GOVERNMENT POLYTECHNIC, PUNE

(AN AUTONOMOUS INSTITUTE OF GOVT. OF MAHARASHTRA)

180 OB CURRICULUM

(Since 2019-20)

DIPLOMA IN METALLURGICAL ENGINEERING PROGRAMME

IN

DEPARTMENT OF METALLURGICAL ENGINEERING

DIPLOMA IN METALLURGICAL ENGINEERING

Programme Structure TO BE IMPLEMENTED FROM YEAR 2019-20 (180OB-OB1)

Course Code	Course Name	Course Type	Compulsary/ Optional	Pre-Requ -isite	Teaching Scheme			Total Credits	Examination Scheme									Internal/ External	Class Declaration	Section
									Theory				Practical/Oral				Total Marks			
					L	P	T	C	ESE		PA		ESE		PA					
									Min	Max	Min	Max	Min	Max	Min	Max				
LEVEL-1: Foundation Level Courses(All Compulsory)																				
HU1101	COMMUNICATION SKILLS I	Regular	Compulsory		2	0	1	3	16	40	NA	10	10	25 **$**	10	25	100	Internal	No	No
HU1102	COMMUNICATION SKILLS II	Regular	Compulsory	HU1101	2	0	1	3	16	40	NA	10	NA	NA	20	50	100	-	No	No
SC1101	APPLIED MATHEMATICS I	Regular	Compulsory		3	0	2	5	32	80	NA	20	NA	NA	10	25	125	-	No	No
SC1102	APPLIED MATHEMATICS II	Regular	Compulsory	SC1101	3	0	2	5	32	80	NA	20	NA	NA	10	25	125	-	No	No
SC1103	APPLIED PHYSICS	Regular	Compulsory		3	2	0	5	32	#80	NA	20	10	25 *	10	25	150	Internal	No	No
SC1106	APPLIED CHEMISTRY	Regular	Compulsory		3	2	0	5	32	#80	NA	20	10	25 *	10	25	150	Internal	No	No
6	**Level Total**				**16**	**4**	**6**	**26**	**160**	**400**		**100**	**30**	**75**	**70**	**175**	**750**			
LEVEL-2: Core Technology Courses A(Core Technology Courses- All Compulsory)																				
AM2101	ENGINEERING MECHANICS	Regular	Compulsory		4	2	0	6	32	80	NA	20	NA	NA	10	25	125	-	No	No
CM2102	FUNDAMENTALS OF ICT	Regular	Compulsory		1	2	0	3	NA	NA	NA	NA	10	25 *	10	25	50	Internal	No	No
EE2102	ELECTRICAL TECHNOLOGY	Regular	Compulsory		3	2	0	5	32	80	NA	20	NA	NA	10	25	125	-	No	No
ET2106	PRINCIPLES OF ELECTRONICS	Regular	Compulsory		3	2	0	5	32	80	NA	20	NA	NA	10	25	125	-	No	No

ME2103	ENGINEERING DRAWING	Regular	Compulsory		2	4	0	6	32	80	NA	20	NA	NA	10	25	125	-	No	No
ME2106	ELEMENTS OF MECHANICAL ENGINEERING	Regular	Compulsory		3	2	0	5	32	80	NA	20	NA	NA	10	25	125	-	No	No
SC2106	ADVANCED PHYSICS	Regular	Compulsory		2	2	0	4	32	80	NA	20	NA	NA	10	25	125	-	No	No
WS2101	WORKSHOP PRACTICE	Regular	Compulsory		0	4	0	4	NA	NA	NA	NA	NA	NA	20	50	50	-	No	No
8				**Sub Total**	**18**	**20**	**0**	**38**	**192**	**480**		**120**	**10**	**25**	**90**	**225**	**850**			
LEVEL-2: Core Technology Courses B(Core Technology Courses- Any One)																				
MT2101	FURNACE TECHNOLOGY	Regular	Optional		3	1	0	4	32	80	NA	20	NA	NA	10	25	125	-	No	No
SC2101	APPLIED MATHEMATICS III	Regular	Optional	SC1102	3	0	1	4	32	80	NA	20	NA	NA	10	25	125	-	No	No
1				**Sub Total**	**3**	**1**	**0**	**4**	**32**	**80**		**20**	**0**	**0**	**10**	**25**	**125**			
				Level Total	**21**	**21**	**0**	**42**	**224**	**560**		**140**	**10**	**25**	**100**	**250**	**975**			
LEVEL-3: Basic Technology Courses(All Compulsory)																				
MT3101	BASIC METALLURGY	Regular	Compulsory		3	2	0	5	32	80	NA	20	20	50 **$**	20	50	200	Internal	No	No
MT3102	MATERIAL TESTING & QUALITY ASSURANCE	Regular	Compulsory		3	4	0	7	32	80	NA	20	20	50 *****	10	25	175	External	Yes	Yes
MT3103	METALLURGICAL ANALYSIS	Regular	Compulsory		2	2	0	4	16	40	NA	10	20	50 *****	20	50	150	Internal	No	No
MT3104	IRON MAKING	Regular	Compulsory		3	0	0	3	32	80	NA	20	NA	NA	NA	NA	100	-	No	No
MT3105	STEEL MAKING	Regular	Compulsory		3	0	0	3	32	80	NA	20	NA	NA	NA	NA	100	-	No	No
MT3106	EXTRACTION OF NON FERROUS METALS	Regular	Compulsory		3	0	0	3	32	80	NA	20	NA	NA	NA	NA	100	-	No	No
6				**Level Total**	**17**	**8**	**0**	**25**	**176**	**440**		**110**	**60**	**150**	**50**	**125**	**825**			

LEVEL-4: Applied Technology Courses A(Auxiliary Courses - One Compulsory and Any One Optional)																				
AU4101	ENVIRONMENTAL SCIENCE	Regular	Compulsory		0	2	0	2	NA	NA	NA	NA	NA	NA	20	50	50	-	No	No
AU4102	RENEWABLE ENERGY TECHNOLOGIES	Regular	Optional		2	0	0	2	16	#40	NA	10	NA	NA	NA	NA	50	-	No	No
AU4103	ENGINEERING ECONOMICS	Regular	Optional		2	0	0	2	16	#40	NA	10	NA	NA	NA	NA	50	-	No	No
AU4104	ETHICAL SOURCES AND SUSTAINABILITY	Regular	Optional		2	0	0	2	16	#40	NA	10	NA	NA	NA	NA	50	-	No	No
AU4105	DIGITAL MARKETING	Regular	Optional		0	2	0	2	NA	NA	NA	NA	10	25 $	10	25	50	Internal	No	No
2				**Sub Total**	**2**	**2**	**0**	**4**	**16**	**40**		**10**	**0**	**0**	**20**	**50**	**100**			
LEVEL-4: Applied Technology Courses B(Management Level Courses - One Compulsory and Any One Optional)																				
MA4101	ENTREPRENEURSHIP AND STARTUPS	Regular	Compulsory		2	0	0	2	16	#40	NA	10	NA	NA	NA	NA	50	-	No	No
MA4102	INDUSTRIAL ORGANISATION AND MANAGEMENT	Regular	Optional		2	0	0	2	16	#40	NA	10	NA	NA	NA	NA	50	-	No	No
MA4103	MATERIALS MANAGEMENT	Regular	Optional		2	0	0	2	16	#40	NA	10	NA	NA	NA	NA	50	-	No	No
MA4104	DISASTER MANAGEMENT	Regular	Optional		2	0	0	2	16	#40	NA	10	NA	NA	NA	NA	50	-	No	No
MA4105	INTRODUCTION TO E-COMMERCE	Regular	Optional		2	0	0	2	16	#40	NA	10	NA	NA	NA	NA	50	-	No	No
MA4106	INFORMATION MANAGEMENT	Regular	Optional		2	0	0	2	16	#40	NA	10	NA	NA	NA	NA	50	-	No	No
2				**Sub Total**	**4**	**0**	**0**	**4**	**32**	**80**		**20**	**0**	**0**	**0**	**0**	**100**			
LEVEL-4: Applied Technology Courses C(Programme Specific Courses (All Compulsory))																				

MT4101	INDUSTRY INPLANT TRAINING	Inplant Training	Compulsory	LEVEL 1 AND LEVEL 2 COURSES TERM GRANT	0	6	0	6	NA	NA	NA	NA	20	50 $	20	50	100	Internal	No	No
MT4102	PROJECT (IN-HOUSE / INDUSTRY)	Project Only	Compulsory	90 CREDITS AND LEVEL 1 PASSED	0	4	0	4	NA	NA	NA	NA	20	50 $	20	50	100	External	Yes	No
MT4103	SEMINAR	Seminar Only	Compulsory	90 CREDITS AND LEVEL 1 PASSED	0	2	0	2	NA	NA	NA	NA	10	25 $	10	25	50	Internal	Yes	No
MT4104	ELEMENTS OF PHYSICAL METALLURGY	Regular	Compulsory		4	4	0	8	32	80	NA	20	20	50 *	20	50	200	Internal	No	No
MT4105	FOUNDRY ENGINEERING	Regular	Compulsory		4	4	0	8	32	80	NA	20	20	50 $	10	25	175	External	Yes	Yes
MT4106	POWDER METALLURGY	Regular	Compulsory		3	2	0	5	32	80	NA	20	20	50 $	10	25	175	External	Yes	Yes
MT4107	METAL WORKING PROCESSES	Regular	Compulsory		4	2	0	6	32	80	NA	20	20	50 $	10	25	175	External	Yes	Yes
MT4108	HEAT TREATMENT OF METALS & ALLOYS	Regular	Compulsory	MT4104	4	4	0	8	32	80	NA	20	20	50 *	10	25	175	External	Yes	Yes
8				**Sub Total**	**19**	**28**	**0**	**47**	**160**	**400**		**100**	**150**	**375**	**110**	**275**	**1150**			
				Level Total	**25**	**30**	**0**	**55**	**208**	**520**		**130**	**150**	**375**	**130**	**325**	**1350**			
LEVEL-5: Diversified Courses A(Diversified Courses- Any Two)																				
MT5101	METALLURGICAL DRAWING & DESIGN	Regular	Optional		4	4	0	8	32	80	NA	20	10	25 $	10	25	150	External	Yes	Yes
MT5102	SELECTION OF MATERIALS & FAILURE ANALYSIS	Regular	Optional		4	4	0	8	32	80	NA	20	10	25 $	10	25	150	External	Yes	Yes

MT5103	METAL JOINING PROCESSES	Regular	Optional		4	4	0	8	32	80	NA	20	10	25 **$**	10	25	150	External	Yes	Yes
MT5104	COMPUTER APPLICATIONS IN METALLURGY	Regular	Optional		4	4	0	8	32	80	NA	20	10	25 **$**	10	25	150	External	Yes	Yes
2				**Sub Total**	**8**	**8**	**0**	**16**	**64**	**160**		**40**	**20**	**50**	**20**	**50**	**300**			
LEVEL-5: Diversified Courses B(Diversified Courses- Any Two)																				
MT5105	ADVANCED PHYSICAL METALLURGY	Regular	Optional	MT4108	4	4	0	8	32	80	NA	20	10	25 **$**	10	25	150	External	Yes	Yes
MT5106	MODERN FOUNDRY ENGINEERING	Regular	Optional	MT4105	4	4	0	8	32	80	NA	20	10	25 **$**	10	25	150	External	Yes	Yes
MT5107	CORROSION & SURFACE PROTECTION	Regular	Optional		4	4	0	8	32	80	NA	20	10	25 **$**	10	25	150	External	Yes	Yes
MT5108	NON METALLIC MATERIALS	Regular	Optional		4	4	0	8	32	80	NA	20	10	25 **$**	10	25	150	External	Yes	Yes
2				**Sub Total**	**8**	**8**	**0**	**16**	**64**	**160**		**40**	**20**	**50**	**20**	**50**	**300**			
				Level Total	**16**	**16**	**0**	**32**	**128**	**320**		**80**	**40**	**100**	**40**	**100**	**600**			
				Total Credits	**95**	**79**	**6**	**180**	**896**	**2240**		**560**	**290**	**725**	**390**	**975**	**4500**			

Note: **Prerequisite condition for registration to each class declaration course is that all level 1 courses must be passed.**

Legends : **L**- Lecture, **P**- Practical, **T**- Tutorial, **C**- Credits ,**ESE**-End Semester Examination,**PA**- Progressive Assessment (Test I,II/TermWork) , *****- Practical Exam, **$**- Oral Exam, **#**- Online Examination ,Each Lecture/Practical period is of one clock hour;

Details About 180OB-OB1 Structure

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Note: **The figures at Sr. No. 3,4,5,9,10 may slightly vary depending upon optional courses offered by the programme.**

1.	Total Credits	180
2.	Total No. Courses	37+0(Non Credit Courses)
3.	No of Courses with Theory Examination	31
4.	No. of Courses with Practical/Oral Examination	19
5.	No. of Courses without Theory Examination	7+0(Non Credit Courses)
6.	Total Marks	4500
7.	Marks For Class Declaration	1625
8.	Theory Paper Marks for Class Declaration	900
9.	Theory:Practical Ratio as per Credits	53:47
10.	Theory:Practical Ratio as per Marks	62:38
11.	Class Declaration Courses	11

Government Polytechnic, Pune

Department of Metallurgical Engineering

180 OB Curriculum

Level-1: Foundation Level Courses

(All Compulsory)

Sr. No.	**Course Code**	**Course Name**
1	HU1101	Communication Skills I
2	HU1102	Communication Skills II
3	SC1101	Applied Mathematics I
4	SC1102	Applied Mathematics II
5	SC1103	Applied Physics
6	SC1106	Applied Chemistry

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in CE/EE/ET/ME/MT/CM/IT/DDGM**
Programme Code	**01/02/03/04/05/06/07/08/15/16/ 17/18/19/21/22/23/24/26**
Name of Course	**Communication Skills I**
Course Code	**HU1101**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			**Total Credits (L+T+P)**		**Examination Scheme**				
					Theory		**Practical**		**Total Marks**
L	**T**	**P**	**C**		**ESE**	**PA**	**$ESE**	**PA**	100
02	01	00	03	**Marks**	40	10	25	25	
				Exam Duration	2 Hrs	1/2 Hr	--	--	

Legends: L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE-End Semester Examination, PA- Progressive Assessment (Test I, II/ TermWork), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour.

2. RATIONALE

Communication skills is a natural and necessary part of an organizational life. Thegoal of communication skills course is to produce civic-minded and competentcommunicators. At the end, students will acquire proficiency in oral and written methods along with nonverbal communication.

3. COMPETENCY

The aim of this course is to attend following industry competency through various teaching learning experiences:

- **To develop English Language Speaking Abilities, enrich fluency, and to make students get acquainted with basics of communication skills.**

4. COURSE OUTCOMES (COs)

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 above-mentioned competency**:**

1. Communicate effectively to overcome barriers.
2. Apply Nonverbal codes for effective communication.
3. Apply Learning Skills.
4. Interpret information to present orally.
5. Use Language lab for improving listening and speaking abilities

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	**Practical Exercises** (Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hrs. required
1	1	Introduction to Communication Cycle	1	1
2	1	Analyze Communication Events.	1	1
3	2	Collect Different Pictures Depicting Body actions.	2	2
4	2	Utilize Signs, Symbols & color codes.	2	1
5	3	*Loud Reading of Given Paragraph.	3	2
6	3	*Utilize Techniques of Listening with the help of lingua phone	3	2
7	4	Topic Writing on Current Issues	4	2
8	4	Comprehending Information and extempore it	4	1
9	5	Practice Vocabulary I (Identify words from various Technical Jargons.)	5	2
10	5	Practice Vocabulary II (Homophones/abbreviations/Synonyms/antonyms)	5	2
11	1 to 5	Complete the Micro-project as per the guidelines in point no 11 - Compulsory.	1 to 5	2
		Total Hrs		**16**

*Perform assignment no.5 or 6.

Sr. No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	-
b.	Setting and operation	-
c.	Safety measures	-
d.	Observations and Recording	40
e.	Interpretation of result and Conclusion	-
f.	Answer to sample questions	30
g.	Submission of report in time	30
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned.

Sr. No.	Equipment Name with Broad Specifications	Experiment Sr. No
1	Language Lab	5,6

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit 1 : Introduction and Principles of Communication (08 hrs, 12 marks)	
1a. Interpret different communication skills 1b. Define elements of communication 1c. Describe process of communication 1d. Identify barriers for finding remedies 1e. Interpret principles of communication	1.1 Introduction to communication 1.2 Definition and elements of communication 1.3 Process of communication 1.4 Barriers to communication and remedies to overcome it. 1.5 Principles of communication
Unit 2 : Nonverbal Skills (06 hrs, 10 marks)	
2a. Differentiate graphic communication 2b. Use different nonverbal codes 2c. Interpret various graphic forms.	2.1 Graphic communication 2.2 Nonverbal codes [Kinesics, Proxemics, Chronemics, Haptics 2.3 Vocalics Dress and Appearance] 2.4 Reading graphic forms [Bar graph, Pie chart]
Unit 3 : Learning Skills (06 hrs, 04 marks)	
3a. Recall listened information 3b. Apply oral skills 3c. Perceives various fonts & use it 3d. Compose sentences & paragraphs	3.1 Listening skills 3.2 Speaking skills 3.3 Reading skills 3.4 Writing Skills
Unit 4 : Comprehension (06 hrs, 06 marks)	
4a. Improve writing techniques 4b. Interpret information 4c. Summarize to extempore	4.1 Topic Writing (current issues) 4.2 Comprehend various information 4.3 Extempore some current Activities
Unit 5 : Language Skills (06 hrs, 08 marks)	
5a. Use phonetic signs and symbols for pronunciation 5b. Practice Pronunciation using lingua-phone 5c. Utilize listening skills 5d. Classify jargon wise vocabulary for improvement	5.1 Phonetics(Practice of pronunciation) 5.2 Listening skills 5.3 Use of lingua-phone (language lab) 5.4 Vocabulary building

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction and principles of communication	08	04	06	02	12
II	Nonverbal Communication	06	02	02	06	10
III	Comprehension	06	00	02	04	06
IV	Learning Skills	06	00	00	04	04
V	Language skills	06	-	02	06	08
Total		**32**	**06**	**12**	**22**	**40**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journal based on practical performed inLing phone laboratory. Journal consists of drawing, observations, required equipment's, date of performance with teacher signature.
b. Collection of Paper cuttings from magazines, Newspapers, periodicals etc
c. Encyclopedia

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipment.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operations.
h. Teacher should ask the students to go through instruction and Technical manuals.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to them. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application-based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs and integrate PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain a dated work diary of individual contributions to the project work and give a seminar presentation before submission. The student should submit a micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. The concerned faculty could add similar micro-projects:

a. Student must collect pictures depicting various body actions.
b. Students should utilize signs, symbols, signals and color code to represent traffic signals.
c. Student should prepare a table of Jargon wise vocabulary of various technical domains.
d. Student should extempore on a given topic.
e. Student should collect abbreviations related to corporate world.

12. SUGGESTED LEARNING RESOURCES

Sr. No.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1	Communication skills	JoyeetaBhatacharya	Macmillan Co.
2	Written communication in English	Sarah Freeman	Orient Longman Ltd. ISBN- 13 : 978-8125004264
3	Developing Communication skills	Krishna Mohan and MeeraBanerji	Macmillan India Ltd. 0333929195 9780333929193

13. SOFTWARE/LEARNING WEBSITES

1. www.talkenglish.com
2.Edutech.com
3.Swayam.com
4 .www.mooc.org

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	-	1	-	-	1
CO2	3	-	-	-	1	-	1
CO3	3	1	-	-	1	1	1
CO4	3	-	-	-	1	-	1
CO5	2	-	-	-	1	-	1

	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	3
CO2	-	-	-	1
CO3	-	-	-	2
CO4	-	-	-	2
CO5	-	-	-	1

Sign: Name: Smt. S.C.Patil Smt. S.S.Kulkarni Dr. M.S.Ban (Course Experts)	Sign: Name : Smt.N.S.Kadam (Head of Department)
Sign: Name: Smt.N.S.Kadam (Program Head) (Metallurgical Engineering Department)	Sign: Name: Shri. A.S.Zanpure (CDC In charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in CE/EE/ET/ME/MT/CM/IT/DDGM**
Programme code	**01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26**
Name of Course	**Communication Skills II**
Course Code	**HU1102**
Prerequisite course code and name	**HU1101- Communication Skills I**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	ESE	PA	100
02	01	00	03	Marks	40	10	--	50	
				Exam Duration	2 Hrs	1/2 Hr	--	--	

Legends: L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/ Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour.

2. RATIONALE

Communication skills course is used in all spheres of human life – personal, social and professional. Students will get fair knowledge of communication skills to handle the future jobs in industry. This course includes the practice of oral and written communication, correspond with others and give presentations.

3. COMPETENCY

The aim of this course is to attend following industry competency through various teaching learning experiences:

- **To build confidence in written correspondence required in technical fields.**

4. COURSE OUTCOMES (COs)

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 above-mentioned competency:

1. Prepare various speeches for presentation

2. Write application for Business purposes.
3. Write various technical reports.
4. Write business letters.

5. SUGGESTED PRACTICALS/ EXERCISES

S. No.	Unit No.	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	CO No.	Approx. Hrs. required
1	1	Practice to write various speeches like vote of thanks,guest introduction etc.	1	2
2	1	Write job application, resume, leave application	3	2
3 *	2	Draft a project report to start a new industry (Or to write down the market survey report)	2	2
4	3	Prepare industrial visit report after visit	3	1
5	3	Write a placing an order letter, complaint letter	3	2
6	4	Write a joining letter	4	1
7 *	3	Draft a notice, circular and memorandum	3	2
8	3	Write a fall in production report	3	1
9	3	Work progress report	3	1
10	4	Description of devices	4	2
11	All	Complete a micro project based on guidelines provided in Sr. No. 11	All	2
		Total		16

*** Perform Pr.No. 3 or 7**

Sr.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	-
b.	Setting and operation	-
c.	Safety measures	-
d.	Observations and Recording	50
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	20
g.	Submission of report in time	10
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

NA

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit 1 Writing Speeches (08 hrs, 10 marks)	
1a. Give in own words the introduction of guest. 1b. Express feelings in own words to welcome 1c. Express feelings in own words for Farewell Speech 1d . Give in own words the vote of thanks	1.1 Introduction of guest 1.2 Welcome speech 1.3 Farewell speech 1.4 Vote of thanks
Unit 2 Writing Applications (06 hrs, 08 marks)	
2a. Write official correspondence for Job 2b. Application with Resume 2c. Write application for leave. 2d. Write application for getting NOC from corporation. 2e. Students can write various applications	2.1 Job application with resume 2.2 Leave application 2.3 Miscellaneous applications
Unit 3 Writing Reports and Notices (10 hrs, 10 marks)	
3a. Students can write Industrial visit report after visit. 3b. Students can write survey report. 3c. Students can write Fall in production report. 3d. Students can draft circular and other notices. 3e. Students can draft Memos.	3.1 Visit report 3.2 Survey report (feasibility report) 3.3 Fall in production report 3.4 Circular/notice 3.5 Memos
Unit 4 Drafting Business Letters (08 hrs, 12 marks)	
4a. Students can write Enquiry Letter. 4b. Students can write Placing an order letter. 4c.Student can write Complaint Letter. 4d. Students can write Appointment Letter. 4e. Students can draft Joining Letter.	4.1 Enquiry letter 4.2 Placing an order letter 4.3 Complaint letter 4.4 Appointment letter 4.5 Joining letter

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Writing speeches	08	2	2	6	10
II	Writingapplications	06	2	2	4	08
III	Writing Reports and Notices	10	2	2	6	10
IV	Business letters	08	2	4	6	12
Total		**32**	**8**	**10**	**22**	**40**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journal based on practical performed inLingua- phone- laboratory. Journal consists of drawing, observations,required equipment's, date of performance with teacher signature.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipments.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operations.
h. Teacher should ask the students to go through instruction and technical manuals.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to them. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***
The micro-project could be industry application-based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs and integrate PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain a dated work diary of individual contributions to the project work and give a seminar presentation before submission. The student should submit a micro-project by the end of the semester to develop the industry-oriented COs.
A suggestive list of micro-projects is given here. The concerned faculty could add similar micro-projects:

1. Practice to write various speeches and give speech on any of it.
2. Draft personal Resume/ Biodata/CV.
3. For drafting project report to start a new industry student should have a market survey and search other accepts to be and an entrepreneur.
4. Prepare an industrial visit report after visiting an industry.
5. Describe various technical devices and prepare a PPT on any one of it.

12. SUGGESTED LEARNING RESOURCES

Sr.No.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1	Communication skills	Joyeeta Bhatacharya	Macmillan Co.
2	Written communication in English	Sarah Freeman	Orient Longman Ltd. ISBN- 13‌ः 978-8125004264
3	Developing Communication skills	Krishna Mohan and Meera Banerji	Macmillan India Ltd. 0333929195 9780333929193
4	A Workbook Communication Skills	Sanjay Kumar and Push Lata	Oxford University Press. India. ISBN -9780199488803
5	Advanced skills for communication in English	Jeya Santhi.V., Dr. R.Selvam	New Century Book House. ISBN -978-81-2343-101-7

13. SOFTWARE/LEARNING WEBSITES

1. www.talkenglish.com
2. Edutech.com
3. www.makeuseof.com
4. www.mooc.org

14. PO –PSO- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	-	1	3	1	2
CO2	3	1	-	-	2	1	3
CO3	3	3	-	1	2	1	3
CO4	3	2	-	1	2	-	3

	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	2
CO2	-	-	-	2
CO3	-	-	-	2
CO4	-	-	-	2

Sign: Name: Smt.S.C.Patil Smt.S.S.Kulkarni Dr.M.S.Ban (Course Experts)	Sign: Name : Smt.N.S.Kadam (Head of Department)
Sign: Name: Smt.N.S.Kadam (Program Head) (Metallurgical Engineering Department)	Sign: Name: Shri.A.S.Zanpure (CDC In charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in CE/EE/ET/ME/MT/CM/IT/**DDGM
Programme Code	**01/02/03/04/05/06/07/**08/**15/16/17/18/19/21/22/23/24/26**
Name of Course	**Applied Mathematics I**
Course Code	**SC1101**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Tutorials		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	**ESE**	**PA**	
03	02	00	05	**Marks**	80	20	--	25	125
				Exam Duration	3 Hrs	1 Hr	--	--	

Legends: L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/ Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour.

