studies of law and the constitution.

Name & Signature:

Mr. S.B. Kulkarni
Lecturer in Mechanical Engineering
(Course Experts)

Name & Signature:	Name & Signature:
Smt.N.S.Kadam (Programme Head)	**Shri. S.B. Kulkarni** (CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN ME / MT**
PROGRAMME CODE	**04/ 05**
COURSE TITLE	**COMPUTER AIDED DRAFTING**
COURSE CODE	**ME31206**
PREREQUISITE COURSE CODE & TITLE	**NA**
CLASS DECLARATION COURSE	**NO**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme												
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														Practical							
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA			
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min		
ME31206	COMPUTER-AIDED DRAFTING	SEC	-	-	4	-	4	2	-	-	-	-	-	50	20	50@	20	-	-	100	

Total IKS Hrs for Term: Nil Hrs

Abbreviations: CL-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA** - Formative Assessment**, SA** -Summative assessment, **IKS** – Indian Knowledge System, **SLA**- Self Learning Assessment

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Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as **'Detained'** in that course.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as **'fail'** and will have to repeat and resubmit SLA work.
3. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.

6.* Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

Computer-aided 2D drafting (CAD) has revolutionized the field of design and engineering. By providing tools for the precise and efficient creation of technical drawings, CAD systems enhance productivity and ensure consistency across project documentation. The ability to quickly modify designs and iterate on ideas without the need for manual redrawing saves time and resources. Moreover, CAD's compatibility with other digital tools streamlines the design process, fostering innovation and collaboration, especially in remote settings. As a result, CAD has become a fundamental component in the modern design and engineering toolkit, underpinning the development of complex projects across various industries.

III. COURSE-LEVEL LEARNING OUTCOMES (CO's)

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO1: Use basic commands in CAD software
CO2: Modify complex 2D geometric figures using CAD software
CO3: Use layers and blocks for creating digital drawings using relevant software.
CO4: Create Isometric drawings using a CAD software
CO5: Plot existing drawing using the plot command

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT-I FUNDAMENTALS OF CAD DRAWING (CL Hrs-NIL, Marks- NIL)				
1.	TLO1.1 Explain the use of computers in drafting and TLO1.2 Use the AutoCAD workspace and interface. TLO1.3 Apply different object selection methods in a given situation. TLO1.4 Open, save and close new and given drawings/ templates	1.1 Fundamentals of Computer Aided Drafting (CAD) and its applications, Various Software for Computer Aided Drafting. 1.2 Co-ordinate System- Cartesian and Polar Absolute, Relative mode, UCS, WCS. 1.3 CAD initial setting commands- Snap, grid, Ortho, Osnap, Limits, Units, Object tracking. 1.4 Object Selection methods- picking, window, crossing, fence, last and previous. 1.5 Opening, saving and closing a new and existing drawing/template	Video - Demonstration Hands-On	CO1,
UNIT-II DRAWING AND FORMATTING COMMANDS (CL Hrs-NIL, Marks- NIL)				
2	TLO 2.1 Apply formatting commands. TLO 2.2 Draw simple 2D entities using given Draw commands. TLO 2.3 Determine coordinates, distance, area, length, and centroid of the given 2D entity.	2.1 Draw Command - Line, Polyline, arc, circle, rectangle, polygon, ellipse, spline, block, hatch. 2.2 Formatting commands - Layers, block, line type, line weight, colour.2.3 Enquiry commands – distance, area.	Video - Demonstration Hands-On	CO1, CO2, CO3
UNIT-III MODIFY AND EDIT COMMANDS (CL Hrs-NIL, Marks- NIL)				
3	TLO3.1 Draw given complex 2D entities using Modify commands. TLO3.2 Use the grip command to manipulate the given 2D entity .	3.1 Modify Command - Erase, trim, extend, copy, move, mirror, offset, fillet, chamfer, array, rotate, scale, lengthen, stretch, measure, break, divide, explode,align. 3.2 Editing Objects by Using Grips – Moving, Rotating, Scaling, Mirroring and Stretching	Video - Demonstration Hands-On	CO1, CO2
UNIT- IV ISOMETRIC DRAWING COMMANDS (CL Hrs-NIL, Marks- NIL)				
4	TLO4.1 Draw isometric entities. TLO4.2 Draw an isometric object from given orthographic views. TLO4.3 Use Layers for 2D drawings. TLO4.4 Draw and modify blocks for given 2D entities. TLO4.5 Use blocks in the same and another given file.	4.1 Isometric drafting- Isometric grid & snap, Isometric axis & plane, Polyline,Isocircle. 4.2 Dimensioning Isometric Drawings. 4.3 Layer, Layer properties and applications. 4.4 Blocks: create, modify and use in the same file and another file.	Video- Demonstration Hands-On	CO1, CO4

UNIT –V DIMENSIONING AND PLOT COMMANDS (CL Hrs-NIL, Marks- NIL)				
5	TLO 5.1 Use various dimensioning styles to draw 2D entities. TLO 5.2 Apply Geometric and dimension tolerance symbols on the given entity. TLO 5.3 Write text on a given 2D entity. TLO 5.4 Insert table in the drawing TLO 5.5 Prepare a new template for drawing as per requirement. TLO 5.6 Plot given 2D entities using proper plotting parameters.	5.1 Dimensioning commands: Dimension styles, Dimensional Tolerances and Geometrical Tolerances, Modify dimension style. 5.2 Text commands - dtext, mtext command. 5.3 Insert table: table, table style command. 5.4 Template Drawing- Standard template, loading template, create a new template. 5.5 Plotting a drawing: adding plotter/printer, page setup, and plot style commands.	Video-Demonstration Hands-On	CO1, CO2, CO5

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1	LLO1.1 Prepare template of A4 size with title block	*Preparation of Template	02	01
2	LLO2.1 Use basic commands for drawing 2-D entities LLO2.2 Draw basic entities using CAD software	*Drawing of 2-D Entities (Line, Circle, Polygon, Redraw figure etc)	02	01
3	LLO3.1 Use basic commands for drawing 2-D entities LLO3.2 Draw basic entities using CAD software	Drawing of 2-D Entities using a complex command (Polygon + Circle, Circle+ Line etc.)	04	01,02
4	LLO4.1 Use basic commands for drawing 2-D entities LLO4.2 Draw basic entities using CAD software	*Drawing of Complex object (Any 4 objects)	04	01,02
5	LLO5.1 Use basic commands for drawing 2-D entities LLO5.2 Draw orthographic Projections using CAD software	*Drawing of Orthographic Projections (Any 3 Problems) using the first angle method of Projections	04	01,02,03
6	LLO 6.1 Use basic commands for drawing 2-D entities. LLO6.2 Draw orthographic projections using CAD software	Drawing of Orthographic Projections (Any 3 Problems) using the Third angle method of Projections	04	01,02,03
7	LLO 7.1 Use basic commands for drawing 2-D entities. LLO 7.2 Draw orthographic projections using CAD software.	Drawing of Sectional Orthographic Projections (Any 2 Problems) using the first angle of Projections	04	01,02,03
8	LLO 8.1 Use basic commands for drawing 2-D entities LLO 8.2 Draw orthographic projections using CAD software	*Drawing of Sectional Orthographic Projections (Any 2 Problems) using the Third angle of Projections	04	01,02,03
9	LLO 9.1 Use basic commands for drawing 2-D entities	*Drawing of Simple Isometric Projections (any 4 Problems)	04	01,02,03, 04