2. RATIONALE

The students of Diploma in Engineering and technology must acquire some essential Competencies in Mathematics

3. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Solve various engineering related problems using the principles of applied mathematics**

4. COURSE OUTCOMES (COs)

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 above mentioned competency**:**

1. Apply the concepts of algebra to solve engineering related problems.
2. Utilize basic concepts of trigonometry to solve elementary engineering problems.
3. Solve basic engineering problems under given conditions of straight lines.
4. Solve the problems based on measurement of regular closed figures and regular solids.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	**Unit No.**	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	**Relevant CO**	**Approx. Hrs. required**
1	1	Solve simple problems of Logarithms based on definition and laws	1	2
2	1	Solve problems on determinant to find area of triangle, and solution of simultaneous equation by Cramer's Rules.	1	4
3	1	Resolve into partial fraction using linear non repeated, repeated, and irreducible factors	1	4
4	2	Solve problems on Compound, Allied, multiple and sub multiple angles.	2	4
5	2	Practice problems on factorization and de factorization.	2	2
6	2	Solve problems on inverse circular trigonometric ratios.	2	2
7	3	Practice problems on equation of straight lines using different forms.	3	4
8	3	Solve problems on perpendicular distance, distance between two parallel lines, and angle between two lines.	3	2
9	4	Solve problems on Area, such as rectangle, triangle, and circle.	4	2
10	4	Solve problems on surface and volume, sphere, cylinder and cone.	4	2
11	ALL	Complete a Micro- project as per the guidelines in point no. 11 towards the fulfillment of the COs of the course.	ALL	4
		Total		32

Sr. No.	**Performance Indicators**	**Weightage in %**
a.	Prepare experimental set up	-
b.	Handling of instruments during performing practical.	-
c.	Follow Safety measures	-
d.	Accuracy in calculation	20
e.	Answers to questions related with performed practices.	40
f.	Submit journal report on time	20
g.	Follow Housekeeping	10
h.	Attendance and punctuality	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

S. No.	Equipment Name with Broad Specifications	Experiment Sr. No
1	LCD Projector	1-11
2	Interactive Classroom	1-11

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Units I: Algebra (12 hrs, 24 marks)	
1a. Solve the given simple problem based on laws of logarithm. 1b. Calculate the area of the given triangle by determinant method. 1c. Solve given system of linear 1d. Equations using by Cramer's rule. 1e. Obtain the proper and improper partial fraction for the given simple rational function	1.1 Logarithm: Concept and laws of logarithm 1.2 Determinant a. Value of determinant of order 3x3 b. Solutions of simultaneous equations in three unknowns by Cramer's rule. 1.3 Partial Fractions: Types of partial fraction based on nature of factors and related Problems.
Unit II: Trigonometry (18 hrs, 24 marks)	
2a. Apply the concept of Compound angle, allied angle, and multiple angles to solve the given simple engineering problem(s) 2b. Apply the concept of Sub- multiple angle to solve the given simple engineering related problem 2c. Employ concept of factorization and de-factorization formulae to solve the given simple engineering problem(s). 2d. Investigate given simple problems utilizing inverse trigonometric ratios	2.1 Trigonometric ratios of allied angles, compound angles, multiple angles (2A, 3A), submultiples angle.(without proof) 2.2 Factorization and De factorization formulae (without proof). 2.3 Inverse Trigonometric Ratios and related problems 2.4 Principle values and relation between trigonometric and inverse trigonometric ratios.
Unit III: Co ordinate Geometry (09 hrs, 16 marks)	
3a. Calculate angle between given two straight lines. 3b. Formulate equation of straight lines related to given engineering problems. 3c. Identify perpendicular distance from the given point to the line.. 3d.Calculate perpendicular distance between the given two lines.	3.1 Straight line and slope of straight line a. Angle between two lines. b. Condition of parallel and perpendicular lines. 3.2 Various forms of straight lines. a. Slope point form, two point form. b. Two points intercept form. c. General form. 3.3 Perpendicular distance from a Point on the line. 3.4 Perpendicular distance between two parallel lines
Unit IV: Mensuration (09 hrs, 16 marks)	

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
4a. Calculate the area of given triangle and circle 4b. Determine the area of the given square, parallelogram, rhombus, trapezium. 4c. Compute surface area of given cuboids, sphere, cone and cylinder. 4d. Determine volume of given cuboids, sphere, cone and cylinder.	4.1 Area of regular closed figures, Area of triangle, square, parallelogram, rhombus, trapezium and circle. 4.2 Volume of cuboids, cone, cylinders and sphere.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Algebra	12	6	12	6	24
II	Trigonometry	18	6	6	12	24
III	Co ordinate geometry	09	2	6	8	16
IV	Mensuration	09	2	6	8	16
Total		**48**	**16**	**30**	**34**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

a. Identify engineering problems based on real world problems and solve with the use of free tutorials available on internet.
b. Use graphical software's: EXCEL, DPLOT and GRAPH for related topics.
c. Use Mathcad as Mathematical Tool and solve the problems on Calculus.
d. Indentify problems based on applications of differential equations and solve these problems

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. Use Flash/Animations to explain various components, operations.
d. Teacher should ask the students to go through instruction and Technical manuals.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs.(Affective Domain Outcomes) .Each student will have to maintain activity chart consisting of individual contribution in the project work and give a seminar presentation of it before submission.. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare charts using determinant to find area of regular shapes.
b. Prepare models using trigonometry to solve engineering problems.
c. Prepare models using regular closed figures and regular solids to solve engineering problems.
d. Prepare models using Mensuration to solve engineering problems.

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1.	Higher Engineering Mathematics	Grewal B. S.	Khanna publication New Delhi , 2013 ISBN: 8174091955
2.	A text book of Engineering Mathematics	Dutta. D	New age publication New Delhi, 2006 ISBN: 978-81-224-1689-3
3.	Advance Engineering Mathematics	Kreysizg, Ervin	Wiley publication New Delhi 2016 ISBN: 978-81-265-5423-2
4.	Advance Engineering Mathematics	Das H.K.	S Chand publication New Delhi 2008 ISBN: 9788121903455
5.	Engineering Mathematics Volume I (4^{th} edition)	Sastry S.S.	PHI Learning, New Delhi, 2009 ISBN: 978-81-203-3616-2

13. SOFTWARE/LEARNING WEBSITE

1. www.scilab.org/ -SCI Lab
2. www.mathworks.com/product/matlab/ -MATLAB
3. Spreadsheet Applications
4. www.dplot.com
5. https://www.khanacademy.org/math?gclid=CNqHuabCys4CFdOJaddHoPig

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	1	-	-	-	1
CO2	3	3	1	-	-	1	2
CO3	3	3	-	-	-	-	1
CO4	3	3	1	1	-	-	1

	PSO1	PSO2	PSO3	PSO4
CO1	1	-	-	-
CO2	-	-	-	-
CO3	-	-	-	-
CO4	1	-	-	-

Sign: Name: Shri. S. B. Yede Shri. V. B. Shinde Smt. P. R. Nemade (Course Experts)	Sign: Name: Smt.N.S.Kadam (Head of Department)
Sign: Name: Smt.N.S.Kadam (Program Head) (Metallurgical Engineering Department)	Sign: Name: Shri. A. S. Zanpure. (CDC In charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in CE/EE/ET/ME/MT/CM/IT**/DDGM
Programme Code	**01/02/03/04/05/06/07**/08/**15/16/17/18/19/21/22/23/24/26**
Name of Course	**Applied Mathematics II**
Course Code	**SC1102**
Prerequisite course code and name	**SC1101– Applied Mathematics I**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Tutorials		Total Marks
L	T	P	C		ESE	PA	ESE	PA	
03	02	00	05	Marks	80	20	--	25	125
				Exam Duration	3 Hrs	1 Hr	--	--	

Legends: L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/ Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour.

2. RATIONALE

This subject intends to teach students basic facts, concepts, principles and procedure of Mathematics as a tool to analyze Engineering problems and as such it lays down foundation for the understanding of engineering science and core technology subjects

3. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Solve various engineering related problems using the principles of applied mathematics**

4. COURSE OUTCOMES (COs)

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 above mentioned competency**:**

1. Calculate the equation of tangent, maxima, minima, by differentiation.
2. Solve the given problems of integration using basic formulae.
3. Use basic concepts of statistics to solve engineering related problems.
4. Apply the concept of numerical methods to find the roots of equation.
5. Apply the concept of matrix to solve the engineering problems.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
1	Solve problems based on finding value of the function at different points	1	2
2	*Solve problems based on standard formulae of derivatives	1	2
3	*Solve problems to find derivatives of implicit function and parametric function.	1	2
4	Solve problems to find derivative of logarithmic and exponential functions	1	2
5	Solve problems based on finding equation of tangent and normal.	1	2
6	Solve problems based on finding maxima, minima of function	1	2
7	Solve problems based on finding radius of curvature at a given point.	1	2
8	Solve the problems based on standard formulae of integration.	2	2
9	Solve problems on finding range, coefficient of range and mean deviation.	3	2
10	*Solve problems on standard deviation.	3	2
11	*Solve problems on coefficient of variation and comparison of two sets. 2	3	2
12	Solve the algebraic equation using Bisection method, Regula falsi method and Newton –Raphson method	4	2
13	Solve the simultaneous equation using Gauss elimination method, Gauss Seidal and Jacobi's method	4	2
14	Solve elementary problems on Algebra of matrices.	5	2
15	Solve solution of Simultaneous Equation using inversion method.	5	4
16	*Complete a Micro- project as per the guidelines in point no. 11 towards the fulfillment of the COs of the course.	ALL	4
	Total		32

***Experiment No.16 compulsory, perform experiment 2 or 3 and experiment 10 or 11.**

S.No.	Performance Indicators	Weightage in %
a.	Prepare experimental set up	-
b.	Handling of instruments during performing practical.	-
c.	Follow Safety measures	-
d.	Accuracy in calculation	20
e.	Answers to questions related with performed practices.	40
f.	Submit journal report on time	20

S.No.	Performance Indicators	Weightage in %
g.	Follow Housekeeping	10
h.	Attendance and punctuality	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will be used in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	Experiment Sr. No
1	LCD Projector	1-15
2	Interactive Classroom	1-15

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit I: Differential Calculus (24 hrs, 40 marks)	
1a. Solve the given simple problems on functions. 1b. Solve the given simple problems based on rules of differentiation. 1c. Obtain the derivatives of logarithmic, exponential functions. 1d. Apply the concept of differentiation to find given equation of tangent and normal. 1e. Apply the concept of differentiation to calculate maxima and minima and radius of curvature for given function.	1.1 Functions and Limits : a. Concept of function and simple b. Concept of limits without examples. 1.2 Derivatives: a. Rules of derivatives such as sum, Product, Quotient of functions. b. Derivative of composite functions to find derivative of given function (chain Rule), implicit and parametric functions. c. Derivatives of inverse, logarithmic and exponential functions. 1.3 Applications of derivative : a. Second order derivative without examples. b. Equation of tangent and normal c. Maxima and minima d. Radius of curvature
Unit II: Integration (06 hrs, 10 marks)	
2a. Solve the given simple problem(s) based on rules of integration.	2.1 Simple Integration: Rules of integration and integration of standard functions
Unit III: Statistics (06 hrs, 10 marks)	
3a. Obtain the range and coefficient of range of the given grouped and ungrouped data. 3b. Calculate mean and standard deviation of discrete and grouped data related to the given simple engineering problem. 3c. Determine the variance and coefficient	3.1 Range, coefficient of range of discrete and grouped data. 3.2 Mean deviation and standard from mean of grouped and ungrouped data, weighted means 3.3 Variance and coefficient of variance. 3.4 Comparison of two sets of observation.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
of variance of given grouped and ungrouped data. 3d. Justify the consistency of given simple sets of data.	
Unit IV: Numerical Methods (06 hrs, 10 marks)	
4a. Apply the concept of approximate to find root of algebraic equation 4b. Apply the concept of iteration to solve the system of equations in three unknowns.	4.1 Solution of algebraic equations : a. Bisection method, b. Regula falsi method and c. Newton –Raphson method. 4.2 Solution of simultaneous equations containing three Unknowns : a. Gauss elimination method. b. Iterative methods- Gauss Seidal and Jacobi's method
Unit V: Matrices (06 hrs, 10 marks)	
5a. Solve given system of linear equations using matrix inversion method	5.1 Matrices, algebra of matrices, transpose adjoint and inverse of matrices. 5.2 Solution of simultaneous equations by matrix inversion method.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Differential Calculus	24	8	12	20	40
II	Integration	06	2	8	--	10
III	Statistics	06	2	--	8	10
IV	Numerical methods	06	2	4	4	10
V	Matrices	06	2	4	4	10
Total		**48**	**16**	**28**	**36**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

a. Identify engineering problems based on real world problems and solve with the use of free tutorials available on internet.
b. Use graphical software's: EXCEL, DPLOT and GRAPH for related topics.
c. Use Mathcad as Mathematical Tool and solve the problems on Calculus.
d. Indentify problems based on applications of differential equations and solve these problems

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. Use Flash/Animations to explain various components, operations.
d. Teacher should ask the students to go through instruction and Technical manuals.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs.(Affective Domain Outcomes). Each student will have to maintain activity chart consisting of individual contribution in the project work and give a seminar presentation of it before submission.. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare the model using the concept of tangent and normal bending of roads in case of sliding of a vehicle.
b. Prepare the model using the concept of radius of curvature to bending of railway tracks.
c. Prepare charts for grouped and ungrouped data.
d. Write algorithm to find the approximate roots of algebraic equations.
e. Write algorithm to find the approximate roots of transcendental equations.
f. Write algorithm to solve system of linear equations.
g. Prepare models using matrices to solve simple problems based on cryptography.

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1.	Higher Engineering Mathematics	Grewal B. S.	Khanna publication New Delhi , 2013 ISBN: 8174091955
2.	A text book of Engineering Mathematics	Dutta. D	New age publication New Delhi, 2006 ISBN: 978-81-224-1689-3
3.	Advance Engineering Mathematics	Kreysizg, Ervin	Wiley publication New Delhi 2016 ISBN: 978-81-265-5423-2
4.	Advance Engineering Mathematics	Das H.K.	S Chand publication New Delhi 2008 ISBN: 9788121903455
5.	Engineering Mathematics Volume I (4^{th} edition)	Sastry S.S.	PHI Learning, New Delhi, 2009 ISBN: 978-81-203-3616-2

13. SOFTWARE/LEARNING WEBSITES

1. www.scilab.org/ -SCI Lab
2. www.mathworks.com/product/matlab/ -MATLAB
3. Spreadsheet Applications
4. www.dplot.com
5. https://www.khanacademy.org/math?gclid=CNqHuabCys4CFdOJaddHoPig

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	1	-	-	-	1
CO2	2	2	-	-	-	1	1
CO3	3	3	-	-	-	-	1
CO4	3	3	1	1	-	-	1
CO5	3	3	1	-	-	-	2

	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	-
CO2	1	1	-	-
CO3	-	-	-	-
CO4	1	-	-	-
CO5	-	-	--	-

Sign: Name: Shri. S. B. Yede Shri. V.B.Shinde Smt. P. R. Nemade (Course Experts)	Sign: Name: Smt.N.S.Kadam (Head of Department)
Sign: Name: Smt.N.S.Kadam (Program Head) (Metallurgical Engineering Department)	Sign: Name: Shri. A. S. Zanpure (CDC In charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in CE**/EE/ET/**ME**/**MT**/CM/IT/DDGM
Programme Code	**01**/02/03/**04**/**05**/06/07/08/**15**/16/17/**18**/**19**/**21**/22/23/**24**/26
Name of Course	**Applied Physics**
Course Code	**SC1103**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**#ESE**	**PA**	***ESE**	**PA**	150
03	00	02	05	**Marks**	80	20	25	25	
				Exam Duration	2 Hrs	1 Hrs	2 Hrs	--	

Legends: L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/ TermWork), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour.

2. RATIONALE

This course is designed with some fundamental information to help the diploma engineers to apply the basic concepts and principles of physics to solve broad-based engineering problems. The study of basic principles and the concepts of motion, elasticity, viscosity, surface tension, sound, heat, optics, photo electricity and X-rays will help in understanding the technology courses where emphasis is laid on the applications.

3. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Apply principles of physics to solve broad-based engineering problems.**

4. COURSE OUTCOMES (COs)

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 above mentioned competency**:**

1. Estimate errors in the measurement of physical quantities.
2. Apply laws of motion in various applications.
3. Apply the concepts of elasticity, viscosity and surface tension to solve engineering problems.
4. Use basic principles heat, light and optics in related engineering problems.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Relevant COs**	**Approx. Hrs. required**
1	1	Identify given instrument and i) Mention name and range of given instrument. ii) Calculate least count of given instrument. iii) List the uses of given instrument.	1	02
2	1	Use Vernier caliper to : i) Identify and calculate instrumental error. ii) Measure dimensions of different objects. i) Estimate error in the measurement (if any).	1	04*
3	1	Use micrometer screw gauge to: i) Identify and calculate instrumental error. ii) Measures dimensions and determine volume of given object. iii) Estimate error in the measurement.	1	04*
4	1	Use simple pendulum to determine acceleration due to gravity.	1,2	02*
5	2	Determine surface tension by capillary rise method.	1,3	02
6	2	Measure coefficient of viscosity of given liquid using Stoke's method (Stokes law).	1,3	02*
7	2	Calculate spring constant using Hooke's law.	3	02
8	3	Use resonance tube to determine velocity of sound. (Concept of resonance).	1,3	04*
9	4	Verify of Boyle's law and establish relation between pressure and volume for given gas.	4	04*
10	5	Determine refractive index of glass slab using principle of total internal reflection.	4	02
11	5	Study the properties and working of laser using He-Ne laser beam.	4	02*

12	6	Use photoelectric cell to study effect of : i) Intensity of light on photoelectric current. ii) Applied potential on photoelectric current.	4	04*
13	All	Complete a Micro- project based on guidelines provided in Sr.No.11	1 to 4	04*
		Total		**32**

Note: A suggestive list of Experiments is given in the above table. Minimum 10 practical need to be performed out of which practical marked as * are compulsory. Any one practical out of Sr. No. 1,5,7 & 10 need to be performed.

S.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	10
b.	Setting and operation	10
c.	Safety measures	10
d.	Observations and Recording	20
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	20
g.	Submission of report in time	10
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned**.**

S. No.	Equipment Name with Broad Specifications	Experiment Sr. No.
1	Voltmeter (0-10 V), ammeter (0-5 A),	1
2	Vernier Calliper : Range: 0-15 cm, Resolution 0.01 cm.	1,2,8
3	Micrometer screw gauge: Range 0-25 mm, Resolution 0.01 mm.	1,3,6
4	Simple pendulum, Stop Watch.	4
5	Travelling microscope: Range: 0.05-22 cm, Resolution 0.001 cm, Capillary tube.	5
6	Stoke’s apparatus, Wooden scale, small metal sphere.	6
7	Hooke’s law apparatus	7
8	Resonance tube, tuning fork set, rubber pad.	8
9	Boyles law apparatus.	9
10	Glass Slab 75x50x12mm.	10
11	He-Ne laser kit.	11
12	Photoelectric cell.	12

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit I General Physics (8 hrs, 14 marks)	
1a. List fundamental and derived quantities with their unit. 1b. Explain various systems of unit and its need for the measurement. 1c. Estimate errors in measurement. 1d. Derive relation between linear velocity and angular velocity. 1e. Calculate angular velocity of the given body 1f. Distinguish between centripetal and centrifugal force. 1g. Derive equation of SHM.	**1.1 Units and Measurements:** Introduction, Definition of unit, Fundamental and derived units, Different System of units, Errors in measurements **1.2 Circular Motion**: Definition, Uniform circular motion(UCM), radius vector, angular displacement, angular velocity, angular acceleration and units, relation between linear and angular velocity, relation between linear acceleration and angular acceleration, explanation of centripetal and centrifugal force, examples, applications of centripetal and centrifugal force, analytical treatment. **1.3 SHM**: Concept of time period, frequency, amplitude, wavelength, relation between wave velocity frequency and wavelength. Definition of SHM, examples of SHM, SHM as a projection of UCM, equation of SHM starting from mean position.
Unit II Properties of Matter (12 hrs, 18 marks)	
2a. Compare cohesive and adhesive force. 2b. Explain phenomenon of ST with the help of molecular theory. 2c. Calculate surface tension of given liquid. 2d. State Newton's law of viscosity. 2e. Calculate coefficient of viscosity of given liquid. 2f. Distinguish between streamline flow and turbulent flow 2g. Describe concept of elasticity and plasticity. 2h. State Hooke's law of elasticity. 2i. Establish relation between given types of modulii of elasticity. 2j. Predict the behavior of the given wire.	**2.1 Surface Tension :** Definition and unit, molecular theory of surface tension, Cohesive and adhesive forces, angle of contact and its significance, shape of liquid surface in capillary tube, capillary action and examples, surface tension by capillary rise method (no derivation), analytical treatment, effect of impurity and temperature on surface tension. **2.2 Viscosity:** Definition, velocity gradient and its unit, Newton's law of viscosity, terminal velocity, Stokes law, Stokes formula, coefficient of viscosity by stokes method (no derivation), type of flow of liquid - stream line flow, turbulent flow, Reynolds's number (significance), applications and analytical treatment.

	2.3 Elasticity: Elastic, plastic and rigid bodies, stress, strain and its types, Hook's law, types of elastic modulii with its relation, analytical treatment, behavior of wire under continuously increasing load (stress-strain diagram).
Unit III Sound (6 hrs, 10 marks)	
3a. Distinguish between Transverse and Longitudinal wave. 3b. Describe phenomenon of resonance with example and applications. 3c. Describe properties and applications of ultrasonic wave in engineering.	**3.1 Sound:** Wave motion, Transverse and longitudinal waves, free and forced vibrations, Resonance – explanation, example and applications, absorption, reflection and transmission of sound. **3.2 Ultrasonic:** Definition, properties of ultrasonic waves, applications of ultrasonic in engineering.
Unit IV Heat (6 hrs, 12 marks)	
4a. State Boyle's law, Charles's law and Gay lussac's law. 4b. Verify Boyle's law. 4c. Derive general gas equation 4d. Convert given temperature in different scale. 4e. Explain different modes of heat transfer with example.	**4.1 Gas Laws:** Explanation of Gas laws, Boyle's law, Charles's law, Gay Lussac's law, General Gas Equation, analytical treatment, units of temperature ^{0}C, ^{0}K with their conversion, absolute scale of temperature. **4.2 Heat:** modes of heat transfer, conduction, convection and radiation.
Unit V Optics and Laser (8 hrs, 14 marks)	
5a. State laws of reflection and refraction. 5b. Describe phenomenon of total internal reflection. 5c. Calculate acceptance angle and numerical aperture for given optical fiber. 5d. Distinguish between optical fiber communication system and ordinary system. 5e. Differentiate between properties of ordinary light and laser light. 5f. Explain spontaneous and stimulated emission. 5g. Describe working of He-Ne laser with energy level diagram. 5h. State applications of laser in different field.	**5.1 Light:** Introduction to reflection and refraction of light, laws of reflection and refraction, Snell's law, refractive index, physical significance of refractive index, critical angle, total internal refraction of light. **5.2 Fiber optics**: Propagation of light through optical fiber, structure of optical fiber, numerical aperture, acceptance angle, acceptance cone, types of optical fibers, applications of optical fiber, comparison of optical fiber communication with electrical cable communication, analytical treatment. **5.3 LASER:** Definition, properties of LASER, spontaneous and stimulated emission, population inversion, metastable state, pumping, life time, He-Ne laser-construction and working with energy level diagram, engineering applications of laser.

Unit VI Modern Physics (8 hrs, 12 marks)	
6a. Describe properties of photon 6b. Derive Einstein's photoelectric equation. 6c. Explain working of given photoelectric device. 6d. Explain production of X-rays. 6e. Describe properties and applications of X-ray in different field.	**6.1 Photo electricity**: Photoelectric effect, Plank's quantum theory, concept of photon, properties of photon, threshold frequency, threshold wavelength, stopping potential, photoelectric work function, Einstein's photoelectric equation, photocell (circuit diagram and working), applications of photoelectric cell, analytical treatment. **6.2 X- ray:** principle, production of X-rays using Coolidge tube, origin of X-rays, types of X-rays, properties of X-rays, engineering applications.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	General Physics	8	4	4	6	14
II	Properties of matter	12	8	6	4	18
III	Sound	6	4	4	2	10
IV	Heat	6	4	4	4	12
V	Optics and Laser	8	6	6	2	14
VI	Modern Physics	8	6	4	2	12
	Total	**48**	**32**	**28**	**20**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journal based on practical performed in Physics laboratory. Journal consists of drawing, observations, required equipment's, date of performance with teacher signature.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.

b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).

c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.

d. Use proper equivalent analogy to explain different concepts.

e. Use Flash/Animations to explain various components, operations.

f. Teacher should ask the students to go through instruction and Technical manuals.

11. SUGGESTED MICRO-PROJECT

Only one Micro Project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. She/He ought to submit it by the end of semester to develop industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs. The Micro-Project could be industry application based, internet based, workshop based, laboratory based or field based. The assessment of micro-project is to be done under Practical (PA) Assessment. The Micro Project preferably assign to the group of (4-6) students or an individual taking into the considerations the capabilities and circumstances at the time .
A suggested list is given here. Similar micro-project could be added by the concerned faculty.

a. **Systems and Units** : Prepare Chart on comparison of systems of units for different physical quantities.

b. **Gas Laws :** Prepare report on Boyles law, Charles law and Guy Lussacs law .

c. **Optics :**Prepare chart to study Total Internal Reflection/LASER.

d. **X-Ray** :Prepare chart showing properties of X-rays/Photoelectric cell.

e. Collect different **Viscous Liquids** and List their applications.