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
	LLO 9.2 Draw isometric projections using CAD software			
10	LLO10.1 Use basic commands for drawing 2-D entities LLO10.2 Draw isometric projections using CAD software	Drawing of Complex Isometric Projections (any 4 Problems)	04	01,02,03 04
11	LLO11.1 Use basic commands for drawing 2-D entities LLO11.2 Use different commands for drawing assembly	*Drawing an assembly of Cotter Joint/Knuckle Joint/Universal Coupling (Any One) drawing from the given detailed drawing showing assembly dimensions, part number and bill of Material.	06	01,02,03
12	LLO12.1 Use basic commands for drawing 2-D entities LLO12.2 Use different commands for drawing assembly	*Drawing working drawings from Practical No. 11 showing conventional representation, dimensions, geometrical tolerances and machining symbols.	06	01,02,03
13	LLO13.1 Use basic commands for drawing 2-D entities LLO13.2 Use different commands for drawing assembly	Drawing an assembly of Screw Jack/Bench Vice/Steam Stop Valve/Toggle Jack (Any One) drawing from the given detailed drawing showing assembly dimensions, part number and bill of Material.	06	01,02,03
14	LLO14.1 Use basic commands for drawing 2-D entities LLO14.2 Use different commands for drawing assembly	Drawing working drawings from Practical No. 12 showing conventional representation, dimensions, geometrical tolerances and machining symbols.	06	01,02,03
15	LLO 15.1 Use of plotter for plotting given drawing	*Plot the drawing from Sr.No 2 to 14 using a plotter	04	05

VI. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

Micro project:

NOT APPLICABLE

Assignment: -

NOT APPLICABLE

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Latest version of Computer Aided Drafting software with License (1+50)	All
2	CAD workstation with the latest configurations for each student.	All
3	Plotter/Printer with latest versions.	All
4	LCD projector and Screen/ Interactive board.	All

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE

(Specification Table)

Sr. No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Fundamentals of CADD drawing	1	-	-	-	-	-
2	II	Drawing and Formatting Commands	1,2,3	-	-	-	-	-
3	III	Modify and Edit Commands	1,2	-	-	-	-	-
4	IV	Isometric drawing Commands	1,4	-	-	-	-	-
5	V	Dimensioning and Plot Commands	1,5	-	-	-	-	-
Grand Total				-	-	-	-	-

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
1. Term work	1. End Semester Practical Examination

X. SUGGESTED COs- POs MATRIX FORM

Course Outcomes (COs)	Programme Outcomes(POs)								
	PO-1 Basic and Discipline-Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO1	**3**	**-**	**-**	**3**	**-**	**-**	**2**	3	-
CO2	**3**	**-**	**-**	**3**	**-**	**-**	**2**	3	-
CO3	**2**	**-**	**-**	**3**	**-**	**-**	**2**	3	-
CO4	**3**	**-**	**-**	**3**	**-**	**-**	**3**	3	-
CO5	**3**	**-**	**-**	**3**	**-**	**-**	**3**	3	-

XI. SUGGESTED LEARNING MATERIALS /B OOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Sankar Prasad Dey	AutoCAD 2014 for Engineers Volume 1	Publisher: Vikas, 21 December 2021, ISBN-13: 978-9325983373
2	Kulkarni D.M	Engineering Graphics with AutoCAD	Publisher: Prentice Hall India Learning Private Limited, 1 January 2010, ISBN-10: 8120337832, ISBN-13: 978-8120337831
3	Dr.Sharad K. Pradhan, K K Jain	Engineering Graphics, AICTE Prescribed Textbook	Khanna Book Publishing; First Edition, 1 January 2023, ISBN-10 9391505503, ISBN-13 978-9391505509

XII. LEARNING WEBSITES & PORTALS

Sr.No	Link/Portal	Description
1.	https://ocw.mit.edu/courses/mechanical-engineering/	Lectures, assignments and projects covering topics such as engineering design, CAD/CAM, and product development.
2.	https://www.engineering.com/LearningCenter/CAD.aspx	Tutorials, articles, and videos covering CAD software, simulation tools, and engineering design concepts.
3.	https://www.youtube.com/watch?v=QuR-VKis3jU	2D mechanical drawings in AutoCAD, including drawing parts, adding dimensions, annotations and creating detailed technical drawings.
4.	https://www.youtube.com/watch?v=PHSmwXQriIc	Isometric drawings in AutoCAD
5.	https://www.cadtutor.net/	Tutorials, articles, forums and downloadable resources covering various CAD software application

Name &Signature:

Mr. S. S. Harip
Lecturer in Mechanical Engineering

Mr. R. S. Solanke
Lecturer in Mechanical Engineering

(Course Experts)

Name & Signature:

Smt.N.S.Kadam
(Programme Head)

Name & Signature:

Shri.S.B.Kulkarni
(CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN MT**
PROGRAMME CODE	**05**
COURSE TITLE	**FURNACE TECHNOLOGY**
COURSE CODE	**MT21202**
PREREQUISITE COURSE CODE & TITLE	**NA**
CLASS DECLARATION COURSE	**NO**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration Hrs.	Theory				Based on LL & TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
MT21202	FURNACE TECHNOLOGY	DSC	4	-	2	2	8	4	3	30	70	100	40	25	10	25@	10	25	10	175

Total IKS Hrs for Term: 0 Hrs

Abbreviations: CL-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA** - Formative Assessment**, SA** -Summative assessment, **IKS** – Indian Knowledge System, **SLA**- Self Learning Assessment

Legends: @-Internal Assessment, # - External Assessment, *# - Online Examination, **@$** - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as **'Detained'** in that course.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as **'fail'** and will have to repeat and resubmit SLA work.
3. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.
6. * Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

Refractories and fuels or electric energy are basic requirements of Metallurgical furnaces for melting any ferrous and non-ferrous metals and alloys. Refractory is an important material for the construction of furnaces, whereas fuels play an important role in the overall quality and cost of any metallurgical product. Thus, students must study the refractories, fuels and use of electric energy in the construction and working of various melting furnaces.

III. COURSE-LEVEL LEARNING OUTCOMES (CO's)

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO1: State properties and applications of refractories and fuels.

CO2: Relate various modes of heat transfer in metallurgical furnaces.

CO3: Explain the working of fuel-fired furnaces.

CO4: Explain the working of recuperator and regenerator.

CO5: Explain the working of electric resistance, arc and induction furnaces.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT-I REFRACTORIES (CL Hrs- 04, Marks- 04)				
1	TLO 1.1 Define refractories. TLO 1.2 Explain the classification, properties and factors for the selection of refractories. TLO 1.3 State applications of refractories in different types of furnaces.	1.1 Definition and classification of refractories. 1.2 Properties are required in refractory materials. 1.3 Factors affecting the selection of refractories. 1.4 Applications of refractories.	Lecture Assignment	**CO1**
UNIT-II FUELS (CL Hrs- 04, Marks- 04)				
2	TLO 2.1 Define fuels. TLO 2.2 Explain the classification of fuels. TLO 2.3 Explain factors for the selection of fuels. TLO 2.4 Explain the properties of fuels. TLO 2.5 Distinguish between solid, liquid and gaseous fuels.	2.1 Introduction and classification of conventional fuels. 2.2 Factors Affecting Selection of Fuels. 2.3 Properties of solid, liquid & gaseous fuels. 2.4 Comparison of solid, liquid and gaseous fuels.	Lecture Assignment	**CO1**
UNIT-III PRINCIPLE OF HEAT TRANSFER (CL Hrs- 04, Marks- 04)				
3	TLO 3.1 State basic principle of heat transfer. TLO 3.2 Explain various modes of heat transfer. TLO 3.3 Explain the role of conduction, convection and radiation in fuel fuel-fired furnaces.	3.1 Basic principle of heat transfer. 3.2 Principle of heat transfer by conduction, convection and radiation. 3.3 Role of conduction, convection and radiation in the fuel-fired furnace.	Lecture Assignment	**CO2**
UNIT-IV FUEL FIRED FURNACES (CL Hrs- 12, Marks- 14)				
4	TLO 4.1 Explain the classification of furnaces based on various criteria. TLO 4.2 Explain the role of various auxiliary equipment in the working of furnaces. TLO 4.3 Explain the working of fuel-fired furnaces. TLO 4.4 State the need to control the furnace atmosphere. TLO 4.5 Explain the role of various furnace atmospheres. TLO 4.6 Describe the procedure for measurement of the furnace	4.1 Classification of industrial furnaces based on various criteria like- heating source, mode of operation, shape, and purpose. 4.2 Role of auxiliary equipment such as dampers, burners, blowers, control valves, vacuum pumps and exhaust systems in furnaces. 4.2 Explain the working of fuel-fired furnaces- crucible type, barrel type, reverberatory. 4.3 Atmospheric control in furnaces- need, types of furnace atmosphere; oxidizing, reducing, neutral.	Lecture Assignment	**CO3**

Sr. No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
	atmosphere using a Carbon/Oxygen probe and Dew point (chilled mirror) controller.	4.4 Furnace atmosphere measurement using Carbon/Oxygen probe and Dew point (chilled mirror) controller.		
UNIT-V WASTE HEAT RECOVERY (CL Hrs- 06, Marks- 08)				
5	TLO 5.1 State the need for waste heat recovery from furnaces. TLO 5.2 Describe the working principle of different types of recuperators. TLO 5.3 Describe the construction and working of the regenerator. TLO 5.4 Distinguish between recuperators and regenerators.	5.1 Need for waste heat recovery from furnaces. 5.2 Recuperators- Principle of working of parallel flow, counter-current flow and cross-flow type recuperators. 5.3 Regenerators- Construction and working principle of regenerators in open hearth furnace. 5.4 Comparison between recuperators and regenerators.	Lecture Assignment	**CO4**
UNIT-VI ELECTRIC RESISTANCE FURNACES (CL Hrs- 10, Marks- 12)				
6	TLO 6.1 Explain the principle and working of a direct resistance furnace. TLO 6.2 Explain the principle and working of an indirect resistance furnace. TLO 6.3 State the types, compositions & properties of heating elements. TLO 6.4 Explain the significance of coil dimensions in a resistance furnace.	6.1 Principle of direct resistance furnace. 6.2 Working of direct resistance (salt bath) furnace. 6.3 Principle of indirect resistance furnace. 6.4 Construction and working of muffle furnace. 6.5 Heating elements- Types, compositions and properties. 6.6 Significance of coil dimensions of heating element in an indirect resistance furnace.	Lecture Assignment Demonstration	**CO5**
UNIT-VII ELECTRIC ARC FURNACES (CL Hrs- 10, Marks- 12)				
7	TLO 7.1 Explain the principle and working of a direct arc furnace. TLO 7.2 Explain the principle and working of an indirect arc furnace. TLO 7.3 State the significance of electrodes in arc furnaces.	7.1 Principle of direct arc furnace. 7.2 Construction, working and applications of direct arc furnace. 7.3 Principle of indirect arc furnace. 7.4 Construction, working and applications of indirect arc furnace. 7.5 Significance of electrodes in arc furnaces.		**CO5**
UNIT-VIII ELECTRIC INDUCTION FURNACES (CL Hrs- 10, Marks- 12)				
8	TLO 8.1 Explain the principle and working of core-type induction furnaces. TLO 8.2 Explain the principle and working of a coreless induction furnace. TLO 8.3 State the significance of	8.1 Principle of core type induction furnace. 8.2 Construction, working and applications of core-type induction furnace. 8.3 Principle of coreless induction furnace.	Lecture Assignment	**CO5**

Sr. No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
	skin effect, minimum frequency, power generation and depth of penetration.	8.4 Construction, working and applications of coreless induction furnace. 8.5 Parameters in induction heating-skin effect, minimum frequency, power generation and depth of penetration. 8.6 Principle and working of vacuum induction furnace.		

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1	LLO 1.1 Explain the classification, properties and applications of furnace refractories.	Study of classification, properties and applications of furnace refractories.	2	CO1
2	LLO 2.1 Explain the classification, properties and applications of fuels.	Study of classification, properties and applications of fuels.	2	CO1
3	LLO 3.1 Explain various modes of heat transfer in furnaces.	Study of modes of heat transfer in furnaces.	4	CO2
4	LLO 4.1 Explain the construction and working of a crucible-type fuel-fired furnace.	Study of construction and working of crucible-type fuel-fired furnace.	2	CO3
5	LLO 5.1 Explain the construction and working of barrel-type fuel-fired furnaces.	Study of construction and working of barrel-type fuel-fired furnace.	2	CO3
6	LLO 6.1 Explain the construction and working of the reverberatory furnace.	Study of construction and working of reverberatory furnace.	2	CO3
7	LLO 7.1 Explain the working of recuperators.	Study of working of recuperators.	2	CO4
8	LLO 8.1 Explain the working of regenerators.	Study of working of regenerators.	2	CO4
9	LLO 9.1 Explain the construction and working of electric resistance (direct and indirect) furnaces.	Study of construction and working of electric resistance (direct and indirect) furnaces.	4	CO5
10	LLO 10.1 Explain the construction and working of electric arc (direct and indirect) furnaces.	Study of construction and working of electric arc (direct and indirect) furnaces.	4	CO5
11	LLO 11.1 Explain the construction and working of electric induction (core and coreless type) furnaces.	Study of construction and working of electric induction (core and coreless type) furnaces.	4	CO5

VI. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

Micro projects-

- Prepare industrial survey report of furnace refractories/ fuels/ waste heat recovery equipment/fuel-fired furnaces/ atmospheres/ electric resistance furnaces/ arc furnaces/ induction furnaces etc.
- Prepare a demonstration model of any of the furnaces.
- Prepare a report on the fuel consumption of various fuel-fired furnaces.
- Prepare a report on the energy consumption of various electric furnaces.
- Collect technical specifications of various furnace refractories/ fuels/ waste heat recovery equipment/fuel-fired furnaces/ atmospheres/ electric resistance furnaces/ arc furnaces/ induction furnaces etc.
- Prepare tabulated summary for refractories/ fuels/ insulating materials etc used in various furnaces.

Assignment

- Prepare display charts showing the construction of different types of furnaces.
- Prepare flow sheets to explain the working of different types of furnaces.
- Prepare a report on the construction of various furnaces.
- Prepare a report on the working of various furnaces.
- Prepare reports on specifications and sketches of various furnaces.
- Prepare a visit report on any industry using different furnaces.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr. No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Samples of common types of furnace refractories	1
2	Coke fired furnace	2,4
3	Oil fired furnace	2,5
4	Gas fired furnace	2,6
5	Models of recuperators and regenerator	7,8
6	Electric resistance muffle furnace	9
7	Model of electric arc furnace	10
8	Electric induction furnace	11

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE

(Specification Table)

Sr. No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	REFRACTORIES	CO1	04	2	2	-	04
2	II	FUELS	CO1	04	2	2	-	04
3	III	PRINCIPLE OF HEAT TRANSFER	CO2	04	2	2	-	04
4	IV	FUEL FIRED FURNACES	CO3	12	4	6	4	14
5	V	WASTE HEAT RECOVERY	CO4	06	2	4	2	08
6	VI	ELECTRIC RESISTANCE FURNACES	CO5	10	4	4	4	12
7	VII	ELECTRIC ARC FURNACES	CO5	10	4	4	4	12
8	VII	ELECTRIC INDUCTION FURNACES	CO5	10	4	4	4	12
Grand Total				**60**	**24**	**28**	**18**	**70**

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
1. Unit Tests: Average of two unit tests (30 marks) 2. Term Work: FA-PR (25 marks) 3. Self-Learning: SLA (25 marks)	1. End Term Exam: SA-TH (70 marks) 2. End Term Exam: SA-PR (25 marks)

X. SUGGESTED COs- POs MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)			
	PO-1 Basic and Discipline-Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3	PSO-4
CO1	3	--	2	--	3	1	2	3	--	--	1
CO2	3	--	2	--	2	1	1	3	--	--	1
CO3	3	2	3	--	3	2	3	3	--	2	2
CO4	2	--	2	--	3	2	2	3	--	--	1
CO5	3	2	3	--	3	2	3	3	--	2	2
Legends:- High: 03, **Medium:** 02, **Low:** 01, **No Mapping:** ---											