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publisher, Edition Year of publication and ISBN Number
1	Physics Textbook Part I- Class XI	J.V.Narlikar, A.W.Joshi, et al.	National Council of Education Research and Training, New Delhi,2010, ISBN:8174505083
2	Physics Textbook Part II- Class XI	J.V.Narlikar, A.W.Joshi, et al.	National Council of Education Research and Training, New Delhi,2015, ISBN:8174505660
3	Physics Textbook Part I- Class XII	J.V.Narlikar, A.W.Joshi, et al.	National Council of Education Research and Training, New Delhi,2013, ISBN:8174506314
4	Physics Textbook Part II- Class XII	J.V.Narlikar, A.W.Joshi, et al.	National Council of Education Research and Training, New Delhi,2013, ISBN:8174506713
5	Fundamentals of Physics	David Halliday, Robert Resnick and Jearl Walker	7th Edition, John Wily (2004), ISBN :9781118230718,111823071X
6	Engineering Physics	R.K. Gaur and S. L. Gupta	DhanpatRai Publications ISBN 9788189928223 (1981)
7	Applied Physics	PrakashManikpure	S. Chand Publishing ISBN 9788121919548
8	Applied Physics	Arthur Beiser	Schaum's Outline Series McGraw-HILL, ISBN :9780071426114
9	Engineering Physics	Avadhanulu, Kshirsagar	S Chand ISBN 9788121908177

13. SOFTWARE/LEARNING WEBSITES

1. https://en.wikipedia.org/wiki/**Engineering_physics**
2. www.nanowerk.com
3. www.brainscape.com
4. https://www.open2study.com/courses/basic-physics
5. http://nptel.ac.in/course.php?disciplineId=115
6. http://nptel.ac.in/course.php?disciplineId=104
7. http://hperphysics.phy-astr.gsu.edu/hbase/hph.html
8. www.physicsclassroom.com
9. www.physics.org

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	-	2	-	2	2
CO2	3	2	-	-	-	-	2
CO3	3	2	-	2	-	-	2
CO4	3	-	-	1	-	2	2

	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1
CO2	-	-	-	-
CO3	1	2	1	-
CO4	2	1	1	-

Sign: Name: Smt. D. V. Saurkar Dr. R. B. Birajadar (Course Experts)	Sign: Name : Smt.N.S.Kadam (Head of Department)
Sign: Name: Smt.N.S.Kadam (Program Head) (Metallurgical Engineering Department)	Sign: Name: Shri. A. S. Zanpure. (CDC In charge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in CE/**EE/ET/**ME/MT/**CM/IT/DDGM
Programme code	**01**/02/03/**04**/**05**/06/07/08/**15**/16/17/**18**/**19**/**21**/22/23/**24**/26
Name of Course	**Applied Chemistry**
Course Code	**SC1106**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		#ESE	PA	*ESE	PA	
03	00	02	05	Marks	80	20	25	25	150
				Exam Duration	2 Hrs	1 Hr	2 Hrs	--	--

***Legends: L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/ TermWork), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour*.**

2. RATIONALE

Applications of Material Science and Chemical Principles have resulted into the development of new materials used in modern medicines and automobiles, synthetic fibers, polymers, alloys, new energy sources and many other important products and processes. Steels, alloys, plastic and elastomers are included considering their present extensive use in automobiles, chemicals and heavy engineering industries.

Corrosion and methods of prevention will make students realize the importance of care and maintenance of machines and equipment. Study of impurities and hardness in water and methods for water softening will help the students to make proper use of water.

3. COMPETENCY

The aim of this course is to help the students:

- **To solve engineering problems applying principles of chemistry**

4. COURSE OUTCOMES (COs)

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 above mentioned competency:

1. Distinguish materials on the basis of atomic structure.
2. Select metals and non metals for given applications.
3. Use corrosion preventive measures in industry.
4. Use relevant water treatment processes to solve industrial problems.
5. Select relevant fuel and lubricant in relevant applications.

5. SUGGESTED PRACTICALS/ EXERCISES

Expt. Sr. No.	**Unit No.**	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	**Relevant COs**	**Approx. Hrs. required**
1	1	Write the electronic configuration of atoms from Z=1 to Z=30	1	2
2	1	Write the formation of compounds NaCl, $AlCl_3$, H_2O, CO_2, N_2	1	4
3	1	*Determine acidic and basic radical from unknown solution (solution 1)	1	4
4	1	*Determine acidic and basic radical from unknown solution (solution 2)	1	4
5	2	Determine the percentage of iron in a given steel sample by redox titration.	2	4
6	3	Preparation of phenol formaldehyde resin.	1	2
7	4	Determine the rate of corrosion of Aluminium in acidic medium.	3	2
8	5	Determination of hardness of given water sample by EDTA method.	4	2
9	6	Determine the coefficient of viscosity using Ostwald's viscometer.	5	2
10	7	Determine moisture content from a given coal sample.	5	2
11	8	Determine thinner content in oil paint.	5	4
12	1 to 8	*Complete a Micro- project as per the guidelines in point no. 11	1 to 5	4
			Total	32

***Experiment Sr.No.12 compulsory, perform Expt.Sr. No 3 or 4**

Scheme of Practical Evaluation

Sr.No.	Performance Indicators	Weightage in %
a.	Prepare experimental set up	20
b.	Handling of instruments during performing practical.	20
c.	Follow Safety measures	10
d.	Accuracy in calculation	20
e.	Answers to questions related to performed practices.	10
f.	Submit journal report on time	10
g.	Follow Housekeeping	5
h.	Attendance and punctuality	5
	Total	**100**

6 MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

S. No.	Equipment Name with Broad Specifications	Experiment Sr. No
1	Digital Hot Air Oven GR Lab temperature range 100 to 250 ^{0} c	7, 8
2	Electronic balance with the scale range of 0.001 gm to 500 gm	All

7 THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT I: Atomic Structure (06 hrs, 10 marks)	
1a. Explain the characteristics of fundamental particles 1b. Distinguish between atomic number and atomic mass number 1c. Distinguish between orbit and orbital. 1d. Describe significance of quantum numbers. 1e. Explain the formation of molecules. 1f. Draw orbital electronic configurations (s, p, d, f) of elements. 1g. Define metallic bond with example.	1.1 Definition of atom, structure of atom, Characteristics of fundamental particles of an atom, definition of atomic number, atomic mass number and their difference 1.2 Orbits: Bohr’s energy levels, sub-energy levels, s, p, d, f orbital, shapes and description of s and p orbital. Definition and significance of quantum numbers 1.3 Aufbau’s principle, Hund’srule,orbital electronic configurations (s, p, d, f) of elements having atomic number 1 to 30. 1.4 Definitions of valence electrons, valency, types of valencies, definition of metallic bond. Definition of electrovalency, positive and negative electrovalency. 1.5 Formation of Electrovalent compounds-Nacl, $AlCl_3$ Definition of covalency, single, double and triple covalent bonds, formation of Covalent compounds H_2O, CO_2, N_2

UNIT II: METAL AND ALLOYS (08 hrs, 12 marks)	
2a. Draw the flow chart showing different processes in metallurgy. 2b. Classify carbon steel giving properties and application of each type. 2c. Define heat treatment and state the purposes of the hardening method. 2d. Describe purposes of making alloys. 2e. Explain effects of alloying elements on the properties of steel. 2f. State the composition, properties and uses of given alloy.	2.1 Occurrence of metals, definitions of mineral, ore, flux, matrix, slag and metallurgy, mechanical properties of metal. 2.2 Flow chart showing different processes in metallurgy, classification, properties and application of carbon steel, heat treatment (definition, purposes and methods) 2.3 Definition of alloy, purposes of making alloys with examples, classification of alloys (ferrous and non-ferrous), effects of alloying elements on the properties of steel (Ni, Co, Si, Mn, V, W) 2.4 Composition, properties and uses of Heat resisting steel, Magnetic steel, Shock resistance steel, Stainless steel, High speed steel, Spring steel, Tool steel, Duralumin, Woods metal, Brass and Monel metal.
UNIT III: PLASTIC AND RUBBER (06 hrs, 10 marks)	
3a. Describe the formation of a given polymer. 3b. Distinguish between thermosoftening and thermosetting plastics. 3c. List the applications of Plastic based on its properties. 3d. Explain the vulcanization process of natural rubber. 3e. Distinguish between synthetic and natural rubber. 3f. Describe preparation reaction of given synthetic rubber.	3.1 Definition of monomer and polymer, polymerization, classification of plastic on the basis of monomer, on basis of thermal behavior, on basis of monomer structure, 3.2 Types of polymerization (Addition, and Condensation) applications of Plastic based on its properties. 3.3 Synthesis, properties and applications of- Polythene, PVC, Teflon, Bakelite, Polystyrene. 3.4 Types of rubber, processing of natural rubber, properties of rubber, drawbacks of natural rubber, vulcanization of rubber. 3.5 Synthetic rubber – preparation, properties and application of BUNA-S, BUNA-N, Neoprene, Thiokol.
UNIT IV: CORROSION (06 hrs, 08 marks)	
4a. Explain different types of oxide films. 4b. Explain the mechanism of electrochemical corrosion. 4c. Explain the factors affecting rate of atmospheric corrosion and electrochemical corrosion. 4d. Describe the galvanization process of protection of metal from corrosion.	4.1 Definition, causes of corrosion types of corrosion- definition (atmospheric and electrochemical) Types of oxide films 4.2 Mechanism of atmospheric and electrochemical corrosion (evolution of hydrogen, absorption of oxygen). 4.3 Factors affecting rate of atmospheric corrosion and electrochemical corrosion. 4.4 Protection Methods- Galvanization and Tinning processes, Sherardizing, Metal spraying, Metal cladding.

4e. Distinguish between galvanization and tinning.	
UNIT V: WATER (06 hrs, 10 marks)	
5a. Explain the bad effects of hard water in paper and textile industries. 5b. Describe the method of removal of hardness by zeolite process. 5c. Explain reverse osmosis process of water. 5d. Explain sewage treatment of water. 5e. Calculate the pH and pOHfor a given solution.	5.1 Definition of hard water and soft water causes of hardness, types of hardness. 5.2 Bad effect of hard water in industries (paper, textile, dye, sugar) 5.3 Removal of hardness by lime soda method, zeolite, ion exchange method, reverse osmosis. 5.4 reverse osmosis, sewage treatment- 5.5 pH scale, applications of pH in engineering. Numerical based on pH.
UNIT VI: LUBRICANT (04 hrs, 08 marks)	
6a. Explain the mechanism of fluid film lubrication. 6b. Classify lubricant and list the examples of each type. 6c. Describe given physical and chemical properties of lubricant. 6d. Select the proper lubricant for given machines, (I.C.E., gears, cutting tools, high pressure.)	6.1 Definition and functions of lubricant, mechanism of lubrication (fluid film, boundary, extreme pressure lubrication) 6.2 Classification of lubricant, properties of lubricating oils (physical and chemical) 6.3 Selection of lubricant for light machines, I.C.E., gears, cutting tools, high pressure and low speed machines, transformers, spindles in textile industry, for refrigeration system.
UNIT VII: FUELS (06 hrs, 10 marks)	
7a. Describe the characteristics of good fuel. 7b. Compare solid, liquid and gaseous fuel on the basis of ignition point, calorific value, ash content and mode of supply. 7c. Explain proximate analysis of coal. 7d. Draw the diagram of refining of crude petroleum.	7.1 Definition, classification of fuels, characteristics of good fuel. 7.2 Comparison between solid, liquid and gaseous fuel, types of coal, analysis of coal by proximate and ultimate analysis 7.3 Refining of crude petroleum. 7.4 Fractions obtained by distillation of crude oil, gasoline, kerosene, diesel as a fuel (properties and uses)

UNIT VIII: MATERIALS (06 hrs, 12 marks)	
8a. Describe the different constituents of paint. 8b. Distinguish between varnish and paint. 8c. Describe the preparation and properties of a given insulator. 8d. Explain the function of different constituents of cement.	8.1 Paints: Definition, purpose of applying paints, characteristics of paint, constituents of paint, function and examples of each constituent. 8.2 Varnish: Definition, types, difference between varnish and paint. 8.3 Insulators: Definition, characteristics, preparation, properties and application of Glass wool and Thermocole. 8.4 Cement: Definition, classification of cement, chemical composition of Portland cement, function of constituent in cement.

8 SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Atomic structure	06	02	08	00	10
II	Metals and alloys	08	02	04	06	12
III	Polymer and elastomer	06	02	02	06	10
IV	Corrosion	06	00	02	06	08
V	Water	06	02	02	06	10
VI	Lubricant	04	02	00	06	08
VII	Fuel	06	02	04	04	10
VIII	Materials	06	02	04	06	12
Total		**48**	**14**	**26**	**40**	**80**

9 SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare a journal based on practical performed in a Chemistry laboratory. Journal consists of drawing, observations, required equipment, date of performance with teacher signature.

10 SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.

b. About ***15-20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Use Flash/Animations to explain various components, operations.
e. Teacher should ask the students to go through instruction and Technical manuals.

11 SUGGESTED MICRO-PROJECTS

Only **one micro- project** is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.*** S/he ought to submit it by the end of the semester to develop the industry oriented COs .Each micro project should encompass two or more COs which are in fact, an integration of PrOs. UOs and ADOs. (Affective Domain Outcomes) .The micro project could be application based, internet based, workshop based, laboratory based or field based. Each student will have to maintain a dated work diary consisting of individual contributions in the project work.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Types of bonds: Prepare a chart and models displaying different types of bonds with examples.

b.Metals and Alloys: Prepare a chart showing Composition, properties application of Ferrous Alloys.

c. Insulating materials: Prepare a chart including different synthetic Plastic and Rubber and list their uses.

d.Lubricants: Prepare a chart includingSelection of lubricant for different machines.

e. Water: Collect & Analyse different water samples from different sources.

12 SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publisher, Edition and Year of publication, ISBN Number
1	Engineering Chemistry	Dara S.S. Umare S.S.	S. Chand and Co publication, New Delhi, 201, ISBN: 8121997658
2	Engineering Chemistry	Jain and Jain	DhanpatRai and Sons, New Delhi,2015, ISBN: 9352160002
3	Engineering Chemistry	Vairam. S	Wiley Indian Pvt. Ltd, New Delhi, 2013 ISBN: 9788126543342
4	Chemistry for Engineers	Agnihotri, Rajesh	Wiley Indian Ptd. Ltd, New Delhi, 2014, ISBN: 9788126550784
5	Engineering Chemistry	Agrawal Shikha	Cambridge University press, New Delhi, 2015 ISBN: 97811074764

13 SOFTWARE/LEARNING WEBSITES

1. www.chemistrytesching.com
2. www.visionlearning.com
3. www.chem1.com
4. www.onlinelibrary.wiley.com
5. www.rsc.org
6. www.chemcollective.org
7. www.wqa.org

14 PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	-	-	2	-	1
CO2	3	2	-	-	2	1	1
CO3	3	-	-	2	-	-	1
CO4	3	2	-	2	2	1	1
CO5	3	-	-	2	1	1	1

	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	-
CO2	1	1	1	-
CO3	1	-	1	-
CO4	-	-	-	-
CO5	1	-	-	-

Sign: Name: Smt. S.A.Kakade Smt. G.M.Patel (Course Experts)	Sign: Name: Smt. N.S.Kadam (Head of Department)
Sign: Name: Smt. N.S.Kadam (Program Head) (Metallurgical Engineering Department)	Sign: Name: Shri. A.S.Zanpure (CDC In charge)

Government Polytechnic, Pune

Department of Metallurgical Engineering

180 OB Curriculum

Level-2A: Core Technology Courses

(All Compulsory)

Sr. No.	Course Code	Course Name
1	AM2101	Engineering Mechanics
2	CM2102	Fundamentals of Information & Computer Technology (ICT)
3	EE2102	Electrical Technology
4	ET2106	Principles of Electronics
5	ME2103	Engineering Drawing
6	ME2106	Elements of Mechanical Engineering
7	SC2106	Advanced Physics
8	WS2101	Workshop Practice

Government Polytechnic, Pune

180OB– Scheme

Programme	**Diploma in CE/ME/EE/MT**
Programme Code	**01**/**02**/03/**04**/**05**/06/07/08/**15**/**16**/17/**18**/**19**/**21**/22/23/**24**/26
Name of Course	**Engineering Mechanics**
Course Code	**AM2101**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	**ESE**	**PA**	
04	00	02	06	**Marks**	80	20	--	25	125
				Exam Duration	3 Hrs	1 Hr	--	--	

Legends: L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/TermWork), *- Practical Exam, $- Oral Exam, #- Online Examination Each Lecture/Practical period is of one clock hour.

2. RATIONALE

To find solutions to various practical problems, the student needs tostudy and getacquainted with the various aspects of Statics and Dynamics. The fundamental concepts to be studied in this course are required to studythe strength of materials, Mechanics of Structures, and other Mechanical & Civil Engineering courses to be studied at a higher level.

3. COMPETENCY

This course aims to attend the following identified competency through various teaching-learning experiences:

- **Use different types of concepts and force systems for engineering applications.**

4. COURSE OUTCOMES (COs)

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 above**:**

1. Apply concepts of engineering mechanics in the engineering field.
2. Determine the resultant of various Force systems and locate it
3. Verify simple laws and equations of equilibrium of forces.
4. Locate centroids and centre of gravity of plane laminas and solid bodies.
5. Solve numerical related to friction, simple lifting machines, work, power, energy, and kinetics.
6. Compute the Efficiency of different machines and draw graphs for the Law of machines, for load, and Efficiency.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hrs. required
1	To verify Law of polygon of Forces.	1	02
2	To verify Law of Moments.	2	02
3	To verify Lami's Theorem.	2	02
4	To determine Beam Reactions.	2	02
5	Graphic Statics: On Graph papers solve graphically two problems each on resultant of concurrent and parallel forces.	1	06
6	Graphic statics- On Graph papers solve graphically Two problems on beam reactions.	2	06
7	To Determine coefficient of friction for different surfaces in contact .(Minimum two different surfaces to be studied)	5	02
8	To study various lifting machines –To plot graphs forload Vs effort ,load Vs Efficiency and obtain Law of machine .for Differential axle and wheel, Worm and worm wheel, simple screw jack, Single purchase crab.	6	06
9	Complete a micro project based on guidelines provided in Sr. No. 11	1 to 6	4
	Total Hrs		32

Sr.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment/test rig or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of a report in time	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with the broad specification mentioned here will usher in uniformity in the conduct of practical and aid to procure equipment by authorities concerned**.**

Sr. No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	Worm &worm wheel	8
2	Single Purchase crab	8
3	Differential Axle & wheel	8
4	Parallel Forces Apparatus	4
5	Simple Screw Jack Indian make.	8
6	Cast Iron weights and hangers	All
7	Brass/Steel weights and Hangers	All
8	Aluminium pulley with Bracket, smoothly rotating	1 and 3
9	Combined Inclined Plane & friction slide ordinary	7
10	Law of moments apparatus	2
11	Universal Force Table	1
12	Sundry items like measuring scale, mirrors, thread, spirit levels, caliper.	All

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in the cognitive domain)	**Topics and Sub-topics**
Unit– I Introduction (2 hrs, 2 marks)	
1a. Define terms related to engineering mechanics 1b. State the units of different Scalar and Vector quantity.	1.1 Fundamental Concepts such as Fundamental Units, Derived unit, system of unit, Scalar and Vector quantity, 1.2 Definition of Applied Mechanics, Statics Dynamics, Kinematics & Kinetics. 1.3 Definition of Gravity, Mass, Weight, Inertia, Newton's Law of Gravitation and Newton's laws of motion.
Unit– II Resolution and composition of Forces (10 hrs, 14 marks)	
2a Define terms related to force 2b Define terms related to the moment. 2c Principle of transmissibility of forces. 2d State Law of Parallelogram of forces. 2e Describe resolution and Composition of Coplanar force. 2f Solve problems on Composition & Resolution forces.	2.1 Concept of force, unit force, graphical Representation of force, Principle of transmissibility. 1.2 Systems of forces, coplanar, non-coplanar, concurrent non-concurrent, Parallel. 2.3 Resolution of a force, resolved parts, orthogonal and non-orthogonal Components of a force. 2.4 Concept of composition & resultant of Forces 2.5 Law of Parallelogram of forces, Triangle law of forces, Polygon law of forces. 2.6 Moment of a force, Varignon'sA theorem of moments, couple & characteristics of a couple 2.7 Composition of Coplanar forces- Concurrent, parallel (like and unlike) Non-concurrent forces by analytical methods.
Unit– III Equilibrium (10 hrs, 14 marks)	
3a Define terms related to equilibrium. 3b State analytical conditions of equilibrium. 3c State Lami's theorm 3d Define terms related to beam. 3e Solve problems related to Lami's theorem and beam reactions.	3.1 Concepts of equilibrium, equilibrant, Relation between resultant & Equilibrium. Analytical conditions of Equilibrium. 3.2 Equilibrium of coplanar concurrent forces, Lami's theorem & it's Applications. 3.3 Equilibrium of coplanar parallel and non-concurrent forces. 3.4 Beams reactions - simply supported beams subjected to concentrated & UDL only, beam supported on roller and hinge supports.
Unit– IV Centroid and Centre of Gravity (8 hrs, 10 marks)	
4a Define Centre of Gravity & Centroid. 4b State Centroid of a regular plane lamina. 4c Locate centroid of different geometrical areas. 4d Solve problems related to the compound lamina 4e State the centre of gravity of solidbodies. 4f Simple numerical on Centre of gravity of simple solids bodies.	4.1 Concept of Centre of Gravity & Centroid. 4.2 Centroid of regular plane areas & compound areas consisting of regular Plane areas. Centroid of hollow objects such as hollow cylinder, hollow cone, hollow sphere. (No numericals to be set on hollow Objects in theory paper.) 4.3 Centre of gravity of simple solids- cylinder, cone, sphere and C.G of compound solid objects made Up of simple solids.

Unit Outcomes (UOs) (in the cognitive domain)	Topics and Sub-topics
Unit– V Friction (10 hrs, 10 marks)	
5a Define terms related to friction. 5b State laws of friction. 5c Apply Concept of friction. 5d Solve problems related to friction.	5.1 Introduction to Friction. 5.2 Types of friction, laws of static friction, coefficient of friction, angle of friction And angle of repose. 5.3 Equilibrium of body on horizontal & Inclined planes. 5.4 Ladder friction. (Numerical with smooth wall and flooring rough or Smooth to be only covered in theory.)
Unit– VI Kinetics (6 hrs, 8 marks)	
6a Define the concept of momentum and impulse. 6b Solve problems on momentum, impulse and impact. 6c State principle of conservationof momentum. 6d Solve the problem on the recoil velocity of the gun.	6.1 Concept of force, mass, acceleration, Momentum, impulse & impact. 6.2 Principle of conservation of Momentum & its applications, Recoil velocity of the gun.
Unit– VII Work, Power, Energy (8 hrs, 10 marks)	
7a. Define Work, Power, and Energy. 7b. Solve the problem on Work, Power, and Energy. 7c. State law of conservation of energy.	7.1 Definition and units of work, graphical Representation of work, work done by Constant and variable force. 7.2 Energy, types of energy, Law of conservation of energy, work-energy Principle and its applications. 7.3 Power- Definition, units. Numerical on Power of water pumps to be covered.
Unit– VIII Simple Machine (10 hrs, 12 marks)	
8a. Define terms related to simple lifting machine. 8b. Describe different types of simple lifting machine. 8c. State velocity ratio of machine. 8d. Solve problems related to simple lifting machine.	8.1 Definition of simple machine, mechanical advantage, velocity ratio,the efficiency with relations between them, friction in machines, Effort lost in friction (P_f). 8.2 condition of Reversibility, Law of a machine, Max MA & max efficiency. (Simple Numerical) 8.3 Study of machines - differential axle and wheel, simple screw jack, worm & Worm wheel, single purchase crab only. (Numerical to determine V.R,P_f., M.A. and Efficiency.)

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction	02	02	00	00	02
II	Resolution & composition of forces	10	04	04	06	14
III	Equilibrium	10	02	04	08	14
IV	Centroid and centre of Gravity	08	02	04	04	10
V	Friction	10	02	02	06	10
VI	Kinetics	06	02	02	04	08
VII	Work, Power, energy	08	02	02	06	10
VIII	Simple lifting machines	10	04	04	04	12
Total		**64**	**20**	**22**	**38**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning following are the suggested student - related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in this course.

a. Collect five different photographs indicating concurrent,parallel, general force system in equilibrium
b. Prepare a table of type of machine and relevant industrial application.
c. Collect five different situations where Law of movement plays an important role.
d. Prepare models representing various types of support (hinged, roller and fixed)
e. Illustrate situation wherein friction is essential and not essential
f. Prepare models in the form of geometrical figures and solids and locate centroid andcentre of gravity of them.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (MOOCs) may teach various topics/subtopics.
b. 'L' in item No. 4 does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About 15-20% of the topics/sub-topics that are relatively simpler or descriptive are to be given to the students for self-directed learning and assess the development of the LOs/COs through classroom presentations (see implementation guideline for details).
d. For item No.09, teachers need to create opportunities and provisions for co-curricular activities. Guide student(s) in undertaking micro-projects.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student assigned to them in the beginning of the semester. They ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COsthat integratepractical's, cognitive domain and affective domain LOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain a dated work diary of individual contributions to the project work and give a seminar presentation before submission.
In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become a problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. The concerned faculty could add similar micro-projects:

a. **Types of Forces:** Prepare a chart showing real-life examples indicating various types of forces
b. **Lifting Machine:** Collect photographs of specific simple lifting machine and relate these machines with the machines being studied and prepare models of simple lifting machines using tools in "MECHANO" and "MECHANIX"
c. **Types of support:** Prepare chart showing actual and corresponding schematic diagram of various types of support
d. **Beams:** Prepare models of a beam subjected to point loads, uniformly distributed loads, simply supported, overhang and cantilever type beam.
e. **Friction:** Prepare a chart regarding the type of friction in various field conditions and collect data regarding the coefficient of friction by referring to books. Determine the coefficient of friction for three different types of surfaces
f. **Centre of Gravity:** Prepare a chart of situations wherein the concept of Centre of Gravity is vital.