XI. SUGGESTED LEARNING MATERIALS/BOOKS

Sr. No	Author	Title	Publisher
1	O.P.Gupta	Element of Fuels, Furnace & Refractories	Khanna Publishers, Delhi ISBN-13: 9788174090881 ISBN-10: 8174090886
2	W. Trinks & M.H.Nawhiney	Industrial Furnaces	Wiley Publisher, Newyork, VI Edition, 2004 ISBN-13: 9780471387060 ISBN-10: 0471387061
3	H. Barber	Electroheat	Granada Publication, London ISBN-13: 9780246117397 ISBN-10: 0246117397

XII. LEARNING WEBSITES & PORTALS

Sr. No	Link/Portal	Description
1	www.nptel.com- http://www.nptelvideos.in/2012/12/fuels-refractory-and-furnaces.html	Fuels, refractories and furnaces
2	https://youtu.be/1qnhXgqgWKc	Direct Arc Furnace
3	https://youtu.be/RswesHu--Cw	Indirect Arc Furnace
4	https://youtu.be/RgFEiRu7sUM	Induction Furnace

Name & Signature: **Mr. Abhijit V. Mehtre** Lecturer in Metallurgical Engineering (Course Expert)	
Name & Signature: **Mrs. Namita S. Kadam** (Programme Head)	Name & Signature: **Mr. Sudin B Kulkarni** (CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN MT**
PROGRAMME CODE	**05**
COURSE TITLE	**METALLURGICAL CHEMICAL ANALYSIS**
COURSE CODE	**MT31203**
PREREQUISITE COURSE CODE & TITLE	**NA**
CLASS DECLARATION COURSE	**NO**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
MT31203	METALLURGICAL CHEMICAL ANALYSIS	DSC	3	-	2	1	6	3	2	30	70*#	100	40	25	10	25@	10	25	10	175

Total IKS Hrs for Term: 1 Hrs

Abbreviations: CL-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA** - Formative Assessment**, SA** -Summative assessment, **IKS** – Indian Knowledge System, **SLA**- Self Learning Assessment

Legends: @- Internal Assessment, **#** - External Assessment,***#** - Online Examination, **@$** - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as **'Detained'** in that course.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as **'fail'** and will have to repeat and resubmit SLA work.
3. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.

6.* Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

The material science field is continuously expanding. New alloys and composite materials are coming up rapidly to meet common needs in general and specific needs in particular. The chemical analysis became essential to investigate the composition of these materials to provide data concerning composition and properties, therefore. The metallurgist is expected to be conversant with various processes of chemical analysis. He should know the principles and laws governing chemical reactions, which can be applied to decide the extraction path of metals from their specific ores. Metallurgists should have an insight into instruments and their operating principles used for chemical analysis.

III. COURSE-LEVEL LEARNING OUTCOMES (CO's)

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO1: Apply fundamentals of various standard quantitative chemical analysis testing methods.
CO2: Perform various gravimetric analysis procedures & predict the result for testing of material in the laboratory.
CO3: Precisely apply the procedure and predict the result of volumetric analysis.
CO4: Enable to handle various instruments of instrumental analysis for testing of materials.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT-I INTRODUCTION (CL Hrs-07 Marks-10)				
1	TLO 1.1 Enlist various areas of chemical analysis TLO 1.2 compare qualitative and quantitative analysis TLO 1.3 Define various terminology in chemical analysis	1.1 Purpose/Areas of analysis. Types of analysis, qualitative and quantitative. Methods of quantitative analysis such as gravimetric, volumetric & instrumental 1.2 Solubility, standard solution, saturated solution, supersaturated solution, Solubility Product.	Improved Lecture Tutorial Assignment Demonstration	**CO1**
UNIT-II GRAVIMENTRIC ANALYSIS (CL Hrs-14, Marks-24)				
2	TLO 2.1: Conversant with equipment and procedure of gravimetric method. TLO 2.2: Apply the concept of solubility product concerning the condition of precipitation. TLO 2.3: Use of the concept of masking, and coprecipitation to investigate simple engineering works for gravimetric. TLO 2.4 Explain filtration, washing, drying & igniting of precipitate in terms of procedure & purpose. TLO 2.5 Explain the advantages & uses of gravimetric.	2.1 Chemical balance and their precision, Equipment and glassware used. 2.2 Solubility products, requirement of precipitation form, etc. 2.3 Condition of precipitation, factor effect on precipitation, completeness of precipitation reaction, Masking, co-precipitation etc 2.4 Filtration, Washing, Drying & Igniting of precipitate, Weighing & requirement of weighing form. 2.5 Determination of weight % of the element from the precipitate. 2.6 Advantages, disadvantages & uses of method. 2.7 Simple example of gravimetric analysis.	Improved Lecture Tutorial Assignment Demonstration Simulation	**CO2**

UNIT-III VOLUMETRIC ANALYSIS (CL Hrs-12, Marks-18)				
3	TLO 3.1. Define various terms in volumetric analysis. TLO 3.2. Explain the requirement of volumetric analysis. TLO 3.3 State types of volumetric reactions TLO 3.4 Explain various titration curve TLO 3.5 Enlist indicators and relation of indicator ph and equivalence ph. TLO 3.6. Explain Redox titration TLO 3.7 Explain the advantages & uses of volumetric analysis.	3.1 The solution, concentration of the solution, methods to express solution strength, Equivalent weight, Normality of solution, and preparation of the standard solution. Types of volumetric reaction, requirements of volumetric analysis, advantages etc 3.2 Acid-Base neutralization reaction 3.3 Titration, types and methods of titration. Equivalence point, End point and Neutral point in Acid-Base titrations. 3.4 Indicators, role and action of indicators in titration, PH range of indicator, Selection of indicator for acid-base titration. 3.5 Titration curve, plotting of different titration curves depending upon different strength of acid and base e.g. weak acid with strong base etc. 3.6 Oxidation-Reduction reactions, Oxidizing and Reducing agents, Oxidation-Reduction potential. Redox titration curve, titrations with potassium permanganate solution, Gram-equivalent of oxidizing and reducing agents, Determination of Fe++ by redox method. 3.7 Comparisons between volumetric and instrumental analysis 3.8 Simple calculations concerning the strength of the solution.	Improved Lecture Tutorial Assignment Demonstration	**CO3**
UNIT- IV INSTRUMENTAL ANALYSIS (CL Hrs-12, Marks-18)				
4	TLO 4.1 Explain characteristics and advantages TLO 4.2 Compare vacuum emission and atomic absorption spectrometer TLO 4.3 Explain the procedure of the colourimetric method. TLO 4.4 Explain the procedure to determine c & s in steel by combustion.	4.1 Scope for instrumental analysis. Advantages of instrumental analysis. 4.2 Introduction to Spectroscopy, classification of the spectrometer, principal, working & advantages of emission and atomic absorption spectrometer; Introduction to X-ray fluorescence process(XRF), Polarography and Colourimetry. Beer's Law and Lambert's Law 4.3 Colorimetric methods, Photoelectric colorimeter. 4.4 Electrolysis, Potentiometric Titration 4.5 Carbon and sulphur determination in steel by combustion method	Improved Lecture Tutorial Assignment Demonstration	**CO4**

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1	LLO 1.1: Making of standard solutions of different salts using the concentration principle.	Preparation of standard solution.	2	CO1
2	LLO 2.1 To identify accuracy precision & error, prepare & present the report.	Presentation of the analysis report.	2	CO1
3	LLO 3.1: Elemental Analysis of steel & cast iron.	Determination of C, Si, Mn, Cr & Mo by using gravimetric & Volumetric analysis.	8	CO2
4	LLO 4.1: To understand common & diverse ion effects.	Observing the effects of common ions and diverse ions on solubility	2	CO3
5	LLO 5.1: Familiar with the working procedure of titration.	To perform acid-base titration.	4	CO3
6	LLO 6.1: Familiar with working on redox titreation	Determination of Fe++ by redox method	4	CO3
7	LLO 7.1: Use of colour comparison to determine element amount in a given sample.	Colorimetric determination of concentration of solution [CuSO4 and/or KMNO4].	2	CO4
8	LLO 8.1: Measure % c & % s in LC steel.	Determination of C/S in steel by combustion method	2	CO4
9	LLO 9.1: Measure % copper & % Zinc in brass.	Analysis of brass & bronzes using electrogravimetric apparatus or standard method.	2	CO4
10	LLO 10.1: To understand the workings of a spectrometer.	Study of various spectrometers.	2	CO4

VI. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

Micro project –

- Chart of Classification of Chemical Analysis Method: Prepare a classification of the analysis method with advantages, examples and uses.
- Gravimetric Analysis methods: Draw and explain the procedure/flow diagram of the gravimetric method.
- Volumetric Analysis methods: Collect information on volumetric method area application & uses in industry.
- Instrumental analysis: Collect data of each instrument used in the industry for chemical analysis such as a spectrometer etc in terms of quality control analysis, energy efficiency assessment, environmental monitoring, and process optimization., and create a presentation, including short videos, to present your findings.

Assignment –

- Collect examples based on applications of metallurgical analysis principle & importance, and make a PDF file.
- Calculate/make the theoretical concentration of the solution using any concentration method. Eg 1 N Solution.
- Collect examples of area application of chemical analysis in different fields. Make a PDF file.
- Collect information about various Gravimetric methods in terms of procedure, precautions, controlling parameters, and determination and Make a PDF file.
- Collect information about various Volumetric methods in terms of procedure, precautions, controlling parameters, and determination and Make a PDF file.
- Collect information about various Instrumental methods in terms of procedure, precautions, controlling parameters, and determination and Make a PDF file.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr. No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Single pan digital precise weigh balance, Heating source/unit, Glasswares, pipette and measuring flask	LLO 1.1 to LLO 4.1
2	Titration setup; colourimeter tubes	LLO 5.1 to LLO 7.1
3	Strohein's apparatus; Electrogravimetric apparatus & spectrometer	LLO 8.1 to LLO 10.1

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr. No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	INTRODUCTION	CO1	07	3	3	4	10
2	II	GRAVIMETRIC ANALYSIS	CO2	14	8	8	8	24
3	III	VOLUMETRIC ANALYSIS	CO3	12	6	6	6	18
4	IV	INSTRUMENTAL ANALYSIS	CO4	12	6	6	6	18
			Grand Total	**45**	**23**	**23**	**24**	**70**

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
1. Tests 2. Rubrics for COs 3. Assignment 4. Midterm Exam 5. Self-Learning 6. Term Work 7. Seminar/Presentation	1. End Term Exam 2. Micro-project 3. Tutorial Performance

X. SUGGESTED COS- POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes *(PSOs)			
	PO-1 Basic and Discipline-Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3	PSO-4
CO1	2	1	1	2	1	1	1	1	2	1	1
CO2	3	2	2	2	1	1	--	2	2	2	1
CO3	3	3	2	3	1	1	2	3	3	2	1
CO4	3	2	2	2	1	1	2	3	2	2	1

Legends:- High:03, **Medium:**02, **Low:**01, **NoMapping:** --
*PSOs are to be formulated at the institute level

XI. SUGGESTED LEARNING MATERIALS/BOOKS

Sr. No	Author	Title	Publisher
1	B.C.Agarwal, S.P. Jain	Text Book Of Metallurgical Analysis	Khanna Publisher, N. Delhi
2	Dr. S.B. Salunke, Dr. B.B. Deogadkar, Dr. C.M. Bhavasar	Physical and Analytical Chemistry	Nirali Prakashan, Pune
3	V. Alexeyev	Quantitative Analysis	MIR Publisher, Moscow

XII. LEARNING WEBSITES & PORTALS

Sr. No	Link/Portal	Description
1	https://www.youtube.com/watch?v=XPhgQGLBOiM	Gravimetric stepwise procedure
2	https://www.youtube.com/watch?v=kMeJj2YgwZw	Ba in an unknown sample by gravimetric analysis method.
3	https://www.youtube.com/watch?v=r8tr0kZnSPo	Introduction to volumetric analysis
4	https://www.youtube.com/watch?v=xQDQNghs5dc	Glasswares & Consumables used in volumetric analysis
5	https://www.youtube.com/watch?v=laY9YIwznr4	Introduction to instrumental method
6	https://www.youtube.com/watch?v=n5qZMgOnsAs	Introduction to XRD

Name & Signature:
Mr. Pravin B. Kamble
(Course Expert)

Name & Signature:	Name & Signature:
Mrs. Namita S. Kadam (Programme Head)	Mr. Sudin B Kulkarni (CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN MT**
PROGRAMME CODE	**05**
COURSE TITLE	**IRON MAKING**
COURSE CODE	**MT31204**
PREREQUISITE COURSE CODE & TITLE	**NA**
CLASS DECLARATION COURSE	**NO**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration Hrs.	Theory				Based on LL & TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
MT31204	IRON MAKING	DSC	4	--	2	2	8	4	3	30	70	100	40	25	10	--	--	25	10	150

Total IKS Hrs for Term: 2 Hrs

Abbreviations: CL-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA** - Formative Assessment**, SA** -Summative assessment, **IKS** – Indian Knowledge System, **SLA**- Self Learning Assessment

Legends: @-Internal Assessment, # - External Assessment, *# - Online Examination, **@$** - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as **'Detained'** in that course.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as **'fail'** and will have to repeat and resubmit SLA work.
3. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.
6. * Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

The extraction of ferrous metals from their ores is the stepping-stone in understanding the metallurgical courses. This course deals with the important extraction techniques involved in Ferrous Metallurgy. Emphasis is given to the study of blast furnaces, pig iron production and sponge iron production.

III. COURSE-LEVEL LEARNING OUTCOMES (CO's)

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO1: Study the development of iron making.

CO2: Notify the role of charging materials and the importance of agglomeration.

CO3: Explain the working of the Blast Furnace and necessary equipment with a neat sketch.

CO4: Write down various reactions in the Blast Furnace.

CO5: Suggest suitable remedies for various irregularities in the Blast Furnace.

CO6: Understand the importance of modern practices in Blast Furnace and alternative routes of iron production.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT I. INTRODUCTION (CL Hrs- 04, Marks- 04)				
1	TLO 1.1 Write about ancient iron-making processes. TLO 1.2 Describe developments in iron making. TLO 1.3. Describe modern iron making. TLO 1.4. Enumerate alternative methods of iron production. TLO 1.5 Define integrated steel plant	1.1 Ancient Iron Making Processes. 1.2 Development in Iron Making. 1.3 Modern Iron Making. 1.4 Alternative methods of Iron Production. 1.5 Introduction to integrated Steel Plant.	Lecture Assignment	**CO1**
UNIT-II RAW MATERIALS AND BURDEN PREPARATION (CL Hrs- 12, Marks- 14)				
2	TLO 2.1 Enumerate types of iron ores. TLO 2.2 State the properties and functions of Coke. TLO 2.3. State types and functions of flux. TLO 2.4 State the purpose and methods of beneficiation of iron ore. TLO 2.5. State the purpose and classification of agglomeration. TLO 2.6. State the principles and advantages of sintering and pelletisation. TLO 2.7. Describe the process of sintering and pelletisation. TLO 2.8. Enumerate burden qualities. TLO 2.8. State the importance of burden distribution.	2.1 Iron Ores - Types. 2.2 Fuel: Coke- Properties, functions. 2.3 Fluxes – Types, functions. 2.4 Beneficiation of Iron ore - Purpose, methods of beneficiation. 2.5 Agglomeration – Purpose, classification. a. Sintering - Principle, process: Dwight-Lloyed sintering machine, advantages. b. Pelletisation - Principle, process: disc pelletiser, drum pelletiser, Advantages. 2.6 Burden qualities. 2.7 Burden Distribution- Introduction	Lecture Assignment Videos	**CO2**
UNIT-III BLAST FURNACE CONSTRUCTION (CL Hrs-12, Marks-16)				
3	TLO 3.1 Draw a neat sketch of the Blast furnace. TLO 3.2. Describe constructional details of various parts of the Blast furnace TLO 3.3. State functions of each part of the Blast furnace. TLO 3.4. Select appropriate refractories for the Blast furnace. TLO 3.5. Recommend a suitable charging system.	3.1 Construction details and functions of Blast Furnace parts: a. Stack b. Bosh c. Hearth d. Bustle pipe e. Tuyers 3.2 Refractories used in Blast furnace. 3.3 Burden charging systems. 3.4 Gas Cleaning System - Functions a. Dust catcher – Working b. Scrubbers - Working c. Electrostatic Precipitator – Working. 3.5 Hot blast stove- Construction,	Lecture Assignment Videos	**CO3**