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publisher, Edition and Year of publication, ISBN Number
1	Engineering Mechanics	Timoshenko, DHYoung	McGraw Hill Education ISBN-10,9781259062667
2	Engineering Mechanics	Dwaraka Prasad Sharma	Pearson Education ISBN-13,978131732229
3	Applied Mechanics	Khurmi R.S.	S.Chand Publication ISBN-13,9789352833961

13. SOFTWARE/LEARNING WEBSITES

1.https://www.youtube.com/watch?v=-FUWGovGCAM&list=PLhD3O8cMTw14U-jtWrBGFAzXZkOzHL4Iq&index=3
2. https://www.youtube.com/watch?v=W9UDs-kSR0g assesedon 30 March 2016

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	2	1	-	-
CO2	3	3	2	1	2	-	-
CO3	3	2	2	2	3	-	-
CO4	2	2	2	2	-	-	-
CO5	1	2	2	2	1	-	-
CO6	2	1	2	3	-	-	-

	PSO1	PSO2	PSO3	PSO4
CO1	2	1	-	-
CO2	2	1	-	-
CO3	1	1	-	-
CO4	1	-	-	-
CO5	1	1	-	-
CO6	1	-	-	-

Sign: Name: Shri. H.P. Naiknavare (Course Expert)	Sign: Name: Shri. H. P. Naiknavare (I/c HoD AMD) Dr. S.M.S.Shashidhara (Former Head of Department) Shri. V G Tambe (HOD I Shift) Shri. V B Kondawar (HOD II shift)
Sign: Name: Smt.N.S.Kadam (Program Head) (Metallurgical Engineering Department)	Sign: Name: Shri. A.S.Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in CE/EE/ET/ME/MT/CM/IT/DDGM**
Programme Code	**01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26**
Name of Course	**Fundamentals of ICT**
Course Code	**CM2102**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	***ESE**	**PA**	
01	00	02	03	**Marks**	--	--	25	25	50
				Exam Duration	--	--	--	--	--

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

In any typical business setup, to carry out routine tasks related to creating business documents, performing data analysis and its graphical representations, and making electronic slide show presentations, the student needs to learn various software such as office automation tools like word processing applications and spreadsheets and presentation tools. They also need to use these tools for making their project reports and presentations. The objective of the Information and Communication Technology course is to develop the basic competency in students for using these office automation tools to accomplish the job.

3. COMPETENCY

This course aims to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Use Computers for electronic documentation, data analysis, slide presentations and use of various internet services.**

4. COURSE OUTCOMES (COs)

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 above**:**

1. Connect Computer System and its peripherals.
2. Prepare document using word processing tool.
3. Create and design spreadsheets and data tables.
4. Prepare professional presentations.
5. Use various web services.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1	1	i) Identify various Input/output devices, connections, and peripherals of the computer system ii) Demonstration of Front Panel View, Rear Panel View, I/O Serial and Parallel Ports iii)Demonstration of opening and closing of the computer	1	1
2	1	i) Connections inside CPU and its demonstration ii) Setting up the Cabinet. iii) Identification and Demonstration of different slots on the motherboard. Mounting and Unmounting of RAM, Graphics card, and Network card	1	1
3	1	i) Connecting various I/O Devices such as Mouse, Keyboards, Monitors, Printers, Web Cameras, Speakers, Scanners and External Hard disks ,etc. ii)Demonstration of RJ45 connector and its use and Bluetooth as an external interface	1	2
4	1	Functions and working of Secondary Storage devices i) Study of various types of Secondary Storage devices. ii) BIOS Settings for Primary and Secondary Memory. iii) Installation, Configuration and Setting of Hard Disks and working of CD-ROM/DVD-ROM/ DVD-Combo/ DVD- Writer (Internal and External).	1	1
5	1	Execution of basic commands in the command window: Ex: dir, md, copy, cd, move, rmdir, rd etc.	1	1
6	1	Various operations on Window based operating system part I: i) Windows Operations: Minimizing, Maximizing, Resizing. ii) Managing files and folders: Create, copy, rename, delete, move files and folders, Creating shortcuts.	1	1
7	1	Various operations on Window based operating system part II: i) Creating and Removing/Deleting User Accounts. ii) Using Add /Remove Programs and Hardware Utility. iii)Adding Fonts and Viewing Computer Configuration	1	2

		iv)Desktop settings: Display properties, Time and Date setting, Screen Saver, Appearance		
8	2	i) Create, edit and save the document: apply formatting features on the text - line, paragraph ii) Use bullets, numbering, page formatting iii) Insert and edit images and shapes, sizing, cropping, color, background, group/ungroup	2	2
9	2	i) Insert and apply various table formatting features on it. ii) Use mail merge with options.	2	1
10	2	Apply page layout features i)Themes, page background, paragraph, page setup ii)Create a multicolumn page iii)Use different options to print the documents	2	2
11	3	Create, open and edit worksheet i)Enter data and format it, adjust row height and column width ii)Insert and delete cells, rows and columns iii) Apply wrap text, orientation feature on cell.	3	2
12	3	i) Insert formulas, "IF" conditions, functions and named ranges in the worksheet. ii) Apply data Sort Filter and Data Validation features.	3	3
13	3	Create charts to apply various chart options.	3	2
14	3	Apply Page setup and print options fthe or worksheet to print the worksheet.	3	1
15	3	Perform following in GUI based database software using GUI like MS-Access i) Create Database ii) Create tables and assign the primary key. iii) Modify the table structure-add column, change the column's data type, and delete the column from the table. iv) Insert, update and delete the record from table. v) Retrieve data from the table according to condition given.	3	2
16	4	i)Create slide presentation ii)Apply design themes to the given presentation iii) Add new slides and insert pictures/images, shapes, apply animation effects to the text and slides. iv)Add tables and charts in the slides. v) Run slide presentation in different modes and print it.	4	2
17	5	Configure Internet connection	5	1
18	5	Use internet for different web services.	5	2
19	5	Configure browser settings and use browsers.	5	1
20	All	Micro-project (Refer point 11 for micro project list)	All COs	2
		Total		**32**

Sr.No.	Performance Indicators	Weightage in %
a.	Use of Appropriate tool to solve the problem (Process)	40
b.	Quality of output achieved (Product)	30
c.	Complete the practical in stipulated time	10
d.	Observations and Recording	10
e.	Answer to sample questions	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned**.**

Sr. No.	Major Equipment/ Instruments Required	Experiment Sr.No.
1	Computer system with all necessary components like; motherboard, random access memory (RAM), read-only memory (ROM), Graphics cards, sound cards, internal hard disk drives, DVD drive, Network interface card, Mouse, Keyboard, Monitors, Printers, Web Cameras, Speakers, Scanners and External Hard disks etc.	1 to 7
2	Laser printer	1,14,16
3	Hard Disks, CD-ROM/DVD-ROM/ DVD-Combo/ DVD-Writer (Internal and External).	3,4
4	Hubs, Switches, Modems.	18,19
5	Any operating system.	5 to 20
6	Any Office Software.	8,9,10, 11, 12, 13, 15,16,17
7	Any browser.	18,19,20

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit -I Introduction to Computer System (04 hrs)	
1a. Explain the given block diagram of computer system. 1b. Classify the given types of software. 1c. Explain characteristics of the specified type of network. 1d. Describe Procedure to manage file/folders. 1e. Describe application of the specified type of network connecting device.	1.1 Basics of Computer System: Overview of Hardware and Software, block diagram of Computer System, Input /Output unit, CPU, Control unit, Arithmetic logic unit (ALU), Memory Unit 1.2 Internal Components: Processor, Motherboards, random access memory (RAM), read-only memory (ROM), Video cards, Sound cards and internal hard disk drives 1.3 External Devices: Types of Input/ Output Devices, Types of monitors, Keyboards, Mouse, Printers: Dot Matrix, Inkjet and LaserJet, Plotter and scanner, external storage devices CD/DVD, Hard disk and pen drive 1.4 Basic Commands in command window: Ex: dir, md, copy, cd, move, rmdir, rd etc. 1.5 Application Software: Word processing, Spreadsheet,

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	database management systems, Control software, measuring software, photo editing software, video editing software, graphics manipulation software system software compilers, linkers, device drivers, operating systems and utilities 1.6 Network environments: Network interface cards, hubs, switches, routers and modems, concept of LAN, MAN, WAN, WLAN, Wi-Fi and Bluetooth 1.7 Working with Operating Systems: Create and manage file and folders, copy a file, renaming and deleting files and folders, searching files and folders, application installation, creating shortcut of application on the desktop
Unit - II Word Processing (03 hrs)	
2a. Write steps to create the given text document. 2b. Explain the specified feature for document editing. 2c. Explain the given page setup features of a document. 2d. Write the specified table formatting feature	2.1 Word Processing: Overview of Word processor, Basics of Font type, size, color, Effects like Bold, italic, underline, subscript and superscript, Case changing options, previewing a document, saving a document, closing a document and exiting application. 2.2 Editing a Document: Navigate through a document, scroll through text, Insert and delete text, select text, Undo and redo commands, Use drag and drop to move text, Copy, cut and paste, Use the clipboard, Clear formatting, Format and align text, Formatting Paragraphs, Line and paragraph spacing, using FIND and REPLACE, setting line spacing, add bullet and numbers in lists, add borders and shading, document views, Page settings and margins, Spelling and Grammatical checks 2.3 Changing the Layout of a Document: Adjust page margins, Change page orientation, create headers and footers, Set and change indentations, Insert and clear tabs 2.4 Inserting Elements to Word Documents: Insert and delete a page break, insert page numbers, Insert the date and time, insert special characters (symbols), Insert a picture from a file, Resize and reposition a picture 2.5 Working with Tables: Insert a table, convert a table to text, Navigate and select text in a table, resize table cells, align text in a table, format a table, Insert and delete columns and rows, Borders and shading, Repeat table headings on subsequent pages, Merge and split cells. 2.6 Working with Columned Layouts and Section Breaks: Add Columns, Section breaks, creating columns, Newsletter style columns, changing part of a document layout or formatting, remove section break, add columns to remainder of a document, Column widths, adjust column spacing, Insert manual column breaks
Unit -III Spreadsheets and Database (04 hrs)	

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
3a. Write steps to create the given spreadsheet. 3b. Explain the specified formatting feature of a worksheet. 3c. Write steps to insert formula and functions in the given worksheet. 3d. Write steps to create charts for the specified data set. 3e. Explain steps to perform advance operation on the given dataset	3.1 Working with Spreadsheets: Overview of workbook and worksheet, Create Worksheet Entering sample data, Save, Copy Worksheet, Delete Worksheet, and Open & Close Workbook. 3.2 Editing Worksheet: Insert and select data, adjust row height and column width, delete, move data, insert rows and columns, Copy and Paste, Find and Replace, Spell Check, Zoom In-Out, Special Symbols, Insert Comments, Add Text Box, Undo Changes, - Freeze Panes, hiding/un hiding rows and columns. 3.3 Formatting Cells and sheet: Setting Cell Type, Setting Fonts, Text options, Rotate Cells, Setting Colors, Text Alignments, Merge and Wrap, apply Borders and Shades, Sheet Options, Adjust Margins, Page Orientation, Header and Footer, Insert Page Breaks, Set Background. 3.4 Working with Formula: Creating Formulas, Copying Formulas, Common spreadsheet Functions such as sum, average, min, max, date, In, And, or, mathematical functions such as sqrt, power, applying conditions using IF. 3.5 Working with Charts: Introduction to charts, overview of different types of charts, Bar, Pie, Line charts, creating and editing charts. Using chart options: chart title, axis title, legend, data labels, Axes, grid lines, moving chart in a separate sheet. 3.6 Advanced Operations: Conditional Formatting, Data Filtering, Data Sorting, Using Ranges, Data Validation, Adding Graphics, Printing Worksheets, print area, margins, header, footer and other page setup options 3.7 Introduction to Database Management System: Meaning of Data, Database, DBMS, GUI based database software Creating tables and assign primary key, Modifying the table structure-add column, change the data type of column, and delete the column from table. And insert, update and delete the record from table.
Unit – IV Presentation Tool (03 hrs)	
4a. Write the steps to create the specified slide presentation. 4b. Write the steps to insert multiple media in the given presentation. 4c. Write steps to apply table features in the given presentation 4d. Write steps to manage charts in the given	4.1 Creating a Presentation: Outline of an effective presentation, Identify the elements of the User Interface, starting a New Presentation Files, creating a Basic Presentation, working with text boxes, Apply Character Formats, Format Paragraphs, view a Presentation, saving work, creating new Slides, changing a slide Layout, applying a theme, Changing Colors, fonts and effects, apply custom Color and font theme, changing the background, Arrange Slide sequence, 4.2 Inserting Media elements: Adding and Modifying Graphical Objects to a Presentation - Insert Images into a

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
presentation	Presentation, insert audio clips, video/animation, Add Shapes, Add Visual Styles to Text in a Presentation, Edit Graphical Objects on a Slide, Format Graphical Objects on a Slide, Group Graphical Objects on a Slide, Apply an Animation Effect to a Graphical Object, Add transitions, , Add Speaker Notes, Print a Presentation. 4.3 Working with Tables: Insert a Table in a Slide, Format Tables, and Import Tables from Other Office Applications. 4.4 Working with Charts: Insert Charts in a Slide, modify a Chart, Import Charts from Other Office Applications
Unit - V Basics of Internet (02 hrs)	
5a. Explain the use of the given setting option in browsers. 5b. Explain features of the specified web service. 5c. Describe the given characteristic of cloud. 5d. Explain the specified option used for effective searching in search engine	5.1 World Wide Web: Introduction, Internet, Intranet, Cloud, Web Sites, Web Pages, URL, web servers, basic settings of web browsers-history, extension, default page, default search engine, creating and retrieving bookmarks, use search engines effectively for searching the content. 5.2 Web Services: e-Mail, Chat, Video Conferencing, e-learning, e-shopping, e-Reservation, e-Groups, Social Networking.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to Computer System	4	--	--	--	--
II	Word Processing	3	--	--	--	--
III	Spreadsheets and Database	4	--	--	--	--
IV	Presentation Tool	3	--	--	--	--
V	Basics of Internet	2	--	--	--	--
Total		**16**	--	--	--	--

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, the following are the suggested student-related ***co-curricular*** activities that can be undertaken to accelerate the attainment of the various outcomes in this course:
Students should conduct the following activities in groups and prepare reports of about five pages for each activity, also collect/record physical evidence for their (student's) portfolio, which will be helpful in their placement interviews:

a. Prepare a journal of practicals.
b. Prepare a sample document with all word processing features. (Course teacher shall allot appropriate document type to each student)
c. Prepare PowerPoint Presentation with all the presentation features. (Course teacher shall allot various topics to the groups of students)
d. Prepare Database/spreadsheets in groups related to various Fields/Organizations
e. Undertake micro projects

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:
a. Massive open online courses (***MOOCs***) may teach various topics/subtopics.
b. About ***15-20% of the topics/sub-topics,*** which is relatively simpler or descriptive, is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. For item No.8, teachers need to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant systems and equipments.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operations.
h. Teachers should ask the students to go through instruction and technical manuals.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to them. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.*** The micro-project could be industry application-baddd, internet-based, workshop-based, laboratory-based, or field-based. Each micro-project should encompass two or more COs that are the integration of PrOs, UOs and ADOs. (Affective Domain Outcomes). Each student will have to maintain an activity chart consisting of individual contributions in the project work and give a seminar presentation before submission. The student ought to submit micro-project by the end of the semester to develop the industry-oriented COs.
A suggestive list of micro-projects is given here. The concerned faculty could add similar micro-projects:
a. Word documents: Prepare Time Table, Application Notes, Reports (Subject

teacher shall assign a document to be prepared by each student)

b. Slide Presentations: Prepare slides with all Presentations of reports (Subject teacher shall assign a presentation to be prepared by each student.
c. Spreadsheets: Prepare pay bills, tax statements, student's assessment records using spreadsheets (Teacher shall assign a spreadsheet to be prepared by each student
d. Web Browser/E-mail: Create an E-mail ID using any web browser and E-mail service and explore all the options available in e-mail, e.g., drive, forms etc.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition, Year of publication, ISBN Number
1	Computer Fundamentals	Goel, Anita	Pearson Education, New Delhi, 2014 • ISBN-13: 978-8131733097
2	Computer Basics Absolute Beginner's Guide, Windows 10	Miller, Michael	QUE Publishing; 8th edition August 2015 • ISBN: 978-0789754516
3	Microsoft Office 2010 for Windows: Visual Quick Start	Schwartz, Steve	Pearson Education, New Delhi India, 2012 • ISBN:9788131766613
4	OpenOffice.org for Dummies	Leete, Gurdy, Finkelstein Ellen, Mary Leete	Wiley Publishing, New Delhi 2003 • ISBN: 978-0764542220
5	Microsoft Office 2010: On Demand	Johnson, Steve	Pearson Education, New Delhi India, 2010. • ISBN: 9788131770641

13. SOFTWARE/LEARNING WEBSITES

1. http://www.nptel.ac.in
2. https://www.microsoft.com/en-in/learning/office-training.aspx
3. http://www.tutorialsforopenoffice.org
4. https://s3-ap-southeast-1.amazonaws.com/r4ltue295xy0d

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	-	-	2	1	-	2
CO2	-	-	-	2	2	2	3
CO3	3	2	2	2	2	2	3
CO4	-	-	-	2	2	2	3
CO5	1	-	-	-	1	-	1

	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	-
CO2	-	-	-	1
CO3	-	-	-	-
CO4	-	-	-	1
CO5	-	-	-	2

Sign: Name: Smt. A. D. Kshirsagar Smt. K. S. Sathawane Smt. P.L. Sonwane (Course Experts)	Sign: Name: Smt.M U Kokate (Head of Department) (Department of Information Technology)
Sign: Name: Smt.N.S.Kadam (Program Head) (Metallurgical Engineering Department)	Sign: Name: Shri A. S. Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in** CE/EE/ET/**ME**/**MT**/CM/IT/DDGM
Programme code	01/02/03/**04**/**05**/06/07/08/16/17/**18**/**19**/21/22/23/**24**/26
Name of Course	**Electrical Technology**
Course Code	**EE2102**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			**Total Credits (L+T+P)**		**Examination Scheme**				
					Theory		**Practical**		**Total Marks**
L	**T**	**P**	**C**		**ESE**	**PA**	**ESE**	**PA**	
03	00	02	05	**Marks**	80	20	--	25	125
				Exam Duration	3 Hrs	1 Hr	--	--	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour.

2. RATIONALE

Diploma holders in mechanical & metallurgy have to deal with electrical fundamentals & applications in various industrial processes. They have to handle various electrical drives, meters, & machines in industries. While working with electricity, they must be conversant with safety rules & devices used in industry. Hence they must study the electrical principles and working characteristics of electrical Machines & electrical safety.

3. COMPETENCY

This course aims to attend the following industry identified competency through various teaching learning experiences:

- **Apply basic laws and principles of Electrical Engineering**.

4. COURSE OUTCOMES (COs)

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 above**:**

1. Evaluate the effect of resistance in electrical circuits.
2. Apply the principles of magnetic circuits & electromagnetic induction to DC & AC motors,transformers & supervise their operation.
3. Select the appropriate drivers for a particular application.
4. Use electric protective devices safely.
5. Measure electrical quantities like current, voltage, power in AC circuit.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hrs. required
1	1	Determine temperature rise of resistance of the metal.	1	02
2		Verify equivalent resistance of series & parallel resistive circuits.	1	04
3	2	Plot B-H curve of magnetic material on D.C. generator.	2	02
4	3	Verify Faraday's laws of Electromagnetic Induction	2	02
5	4	Verify the relation between line & phase values of current and voltage in a balanced star & delta connected three phase circuit	1	04
6		Measure voltage, current & power in RL series circuit & calculate power factor.	5	02
7	5	Find the voltage ratio & current ratio of a single-phase transformer.	2	02
8	6	Operate D.C. shunts motor inthe reverse direction of rotation.	2	02
9	7	Study variable frequency drive.	3	02
10	8	Verify the use of MCB in a simple electric circuit.	4	02
11		Verify the use of ELCB in a simple electric circuit.	4	02
12		Complete any one suggested student activity from Sr. No. 10		02
13		Complete a micro project based on guidelines provided in Sr. No. 11	1 to 5	04
		Total Hrs		32

Sr.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	15
b.	Setting and operation	15
c.	Safety measures	10
d.	Observations and Recording	20
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with the broad specification mentioned here will usher in uniformity in the conduct of practical and aid to procure equipment by authorities concerned**.**

Sr. No.	Equipment Name with Broad Specifications	Experiment Sr. No.
1	Wire wound Rheostat	1, 2, 3,
2	DC Ammeter,voltmeter with probes, multimeter.	2, 3
3	Solenoid coil, dipole magnet, galvanometer	4
4	Motor-Generator set	3,
5	Three phase lamp bank	5, 10
6	Dimmerstat	6
7	Single phase transformer	7
8	D.C. Motor with starter, connecting wires.	8
9	Variable frequency drive, connecting wires & three phase induction motor, multimeter, tachometer.	9
10	MCB, ELCB	10, 11
11	AC voltmeter, ammeter	5, 6, 7, 10, 11

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in the cognitive domain)	Topics and Sub-topics
Unit I: Introduction to Electrical power supply system & Circuit (04 hrs, 08 marks)	
1a. Describe the details of the Electrical power supply System & circuits. **1b.** Explain the effect of temperature on the commonly used materials in electrical circuits. **1c.** Apply voltage division rulefor series circuit, current division rule for parallelcircuit.	**1.1** Introduction to the electric power supply system, Single line diagram of electric power supply system.AC supply –single phase and three phase, DC supply- applications. Comparison between AC & DC supply. **1.2** Definition of Resistance. Effect of temperature on resistance of pure metals, insulators, semiconductors &alloys, the concept of resistance temperature coefficient. Simple numerical. **1.3** Resistances in series, Voltage division rule & practical examples of series connection. & simple numerical.Resistances in parallel, Current divisionrule & practical examples of parallelconnection & simple numerical.
Unit II: Magnetic Circuit (04 hrs, 08 marks)	
2a. Describe the basic parameters of magnetic circuits. **2b.** Give the comparison between magnetic & electric circuits.	**2.1** Introduction to magnetic circuit, Definitions of magnetic flux, magnetic flux density, magnetomotive force (MMF),permeability, absolute permeability, relative permeability,

Unit Outcomes (UOs) (in the cognitive domain)	Topics and Sub-topics
2c. Explain the concept of useful flux, Leakage flux, total flux & fringing. **2d.** Describe the significance of magnetization curves & hysteresis loop. **2e.** State & explain Fleming's left hand rule & applications of it.	reluctance, relation between M.M.F. and reluctance **2.2** Compare between magnetic & electrical circuits. Simple series magnetic circuits. **2.3** concept of useful flux, leakage flux, total flux and fringing. **2.4** Magnetization curves& their practical importance, concept of hysteresis, hysteresis loops. Practical importance of Hysteresis loop. No numerical. **2.5** Force on current carrying conductor & correlate it with motor action—Fleming's left hand rule.
Unit III: Electromagnetic Induction (04 hrs, 06 marks)	
3a. State & explain Faraday's laws of electromagnetic induction. **3b.** Describe the types of induced e.m.fs State & explain various laws related with electromagnetic induction.	**3.1** Faradays laws of Electromagnetic Induction.Types of induced e.m.f.-dynamically induced e.m.f. and statically induced e.m.f., Self and mutually induced e.m.f., applications. No numerical. **3.2** Lenz's law, Fleming's right hand rule.
Unit IV: Single Phase & Three phase A.C.Circuits (14 hrs, 16 marks)	
4a. Explain the working of the elementary alternator. **4b.** Describe the terms related to AC circuits. **4c.** Explain the concept of phasors **4d.** Draw the phasor diagram Waveforms of pure & simple series circuits. **4e.** State the voltage, current, power relations for above circuits. Solve numerical problems. **4f.** Describe the working of an elementary three phase alternator. **4g.** State the importance of three phase supply **4h.** Describe the concept of phase sequence & balanced load. **4i.** State the voltage, current & power relations for three phase star &delta connected load. **4j.** Solve simple numerical.	**4.1** Generation of single-phase alternating voltage and current, Graphical representation of sinusoidal E.M.F. and current.General Equation of alternating quantity. **4.2** Definitions of instantaneous value, cycle, period, frequency, amplitude, Peak value, average value, R.M.S. value of an alternating sinusoidal voltage and current, peak factor and form factor. **4.3** Concept of phase and phase difference, concept of lagging and leading **4.4** Representation of an alternating quantity by phasor. Waveforms and phasor diagram for a purely resistive AC circuit, purely inductive AC circuit, purely capacitive AC circuit. R-L, R-C & R-L-C Series circuits (Voltage, Current, Power, p.f. relations and phasor diagrams). **4.5** Simple numerical on above topics. **4.6** Generation of 3-phase voltages and its waveform. **4.7** Advantages of 3-phase supply over 1- phase supply. **4.8** Definition of phase sequence, balanced load **4.9** Definition of star & delta connected load, Voltage, current, power relations in star & delta connected system **4.10** Simple numerical.
Unit V: Transformer (04 hrs, 10 marks)	

Unit Outcomes (UOs) (in the cognitive domain)	Topics and Sub-topics
5a. Define transformer; explain the functions of its various parts. **5b.** Classify transformer on various basis. **5c.** State E.M.F equation of single phase transformer. **5d.** Describe the concept of losses, efficiency and regulation of transformer. **5e.** State the specification of transformer. **5f.** State the applications of Transformer.	**5.1** Definition, principle of operation, Construction. **5.2** Types of transformer based on voltage, construction, & use. **5.3** E.M.F. equation (No derivation).Voltage, current ratio of a transformer. **5.4** Losses in transformer, efficiency & regulation of transformer. **5.5** Specifications & Rating (No numerical) **5.6** Concept of Three phases Transformer. Applications of transformers
Unit VI: D.C. Motor (04 hrs, 08 marks)	
6a. State the functions ofdifferent parts of DC Motors and explain its working principle. **6b.** State different types of DC motors with their applications. **6c.** Describe the concept of reversal of DC Motor with circuit diagrams.	**6.1** Construction and working principle of DC motor, significance of back E.M.F., Voltage equation& Torque equation. **6.2** Types of motors & their applications. **6.3** Reversal of rotation of DC shunt Motor.
Unit VII: Three Phase & Single phase A.C.Motors (10 hrs, 14 marks)	
7a. State the functions of different parts of 3 Phase induction Motors and explain its working principle. **7b.** Draw schematic diagrams of different types of 3 Phase induction motors, speed- torque characteristics and state their applications. **7c.** Reverse the direction of rotation of 3 Phase induction motor. **7d.** Explain the need of starter for 3phase induction motor. **7e.** Describe the features of various starters for 3 phase induction motor and their advantages &limitations. **7f.** Draw schematic diagrams of different types of singlephase induction motors, state their applications & state their specifications. **7g.** Draw the schematic diagrams & applications of special purpose motors.	**7.1** Three Phase induction motor: Construction and working principle, Definition of synchronous speed, slip. **7.2** Schematic diagrams of three phase squirrel cage and slipring induction motor, speed-torque characteristics, Applications. **7.3** Reversal of rotation of 3 Phase Induction motor . **7.4** Necessity of a starter, **7.5** Comparison between DOL, Star-Delta starter, variable frequency drive. **7.6** Single Phase Induction Motors- schematic diagrams, specifications, ratings and applications of following Motors: - a) Split Phase: - i) Resistance ii) Capacitance. b) Capacitor start capacitor run, capacitor start induction run, permanent capacitor c) Shaded pole **7.7** Schematic diagrams and applications of following MotorsA.C. Servo Motor, ii) D.C. Servo Motoriii) Universal motor iv) stepper motor

Unit Outcomes (UOs) (in the cognitive domain)	Topics and Sub-topics
Unit VIII: Electric Safety (06 hrs, 10 marks)	
8a. State the various reasons for electrical accidents and fire. **8b.** State safety rules to be followed while working on electrical installations. **8c.** State the need of earthing. **8d.** State the types of fire extinguishers with their applications. **8e.** State the use of various safety devices.	**8.1** Causes of electrical accidents & electric fire . **8.2** Safety rules to be followed while working with electrical appliances, installations. **8.3** Necessity of earthing **8.4** Types of fire extinguishers for A,B,C& D types of fire . **8.5** Use of safety devices viz fuse, MCB,& ELCB

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Electrical Circuits	04	02	02	04	08
II	Magnetic Circuits	04	04	04	00	08
III	Electromagnetic Induction	04	04	02	00	06
IV	Single Phase & Three Phase AC Circuits	12	06	06	04	16
V	Transformer	04	04	04	02	10
VI	D.C. Motor	04	04	02	02	08
VII	Three Phase & Single Phase A.C. Motor	10	04	04	06	14
VIII	Electric Safety	06	04	04	02	10
Total		**48**	**32**	**28**	**20**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, the following are the suggested student-related ***co-curricular*** activities that can be undertaken to accelerate the attainment of the various outcomes in this course:
Students should conduct the following activities in groups and prepare reports of about five pages for each activity, also collect/record physical evidence for their (student's) portfolio which will be helpful in their placement interviews:

a. Prepare journal based on practical performed in Electrical machines laboratory. Journal consists of drawing, observations, required equipment, date of performance with teacher signature.
b. Read the nameplate data on the available AC & DC motors in the laboratory &interpret the same.
c. Conduct a market survey & collect the manufacturers' information of various types of transformers, their specifications, applications and price range.

d. Prepare a chart showing special purpose motors with the following details. i) Photograph ii) Schematic diagram iii) Torque/Speed characteristics iv) Applications.
e. Conduct the market survey and collect the manufacturers' information of single phase and three phase induction motors with specification and price range.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of thevarious outcomes in this course:

a. Massive open online courses (MOOCs) may teach various topics/subtopics.
b. About 15-20% of the topics/sub-topics that are relatively simpler or descriptive in nature are to be given to the students for self-directed learning and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. For item No.8, teachers need to create opportunities and provisions for co-curricular activities.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant systems and equipments.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operations.
h. A teacher should ask the students to go through instruction and Technical manuals.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to them. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application-based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs that are integration of PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain a dated work diary consisting of individual contributions to the project work and give a seminar presentation before submission. The student ought to submit micro-project by the end of the semester to develop the industry-orientedCOs.