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
	TLO 3.6 State functions of the gas cleaning system. TLO 3.7. Explain the working of various parts of the gas cleaning system. TLO 3.8. Describe the construction and working of the hot blast stove.	refractories used, working.		
UNIT-IV BLAST FURNACE OPERATION (CL Hrs- 08, Marks- 12)				
4	TLO 4.1. State working principle of a blast furnace. TLO 4.2 Describe the operational steps of the Blast furnace. TLO 4.3. Write down chemical reactions in different zones of the Blast Furnace. TLO 4.4. Draw temperature profile in Blast Furnace. TLO 4.5 State composition of Blast Furnace products. TLO 4.6. Describe the behaviour of S, P, Zn and alkali metals. TLO 4.7 Write down the average quantity of charge required per ton of pig iron.	4.1 Working principle of a blast furnace. 4.2 Operations of a blast furnace. 4.3 Chemical reactions at different zones in Blast Furnace, temperature profile in Blast Furnace. 4.4 Blast Furnace products-– Composition of pig iron, slag and gases. 4.5 The behaviour of S, P, Zn and alkali metals. 4.6 The average quantity of charge per ton of pig iron.	Lecture Assignment Videos	**CO4**
UNIT-V IRREGULARITIES & MODERN TRENDS IN BLAST FURNACE (CL Hrs- 12, Marks- 12)				
5	TLO 5.1. State the causes and remedies of various irregularities in the Blast furnace. TLO 5.2. Describe various modern trends in blast furnaces.	5.1 Irregularities in Blast furnace operation and their remedies: a. Hanging, b. Scaffolding, c. Chilled Hearth, d. Pillaring, e. Breakout, f. Channeling. 5.2 Modern trends in Blast Furnace practice: a. High top pressure, b. Oxygen Enrichment of Blast, c. Humidification of blast, d. Higher blast temperature	Lecture Assignment Videos	**CO5**
UNIT-VI SPONGE IRON PRODUCTION (CL Hrs- 12, Marks- 12)				
6	TLO 6.1. Define Sponge Iron. TLO 6.2. Describe the physical chemistry of Sponge Iron processes. TLO 6.3. Explain HyL, Midrex and Rotary Kiln processes with a neat sketch. TLO 6.4 Enlist the Sponge Iron-making areas in India. TLO 6.5. State uses of Sponge Iron.	6.1 Sponge Iron – Definition, contents. 6.2 Physical chemistry of Sponge Iron processes. 6.3 Sponge Iron making processes– a. HyL Process, b. Midrex Process, c. Rotary Kiln Process. 6.4 Sponge Iron Making in India 6.5 Uses of Sponge Iron.	Lecture Assignment Videos	**CO6**

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/TUTORIAL EXPERIENCES

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1	LLO 1.1 Explain Ancient Iron-Making Processes and Development in Iron-Making	1.1 Study of Ancient Iron-Making Processes and Development in Iron-Making	2	CO1
2	LLO 2.1 Explain the beneficiation methods principle.	2.1 Study various beneficiation methods for iron ore.	2	CO2
3	LLO 3.1 Explain the Principle and process of the Dwight-Lloyed sintering machine.	3.1 To study principle, process: Dwight-Lloyed sintering machine.	2	CO2
4	LLO 4.1 Explain the Working of Dust Catcher and Scrubbers Gas Cleaning System.	4.1 To study the working of the Dust catcher and scrubber gas cleaning System.	2	CO3
5	LLO 5.1 Explain the Construction and working of Hot blast stove.	5.1 To study the construction and working of Hot blast stove.	2	CO3
6	LLO 6.1 Explain the Principle and process of the Dwight-Lloyed sintering machine.	6.1 Study of construction and working of Blast furnace.	4	CO4
7	LLO 7.1 Explain Chemical reactions at different zones in the Blast Furnace.	7.1 To study Chemical reactions at different zones in the Blast Furnace.	4	CO4
8	LLO 8.1 Explain the Operations of a blast furnace and the temperature profile in a Blast Furnace.	8.1 To study the Operations of a blast furnace. and temperature profile in the Blast Furnace.	4	CO4
9	LLO 9.1 Explain Irregularities in Blast furnace operation and their remedies	9.1 To study Irregularities in Blast furnace operation and their remedies	4	CO5
10	LLO 10.1 Explain Sponge Iron making processes– a. HyL Process, b. Midrex Process, c. Rotary Kiln Process.	10.1 To study Sponge Iron making processes– a. HyL Process, b. Midrex Process, c. Rotary Kiln Process.	4	CO6

VI. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

- Gather the data of an integrated steel plant in India.
- Prepare the sheet of schematic arrangement for various sections of a Blast Furnace plant.
- Write in detail about any one sintering ore pelletisation process.
- Prepare the poster of a neat sketch of Blast Furnace with reactions.
- Write down the causes and remedies of irregularities in the Blast Furnace.
- Write down in detail about the modern trends in Blast Furnace practice.
- Collect information on alternative routes of iron production.
- To make a mini model of any furnace with the help of cardboard/chart.
- Prepare the report on Ancient Iron making.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr. No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Model Magnetic Separation machine	LLO 2.1
2	Model of Blast furnace.	LLO 2.6, LLO 2.7, LLO 2.8
3	Model of Hot blast stove	LLO 2.5

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr. No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	INTRODUCTION	CO1	04	4	—	—	04
2	II	RAW MATERIALS AND BURDEN PREPARATION	CO2	12	4	8	2	14
3	III	BLAST FURNACE CONSTRUCTION	CO3	12	6	6	4	16
4	IV	BLAST FURNACE OPERATION	CO4	08	2	4	6	12
5	V	IRREGULARITIES & MODERN TRENDS IN BLAST FURNACE	CO5	12	2	6	4	12
6	VI	SPONGE IRON PRODUCTION	CO6	12	4	6	2	12
			Grand Total	**60**	**22**	**30**	**18**	**70**

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
1. Unit Tests: Average of two unit tests (30 marks) 2. Term Work: FA-PR (25 marks) 3. Self-Learning: SLA (25 marks)	1. End Term Exam: SA-TH (70 marks) 2. End Term Exam: SA-PR (25 marks)

X. SUGGESTED COs- POs MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)			
	PO-1 Basic and Discipline-Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3	PSO-4
CO1	3	1	2	1	3	2	2	3	--	--	2
CO2	3	1	2	1	1	2	2	3	--	--	2
CO3	2	1	2	1	1	1	1	3	--	--	2
CO4	3	1	1	1	2	1	1	2	--	--	1
CO5	3	3	2	2	1	3	3	3	1	2	3
CO5	3	2	3	2	1	3	3	3	--	--	1
Legends:- High: 03, **Medium:** 02, **Low:** 01, **No Mapping:** -											