A suggestive list of micro-projects is given here. The concerned faculty could add similar micro-projects:

a) Conduct the market survey for collecting information of MCB and write a report based on 1) Manufacturers 2) Constructional Details 3) Types 4) Selection of the right type of MCB by i) Ampere rating ii) Breaking capacity iii) Brands
b) Search on a website to collect the information of ELCB and write a report based on 1) Manufacturers 2) Constructional Details 3) Types 4) Advantages and disadvantages.
c) Search on the website to collect the information of variable frequency drives and write a report based on 1) Manufacturers 2) Constructional Details 3) Specifications 4) Cost.
d) Prepare a PowerPoint presentation on safety in electrical engineering.

e) Search on the website to collect the information of various adjustable speed drives regardingtheir applications. Compare electrical variable frequency drives and mechanical adjustable speed drives and write a report based on the advantages of variable frequency drives and limitations of adjustable speed drives. Also, collect the information of variable voltage variable frequency (VVFD) drives.

12. SUGGESTED LEARNING RESOURCES

Sr. No.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1	Electrical Technology Vol. I & II	B.L. Theraja	S. Chand & Co., 2006 Vol. I- ISBN 10-8121924405 ISBN 13: 9788121924405 Vol. II - ISBN 10: 8121924375 / ISBN 13: 9788121924375
2	ABC of Electrical Engineering	Jain & Jain	Dhanpat Rai Publishing Company ,1 January 2013 ISBN-10 9384378011
3	Electrical Technology	Edward Hughes	Longman, 1972 ISBN 10: 0582411440 / ISBN 13: 9780582411449
4	Electrical Technology	H. Cotton	CBS, Delhi, 2005 ISBN-8123909284, 9788123909288
5	Basic Electrical Engineering	V.N. Mittle	Tata Mc-Graw Hill, 1989 ISBN- 0074516329, 9780074516324

13. SOFTWARE/LEARNING WEBSITES

1. http://sdeuoc.ac.in/sites/default/files/sde_videos/Electrical%20Drives%20and%20Controls_0.pdf
2. http://www.ene.ttu.ee/elektriajamid/oppeinfo/materjal/AAV0020/4Drives_Lehtla.pdf
3. https://beeindia.gov.in/sites/default/files/3Ch2.pdf

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	1	2	1	3
CO2	1	2	1	2	2	1	2
CO3	1	1	1	2	1	1	3
CO4	2	1	1	2	2	1	3
CO5	1	3	3	2	2	1	3

	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	1
CO2	2	1	2	1
CO3	2	1	2	1
CO4	1	1	2	1
CO5	3	1	2	1

Sign: Name: Smt. A. N. Duraphe (Course Expert)	Sign: Name: Dr. S. S. Bharatkar (Head of Electrical Department)
Sign: Name: Smt. N. S. Kadam (Program Head) (Metallurgical Engineering Department)	Sign: Name: Shri. A. S. Zanpure (CDC In charge)

Government Polytechnic, Pune

'180OB'– Scheme

Programme	**Diploma in** CE/EE/ET/ME/**MT**/CM/IT/DDGM
Programme Code	01/02/03/04/**05**/06/07/08/16/17/**19**/21/22/23/24/26
Name of Course	**Principles of Electronics**
Course Code	**ET2106**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

<table>
<tr><th colspan="3">Teaching Scheme (In Hours)</th><th rowspan="2">Total Credits (L+T+P)</th><th rowspan="2"></th><th colspan="5">Examination Scheme</th></tr>
<tr><th colspan="2">Theory</th><th colspan="2">Practical</th><th rowspan="2">Total Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>C</th><th></th><th>ESE</th><th>PA</th><th>ESE</th><th>PA</th></tr>
<tr><td rowspan="2">03</td><td rowspan="2">00</td><td rowspan="2">02</td><td rowspan="2">05</td><td>Marks</td><td>80</td><td>20</td><td>--</td><td>25</td><td>125</td></tr>
<tr><td>Exam Duration</td><td>3 Hrs</td><td>1 Hr</td><td>--</td><td>--</td><td></td></tr>
</table>

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

In today's world most of the consumer appliances are based on electronic circuits and devices. The foundation for working of computer or any of its peripherals are 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.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Maintain electronic circuits comprising of discrete electronic components**.

4. COURSE OUTCOMES (COs)

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 above mentioned competency**:**

1. Plot the characteristics of semiconductor devices.
2. Interpret working of oscillators.
3. Verification of logic gates and relevant application.
4. Use OP-AMP IC in circuits.
5. Operate CRO and Function generator.
6. Select appropriate transducers for relevant applications

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	1	Calculate the values of different resistors by colour coding method	1	02
2.		Plot V-I characteristics of P-N junction diode.	1	02
3.		Test performance of diode as Half wave and Full wave rectifier with and without filter.	1	02
4.		Plot the input and output characteristics in CE configuration.	1	02
5.	2	Calculate frequencyof oscillations for Hartley and Colpitts oscillator.	2	02
6.	3	Verification of truth table for logic gates.	3	02
7.	4	Observe input-output waveforms of Inverting Amplifier.	4	02
8.		Observe input-output waveforms of Non Inverting Amplifier.	4	02
9.		Observe input/output waveforms of Integrator .	4	02
10.		Observe input/output waveforms of Differentiator	4	02
11.	5	Study of front panelof C.R.O.	5	02
12.		Study of front panel of Function generator.	5	02
13.		Measure amplitude, Time period of sine, triangular and square wave with the help of CRO.	5	02
14.	6	Test performance of inductive transducer LVDT.	6	02
15.	All	Complete a Micro- project as per the guidelines in point no. 11 towards the fulfillment of the COs of the course.	All	04
		Total Hrs		**32**

S.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	Experiment Sr.No.
1	Variable DC Power supply 0-30V with display for voltage and current	2,3,4,5,7,8,9,10
2	Digital Multimeter	1,2,4,14
3	CRO	3,5,7,8,9,10,11,12,13
4	Function Generator	3,5,7,8,9,10,12,13
5	Different types of cables and connectors	All

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT 1. SEMICONDUCTOR DEVICES (15 hrs, 20 marks)	
1a. Plot V-I characteristics of PN Diode 1b. Define and Measure parameters of diode 1c. Implement Zener diode as voltage regulator. 1d. Compare salient features of the given type of rectifiers. 1e. Explain with sketches the working principle of the given transistor configuration. Analyze and differentiate between CE, CB, CC configurations	1.1 Semiconductor Theory Types : 1] Intrinsic Semiconductor 2] Extrinsic semiconductor- P – type and N - type semiconductor. P-N junction diode: Diode symbol, Working, Barrier voltage, depletion region, Junction Capacitance, Forword & reverse Characteristics 1.2 Zener diode : Diode symbol, Working, Forword & reverse Characteristics Avalanche & Zener breakdown. Introduction to LED **:** symbol, working 1.3 Rectifier : Definition, Classification Half wave and Full wave Rectifier: circuit diagram, working, comparison, merits and demerits. Filters, necessity, types, comparison, merits, demerits. 1.4 Transistor : construction, symbol, operating principle, characteristics, configurations, comparison between CB, CE, CC , applications as switch and amplifier.
UNIT 2. OSCILLATORS (07 hrs, 12 marks)	

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
2a. State Barkhausen criteria for oscillator. 2b.Classify oscillators. 2c. Draw circuit and explain working of Different types of oscillators.	2.1 Block diagram, Barkhausan Criteria for sustained oscillations, Oscillations in LC tank circuit; 2.2 Classification: LC and RC. Classification of RC Oscillator: Working of RC Phase shift and Wein Bridge Oscillator. 2.3 Clasification of LC Oscillator: Working of Hartley , Colpitts , 2.4 Crystal Oscillator
UNIT 3. DIGITAL FUNDAMENTALS (07 hrs, 12 marks)	
3a. Understand different numbering system with numerical examples 3b. Draw symbols for different logic gates with truth tables. 3c.Implement different Boolean laws using different gates. 3d. Verify De Morgan's theorem.	3.1Number systems: Decimal, Binary, Hexadecimal, Octal. 3.2Basic logic gates: AND, OR, NOT, NAND, NOR, EXOR symbols, IC numbers and Truth Table. 3.3Boolean Algebra: Fundamentals of Boolean algebra, Basic laws 3.4 De Morgan`s theorem.
UNIT 4. LINEAR ICS (07 hrs, 12 marks)	
4a. Draw symbol and pin diagram of IC 741. 4b. Define various parameters related to OP-AMP. 4c. Derive expression for various mathematical operation of OP-AMP.	4.1 OP AMP. IC 741, symbol, pin diagram, ideal and typical characteristics, 4.2 Applications such as Inverting, Non Inverting amplifier, Difference amplifier, adder, subtractor, Integrator, differentiator. (using closed loop system)
UNIT 5. INSTRUMENTATION (05 hrs, 12 marks)	
5a. Draw and explain blocks of CRT, CRO and Function generator. 5b. State applications & specifications of CRO and Function generator.	5.1 CRO: Cathode Ray Tube, Oscilloscope Block diagram, operation, oscilloscope specifications, Applications. 5.2 Function generator, Block diagram, operation, specifications,
UNIT 6. TRANSDUCERS (07 hrs, 12 marks)	
6a. Differentiate between sensor and transducer. 6b. Define and classify transducers. 6c. State selection criteria of transducer. 6d. Differentiate between Active- Passive, Primary-Secondary, and Analog- Digital transducers. 6e. Interpret working principle and application of Resistive, Capacitive, Inductive,	6.1 Definition, classification: Active, Passive, Primary, Secondary, Analog, Digital 6.2 Selection criteria for transducer 6.3 Classification: Active, Passive, Primary, Secondary, Mechanical, Electronic, Analog, Digital, Resistive, Capacitive, Inductive Transducers. 6.4 Construction, Operation, Applications : LVDT, RTD, Thermocouple , Photoelectric, Piezoelectric Transducers, PLC, Digital Readout Introduction (flow chart)

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Transducers (LVDT), photodiode, phototransistor, Piezoelectric Transducers	

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Semiconductor Devices	15	08	08	04	20
II	Oscillators	07	04	06	02	12
III	Digital Fundamentals	07	04	04	04	12
IV	Linear ICs	07	04	04	04	12
V	Instrumentation	05	02	04	06	12
VI	Sensors and Transducers	07	04	06	02	12
Total		**48**	**24**	**32**	**24**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on practical performed inlaboratory.
b. Study of datasheet of electronic components.
c. Prepare charts of symbols of Electronic components.
d. Search information about Ratings and specifications of Regulator, diodes, transistors, CRO, function generator.
e. Collect information of passive transducers and prepare charts of the same.
f. Prepare posters to illustrate the use of photoelectric sensors in remote controls.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipments.

f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operations.
h. Teacher should ask the students to go through instruction and Technical manuals.

11. SUGGESTED MICRO-PROJECTS

Only one Micro Project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. She/He ought to submit it by the end of semester to develop industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs. The Micro-Project could be industry application based, internet based, workshop based, laboratory based or field based. The assessment of micro-project is to be done under Practical (PA) Assessment. The Micro Project preferably assign to the group of (4-6) students or an individual taking into the considerations the capabilities and circumstances at the time

A suggested list is given here. Similar micro-project could be added by the concerned faculty.

a. Prepare a chart of different types of Resistors showing their specifications and applications
b. Prepare chart of different types of Capacitors showing their specifications and applications
c. Prepare a chart of different types of Inductors showing their specifications and applications
d. Prepare a chart of different types of Diodes showing their specifications and applications
e. Prepare a chart of different types of Inductors showing their specifications and applications
f. Prepare a chart of different types of Rectifiers showing their specifications and applications
g. Prepare a chart of different types of Logic Gates and their truth tables.
h. Prepare a chart of different types of Sensors & Transducers showing their specifications and applications

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition, Year of publication, ISBN Number
1	Basic Electronics.	Albert Malvino	8thEdition, Tata McGraw Hill, 2015 ISBN10:1259200116 ISBN13:9781259200113
2	Basic Electronics.	J.S.Katre	Edition 2017, Techmax Publishers ISBN10:9350779641 ISBN13:9789350779644
3	Basic Electronics.	B.L.Theraja	S Chand Publishing, 2007 ISBN10:8121925568 ISBN13:9788121925563
4	Linear Integrated Circuits	Ramakant Gaikwad	4TH Edition, PHI Publication, ISBN10:8120320581 ISBN13: 9788120320581
5	Modern Digital Electronics	R P Jain	McGraw Hill Education Pvt Ltd, 4th Edition 2012 ISBN10:0070669112 ISBN13:9780070669116
6	Instrumentation	A K Sawheny	19TH Edition, 2017, DhanpatRai publication ISBN :8177001006

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. http://www.electronics-tutorials
3. https://en.wikipedia.org/wiki/P%E2%80%93n_junction
4. https://learn.sparkfun.com/tutorials/transistors
5. http://www.pitt.edu/~qiw4/Academic/ME2082/Transistor%20Basics.pdf
6. http://faculty.cord.edu/luther/physics225/Handouts/transistors_handout.pdf
7. http://www.technologystudent.com/elec1

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	2	2	-	-	2
CO2	2	3	1	-	-	-	2
CO3	3	-	-	3	-	-	3
CO4	3	3	2	2	-	-	2
CO5	1	-	-	3	1	-	2
CO6	3	2	1	3	-	3	3

	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	-
CO2	-	-	-	-
CO3	-	-	-	-
CO4	-	-	-	-
CO5	-	-	-	-
CO6	-	-	-	-

1)Sign: Name: Shri.M.J.Deshpande Smt.M.S.Datar (Course Experts)	Sign: Name: (Head of Department) (Electronics & Telecommunication Department)
Sign: Name: Smt.N.S.Kadam (Program Head) (Metallurgical Engineering Department)	Sign: Name: Shri. A.S.Zanpure (CDC In charge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in CE**/EE/ET/ME/**MT**/CM/IT/DDGM
Programme code	**01**/02/03/04/**05**/06/07/08/**15**/16/17/18/**19**/**21**/22/23/24/26
Name of Course	**Engineering Drawing**
Course Code	**ME2103**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	ESE	PA	
02	00	04	06	Marks	80	20	--	25	125
				Exam Duration	4 Hrs	1/2 Hr	--	--	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE:

Engineering drawing is the graphical language. It is used by engineers, designers, planners, supervisors and also the workers to express their thoughts, ideas and concepts. The expression by drawing is very accurate precise and brief. At a glance one can understand detailed description of any part to be manufactured or a dam to be built or an electric circuit to be used. For all technicians through understanding of principles of engineering drawing (Graphic Skills) is essential.

3. COMPETENCY:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Interpret, understand and prepare orthographic and isometric drawing of given component and prepare sectional mechanical working drawing/production drawing of given component and also draw projections of lines planes solids and free hand sketches.**

4. COURSE OUTCOMES (COs)

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:

After studying this course, the student will be able to

1. Draw geometrical figures and Engineering Curves
2. Draw views of given object using principles of orthographic projections
3. Draw isometric view of a given object from orthographic projections
4. Draw projection of lines and planes and regular solids.
5. Draw free hand sketches of given engineering elements

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No	Sheet No.	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hrs. required
1	01	--	Draw horizontal, vertical, 30 degree, 45 degree, 60 and 75 degrees lines, different types of lines, dimensioning styles using Set squares/ drafter. (do this exercise in sketch book)	--	02
2	01	01	Line letters and numbers. Dimensioning technique. One problem on Redraw the figure (Sheet No.1).	--	04
3	02	02	Engineering curves Any four problems (Sheet No.2)	1	08
4	03	03	Draw a problem on orthographic projections using First angle method of projection having plain surfaces. (Sheet No.3-Problem-1)	2	04
5	03	03	Draw a problem on orthographic projections using Third angle method of projection having plain surfaces. (Sheet No.3-Problem2)	2	04
6	03	04	Draw a problem on orthographic projections using first angle method of projection having slanting surfaces, cylindrical surfaces, ribs.(Sheet No-4-Problem-1)	2	04
7	03	04	Draw a problem on orthographic projections using Third angle method of projection having slanting surfaces, cylindrical surfaces, ribs.(Sheet No-4-Problem-2)	2	04
8	04	05	Draw a problem on sectional orthographic projections using first angle method of projection having slanting surfaces, cylindrical surfaces, ribs.(Sheet No-5-Problem-1)	2	04
9	04	05	Draw a problem on sectional orthographic projections using Third angle method of projection having slanting surfaces, cylindrical surfaces, ribs.(Sheet No-5-Problem-2)	2	04
10	05	06	Draw one problems on Isometric view of simple objects having plain and slanting and cylindrical surfaces by using natural scale.(Sheet No.6-Problem-1)	3	04
11	05	06	Draw one problems on Isometric projection of	3	04

			simple objects having plain and slanting and cylindrical surfaces by using isometric scale. (Sheet No.6- Problem-2)		
12	06,07	07	Draw two problems on projection of straight lines and two problems on projection of planes. (Sheet no.7)	4	06
13	08	07	Draw two problems on projection of solid. (Sheet no.7)	4	04
14	09	08	Draw neat and proportionate free hand sketches. Any six elements (Sheet No.8)	5	04
15	All		Complete a micro project based on guidelines provided in Sr. no. 11	1 to 5	04
			Total		**64**

Sr.No.	Performance Indicators	Weightage in %
1	Neatness, Cleanliness on drawing sheet	10
2	Uniformity in drawing and line work	10
3	Creating given drawing	40
4	Dimensioning the given drawing and writing text	20
5	Answer to sample questions	10
6	Submission of drawing in time	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned.

Sr. No.	Equipment Name with Broad Specifications	Experiment Sr.No.
1	Drawing Table with Drawing Board of Full Imperial/ A1 size.	All
2	Models of objects for orthographic / isometric projections	3,4,5,6,7,8,9
3	Models/ Charts of objects mentioned in unit no. 7	-
4	Set of various industrial drawings being used by industries.	All
5	Drawing equipment's and instruments for class room teaching-large size: a. T-square or drafter (Drafting Machine) b. Set squares (450 and 300- 600) c. Protractor d. Drawing instrument box (containing set of compasses and dividers)	All
6	Interactive board with LCD overhead projector	All

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit I: Introduction of Drawing Instruments, Lines, Letters etc. (02 hrs, 00 marks)	
1a. Prepare drawing using drawing instruments. **1b.** Use IS SP-46 for dimensioning. **1c.** Use different types of lines. **1d.** Draw regular geometrical figures. **1e.** Draw figures having tangency constructions.	**1.1** Drawing Instruments and supporting material: method to use them with applications. **1.2** Standard sizes of drawing sheets (ISO-A series). I.S. codes for planning and layout. Letters and numbers (single stroke vertical) **1.3** Conventions of lines and their applications. Scale - reduced, enlarged and full size **1.4** Dimensioning techniques as per SP-46(Latest edition) – types and applications of chain, parallel and coordinate dimensioning.
Unit II: Engineering Curve and Tangential Exercises (06 hrs, 16 marks)	
2a. Explain different engineering curves with areas of application. **2b.** Draw different conic sections based on given situation. **2c.** Draw involute and cycloidal curves based on given data. **2d.** Draw helix and spiral curves from given data	**2.1** Concept of focus, directrix, vertex and eccentricity. Conic sections. **2.2** To draw an ellipse by concentric circle method and Directrix focus method. **2.3** To draw a parabola by :- 1) Directrix focus method. **2.4** To draw a hyperbola by :- 1) Directrix focus method. **2.5** To draw involute of circle, Regular polygon such as pentagon **2.6** To draw a cylindrical helix (limited to two turns). **2.7** To draw cycloid, epicycloids and hypocycloid.
Unit III: Orthographic Projections (06 hrs, 08 marks)	
3a. Explain methods of Orthographic Projections. **3b.** Draw orthographic views of given simple 2D entities containing lines, circles and arcs only. **3c.** Draw the orthographic views from given pictorial views.	**3.1** Projections-orthographic, perspective, isometric and oblique: concept and applications.(No question to be asked in examination). **3.2** Orthographic projection, First angle and Third angle method, their symbols. **3.3** Conversion of pictorial view into Orthographic Views – object containing plain surfaces, slanting surfaces, slots, ribs, cylindrical surfaces. (use First Angle and Third Angle Projection Method.)

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit IV: Sectional orthographic views (04 hrs, 08 marks)	
4a. Classify various types of sectional views. **4b.** Explain sectioning and hatching conventions. **4c.** Convert pictorial views of given object into sectional orthographic views. **4d.** Interpret the given Drawing	**4.1** Cutting plane line **4.2** Types of sectional views: Full section, Half section, Partial or broken section, Revolved section, Removed section, offset section, Aligned section. **4.3** Sectioning conventions **4.4** Hatching or section lines **4.5** Conversion of pictorial views into sectional orthographic views
Unit V: Isometric Projections (06 hrs, 16 marks)	
5a. Prepare isometric scale. **5b.** Draw isometric views of given simple 2D entities containing lines, circles and arcs only. **5c.** Interpret the given orthographic views. **5d.** Draw Isometric views from given orthographic views.	**5.1** Isometric view **5.2** Isometric projection. **5.3** Isometric scale and Natural Scale. **5.4** Illustrative problems related to simple objects having plain, slanting, cylindrical surfaces and slots on slanting surfaces. **5.5** Conversion of orthographic views into Isometric view/Projection.
Unit VI: Projection of Lines (02 hrs, 08 marks)	
6a. Classify various positions of lines with respect to projection planes. **6b.** Draw projection of lines in different positions.	**6.1** Projection of straight lines with following positions: a) Parallel to both the planes. b) Perpendicular to one plane. c) Inclined to one plane and parallel to the other. d) Inclined to both the planes. Traces of Line. (Concept purpose only ,No problems)
Unit VII: Projection of Planes (02 hrs, 08 marks)	
7a. Classify various types of planes according to orientations. **7b.** Draw projection of planes with different orientations.	**7.1** Projection of Planes with following orientations: a) Plane parallel to one principal plane and perpendicular to the other. b) Plane inclined to one principal plane and perpendicular to the other
Unit VIII: Projection of solids (02 hrs, 08 marks)	
8a. Classify various types of solids. **8b.** Explain orientation of axis with respect to projection planes. **8c.** Draw projection of standard regular solids like polyhedron, prisms, pyramids, solids of revolution.	**8.1** Types of Solids **8.2** Projection of the following solids: a) Regular Polyhedron – Tetrahedron, b) Regular prisms and Pyramids – Triangular, Square, Pentagonal, Hexagonal

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	c) Regular solids of Revolution – Cylinder, Cone. With Axis: i) Perpendicular to one of the principal projection plane. ii) Inclined to one of the principal plane and parallel to the other. iii) Parallel to both principal planes
Unit IX: Free Hand Sketches (02 hrs, 08 marks)	
9a. Sketch proportionate freehand sketches of given machine elements. **9b.** Select proper fasteners and locking arrangement for given situation.	**9.1** Free hand sketches of machine elements: Thread profiles, nuts, bolts, studs, set screws, washers, Locking arrangements.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to Drawing instruments lines letters etc.	02	--	--	--	--
II	Curve and Tangential exercises	06	--	16	--	16
III	Orthographic Projection	06	--	--	08	08
IV	Sectional orthographic views	04	--	--	08	08
V	Isometric Views	06	--	--	16	16
VI	Projection of Lines.	02	--	--	08	08
VII	Projection of Planes.	02	--	--	08	08
VIII	Projection of solids	02	--	--	08	08
IX	Free hand sketches	02	08	--	--	08
Total		**32**	**08**	**16**	**56**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Following is the list of proposed student activities like:

a. Student should maintain a separate A3 size sketch book which will be the part of term work and submit it along with drawing sheets.
b. Students should collect Maps, Production drawings, Building Drawings, Layouts from nearby workshops/industries/builders/contractors and try to list
   i. types of lines used
   ii. lettering styles used
   iii. dimension styles used
   iv. IS code referred
c. List the shapes and curves you are observing around you in real life with name of place and item. (For Ex.ellipse, parabola, hyperbola, cycloid, epicycloids, hypocycloid, involute, spiral helix).

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:
Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.

a. Guide student(s) in fixing the sheet and mini drafter on drawing board.
b. Show video/animation films to explain orthographic and Isometric projection.
c. Demonstrate engineering curves through actual cut sections of cone, pyramid, etc
d. Demonstrate first and third angle method using model.
e. Use charts and industrial drawing to teach standard symbols Teacher should ask the students to go through instruction and Technical manuals.
f. Encourage students to refer different websites to have deeper understanding of the subject.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***
The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.
A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Helical springs: Each batch will collect 5 open coil and closed coil helical springs of various sizes. Each student will measure the significant parameters of one spring and draw corresponding helix curve in his sketch book.
b. Flat coil or spiral springs: Each batch will collect 10 spiral springs of various sizes. Each student will measure the significant parameters of one spring and draw corresponding helix curve in his sketch book.
c. Isometric views: Each student of the batch will try to collect at least one production drawings/ construction drawings/plumbing drawings from local workshops/builders /electrical and mechanical contractors and try to generate isometric views from the orthographic views given in the drawings.
d. Isometric views: Each student of a batch will select a household/industrial real item and will draw its isometric view in the sketch book.
e. Isometric and orthographic views: Each batch will collect a single point cutting tool from workshop and draw its Isometric and orthographic views with a ten times enlarged scale. In carpentry shop each batch will try to make wooden model from these views.
f. Isometric views: The teacher will assign one set of orthographic projections and ask the student to develop 3D thermocol models of the same.

g. Involute curves: Each batch will try to develop cardboard/thermocol working models which can generate involute curve of any regular geometrical shape.
h. Cycloidal curves: Each batch will collect 3 different sizes bicycle tyres and compare the locus of tube air valve by rolling them on flat road.
i. Conic curves: Each batch will go to institute's play ground and one student standing on the boundary throws a ball to the wicket keeper who is 30 meters away from the thrower and the ball has reached a maximum height of 20meters from the ground, draw the path of the ball and identify the type of conic curve it has traced in air.
j. Involute and Cycloidal curves: Each batch will collect one Involute and one cycloidal tooth profile spur gear and find out the Involute function.

12. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publisher, Edition and Year of publication, ISBN Number
1	Elementary Engg.Drawing(Including plan and solid geometry)	N.D. Bhatt	Charotar Publication, Anand ISBN-978-93-80358-17-8
2	Engineering Drawing	Mali, Chaudhary	Vrinda Prakashan, Jalgaon ISBN: 9789389251012.
3	--	I.S. 696 Latest version	B.I.S.
4	Engineering Drawing Practice for Schools and Colleges IS: SP-46	Bureau of Indian Standards.	Third Reprint, October 1998 ISBN No. 81-7061-091-2
5	Engineering Drawing and Graphics + AutoCAD	K. Venugopal	New Age International Publishers. ISBN :9788122415452
6	Engineering Drawing	D. A. Jolhe	Tata McGraw Hill Edu. New Delhi, 2010, ISBN No. 978-0-07-064837-1
7	Engineering Drawing	R. K. Dhawan	S. Chand and Company New Delhi, ISBN No. 81-219-1431-0

13. SOFTWARE/LEARNING WEBSITES

1. https://www.youtube.com/watch?v=TJ4jGyD-WCw
2. https://www.youtube.com/watch?v=dmt6_n7Sgcg
3. https://www.youtube.com/watch?v=_MQScnLXL0M
4. https://www.youtube.com/watch?v=3WXPanCq9LI
5. https://www.youtube.com/watch?v=fvjk7PlxAuo
6. http://www.me.umn.edu/courses/me2011/handouts/engg%20graphics.pdf

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	2	1	1	2
CO2	3	3	2	2	1	1	2
CO3	3	3	2	2	1	1	2
CO4	3	3	2	2	1	1	2
CO5	3	3	2	2	1	1	2

	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1
CO2	2	1	1	1
CO3	2	1	1	1
CO4	2	1	1	1
CO5	2	1	1	1

Sign: Name: Shri. M. W. Giridhar Shri. M.R.Mundhe (Course Experts)	Sign: Name: Dr. N.G. Kulkarni (Head of Mechanical Department)
Sign: Name: Smt. N.S. Kadam (Program Head) (Metallurgical Engineering Department)	Sign: Name: Shri. A.S. Zanpure (CDC In charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme Code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19**/21/22/23/24/26
Name of Course	**Elements of Mechanical Engineering**
Course Code	**ME2106**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

<table>
<tr><th colspan="3">Teaching Scheme (In Hours)</th><th>Total Credits (L+T+P)</th><th></th><th colspan="5">Examination Scheme</th></tr>
<tr><th colspan="3"></th><th></th><th></th><th colspan="2">Theory</th><th colspan="2">Practical</th><th rowspan="2">Total Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>C</th><th></th><th>ESE</th><th>PA</th><th>ESE</th><th>PA</th></tr>
<tr><td rowspan="2">03</td><td rowspan="2">00</td><td rowspan="2">02</td><td rowspan="2">05</td><td>Marks</td><td>80</td><td>20</td><td>--</td><td>25</td><td rowspan="2">125</td></tr>
<tr><td>Exam Duration</td><td>3 Hrs</td><td>1 Hr</td><td>--</td><td>--</td></tr>
</table>

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

Metallurgy Engineers often come across various engg. components for selection of materials and manufacturing processes .They are required to know basic principles of working of different machines and equipments. They are also required to look after the maintenance of the machines .It is therefore necessary for them to know how to interpret the assembly drawings, component drawings in order to carry out any engineering work

3. COMPETENCY

The aim of this course is to attain following industry identified competencies through various teaching learning experiences.

- **Operate different mechanical engineering devices and software.**

4. COURSE OUTCOMES (COs)

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 above-mentioned competency:

1. Draw proportionate free hand drawing of IC engine parts etc.
2. Develop the ability to read the drawing and identify conventional representations.
3. Use principles of heat transfer.
4. State working principal of IC engines, compressors, pumps etc.
5. Identify different power transmission devices.
6. Prepare drawings on AutoCAD.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	Relevent CO	Approx. Hrs. Required
1	Draw three views from given isometric view	2	04
2	Draw assembly and details.	2	04
3	Draw free hand sketches of IC engine parts	1	02
4	Observe IC engine parts and write function of each.	1, 4	02
5	Demonstrate working of centrifugal and reciprocating pump	4	02
6	Demonstrate working of compressor.	4	04
7	Calculate parameters of heat transfer for furnace.	3	04
8	Demonstrate working of power transmission devices	5	04
9	Draw simple drawings on AutoCAD.	6	04
10	Complete the given micro project as per guidelines given at Sr. no 11	4, 5	02
	Total		**32**

Sr. No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will used in uniformity in conduct of practical.

Sr. No.	Equipment Name with Broad Specifications	Experiment Sr. No.
1	Drawing board/minidrafter and drawing instruments, Std.specifications	1,2,
2	Petrol engine with any standard specifications	2
3	Centrifugal pump with any standard specifications	3
4	Reciprocating pump with any standard specifications	3
5	Belt drive, chain drive with any standard specifications	5
6	Different models of gears	5
7	AutoCAD software	6

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit I Advanced Sectional Views (13 hrs, 18 marks)	
1a. Draw different types of sections 1b. Draw sectional views of IC engine parts 1c. Draw sectional views of pulley, gear, flanged couplings and bearings.	1.1 Types of sections: Conventional, revolved, removed, partial, offset. 1.2 Crankshaft, Engine body, camshaft, flywheel 1.3 Pump body, pulley, gear, flanged coupling, bearing.
Unit-II Blue Print Reading (9 hrs, 14 marks)	
2a. Draw machine symbols and surface finish symbols. 2b. Identify specifications on drawing 2c. Draw simple assembly.	2.1 Machine symbols, surface finish. 2.2 Specification on drawing such as material hardness, heat treatment, micro structure. 2.3 Simple assembly containing six parts.
Unit-III IC Engines Working (4 hrs, 10 marks)	
3a. Classify IC engines. 3b. Identify different IC engine parts. 3c. State working of two stroke and four stroke engines.	3.1 Classification of I.C.engine, construction 3.2 Working of 2 stroke and 4 stroke I.C.engine
Unit-IV Pumps and Compressors (8 hrs, 12 marks)	
4a. Classify pumps. 4b. State working of pump. 4c. Classify compressors.	4.1 Pumps: Classification, Construction, Working, application. 4.2 Compressors: Classification, working of reciprocating, rotary, roots blower, vacuum pumps.
Unit-V Heat Transfer (6 hrs, 10 marks)	
5a. Identify modes of heat transfer for practical	5.1 Modes of heat transfer, calculations of heat transfer for given condition,

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
applications. 5b. Solve problems on conduction, convection, radiation. 5c. Identify different heat exchangers.	5.2 Simple problems on conduction, Convection, radiation. 5.3 Heat exchangers.
Unit VI Power Transmission Devices (6 hrs, 10 marks)	
6a. Identify different types of drives. 6b. Name different types of gears. 6c. Compare different drives and gears.	6.1 Belt- Open and cross belt, Flat belt and V belt. Chain Drives. 6.2 Gears- Spur, Helical, Bevel, Worm. Gear Terminology- circular pitch, module, addendum, dedendum, pressure angle. 6.3 Comparison, advantages & disadvantages of different drives.
Unit VII Introduction to Autocad (2 hrs, 6 marks)	
7a. Draw simple drawings on autocad.	7.1 Introduction to AutoCAD and AutoCAD commands.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	**Unit Title**	**Teaching Hours**	**Distribution of Theory Marks**			
			R Level	**U Level**	**A Level**	**Total Marks**
I	Advance Sectional Orthographic view	13	02	08	08	18
II	Blue print reading	09	04	05	05	14
III	IC engine working	04	04	04	02	10
IV	Pumps and compressors	08	04	06	02	12
V	Heat transfer	06	04	04	02	10
VI	Power transmission device	06	02	04	04	10
VII	Introduction to AutoCAD	02	--	04	02	06
Total		**48**	**20**	**35**	**25**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journal based on practical performed in laboratory. Journal consists of drawing, observations, required equipment's, date of performance with teacher signature.
b. Group discussion
c. Assignments
d. Seminar

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations.
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Correlate subtopics with practical applications.
e. Use proper equivalent analogy to explain different concepts.
f. Use Flash/Animations to explain various components, operations.
g. Teacher should ask the students to go through instruction and Technical manuals.

11. SUGGESTED MICRO-PROJECTS

Only one micro project is planned to be undertaken by student that needs to be assigned to him/her. It should preferably be undertaken individually to build up skill and confidence in every student to become problem solver so that he/she contributes to the projects of industry. In special situations where groups have to be formed for micro projects, the number of students in one group should not exceed three.

A suggestive list of micro projects is given here.
a. Prepare model of any suitable topic from syllabus.
b. Prepare charts of suitable topics from syllabus.
c. Any other suitable micro project as decided by teacher and industry expert.
d. Literature survey and report writing on recent developments in any area from syllabus.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1	Machine Drawing	N.D.Bhatt	Chartor Publishing House ISBN: 9789385039232
2	Machine Drawing	N.Sidheswar P.Kannaiah Sastry V.V.S	McGraw Hill Education ISBN: 9780074603376
3	Hydraulic Machinery	R S Khurmi	S. Chand Co Ltd.,New Delhi ISBN: 9788121901628
4	IC Engines	V.Ganesan	Tata Mc Graw Hill ISBN: 9781259006197
5	Hydraulic Machinery	Jagadish Lal	Metropolitan Publishers ISBN: 9788120004405
6	S.P.Sukhatme	Heat Transfer	Tata Mc Graw Hill ISBN: 9788173715440

13. SOFTWARE/LEARNING WEBSITES:

Software: - Autocad
Websites: -www.howstuffworks.com
Other websites related to relevant topics from syllabus.

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	--	1	--	1	1	2
CO2	2	1	2	--	--	1	2
CO3	2	1	--	--	--	1	2
CO4	2	--	1	1	1	1	2
CO5	2	--	1	1	--	1	2
CO6	2	1	2	2	--	1	2

	PSO1	PSO2	PSO 3	PSO4
CO1	--	--	--	1
CO2	--	--	--	1
CO3	1	--	--	1
CO4	--	--	--	1
CO5	--	--	--	1
CO6	--	--	--	--

Sign: Name: Dr.R R Saraf (Course Expert)	Sign: Name: Dr. N. G. Kulkarni (Head of Mechanical Department)
Sign: Name: Smt.N.S.Kadam (Program Head) (Metallurgical Engineering Department)	Sign: Name: Shri. A. S. Zanpure (CDC In charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme Code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19**/21/22/23/24/26
Name of Course	**Advanced Physics**
Course Code	**SC2106**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

<table>
<tr><th colspan="3" rowspan="2">Teaching Scheme (In Hours)</th><th rowspan="2">Total Credits (L+T+P)</th><th rowspan="2"></th><th colspan="5">Examination Scheme</th></tr>
<tr><th colspan="2">Theory Marks</th><th colspan="2">Practical Marks</th><th>Total Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>C</th><th></th><th>ESE</th><th>PA</th><th>ESE</th><th>PA</th><td rowspan="3">125</td></tr>
<tr><td rowspan="2">02</td><td rowspan="2">00</td><td rowspan="2">02</td><td rowspan="2">04</td><th>Marks</th><td>80</td><td>20</td><td>--</td><td>25</td></tr>
<tr><th>Exam Duration</th><td>03 Hrs</td><td>01 Hr</td><td>--</td><td>--</td></tr>
</table>

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/TermWork), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

Metallurgical diploma engineers have to deal with various materials and machines. The study of concepts and principles of lens aberrations, microscopy, laser, temperature measurement, interference, superconductivity and nanotechnology will help them in understanding the technology courses where emphasis is laid on the applications. This course is designed in the way by which fundamental information will help the diploma engineers to apply the concepts and principles of advanced physics in various applications.

3. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Apply principles of physics to solve broad-based engineering problems.**

4. COURSE OUTCOMES (COs)

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 above mentioned competency**:**

1. Identify the different type of lens aberrations and minimization of aberrations.
2. Use different measuring instrument like spectrometer, thermometer, travelling microscope.
3. Apply the principles of laser, magnetism and superconductivity to solve engineering problems.
4. Use the basic principles of thermoelectricity, interference, nanotechnology in related engineering problems.

5. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency**:**

S. No.	**Unit No.**	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	**Relevant CO**	**Approx. Hrs. required**
1	1	Study of new Cartesian sign conventions and image formation by lenses.	1	04*
2	2	Draw ray diagrams of simple microscope, compound microscope and metallurgical microscope.	2	04*
3	2	Use travelling microscope to calculate surface tension of water.	2	04*
4	4	Determination of angle of divergence of laser beam using He-Ne Laser.	3	02*
5	5	Use spectrometer to calculate refractive index of prism.	2	04*
6	5	Measurement of wavelength using spectrometer.	2	04*
7	6	Determine radius of curvature of convex surface using Newton's ring apparatus.	4	04*
8	7	Determine the temperature coefficient of resistance using platinum resistance thermometer.	4	02
9	7	Measurement of unknown temperature using thermocouple.	4	02
10	8	Measurement of pole strength of given magnet.	3	02
11	8	Use of magnetic compass to determine the neutral points.	3	02
12	9	Study of properties and applications of nano materials in different field	4	02
13	ALL	Complete a Micro- project based on guidelines provided in Sr.No 11	1 to 4	04*
		Total		**32**

Note: A suggestive list of Experiments is given in the above table. Minimum 09 practical need to be performed out of which practicals marked as * are compulsory. Any one practical out of Sr. No. 8 to 12 need to be performed.

SCHEME OF PRACTICAL EVALUATION

S.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test kit or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned**.**

S. No.	Equipment Name with Broad Specifications	Experiment Sr. No.
1	Convex lens.	1
2	Travelling Microscope. Range: 0.001 cm to 22 cm Resolution 0.001 cm.	3
3	He-Ne Laser Kit.	4
4	Spectrophotometer, Prism. Range: 0 to 360^0 Least count 1’	5,6
5	Newton’s ring apparatus. Range: 0.001 cm to 15 cm Resolution 0.001 cm	7
6	Platinum resistance.	8
7	Thermocouple, Multimeter.	9
8	Bar magnet, Magnetic compass.	10,11

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit I Lens and lens aberration (3 hrs, 8 marks)	
1a. Draw different image using lens. 1b. Calculate- magnification and power of lens. 1c. Identify different types of lens aberrations and minimization of aberration.	1.1 Revision: types of lenses and image formation by lenses. 1.2 Numerical aperture, aperture of lens, magnification and power of lens - Definition, formula, unit, analytical treatment. 1.3 Lens aberrations – chromatic, spherical, coma, astigmatism (no derivations), minimization of aberrations.
Unit II Optical Microscopy (3 hrs, 8 marks)	
2a. Differentiate between simple and compound microscope 2b. Draw ray diagram of metallurgical microscope and explain construction and working of metallurgical microscope. 2c. Distinguish between Huygens and Rams den eyepieces. 2d. State advantages of oil immersion objective	2.1 Simple and compound microscope. 2.2 Metallurgical microscope – construction ray diagrams and applications. 2.3 Eyepieces- Huygens's and Ramsden's eyepiece, comparison. 2.4 Objective- Oil immersion objective, properties, numerical aperture, resolving power.
Unit III Electron Microscopy (4 hrs, 8 marks)	
3a. State Debroglie hypothesis 3b. Distinguish between optical microscope and electron microscope. 3c. Describe working and application of Scanning electron microscope and transmission electron microscope.	3.1 Terminology- De Broglie's hypothesis. 3.2 Electron microscope - Principle, construction, working and applications, comparison with optical microscope. 3.3 Types of Electron Microscopes- Working and application of Scanning Electron Microscope (SEM) and Transmission Electron Microscope (TEM).
Unit IV Laser (2 hrs, 8 marks)	
4 a. Differentiate between spontaneous and stimulated emission. 4b. Define atomic excitation, excitation potential, optical pumping, population inversion. 4c. Describe working of laser system with energy level diagram. 4d. Explain construction and working of He -Ne Laser. 4e. Explain construction and working of Ruby Laser.	4.1 Terminology- atomic excitation, spontaneous absorption, spontaneous and stimulated emission, parts of laser system, optical pumping, active medium, population inversion, metastable state, life time . 4.2 Working - of laser using energy level diagram. 4.3 Production and working of He-Ne (Gas) laser. 4.4 Production and working of Ruby (solid) laser.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
4f. State applications of laser in different field.	4.5 Applications- laser coating and industrial applications.
Unit V Spectroscopy (3 hrs, 8 marks)	
5a. Define line spectra, band spectra, continuous spectra. 5b. Explain different types of spectra. 5c. State applications of spectra.	5.1 Revision on different types of spectrum. 5.2 Terminology- spectral analysis, types of spectra- line, band, continuous & its origin. 5.3 Application of spectra.
Unit VI Interference (4 hrs, 10 marks)	
6a. State Newton's corpuscular and Huygens wave theory with its advantages and disadvantages.	6.1 Newton's corpuscular and Huygens wave theory with its advantages and disadvantages.
6b. Define- interference, constructive and destructive interference. 6c. Sate conditions for steady interference pattern.	6.2 Superposition of waves, phenomena of interference, constructive and destructive interference, conditions for stationary interference pattern.
6d. Describe flatness testing and wedge shape thin film.	6.3 Applications of interference- wedge shape film, flatness testing, measurement of diameter of microscopic objects.
6e. Calculate diameter, radius, refractive index and wavelength of light.	6.4 Newton's rings- measurement of radius, refractive index and wavelength.
Unit VII Temperature Measuring Devices (6 hrs, 12 marks)	
7a. State Seeback effect, Peltier effect.	7.1 Change of properties, thermoelectricity, See beck effect, Peltier effect.
7b. State applications of thermocouple.	7.2 Thermocouple, Variation of emf with temperature, inversion temperature, neutral temperature, applications of thermocouple.
7c. Describe construction, working and applications of thermometric and platinum resistance thermometer.	7.3 Thermometers: - Thermometric thermometer: - principle, construction, working and applications. Platinum resistance thermometer: principle, construction, working and applications.
7d. Describe bimetallic thermometer with its principle, construction, working and application.	7.4 Bimetallic thermometer: principle, construction, working and applications.
7e. State Stefan's Boltzmann's law, Newton's law, Kirchhoff's law, Wien's law.	7.5 Introduction of radiation, Black body radiation, Stefan's Boltzmann's law, Newton's law, Kirchhoff's law, Wien's law.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
7f. Differentiate between thermometry and pyrometer.	7.6 Difference between the thermometer and pyrometer.
7g. Describe disappearing filament optical pyrometer with its principle, construction, working and application.	7.7 Pyrometer: Disappearing filament optical pyrometer- principle, construction, working and applications.
7h. Describe total radiation pyrometer with its principle, working and application.	7.8 Total radiation pyrometer- principle, construction, working and applications.
Unit VIII Magnetism and Superconductivity (5 hrs, 12 marks)	
8a. Define - susceptibility, permeability, hysteresis, retentively, coactivity, area under hysteresis loop and work done.	8.1 Susceptibility, permeability, magnetization, magnetic materials-diamagnetic, paramagnetic and ferromagnetic materials, hysteresis, hysteresis loop, retentivity, coercivity.
8b. Difference between hard and soft magnetic materials and its applications.	8.2 Hard and soft magnetic materials - its relation using hysteresis loop, properties and uses of magnets.
8c. Define superconductivity, critical temperature.	8.3 Superconductivity phenomena, superconducting materials, critical temperature, destruction of superconductivity.
8d. Describe Messenger's effect and type1 and type 2 superconducting materials.	8.4 Messenger's effect, type1 and type 2 superconductors.
Unit IX Nanotechnology (2 hrs, 6 marks)	
9a. Define nonmaterial, nanaoscale. 9b. Describe Properties of nanomaterial.	9.1 Definition of nanoparticles, size dependent properties of nonmaterial's, tools and techniques to study nano materials.
9c. State applications of nanotechnology in different engineering field.	9.2 Applications of nanotechnology in different engineering field.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Lens and lens aberration	03	02	04	02	08
II	Optical Microscopy	03	02	04	02	08
III	Electron Microscopy	04	04	02	02	08
IV	LASER	02	02	04	02	08
V	Spectroscopy	03	02	04	02	08
VI	Interference	04	04	02	04	10
VII	Temperature Measuring Devices	06	04	04	04	12
VIII	Magnetism and Superconductivity	05	04	04	04	12
IX	Nanotechnology	02	02	02	02	06
Total		**32**	**26**	**30**	**24**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journal based on practical performed in physics laboratory. Journal consists of drawing, observations, required equipment's, date of performance with teacher signature.
b. Demonstration
c. Presentation

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipments.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. It should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that she/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.
A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty.

a) **Lens :**Prepare chart showing different Types of Lens .
b) **Optics** :Prepare chart showing properties of Lasers / Nanoparticles.
c) Prepare report on Stefan's Boltzmann's law, Newton's law, Kirchhoff's law, Wien's law.
d) Prepare report to distinguish Simple Pendulum and Compound Pendulum.
e) Prepare chart showing different types of Spectrum.

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publisher, Edition Year of publication and ISBN Number
1	Engineering Physics	R.K. Gaur S. L. Gupta	Dhanpat Rai Publications, Delhi. ISBN: 9788189928223,1981
2	Principles of Metallographic Laboratory Practice	George L. Khel	McGraw-Hill ISBN: 007033479X
3	Modern Engineering Physics	A. S. Vasudeva	S. Chand Publishing ISBN: 9788121917575
4	Perspective of Modern Physics	Arthur Beiser	Mc Graw Hills Text ISBN: 978-0070043503
5	Elements of Physical Metallurgy	Albert G. Guy	Addison-Wesley Press
6	Text Book of Optics	N. Subrahmanyam Brijlal M.N. Avadhanulu	S. Chand ISBN: 9788121926119
7	Introduction to Nanoscience and Nanotechnology	K K Chattopadhyay A N Banerjee	Prentice Hall India Learning Private Limited ISBN:978-8120336087
8	Engineering Physics	D K Bhattacharya Poonam Tandon	Oxford University Press ISBN: 978-0199452811

13. SOFTWARE/LEARNING WEBSITES

1. http://onlinelibrary.wiley.com/book
2. https://en.wikipedia.org/wiki/Electron_microscope
3. www.colorado.edu/physics
4. http://teachingbd24.com
5. https://www.smartzworld.com
6. http://www.faadooengineers.com
7. www.freebookcentre.net/Physics
8. www.kopykitab.com/Engineering-Physics
9. https://nptel.ac.in

14. PO - COMPETENCY- CO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	2	1	1	2
CO2	3	2	2	2	1	1	2
CO3	3	2	2	2	1	1	2
CO4	3	3	2	1	1	1	2

CO	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	1
CO2	3	2	2	1
CO3	2	1	1	1
CO4	1	1	1	1

Sign: Name: Smt. D. V. Saurkar Dr. R. B. Birajadar (Course Experts)	Sign: Name : Smt.N.S.Kadam (Head of Department)
Sign: Name: Smt.N.S.Kadam (Program Head) (Metallurgical Engineering Department)	Sign: Name : Shri.A.S.Zanpure (CDC In charge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in CE**/EE/ET/**ME**/**MT**/CM/IT/DDGM
Programme Code	**01**/02/03/**04**/**05**/06/07/08/**15**/16/17/**18**/**19**/**21**/22/23/**24**/26
Name of Course	**Workshop Practice**
Course Code	**WS2101**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

<table>
<tr><th colspan="3" rowspan="2">Teaching Scheme (In Hours)</th><th rowspan="2">Total Credits (L+T+P)</th><th rowspan="2"></th><th colspan="5">Examination Scheme</th></tr>
<tr><th colspan="2">Theory</th><th colspan="2">Practical</th><th rowspan="2">Total Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>C</th><th></th><th>ESE</th><th>PA</th><th>ESE</th><th>PA</th></tr>
<tr><td rowspan="2">00</td><td rowspan="2">00</td><td rowspan="2">04</td><td rowspan="2">04</td><td>Marks</td><td>--</td><td>--</td><td>--</td><td>50</td><td>50</td></tr>
<tr><td>Exam Duration</td><td>--</td><td>--</td><td>--</td><td>--</td><td></td></tr>
</table>

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE-End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

Workshop Practice is a basic practical engineering course. The knowledge of basic workshops such as wood working, fitting, welding, plumbing and sheet metal shop is essential for technician to perform their duties in industries. Students can perform various operations using hand tool equipment and machineries in various shops. Working in a workshop develops the attitude of group working and safety awareness. This course provides a miniature industrial environment in the educational institute.