XI. SUGGESTED LEARNING MATERIALS/BOOKS

Sr. No	Author	Title	Publisher
1	Dr. R.H. Tupkary, V.R. Tupkary.	An Introduction to Modern Iron Making	Khanna Publication, 4th Edition, 2016. 978-81-7409-021-5
2	Dr. R.H. Tupkary, V.R. Tupkary.	An Introduction to Modern Steel Making	Khanna Publication, 7th Edition, 2017 978-81-7409-026-6
3	Boris Kuznestsov	An Introduction to Modern Steel Making	Mir Publishers, Moscow, 2nd Edition,1979 5-03-000026-7

XII. XII. LEARNING WEBSITES & PORTALS

Sr. No	Link/Portal	Description
1	https://www.youtube.com/watch?v=hBqhGHfzQFQ	Blast furnace
2	https://www.youtube.com/watch?v=ysLqUDa5GEA	Introduction to Iron Making
3	https://www.youtube.com/watch?v=hBqhGHfzQFQ	Blast furnace

Name & Signature: **Mrs. Sarika S. Aglave** Lecturer in Metallurgical Engineering (Course Expert)	
Name & Signature: **Mrs. Namita S. Kadam** (Programme Head)	Name & Signature: **Mr. Sudin B. Kulkarni** (CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMAIN MT**
PROGRAMME CODE	**05**
COURSE TITLE	**PHYSICAL METALLURGY**
COURSE CODE	**MT41201**
PREREQUISITE COURSE CODE & TITLE	**NA**
CLASS DECLARATION COURSE	**NO**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme						Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH	Credits	Paper Duration	Theory				Based on LL & TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
MT41201	PHYSICAL METALLURGY	SEC	03	-	04	1	8	4	3	30	70	100	40	25	10	25@	10	25	10	175

Total IKS Hrs for Term: 0 Hrs

Abbreviations: CL-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA** - Formative Assessment**, SA** -Summative assessment, **IKS** – Indian Knowledge System, **SLA**- Self Learning Assessment

Legends: @-Internal Assessment, # - External Assessment, *# - Online Examination, **@$** - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as **'Detained'** in that course.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as **'fail'** and will have to repeat and resubmit SLA work.
3. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.
6. * Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

This course deals with solidification of metals and alloys. Various types of equilibrium diagrams and their relationship between microstructure and properties of metals and alloys are studied in the course. It forms a vital link in the processes of making, shaping and heat-treating of metals. It thus interfaces with the other areas of metallurgy such as process metallurgy, mechanical metallurgy and engineering metallurgy. Therefore, an engineering diploma student must be conversant with equilibrium diagrams, and metallography from the point of view of producing structures of metals that give the best properties. The study of these concepts and principles of physical metallurgy will develop skills in students to identify and interpret microstructures, and properties of steel, where the emphasis is laid on the application of these metals and alloys.

III. COURSE-LEVEL LEARNING OUTCOMES (CO's)

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO1 – Perform quantitative metallography on metal specimens for testing different metallurgical parameters.
CO2 - Plotand interpret the T-T-T diagram and C-C-T diagram for various grades of steel.
CO3 - Performa hardenability test on steels and interpret the effect of alloying elements on phase diagrams.
CO4 – Interpret microscopic phases in different cast irons and co-relate themwith the properties of cast irons.
CO5 - Interpret the microstructure and properties of non-ferrous metals/alloys by microscopic testing.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT-I QUANTITATIVE METALLOGRAPHY(CL Hrs-08, Marks-12)				
1	TLO 1.1Define the ASTM grain thesize number and itsimportance. TLO 1.2 Determine the grain size number of metal samples. TLO 1.3 Describe the method for themeasurement of the casedepth and coating–platingthickness. TLO 1.4 Define the procedure for the determination ofinclusions in the steels. TLO 1.5 State the importance of nodule count w.r.t.spheroidal graphite castirons.	1.1 Grain size measurement - ASTM grain size number and its significance in metallurgy. 1.2 Methods for the measurement of ASTM grain size number, Comparison method, Planimetric method, Intercept method. 1.3 Measurement of case depth, coating–plating thickness, measurementof depth of decarburization. 1.4 Inclusion rating of steels – Need for the determination of contents of non-metallic inclusions in steels, the types of inclusions present, the volume fraction, the sizes, shapes and distribution of inclusions. 1.5 Graphite nodule count in spheroidal graphite cast iron.	Lectures,Assignments, Digital media, images, technical content videos.	**CO1**
UNIT-II TIME TEMPERATURE TRANSFORMATION DIAGRAM (CL Hrs -07, Marks- 14)				
2	TLO 2.1State the importance of T-T-T diagram. TLO 2.2 Plot T-T-T diagrams of different types of steels. TLO 2.3 Define the factors which affect the T-T-T diagram. TLO 2.4 State the difference between the T-T-T diagram and the C-C-T diagram.	2.1 Introduction to Time Temperature transformation (T-T-T) diagram and itssignificance in metallurgy. 2.2 Construction of T-T-T diagram, T-T-T diagram for different types of steels. 2.3 Factors affecting the T-T-T diagram and its limitations. 2.4 Continuous Cooling Transformation (C-C-T) diagram, Critical cooling rate and its significance, and the Difference between the T-T-T diagram and the C-C-T diagram.	Lectures,Assignments, Digital media, images, technical content videos.	**CO2**

UNIT-III HARDENABILITY & EFFECT OF ALLOYING ELEMENTS (CL Hrs10, Marks- 14)				
3	TLO 3.1 Define hardenability and statethe factors which can affect hardenability. TLO 3.2 Draw cooling curve for quenching of metals indifferentquenching mediums. Write characteristics ofquenching mediums. TLO 3.3Describe Jominy's end quench test and Grossman methodfor determining hardenability of steel. TLO 3.4 Write the grades of metalsalloys having high hardenability and write their industrialapplications. TLO 3.5 Describe the effect of alloying elements on Fe-Fe3Cdiagram and T-T-Tdiagram.	3.1 Definition of Hardenability, the importance of hardenability, factors affecting hardenability, Difference betweenhardness and hardenability. 3.2 Quenching of metals/alloys, cooling the curve for quenching, the severity of quenching, types of quenching mediums, characteristics of different quenchingmediums. 3.3 Determination of hardenability of steel by Jominy end quench test & Grossman method, Determination of ideal critical diameter. 3.4 Examples of metals/alloys with high hardenability, and their applications in industries. 3.5 Types of alloying elements, the effect of alloying elements on the Fe-Fe3C diagram and the T-T-T diagram.	Lectures,Assignments, Digital media, images, technical content videos.	**CO3**
UNIT-IV METALLURGY OF CAST IRONS (CL Hrs12, Marks-16)				
4	TLO 4.1 Define cast iron, state different types of castirons, and explain factorswhich can influence themicrostructure of castirons. TLO 4.2 Describe the properties of different types of cast ironsbased on theirmicrostructure. TLO 4.3 State the types of grey castiron based on thedistribution of graphite anddraw microstructures for thesame. TLO 4.4 Describe the properties ofnodular cast iron based onits microstructure; write itsapplications.	4.1 Definition of cast iron, classification ofcast iron, Graphitization in cast iron,Morphology of graphite, Maurer'sDiagram, Factors influencingmicrostructure of cast irons. 4.2 Chemical composition – Microstructure - Properties – Applications of White CI, Chilled CI, Malleable CI, Compactedgraphite CI, High duty CI (Meehanite), Alloy CI. 4.3 Gray cast iron, Distribution of graphiteflakes and types of Gray CI based onthe distribution of graphite flakes Type A,B,C,D,E, Flake size of graphite in Gray CI, Chemical composition – microstructure – properties – applications of Gray CI. 4.4 Nodular cast iron / Spheroidal graphite iron, Chemical composition – microstructure – properties – applications of nodular cast iron. 4.5 Microstructural changes in hypoeutectic cast iron and hypereutectic cast iron during cooling.	Lectures,Assignments, Digital media, images, technical content videos.	**CO4**