3. COMPETENCY

The course should be taught and implemented to develop the course outcomes (COs) so that students demonstrate the following competency needed by the industry:

- **Prepare simple jobs on the shop floor of the engineering workshop**.

4. COURSE OUTCOMES (COs)

The 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 above:
After studying this course, the student will be able to

1 Select tools and machinery according to a job.
2 Use hand tools in different shops for performing the different operations.
3 Operate equipment and machinery in different shops.
4 Prepare job according to drawing.
5 Maintain workshop related tools, equipment and machinery.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hours Required
1	1	Demonstration of a smithy and forging equipment and process.	1,2,3,4	4
2	2	Prepare job with following operations: a. Marking operation as per drawing b. punching operation as per drawing c. filing operation as per drawing d. chamfering operation as per drawing e. sawing operation as per drawing f. drilling operation as per drawing g. tapping operation as per drawing	1,2,3,4	16
3	3	Prepare job with following operations a. Prepare Socket joint pipe fitting job as per given drawing (individually) b. Prepare elbow joint pipe fitting job as per given drawing c. Prepare bill of material for given pipeline layout	1,2,3,4	8
4	4	Prepare job with following operations: a. Prepare lap joint using gas welding as per given drawing b. Prepare butt joint using gas welding as per given drawing	1,2,3,4	12
5	5	Prepare utility job(like stool, benches, tables or similar jobs) involving arc welding and artificial wood as per given drawing a. Fabrication operation involves measuring, marking, cutting, edgepreparation, welding b. Carpentry operations involve measuring, marking, cutting, and assembly with fabrication parts.	1,2,3,4	16
6	6	Prepare sheet metal utility job using following operations a. Cutting and Bending b. Edging c. End Curling d. Lancing e. Spot Welding f. Riveting	1,2,3,4	8
		Total Hrs		**64**

Sr.No.	Performance Indicators	Weightage in %
1	Setting of experimental set up	20
2	Operate equipment skillfully	30
3	Follow Safety measures	10
4	Work in team	10
5	Record Observations	10
6	Interpret Results to conclude	10
7	Answer to sample questions	05
8	Submit report in time	05
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with the broad specification mentioned here will use uniformity in the conduct of practical and aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	Fire buckets of standard size.	1 to 6
2	Fire extinguisher A,B and C types	1 to 6
3	Wood Turning Lathe Machine, Height of Centre: 200mm, Distance between II Centers: 1200mm, Spindle Bore: 20mm with Taper, Range of Speeds: 425 to 2800 with suitable Motor Drive. with all accessories	5
4	Circular Saw Machine, Diameter of saw blade 200 mm, Maximum Depth of II Cut 50 mm, Table Size -350 x 450 mm, Table Tilting - 450	5
5	Wood working tools- marking and measuring tools, saws, claw hammer, II mallet, chisels, plans, squares,	5
6	Carpentry Vice 200 mm	5
7	Work Benches- size:1800 x 900 x 750 mm	2
8	Bench Drilling machine (upto 13 mm drill cap.) with ½ H.P. Motor 1000 III mm. Height	2
9	Power Saw machine 350 mm mechanical with 1 HP Motor & all III Accessories.	2
10	Bench Grinder 200 mm Grinding Disc diameter 200 mm. with 25 mm. bore III 32 mm. with ½ HP/1HP Motor.	2
11	Vernier height Guage 450 mm	2
12	Surface Plate 600 x 900 mm Grade I	2
13	Angle Plate 450 x 450 mm	2
14	Welding machine 20 KVA 400A welding current 300A at 50, 100, 200, 250, IV 300 with std. Accessories and Welding Cable 400 amp. ISI with holder	4
15	Oxygen and acetylene gas welding and cutting kit with cylinders and IV regulators	4
16	Pipe Bending Machine	3
17	Pipe Vice – 100 mm	3
18	Pipe Cutter- 50 mm	3
19	Bench Vice 100 mm	3

Sr.No.	Major Equipment/ Instruments Required	Experiment Sr. No.
20	Portable Hammer Drill Machine 0-13 mm II, III, A.C. 230 V, 2.5Amp, Pistol type, having different types of bits	6
21	Sheet Bending Machine	6
22	Sheet Cutting Machine	6
23	Brazing Equipment	6
24	Fitting tools - hammers, chisels, files, hacksaw, surface plate, punch, v III block, angle plate, try square, marking block, steel rule, twist drills, reamers, tap set, die set.	2
25	Plumbing tools- pipe vice, pipe bending equipment, pipe wrenches, dies.	3
26	Gas welding hand tools- welding torch, welding tip, pressure regulator, V oxygen and acetylene cylinders, spark lighter	4
27	Arc welding hand tools- electrode holder, cable connector, cable lugs, V chipping hammer, earthing clamp, wire brush.	4
28	Sheet metal hand tools- snip, shears sheet gauge, straight edge, L square, VI scriber, divider, trammel, punches, pliers, stakes, groovers, limit set	4

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
NIL	NIL

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN Not applicable

9. SUGGESTED STUDENT ACTIVITIES

Other than laboratory learning, following are the suggested student-related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

a. Prepare work diary based on practical performed in workshop. Work diary consist of job drawing, operations to be perform, required raw materials, tools, equipments, date of performance with teacher signature. b.
b. Prepare journals to consist of freehand sketches of tools and equipments in each shop, detailed specifications and precautions to be observed while using tools and equipment.
c. Prepare/Download thefollowing specifications: a) Various tools and equipment in various shops. b) Precision equipment in workshop c) Various machineries in workshop.
d. Undertake a market survey of local dealers to procure workshop tools, equipment machineries and raw material. i.e. Visit any fabrication/woodworking/sheet metal workshop and prepare a report.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (MOOCs) may teach various topics/subtopics.
b. Guide student(s) in undertaking micro-projects.
c. Arrange a visit to nearby industries and workshops for understanding various manufacturing processes.
d. Show video/animation films to explain various processes like shaping, lapping, honing, turning, milling, knurling etc.
e. Prepare maintenance charts various workshop machineries.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to them. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***
The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs that are an integration of PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain a dated work diary consisting of individual contributions to the project work and give a seminar presentation before submission. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.
A suggestive list of micro-projects is given here. The concerned faculty could add similar micro-projects:

a. Prepare a utility job using various wood working shop operations as per given drawing.
b. Prepare a utility job using various plumbing operations as per the given drawing.
c. Prepare a utility job using various sheet metal operations as per the given drawing. Note: i. The teacher will assign utility job. ii. Utility Job will be completed in a group of 4 to 5 students. Students have to maintain a work diary consisting of job drawing, operations details, required raw materials, tools, equipments, and date-wise performance records.

12. SUGGESTED LEARNING RESOURCES

Sr.No.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1	Elements of workshop technology - Vol. I	S. K. Hajara Chaudhari A.K. Hajara Chaudhari	Media Promoters and Publishers Pvt. Ltd.,Mumbai-7 ISBN: 8185099146
2	Workshop Practice Manual	V. Kapoor	Dhanpat Rai and Sons, New Delhi-32 ISBN: 9788175154247
3	A course in workshop technology Vol.- I	B.S. Raghuwanshi	Dhanpat Rai and Sons, New Delhi-32 ISBN: 9788185099149

13. SOFTWARE/LEARNING WEBSITES

1.www.carpentryworkshop.com
2.www.weldingworkshop.com
3.www.machineworkshop.com
4.www.turningworkshop.com
5.www.smithyworkshop.com
6.www.plumbingworkshop.com

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	3	2	2	3
CO2	3	3	3	3	2	2	3
CO3	3	3	3	3	2	2	3
CO4	3	3	3	3	2	2	3

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2
CO2	3	2	2	2
CO3	3	2	2	2
CO4	3	2	2	2

Sign: Name: Shri. M. R. Mundhe (Course Expert)	Sign: Name: Dr.N.G.Kulkarni (Head of Mechanical Department)
Sign: Name: Smt.N.S.Kadam (Program Head) (Metallurgical Engineering Department)	Sign: Name: Shri A.S.Zanpure (CDC In charge)

Government Polytechnic, Pune

Department of Metallurgical Engineering

180 OB Curriculum

Level-2B: Core Technology Courses

(Any One)

Sr. No.	Course Code	Course Name
1	MT2101	Furnace Technology
2	SC2101	Applied Mathematics III

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme Code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19**/21/22/23/24/26
Name of Course	**Furnace Technology**
Course Code	**MT2101**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	ESE	PA	
03	00	01	04	Marks	80	20	--	25	125
				Exam Duration	3 Hrs	1 Hr	--	--	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

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

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Select the proper type of furnace with relevant refractory material and appropriate fuel or electric energy for a given melting operation.**

4. COURSE OUTCOMES (COs)

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 above mentioned competency**:**

1. State properties and applications of refractories and fuels.
2. Describe modes of heat transfer in furnaces.
3. Classify metallurgical melting furnaces.
4. Select a proper furnace for melting ferrous and non ferrous metals and alloys.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Relevant CO**	**Approximate Hours Required.**
1.	1	Study of classification, properties and applications of furnace refractories.	1	02
2.	2	Study of classification, properties and applications of fuels.	1	02
3.	4	Study of construction and working of fuel fired furnaces.	1,2,3,4	02
4.	5	Study of construction and working of electric resistance (direct and indirect) furnaces.	1,2,3,4	02
5.	6	Study of construction and working of electric arc (direct and indirect) furnaces.	1,2,3,4	02
6.	6	Study of construction and working of electric induction (core and coreless type) furnaces.	1,2,3,4	02
7.	7	Study of construction and working of crucible furnace.	1,2,3,4	02
8.	All	Complete a micro project based on guidelines provided in Sr. No.11	1 to 4	02
			Total Hrs	**16**

Sr.No.	**Performance Indicators**	**Weightage in %**
a.	Arrangement of available equipment or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned.

Sr.No.	Major Equipments/ Instruments Required	Experiment Sr. No.
1	Samples of common types of furnace refractories	1,4,5,6,7,8
2	Oil/gas fired furnace	3
3	Electric resistance muffle furnace	4
4	Model of electric arc furnace	5
5	Electric induction furnace	6
6	Crucible furnace	7

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit I. Refractories (07 hrs, 12 marks)	
1a. Define refractories. 1b. Explain classification, properties and factors for selection of refractories. 1c. Describe different types of testing procedures of refractories. 1d. State applications of refractories in different types of furnaces.	1.1 Definition, classification, important properties of refractory materials. 1.2 Factors affecting selection of refractories. 1.3 Testing of refractories- visual inspection, Pyrometric cone equivalent (PCE) test, RUL test, Spaling test, thermal conductivity test etc. 1.4 Applications of refractories.
Unit II. Fuels (05 hrs, 08 marks)	
2a. Define fuels. 2b. Explain classification, properties and factors for selection of fuels. 2c. Distinguish the features of 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.
Unit III. Principle of Heat Transfer & Waste Heat Recovery (05 hrs, 08 marks)	
3a. State basic principle of heat transfer. 3b. Explain various modes of heat transfer. 3c. State the need of waste heat recovery from furnaces. 3d. Describe the working principle of different types of recuperators. 3e. Describe the construction and working of regenerator. 3f. Distinguish between recuperators and regenerators.	3.1 Basic principle of heat transfer. 3.2 Modes of heat transfer- Conduction, convection and radiation. 3.3 Need of waste heat recovery from furnaces. 3.4 Recuperators- Principle of working of parallel flow, counter current flow and cross flow type recuperators. 3.5 Regenerators- Construction and working principle of regenerators in open hearth furnace. 3.6 Comparison between recuperators and regenerators.
Unit IV. Introduction to Industrial Furnaces (07 hrs, 12 marks)	

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
4a. Explain classification of furnaces based on various criteria's. 4b. Explain the role of various auxiliary equipments in working of furnaces. 4c. State the need of controlling furnace atmosphere. 4d. Explain the role of various furnace atmospheres. 4e. Describe the procedure for measurement of furnace atmosphere. 4f. Explain working principle of sealed quench and fluidized bed furnace.	4.1 Classification of industrial furnaces based on heating source, mode of operation, shape, purpose etc. 4.2 Materials for Industrial furnace construction, accessories such as dampers, burners, blowers, control valves, vacuum pumps, exhaust system. 4.3 Atmospheric control in furnaces- need, types of furnace atmosphere; oxidizing, reducing, neutral. 4.4 Furnace atmosphere measurement using Oxygen probe, Dew point controller. 4.5 Introduction to Sealed quench and Fluidized bed furnace.
Unit V. Electric Resistance Furnaces (10 hrs, 16 marks)	
5a. Explain the principle, construction & working of direct & indirect resistance furnaces. 5b. State the types, compositions & properties of heating elements. 5c.Explain the significance of coil dimensions in resistance furnace. 5d. Explain the principle, construction & working of glass melting & salt bath furnaces.	5.1 Principle and working of direct and indirect resistance furnaces. 5.2 Heating elements- Types, compositions and properties. 5.3 Significance of coil dimensions. 5.4 Design & construction of muffle furnace. 5.5 Glass melting furnaces. 5.6 Salt bath furnace.
Unit VI. Electric Arc & Induction Furnaces (10 hrs, 16 marks)	
6a. Explain the principle, construction & working of direct & indirect arc furnaces. 6b. Explain the principle, construction & working of core type & coreless induction furnaces.	6.1 Direct & Indirect arc furnaces- construction, working & application, refractory lining, electrodes, operational parameters. 6.2 Induction Furnaces (cast iron & steel melting)- Principle, core & coreless type, skin effect, calculation of minimum frequency, power generation, depth of penetration, crucible preparation, vacuum induction furnace.
Unit VII. Melting of Nonferrous Metals (04 hrs, 08 marks)	
7a. Explain the principle, construction & working of crucible type, reverberatory& barrel type furnaces. 7b. State the procedure for degassing.	7.1 Crucible furnace- Lift out type, Tilting type. 7.2 Reverberatory furnace - Sklener furnace. 7.3 Barrel type furnace. 7.4 Degassing procedure, charge calculation and other individual problem.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Refractories	07	08	02	02	12
II	Fuels	05	04	02	02	08
III	Principle of Heat Transfer & Waste Heat Recovery	05	04	02	02	08
IV	Introduction to Industrial Furnaces	07	08	02	02	12
V	Electric Resistance Furnaces	10	08	04	04	16
VI	Electric Arc & Induction Furnaces	10	08	04	04	16
VII	Melting of Nonferrous Metals	04	04	02	02	08
	Total	**48**	**24**	**32**	**24**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on practical performed in laboratory. Journal consists of write ups, diagrams, observations, required tools, equipment and date of performance with teacher signature.
b. Power Point Presentation on construction of different types of furnaces by group of two/three students. (Duration:10 minutes)
c. Power Point Presentation on working of different types of furnaces by group of two/three students. (Duration:10 minutes)
d. Prepare display charts showing construction of different types of furnaces.
e. Prepare flow sheets to explain working of different types of furnaces.
f. Prepare models of furnaces.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.

d. Guide student(s) in undertaking micro-projects.
e. Prepare and use power point presentations related to different topics.
f. Use Videos/Flash/Animations to explain various topics and subtopics.
g. Expert lectures related to topics.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare industrial survey report of furnace refractories/ fuels/ waste heat recovery equipments/ fuel fired furnaces/ atmospheres/ electric resistance furnaces/ arc furnaces/ induction furnaces etc.
b. Prepare demonstration model of any of the furnaces.
c. Prepare a report of fuel consumption of various fuel fired furnaces.
d. Prepare a report of energy consumption of various electric furnaces.
e. Collect technical specifications of various furnace refractories/ fuels/ waste heat recovery equipments/ fuel fired furnaces/ atmospheres/ electric resistance furnaces/ arc furnaces/ induction furnaces etc.
f. Prepare visit report on any industry using different furnaces.
g. Prepare tabulated summary for refractories/ fuels/ insulating materials etc used in various furnaces.
h. Prepare report on construction of various furnaces.
i. Prepare report on working of various furnaces.
j. Prepare report on specifications, sketches of various furnaces.

12. SUGGESTED LEARNING RESOURCES

S. N.	Title	Author	Publisher, Edition and Year of Publication, ISBN Number
1	Element of Fuels, Furnace & Refractories	O.P.Gupta	Khanna Publishers, Delhi ISBN-13: 9788174090881 ISBN-10: 8174090886
2	Industrial Furnaces	W. Trinks & M.H.Nawhiney	Wiley Publisher, Newyork, VI Edition, 2004 ISBN-13: 9780471387060 ISBN-10: 0471387061
3	Electroheat	H. Barber	Granada Publication, London ISBN-13: 9780246117397 ISBN-10: 0246117397

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com-http://www.nptelvideos.in/2012/12/fuels-refractory-and-furnaces.html
2. Direct Arc Furnace- https://youtu.be/1qnhXgqgWKc
3. Indirect Arc Furnace- https://youtu.be/RswesHu--Cw
4. Induction Furnace- https://youtu.be/RgFEiRu7sUM

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	3	2	1	2
CO2	3	2	2	2	1	1	1
CO3	3	2	2	2	2	2	2
CO4	3	3	2	2	2	2	3

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1
CO2	3	1	2	1
CO3	3	1	2	2
CO4	3	2	2	3

Sign: Name: Shri.A.V.Mehtre (Course Expert)	Sign: Name: Smt.N.S.Kadam (Head of Department)
Sign: Name: Smt.N.S.Kadam (Program Head) (Metallurgical Engineering Department)	Sign: Name: Shri.A.S.Zanpure (CDC In charge)

Government Polytechnic, Pune

‘180 OB’ – Scheme

Programme	**Diploma in CE**/EE/ET/**ME**/**MT**/CM/IT/DDGM
Programme Code	**01**/02/03/**04**/**05**/06/07/**15**/16/17/**18**/**19**/**21**/22/23/**24**/26
Name of Course	**Applied Mathematics III**
Course Code	**SC2101**
Prerequisite course code & name	**SC1102– Applied Mathematics II**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Tutorials		Total Marks
L	T	P	C		ESE	PA	ESE	PA	
03	01	00	04	Marks	80	20	--	25	125
				Exam Duration	3 Hrs	1 Hr	--	--	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

The student shall learn various techniques in integration and differential equations and use these techniques to their related Engineering problems.

3. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Solve various engineering related problems using the principles of applied mathematics.**

4. COURSE OUTCOMES (COs)

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 above mentioned competency**:**

1. Solve the given problems of integration using suitable methods.
2. Apply the concept of integration to find area under the curve and between the curve and volume of a solid revolution.
3. Solve the differential equation of first order and first degree using suitable methods.
4. Obtain PDE using the suitable methods.
5. Use the concept of dot and cross product to calculate work done and moment of force about a point & line respectively.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	**Practical Exercises** (Learning Outcomes in Psychomotor Domain)	Relevant COs	Approx. Hrs. Required
1	1	Solve problems based on methods of integration by substitution	1	2
2	1	*Solve problems based on integration by parts.	1	1
3	1	*Solve problems based on methods of integration by partial fractions	1	1
4	2	Solve practice problems based on properties of definite integration.	2	1
5	2	*Solve practice problems based on finding area under curve, area between two curves.	2	1
6	2	*Solve practice problems based on finding volume of revolutions.	2	1
7	3	*Solve the problems based on formation, order and degree of differential equations	3	1
8	3	*Develop a model using variable separable method to related engineering problem.	3	1
9	3	Develop a model using the concept of linear differential equation to related engineering problem.	3	2
10	4	*Solve the problems based on formation of first order and second order PDE	4	1
11	4	*Application of partial differential equations and related engineering problem	4	1
12	5	Solve the problems based on	5	1

		algebra of vectors (Equality, addition, subtraction and scalar multiplication)		
13	5	Solve the problems based on Dot (Scalar) product with properties Vector (Cross) product with properties	5	1
14	5	Solve the practice problems based on Work done and moment of force about a point & line	5	1
15	ALL	Complete a Micro- project as per the guidelines in point no. 11 towards the fulfillment of the COs of the course.	ALL	4
		Total		16

***Experiment No. 15 compulsory, perform experiment 2 or 3, experiment 5 or 6, experiment 7 or 8 and experiment 10 or 11.**

S.No.	Performance Indicators	Weightage in %
a.	Prepare experimental set up	-
b.	Handling of instruments during performing practical.	-
c.	Follow Safety measures	-
d.	Accuracy in calculation	20
e.	Answers to questions related with performed practices.	40
f.	Submit journal report on time	20
g.	Follow Housekeeping	10
h.	Attendance and punctuality	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned**.**

S. No.	Equipment Name with Broad Specifications	Experiment Sr. No.
1	LCD Projector	1-14
2	Interactive Classroom	1-14

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit I: Integration (09 hrs, 20 marks)	
1a. Obtain the given simple integral(s) using substitution method. 1b. Integrate given simple functions using the integration by parts. 1c. Evaluate the given simple integral by partial fractions.	1.1 Methods of Integration: a. Integration by substitution. b. Integration by parts. c. Integration by partial fractions.
Unit II: Definite Integrals (09 hrs, 16 marks)	
2a. Solve given simple problems based on properties of definite integration. 2b. Apply the concept of definite integration to find the area under the given curve(s). 2c. Utilize the concept of definite integration to find area between given two curves. 2d. Invoke the concept of definite integration to find the volume of revolution of given surface	2.1 Definite Integration: a. Simple examples b. Properties of definite integral (without proof) and simple examples. 2.2 Applications of integration : a. Area under the curve. b. Area between two curves. c. Volume of revolution.
Unit III: Differential Equations (12 hrs, 20 marks)	
3a. Find the order and degree of given differential equations 3b. Form simple differential equation for given simple engineering problems. 3c. Solve given differential equations using the method of Variable separable form. 3d. Solve the given differential equations using linear differential equations.	3.1 Concept of differential equation. 3.2 Order, degree and formation of Differential equations 3.3 Solution of differential equation a. Variable separable form. b. Linear differential equation. 3.4 Application of differential equations and related engineering problem(s).
Unit IV: Partial Differential equations (09 hrs, 12 marks)	
4a. Form partial differential equation for given simple engineering problems 4b. Solve given partial differential equations by direct integration 4c. Solve the linear partial differential equations.	4.1 Concept of PDE 4.2 Formation PDE 4.3 Solution of PDE's a. Equations solvable by direct integration b. Linear partial differential equations
Unit V: Vectors (09 hrs, 12 marks)	
5a. Define different types of Vectors. 5b. Find dot and cross product of vectors. 5c. Find work done and moment of force about the point and line.	5.1 Definition of vector, position vector, Algebra of vectors (Equality, addition, subtraction and scalar multiplication) 5.2 Dot (Scalar) product with properties. 5.3 Vector (Cross) product with properties. 5.4 Work done and moment of force about a point & line.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Integration	09	04	04	12	20
II	Definite integration	09	--	08	08	16
III	Differential equation	12	04	08	08	20
IV	Partial Differential Equations	09	04	04	04	12
V	Vectors	09	04	04	04	12
	Total	**48**	**16**	**28**	**36**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

a. Identify engineering problems based on real world problems and solve with the use of free tutorials available on internet.
b. Use graphical software's: EXCEL, DPLOT and GRAPH for related topics.
c. Use Mathcad as Mathematical Tool and solve the problems on Calculus.
d. Indentify problems based on applications of differential equations and solve these problems

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. Use Flash/Animations to explain various components, operation and
d. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

Only one Micro Project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. She/He ought to submit it by the end of semester to develop industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs. The Micro-Project could be industry application based, internet based, workshop based, laboratory based or field based. The assessment of micro-project is to be done under Practical (PA) Assessment. The Micro Project preferably assign to the group of (4-6) students or an individual taking into the considerations the capabilities and circumstances at the time

A suggested list is given here. Similar micro-project could be added by the concerned faculty.

a. Prepare charts displaying the area of irregular shapes using the concept of integration.
b. Prepare charts displaying the volume of irregular shapes using the concept of integration.
c. Prepare models using the concept of differential equations for radio carbon decay.
d. Prepare models using the concept of differential equations for population growth.
e. Prepare models using the concept of differential equations for thermal cooling.
f. Prepare models using the concept of partial differential equation to solve engineering problems.
g. Prepare models using the concept of vector to solve engineering problems.