UNIT-V METALLURGY OF NON-FERROUS METALS& ALLOYS (CL Hrs08, Marks- 14)				
5	TLO 5.1 State different types of brasses. TLO 5.2 Draw a copper-zinc equilibrium diagram and interpret it. TLO 5.3 State the applications of various brasses. TLO 5.4 Plot Cu-Al, Cu-Sn, Cu-Be, and Cu-Si equilibrium diagrams and interpret the same. TLO 5.5 Write the composition and properties of different grades of bronze. TLO 5.6 Write the chemical composition and applications of different aluminium alloys. TLO 5.7 Plot and interpret Al-Si, Al-Cu, and Al-Mg equilibrium diagrams. TLO 5.8State the classification of bearing metals/alloys. TLO 5.9 Write the properties of good-bearing metals/alloys.	5.1. Brasses (Copper alloys) – Types of brasses, alpha brass, alpha-beta brass, Copper – Zinc equilibrium diagram, Introduction to all the varieties of brasses, basic properties – chemical composition – applications of brasses, Equivalent zinc in brasses, Season cracking of brasses. 5.2 Bronzes – Aluminum bronzes, Tin bronzes, Beryllium bronzes, Silicon bronzes, Chemical composition – properties – microstructure – applications of bronzes, Cu-Al, Cu-Sn, Cu-Be, Cu-Si equilibrium diagram. 5.3 Aluminium and Aluminium Alloys – Al-Si, Al-Cu, Al-Mg equilibrium diagram, As cast aluminium alloys and Wrought aluminium alloys – chemical compositions, microstructures, mechanical properties, Aluminium – Silicon and Aluminium – Silicon – Copper alloys, LM series, Aluminium – Magnesium alloys, Aluminium – Copper alloys. 5.4 Bearing Metals – Classification of bearing metals/alloys, properties required in good bearing metals/alloys, Basic properties, composition and applications of different bearings metals/alloys, and Effect of copper addition on properties of bearing metals.	Lectures,Assignments, Digital media, images, technical content videos.	**CO5**

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1	LLO 1.1 Calculate the ASTM grain size anumber of given metals/alloys.	1.1 Determination of ASTM grain size numberof the given metal/alloy.	08	**CO1**
2	LLO 2.1 Rate the inclusions present in the given steel sample. LLO 2.2 Interpret the data related to graphite nodule count of the given S. G. Iron.	2.1Microscopic examination of a given steel specimen for rating the inclusions in it. 2.2 Microscopic examination of the given specimen of S. G. Iron for graphite nodule count.	06 06	**CO1**
3	LLO 3.1 Measuring the case depth of the case hardened steel.	3.1 Measuring the case depth of the case hardened steel.	08	**CO1**
4	LLO 4.1 Plotting and construction of T-T-T diagram of eutectoid steel and hypereutectoid steel.	4.1 Plot T-T-T diagram of eutectoid steel and hypereutectoid steel.	08	**CO2**
5	LLO 5.1 Calculate the hardenability of steel by the Jominy end quench test.	5.1 Determine the hardenability of steel by the Jominy end quench test.	08	**CO3**
6	LLO 6.1 Draw microstructures of different cast irons by microscopic examination.	6.1 Draw microstructures of different cast irons by microscopic examination.	08	**CO4**
7	LLO 7.1 Draw microstructures of various non-ferrous metals by microscopic examination.	7.1 Draw microstructures of various non-ferrous metals by microscopic examination.	08	**CO5**
Note: 1.Take the practical l in a batch size of 20 to 30 students.				

VI. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

Micro project

1. To collect different metal / alloy samples and study the grain size and mechanical properties.
2. To study and plot T-T-T diagrams of different grades of steels.
3. To study the hardenability data of different grades of steels and to understand the effect of different alloying elements on the hardenability of steels.
4. To collect different specimens of cast irons (Gray cast iron, white cast iron, malleable cast iron, compacted graphite cast iron, spheroidal graphite cast iron, chilled cast iron, alloy cast iron) and to study their microstructure and properties.
5. To collect different specimens of non ferrous metals (Brasses, bronzes, bearing metals, aluminum alloys) and to study their microstructure and properties.

Assignment

1. Study the effect of grain size on the mechanical properties of various metals and alloys.
2. Study and find out the effect of various inclusions on the properties of steels.
3. Analyze the effect of nodule count on the mechanical properties of any one grade of S. G. iron.
4. Note the applications of any five grades of cast irons and any five grades of non ferrous metals.
5. Study and understand the importance of hardenability of steels in various industrial applications.
6. Study in detail and compare the T-T-T diagrams of any two grades of steels.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr. No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Inverted metallurgical microscope with image analyzer	LLO 1.1, LLO 3.1
2	Optical metallurgical microscope	LLO 2.1, LLO 2.2
3	Jominy end quench test set-up	LLO 5.1
4	Specimen cutting machine	LLO 1.1, 2.1, 3.1, 6.1, 7.1
5	Double disc polishing machine	LLO 1.1, 2.1, 3.1, 6.1, 7.1
6	Rockwell hardness testing machine	LLO 5.1

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE

(Specification Table)

Sr. No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	QUANTITATIVE METALLOGRAPHY	CO1	08	2	6	4	12
2	II	TIME TEMPERATURE TRANSFORMATION DIAGRAM	CO2	07	4	6	4	14
3	III	HARDENABILITY AND EFFECT OF ALLOYING ELEMENT	CO3	10	4	6	4	14
4	IV	METALLURGY OF CAST IRONS	CO4	12	6	6	4	16
5	V	METALLURGY OF NON-FERROUS METALS	CO5	08	6	4	4	14
Grand Total				**45**	**22**	**28**	**20**	**70**

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
1. Tests 2. Rubrics for COs 3. Assignment 4. Midterm Exam 5. Self-Learning 6. Term Work 7. Seminar/Presentation	1. End Term Exam 2. Micro-project

X. SUGGESTED COS- POS MATRIX FORM

Course Outcomes (COs)	ProgrammeOutcomes (POs)							Programme Specific Outcomes *(PSOs)			
	PO-1 Basic and Discipline-Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3	PSO-4
CO1	3	3	2	3	1	1	2	3	3	2	1
CO2	3	3	3	3	2	1	2	3	2	2	1
CO3	3	3	2	3	1	1	2	3	3	2	1
CO4	3	3	3	3	2	2	2	3	3	3	2
CO5	3	3	3	3	2	2	2	3	3	3	2

Legends:-High:03, **Medium:**02, **Low:**01, **No Mapping:** -
*PSOs are to be formulated at the institute level

XI. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	Author	Title	Publisher
1	Sidney H. Avner	Introduction to Physical Metallurgy	Second Edition, Tata McGraw-Hill 1997 ISBN 0-07-463006-7
2	Robert W. CAHN, Peter HAASEN	Physical Metallurgy	Volume Fourth Edition, 1996, North Holland ISBN 0 444 89875
3	Dr.V.D. Kodgire, S.V. Kodgire	Material Science and Metallurgy	Everest Publishing House, 43rd Edition ISBN 81-86314-00-8
4	V. Raghavan	Physical Metallurgy	PHI Learning Private Limited

XIII. LEARNING WEBSITES & PORTALS

Sr.No	Link/Portal	Description
1	www.britannica.com	T-T-T Diagram, Hardenability
2	www.nptel.ac.in	ASTM grain size, Continuous cooling transformation in metals
3	www.springer.com	Physical metallurgy of cast irons
4.	www.sciencedirect.com	Hardenability of steels
5.	www.cambridge.org	Metallurgy of non ferrous metals
6.	www.wikipedia.org	Effect of alloying elements, inclusion rating

Name & Signature:
Shri R. S. Tuljapurkar
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(Course Expert)

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Mrs. Namita S. Kadam (Programme Head)	**Mr. Sudin B Kulkarni** (CDC In-charge)