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1.	Higher Engineering Mathematics	Grewal B. S.	Khanna publication New Delhi , 2013 ISBN: 8174091955
2.	A text book of Engineering Mathematics	Dutta. D	New age publication New Delhi, 2006 ISBN: 978-81-224-1689-3
3.	Advance Engineering Mathematics	Kreysizg, Ervin	Wiley publication New Delhi 2016 ISBN: 978-81-265-5423-2
4.	Advance Engineering Mathematics	Das H.K.	S Chand publication New Delhi 2008 ISBN: 9788121903455
5.	Engineering Mathematics Volume I (4th edition)	Sastry S.S.	PHI Learning, New Delhi, 2009 ISBN: 978-81-203-3616-2

13. SOFTWARE/LEARNING WEBSITES

a. www.scilab.org/ -SCI Lab
b. www.mathworks.com/product/matlab/ -MATLAB
c. Spreadsheet Applications
d. www.dplot.com
e. https://www.khanacademy.org/math?gclid=CNqHuabCys4CFdOJaddHoPig

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	1	-	-	-	1
CO2	3	3	1	-	-	1	2
CO3	3	3	-	-	-	-	1
CO4	3	3	1	1	-	-	1
CO5	2	2	-	-	-	-	1

	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	-
CO2	-	-	-	-
CO3	-	-	1	-
CO4	-	-	-	-
CO5	-	-	-	-

Sign: Name: Shri.S. B. Yede Shri V. B. Shinde Smt. P. R. Nemade (Course Experts)	Sign: Name: Smt.N.S.Kadam (Head of Department)
Sign: Name: Smt.N.S.Kadam (Program Head) (Metallurgical Engineering Department)	Sign: Name: Shri A. S. Zanpure (CDC In charge)

Government Polytechnic, Pune

Department of Metallurgical Engineering

180 OB Curriculum

Level-3: Basic Technology Courses

(All Compulsory)

Sr. No.	Course Code	Course Name
1	MT3101	Basic Metallurgy
2	MT3102	Material Testing & Quality Assurance
3	MT3103	Metallurgical Analysis
4	MT3104	Iron Making
5	MT3105	Steel Making
6	MT3106	Extraction of Non Ferrous Metals

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme Code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19**/21/22/23/24/26
Name of Course	**Basic Metallurgy**
Course Code	**MT3101**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			**Total Credits (L+T+P)**		**Examination Scheme**				
					Theory		**Practical**		**Total Marks**
L	**T**	**P**	**C**		**ESE**	**PA**	**$ESE**	**PA**	
03	00	02	05	**Marks**	80	20	50	50	200
				Exam Duration	3 Hrs	1 Hr	--	--	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

Basic metallurgy mainly deals with basic topics required for understanding metallurgical subjects. The subject is a collection of widely different basic topics such as fuels, refractory's, vacuum technology, conceptual understanding of structure of solid materials and their properties.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Selection and proper use of materials, fuels and temperature measuring devices in metallurgical applications.**

4. COURSE OUTCOMES (COs)

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 above mentioned competency**:**

1. Familiar with material structure and properties.
2. Compare cold working and hot working
3. Select and apply various fuels for applications.
4. Appropriate use of refractory.
5. Understand working of various temperature measuring device.
6. Elaborate vacuum production and application in metallurgy.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Relevant CO**	**Approximate Hours Required.**
1	2	Crystal structures and planes – F.C.C., B.C.C., H.C.P., structures to be studied with the help of models, sketching structures and planes. Miller indices planes and direction with the help of models. Crystal defect study	1,2	06
2	4	Proximate analysis of coal and coke: Determination of moisture content volatile matter and ash content of coal and coke	3	02
3	4	Calorific value of fuel: Determination of calorific value of coal and coke by using bomb calorimeter.	3	02
4	5	Study of flash point apparatus: Determination of flash point of liquid fuel such as furnace oil.	3	02
5	5	Study of burners.	3	02
6	5	Study of burners used for gas and liquid fuels.	3	02
7	6	Properties of refractories: Determination of cold crushing strength and porosity of different refractories.	4	06
8	6	Visual inspection of refractories identification of various types of refractories and physical defects such as chips, cracks etc	4	06
9	All	Complete a micro project based on guidelines provided in Sr. No.11	1 to 6	04
			Total Hrs	**32**

S.No.	**Performance Indicators**	**Weightage in %**
a.	Observation, Collection and presentation of data	30
b.	Preparation of report	30
c.	Interpretation of result and Conclusion of report	20
d.	Answer to sample questions	10
e.	Submission of report in time	10
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned.

Sr.No.	Major Equipment/ Instruments Required	Experiment Sr. No
1	Models of crystal structure and defects	1
2	Bomb calorimeter, micro oven, muffle furnace	2,3,4
3	Weigh balance, UTM	7

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit- I. Introduction (01 hrs, 00 marks)	
1a. State the different aspect of basic metallurgy. 1b. State the area applications of Basic metallurgy.	1.1 Importance of metallurgy, branches of metallurgy and scope under Indian condition.
Unit- II. Nature of Solids (08 hrs, 08 marks)	
2a. Conversant with structure and unit cell, types of crystal system and designation of planes and direction with applications. 2b. Explain the defect in crystal with causes and effects. 2c. State properties and advantages of polymorphism.	2.1 States of matter, types of structures, atomic structure of metals, determination of atomic packing factor and density of metal; allotropy, miller indices for planes and directions. 2.2 Imperfections in the crystals of point; line and surface. 2.3 Polymorphism.
Unit- III. Plastic Deformation (04 hrs,10 marks)	
3a. Compare cold & hot working of process, parameter, properties and application. 3b.Explain characteristic and structure of nonmetallic materials. 3c. Explain polymeric materials properties; uses and structure.	3.1 Grain structure, hot working, cold working, annealing, recrystallisation, and recovery and grain growth. 3.2 Structures of silicates, carbon, glasses 3.3 Polymeric structure. Ceramics and their comparison with metals (Strength to weight ratio).
Unit- IV. Solid Fuels (08 hrs, 18 marks)	
4a. Explain term fuel and its classification. 4b. Classify solid fuels. 4c. Explain properties and advantages of each solid fuels. 4d. Compare peat; lignite and anthracite	4.1 Classifications of fuels, solid fuels classification; properties; advantages; limitation and application, Occurrence/origin of coal with reference to Indian conditions. 4.2 Classifications of coal, peat, lignite, bituminous anthracite carbonization of coal-process, products

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
appearance. Properties and uses. 4e. Classify bituminous coal. 4f. Explain carbonization process, list various products of carbonization. 4g. Enlist properties and application of Metallurgical coke or Hard coke 4h. Describe various requirement / selection criteria of fuel for cupola Furnace or any coal fired furnace.	and there uses, properties and uses of Metallurgical coke, bi-products of coke. Use of pulverized and briquetted coal or coke. 4.3 Selection criteria of fuel for particular application. Combustion Mechanism of coke.
Unit- V. Liquid, Gaseous Fuels and Furnace Technology (12 hrs, 18 marks)	
5a. Explain properties, advantages, limitation and general uses of liquid fuels. 5b. Classify petroleum. 5c. Define refinery. List various products of petroleum refining. 5d. Describe properties, calorific value, composition and uses of any one liquid fuels. 5e. Describe manufacturing of water gas or producer gas. 5f. properties and uses of LPG/BF Gas. 5g. Describe any one liquid or gaseous fuel consisting burners.	5.1 Important properties and uses of various liquid fuels. Resources of petroleum , classification of crude oil- properties, refining of petroleum , products and uses Petrol, diesel, kerosene and furnace oil etc 5.2 Manufacture of gaseous fuels. Gaseous fuels composition. Properties and uses of Natural gas. Blast furnace gas, coke oven gas and liquefied petroleum gases. Water gas, producer gas and LPG etc. 5.3 Study of types of flames. Burners required for combustion of liquid and gaseous fuels and their working principles. Regenerators & recuperators.
Unit- VI. Refractory Materials (06 hrs, 08 marks)	
6a. Define and classify refractory 6b. Explain important properties of refractories. 6c. Explain PCE test of refractory. 6d. Explain properties and uses of any one acidic refractory. 6e. Explain properties and uses of any one basic refractory. 6f. Explain any special /neutral refractory advantages and applications.	6.1 Classification of refractory, general properties such as refractoriness, porosity, chemical inertness, strength at elevated temperature etc. 6.2 Testing of refractories such as PCE test etc. 6.3 Properties and Application of acidic refractories such as fireclay, silica, alumina etc. 6.4 Properties and Application of basic refractories such as magnesite, chromite. 6.5 Properties and application of neutral refractories such as carbon and special refractory's like insulation materials, , zirconia, cer-wool
Unit- VII. Furnace Technology (06 hrs, 10 marks)	
7a. Enlist various industrial furnace in metallurgical area application 7b. State refractory and fuel used in cupola furnace. 7c. Classification of furnaces 7d. Explain working & uses of shaft furnace.	7.1 Basic types of furnaces, Use in industries. 7.2 Refractories used in furnaces, different fuels used in furnaces. 7.3 Types of furnaces – Shaft, reverberatory, coke fired furnace. 7.4 Applications of Thermocouples and Pyrometers in

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
7e. Enlist various temperature measuring device and state its working principle 7f. Explain infrared analyzer for temperature measurement	Metallurgical Industries. 7.5 Introduction to Infrared analyzer for temperature measurement.
Unit- VIII. Vacuum Technology (03 hrs, 08 marks)	
8a. Explain term vacuum with measuring unit. 8b. Enlist various vacuum producing pumps 8c. Explain working of vacuum pumps 8d. Enlist & Explain areas of vacuum in metallurgical applications.	8.1 Define vacuum, unit of vacuum. 8.2 Method of vacuum production, equipments, its working principles. 8.3 Application of vacuum metallurgy.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction	01	00	00	00	00
II	Nature of Solids	08	04	02	02	08
III	Plastic Deformation	04	05	05	00	10
IV	Solid Fuels	08	08	06	04	18
V	Liquid, Gaseous Fuels and Furnace Technology	12	08	06	04	18
VI	Refractory Materials	06	02	04	02	08
VII	Furnace Technology	06	06	02	02	10
VIII	Vacuum Technology	03	04	02	02	08
	Total	**48**	**37**	**27**	**16**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course. Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on practical performed in laboratory and study practicals.
b. Prepare the history sheet/information sheet for the particular application in Basic metallurgy topics.
c. Search information about furnaces for melting and heat treatment application.
d. Collect information of new development/instrument in temperature measurement.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Use videos to explain different concepts.
f. Teacher should ask the students to go through instruction and technical manuals.
g. Read ASM handbook for further study of the various topics.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs.(Affective Domain Outcomes) .Each student will have to maintain activity chart consisting of individual contribution in the project work and give a seminar presentation of it before submission.. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare detailed report on materials and human civilization.
b. Prepare report on the different crystal system and arrangement in unit cell.
c. Prepare models of different crystalline defects.
d. Prepare report on hot working / cold working in terms of process parameters, advantages, disadvantages & applications.
e. Prepare tabulated summary for solid/liquid/ gaseous fuels.
f. Prepare report on working of carbonization of coal & it's by products.
g. Prepare report on working of petroleum refinery & products.
h. Prepare report on production of refractory materials & uses.
i. Prepare tabulated summary for various refractories in term properties, advantages, limitations and applications.
j. Prepare report on specifications, sketches of different Industrial furnaces in metallurgical field.
k. Collect technical specifications of vacuum pumps & uses in metallurgical applications.
l. Collect technical specifications of various temperature measuring device / instruments.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of Publication, ISBN Number
1	Fuel Technology Vol I & II	Francis	Pergaman Press, London.
2	Elements of Metallurgy	D Swarup.	Rastogi Publication, Meerut. ISBN-10: 8171338135 ISBN-13: 788171338139
3	Fuels & Refractories	Gilchrist J.D.	Perganson. ISBN-10:0080204295 ISBN13:9780080204291
4	Elements of Fuels, Refractories	O.P.Gupta	Oxford Press. ISBN-10:8174090886 ISBN13:9788174090881

13. SOFTWARE/LEARNING WEBSITES

1. http://nptel.ac.in/courses/112107144/10
2. https://www.youtube.com/watch?v=mUyzb1fzWKs
3. https://www.youtube.com/watch?v=5VmeIunoyKw

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	2	2	1	2
CO2	3	1	1	2	1	-	2
CO3	3	2	2	2	1	-	2
CO4	2	2	1	3	2	2	2
CO5	1	2	2	2	2	2	2
CO6	1	1	2	-	2	1	-

	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	1
CO2	3	1	2	1
CO3	3	*2*	2	1
CO4	3	2	2	1
CO5	3	2	2	1
CO6	2	-	-	1

Sign: Name: Shri. P.B. Kamble (Course Expert)	Sign: Name: Smt. N.S. Kadam (Head of Department)
Sign: Name: Smt. N.S. Kadam (Program Head) (Metallurgical Engineering Department)	Sign: Name: Shri A.S.Zanpure (CDC In charge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme Code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19**/21/22/23/24/26
Name of Course	**Material Testing and Quality Assurance**
Course Code	**MT3102**
Prerequisite course code and name	**NA**
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			**Total Credits (L+T+P)**		**Examination Scheme**				
					Theory		**Practical**		**Total Marks**
L	**T**	**P**	**C**		**ESE**	**PA**	***ESE**	**PA**	
03	00	04	07	**Marks**	80	20	50	25	175
				Exam Duration	3 Hrs	1 Hr	--	--	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

Engineers use different materials for various engineering purposes. These materials and solid objects are subjected to various kinds of forces and stresses during service and often involve the risk of breaking in service and in that situation they cannot be welded or molded instantly. It may take long to further rework on the same to give them shape or they may not be re -shaped at all. Hence, it is necessary to make the material and objects strong enough. To ensure this, these solid objects require various types of destructive and non destructive testing during the manufacturing process so that the risk factor is reduced, facilitating durability and long lasting capacity (or endurance).

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Perform Destructive and Non Destructive tests on materials**.

4. COURSE OUTCOMES (COs)

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 above mentioned competency**:**

1. Use of the general terms and relevant method in testing of materials.
2. Draw and explain the stress strain diagram.
3. Awareness about various types of machines and equipments used for testing.
4. Perform mechanical test on materials and apply test results to improve quality of Material.
5. Inspect and identify defects/soundness by using relevant NDT methods.
6. Describe various components for quality standards for quality assurance.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Relevant CO**	**Approximate Hours Required.**
1.	1	To carry out tensile test on mild steel and aluminum.	1	08
2.	1	To draw stress-strain curve. To interpret the curve with respect to applicability of materials.	1,2	06
3.	1	To acquaint with various tensile test machines.	3,4	08
4.	2	To carry out hardness tests on samples using Vicker, Brinell, Rockwell and Poldi Hardness Testers.	3,4	12
5.	3	To carry out impact tests on brass, aluminum and copper specimens.	3,4	06
6.	4	To carry out fatigue tests on mild steel and aluminum specimens	3,4	06
7.	5	To study creep test. Interpretation of test results.	3,4	08
8.	6	To carry out dye penetrant test and magnetic particle test.	5	06
9.	All	Complete a micro project based on guidelines provided in Sr.No.11	1 to 6	04
			Total Hrs	**64**

S.No.	**Performance Indicators**	**Weightage in %**
a.	Arrangement of available equipment / test rig or model, Performing task, Following safety measures	50
b.	Observations, Interpretation and conclusion	30
c.	Answer to sample questions and submission of report in time	20
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specifications mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned.

Sr.No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	UTM 40T, Vernier caliper, gauge length marker	1,2,3,9
2	Vicker, Brinell, Rockwell and Poldi Hardness Testers.	4,9
3	Impact Tester – Charpy or Izod	5,9
4	Fatigue testing machines- Rotating beam	6,9
5	Creep testing setup	7,9
6	Dye Penetrant Inspection setup	8,9
7	Magnetic Particle Inspection setup	8,9

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Section I	
Unit- I. Mechanical properties of metals (10 hrs, 16 marks)	
1a. Compare the salient features 1b. Understand various loading Condition. 1c. Compare elastic & plastic deformation. 1d. Explain term e.g. stress strain, yield point etc. 1e. Explain Hooks law or modulus of elasticity. 1f. Explain or compare shear & torsion test. 1g. Explain fracture mechanism & its type. 1h. Explain procedure to conduct tensile test.	1.1 A brief introduction to bonding arrangement in materials and especially in metals and alloys i.e. metallic bond. 1.2 Deformation of metals under various loading conditions i.e. tensile, compressive and shear. 1.3 Elastic and plastic deformation, various terms used i.e. stress, strain, elasticity, plasticity, toughness, resilience. Stress- Strain curves, Yield point and yielding phenomenon, percentage elongation and reduction in area, proof stress. Hook’s law, Modulus of elasticity, Young’s modulus. 1.4 Shear and torsion tests. 1.5 Fracture and its mechanism. Fracture of ductile and brittle materials. Operations with tensile testing machines, universal testing machine etc. for tensile, compressive, shear or bending strength.

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit- II. Hardness Tests (07 hrs**,** 12 marks)	
2a. Explain and compare method of hardness test. 2b. Enlist and Explain various indentation. 2c. Explain working and advantages of Brinell, Vicker, Rockwell and Knoop 2d. Draw and explain Poldi hardness test. 2e. State principle of Micro hardness tester.	2.1 Concept of hardness. Methods of hardness test, such as indentation, scratch and rebound. 2.2 Types of indentation hardness tests, such as Brinell, Vicker, Rockwell and Knoop, their indenters and Measurements of hardness number. 2.3 Rebound hardness test. 2.4 Shore Scleroscope. 2.5 Dynamic hardness tester. 2.6 Poldi Hardness Testers. 2.7 Scratch hardness test: Moh's scale of hardness, File test, Brief introduction to hardness machines and their operations. 2.8 Principle of Micro hardness tester.
Unit- III Impact Tests (07 hrs**,** 12 marks)	
3a. Explain significance of impact test. 3b. Give example of dynamic test. 3c. Explain/Compare Charpy and Izod in term of principle, procedure and parameter 3d. Explain factor affect on impact strength.	3.1 Significance of impact test. 3.2 Izod and Charpy impact tests. Their specimen details, mounting of specimens in each case. Effect of variables on the impact test values such as variation in striking velocity, size and shape of specimen, temperature, grain size and composition. 3.3 Embrittlement phenomena: temper and hydrogen embrittlement. 3.4 Impact strength- Temperature relationship and transition temperature range.
Section II	
Unit-IV Fatigue Test (06 hrs**,** 10 marks)	
4a. Explain fatigue 4b. Define repeated loading and state its types. 4c. Explain fatigue strength and endurance limit. 4d. Explain fatigue testing procedure. 4e. Explain factors to improve fatigue properties. 4f. Explain effect of composition /surface condition/stress concentration /size on strength of fatigue.	4.1 Concept of fatigue. Repeated loadings, their types. 4.2 Fatigue test, fatigue strength, and endurance limit. Orowan's and Wood's theories explaining fatigue failure. Effect of composition, stress concentration, size and surface conditions on fatigue strength. 4.3 Measures to be taken to improve fatigue life.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit- V Creep Test (06 hrs**,** 10 marks)	
5a. Explain creep concept 5b. Explain procedure to creep test. 5c. Explain stages in creep curve. 5d. Describe factors affect on creep. 5e. Explain relationship between creep rate, stress and temperature.	5.1 Concept of creep. Creep Test. Standard creep curve with explanation of various stages. Effect of temperature on creep test, equi-cohesive temperature. 5.2 Factors affecting creep such as composition, grain size, method of steel making and heat treatment. 5.3 Relation between creep rate, stress and temperature.
Unit- VI Non-Destructive Testing (08 hrs**,** 12 marks)	
6a. State the need and requirements of NDT. 6b. Classify NDT**.** 6c. Enlist advantages of NDT and state its type 6d. Compare NDT & DT. 6e. Explain testing procedure of penetrant test/Magnetic method etc.	6.1 Need for non-destructive tests. Concept of nondestructive tests. 6.2 Comparison between destructive and non-destructive tests. 6.3 Introduction to various non-destructive tests such as: Visual examination, Leakage testing, Penetrant test, Magnetic methods, Acoustic methods, Ultrasonic test, Radiography, Thermal tests, Electrical methods- Eddy current method.
Unit- VII Quality Aspects (04 hrs**,** 08 marks)	
7a. Explain quality and state its importance. 7b. Enlist various quality standards. 7c. Explain ISO 9000 Series standards.	7.1 Concept of quality. Brief introduction to various quality standards, such as ISI, BIS and ISO. Brief introduction to ISO 9000 series standards.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
Section I						
I	Mechanical properties of metals	10	8	4	4	16
II	Hardness Tests	07	8	2	2	12
III	Impact Tests	07	5	3	4	12
	Total	24	21	9	10	40
Section II						
IV	Fatigue Test	06	5	2	3	10
V	Creep Test	06	5	2	3	10
VI	Non Destructive Testing	08	5	3	4	12
VII	Quality Aspect	04	2	2	4	08
	Total	24	17	9	14	40
	Total	**48**	**38**	**18**	**24**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare a comparative chart overall specifications of materials testing methods of same material class.
b. Prepare journal based on practical performed in laboratory.
c. Survey of testing method used in manufacturing (automobile or metallurgy).
d. Search information and prepare report about ratings and specifications of indenters, load selection, calibration and scale of different hardness machines.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Prepare and use power point presentations related to different topics
f. Industrial visit of students to Material Testing unit/labs.
g. Expert lectures related to topics.
h. Use proper equivalent analogy to explain different concepts.
i. Use Flash/Animations to explain various components, operation and
j. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***
The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs.(Affective Domain Outcomes). Each student will have to maintain activity chart consisting of individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare report on the Stress-Strain curve of ductile / brittle metal.
b. Prepare tabulated summary for UTM Maintenance and operations'
c. Collect technical specifications of Any Hardness tester
d. Prepare report on specifications, sketches of report on working of Fatigue testing of aluminum rod
e. Prepare report on specifications, sketches of Creep behavior/measurement
f. Prepare detailed Procedure of any NDT example DPT Operations and results.
g. Prepare a report of Quality issues and standards.
h. Many more……

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of Publication, ISBN Number
1	Mechanical Metallurgy	George E. Dieter	McGraw-Hill Book Company ISBN-10: 1259064794 ISBN-13: 9781259064791
2	Testing and Inspection of Engineering materials	Davis, Troxell and Wiskonell	McGraw-Hill Book Company
3	Testing of Metallic Materials	A.V.K. Suryanarayan	Printice-Hall of India Pvt Ltd ISBN-10: 9352300378 ISBN-13: 9789352300372
4	Material Science And Metallurgy	Dr.V.D.Kodgire	Everest Publishing House ISBN-13 : 9788186314008

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. http://www.capabilitydevelopment.com

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	1	2	2	2
CO2	3	3	2	1	3	2	2
CO3	2	2	2	2	1	1	1
CO4	2	2	1	2	2	2	1
CO5	3	3	2	2	1	2	2
CO6	2	1	1	1	1	2	1

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2
CO2	3	1	2	1
CO3	2	1	2	2
CO4	3	1	2	1
CO5	3	2	2	2
CO6	3	2	2	1

Sign: Name: Shri. P.B. Kamble (Course Expert)	Sign: Name: Smt. N.S. Kadam (Head of Department)
Sign: Name: Smt. N.S. Kadam (Program Head) (Metallurgical Engineering Department)	Sign: Name: Shri. A.S.Zanpure (CDC In charge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme Code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19**/21/22/23/24/26
Name of Course	**Metallurgical Analysis**
Course Code	**MT3103**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	***ESE**	**PA**	
02	00	02	04	**Marks**	40	10	50	50	150
				Exam Duration	2 Hrs	1/2 Hr	--	--	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

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. Chemical analysis became essential to investigate the composition of these materials to provide data in respect of composition and the properties therefore. The metallurgist is expected to be conversant with various processes of chemical analysis. He should know the principles and laws governing the chemical reactions, which can be applied to decide the extraction path of metals from its specific ores. Metallurgist should have an insight of instruments and their operating principles used for chemical analysis.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Conversant with various method of chemical analysis. to measure composition or control composition in variety of metallurgical process/applications to enhance quality/properties in particular product.**

4. COURSE OUTCOMES (COs)

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 above mentioned competency**:**

1. Elaborates /develops the importance/awareness of quantitative chemical analysis in different application areas.
2. Precisely apply procedure and predict result of volumetric analysis.
3. Enable to handle various instrument of instrumental analysis.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Relevant CO**	**Approximate Hours Required.**
1	1	Preparation of standard solution.	1	04
2	1	Observing the effects of common ion and diverse ion on solubility	1	04
3	2	To perform acid-base titration.	2	04
4	2	Determination of Fe^{++} by redox method	2	04
5	3	Colorimetric determination of concentration of solution [$CuSO_4$ and/or $KMNO_4$].	3	04
6	3	Determination of C/S in steel by combustion method.	3	04
7	3	Study of various spectrometer	3	04
8	All	Complete a micro project based on guidelines provided in Sr. No.11	1 to 3	04
			Total Hrs	**32**

S.No.	**Performance Indicators**	**Weightage in %**
a.	Arrangement of available equipment	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned.

Sr.No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	Single pan digital precise weigh balance, heating source/unit, glasswares, pipette and measuring flask	1,2
2	Titration setup, colorimeter tubes	3,4,5
3	Strohein's apparatus, spectrometer	6,7

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit- I. Introduction (04 hrs, 10 marks)	
1a. Enlist various areas of chemical analysis. 1b. Compare qualitative and quantitative analysis. 1c. 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.
Unit- II Volumetric Analysis (14 hrs, 15 marks)	
2a. Define various term in volumetric analysis. 2b. Explain requirement of volumetric analysis. 2c. State volumetric reactions 2d. Explain various titration curves. 2e. Enlist indicators and relation of indicator ph and equivalence ph. 2f. Explain Redox titration.	2.1 Solution, concentration of solution, methods to express solution strength, Equivalent weight, Normality of solution, preparation of standard solution. Types of volumetric reaction, requirements of volumetric analysis, advantages etc. 2.2 Acid –Base neutralization reaction. 2.3 Titration, types and methods of titration. Equivalence point, End point and Neutral point in Acid-Base titrations. 2.4 Indicators, role and action of indicators in titration, P^H range of indicator, Selection of indicator for acid base titration. 2.5 Titration curve, plotting of different titration curves depending upon different strength of acid and base e.g. weak acid with strong base etc. 2.6 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. 2.7 Comparisons between volumetric and instrumental analysis 2.8 Simple calculations with respect to strength of the solution.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit- III Instrumental Analysis (14 hrs, 15 marks)	
3a. Explain characteristic and advantages 3b. Compare vacuum emission and atomic absorption spectrometer. 3c. Explain procedure of colorimetric method. 3d. Explain procedure to determine c & s in steel by combustion	a. Scope for instrumental analysis. Advantages of instrumental analysis. b. Introduction to Spectroscopy, classification of spectrometer, principal, working & advantages of emission and atomic absorption spectrometer; Introduction to X-ray fluorescence process (XRF), Polorography and Colourimetry. Beer's Law and Lambert's Law c. Colorimetric methods, Photoelectric colorimeter. d. Electrolysis, Potentiometric Titration e. Carbon and sulphur determination in steel by combustion method (Stroheins Apparatus)

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction	04	04	04	02	10
II	Volumetric Analysis	14	03	04	08	15
III	Instrumental Analysis	14	03	04	08	15
	Total	**32**	**10**	**12**	**18**	**40**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course. Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journal based on practical performed in laboratory.
b. Prepare the history sheet/Information sheet for the particular application in metallurgical analysis topics.
c. Search information and prepare report about advanced instruments used in chemical analysis.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the

development of the COs through classroom presentations (see implementation guideline for details).

c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Prepare and use power point presentation for related topics.
e. Guide student(s) in undertaking micro-projects.
f. Use videos to explain different concepts.
g. Teacher should ask the students to go through instruction and technical manuals.
h. Read ASM handbook for further study of the various topics.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs.(Affective Domain Outcomes) .Each student will have to maintain activity chart consisting of individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare detailed layout, equipment, consumables and norms set up chemical analysis laboratory.
b. Collect information about qualitative & quantitative methods used in Metallurgy.
c. Prepare report on specifications, sketches of different glassware's & standards used in chemical laboratory.
d. Prepare tabulated summary for precautions & safety procedures in chemical laboratories.
e. Prepare visit report on any chemical laboratory.
f. Prepare report on standards & procedures of volumetric analysis.
g. Collect information about redox titration and applications.
h. Prepare report on working of any one type of spectrometer.
i. Prepare report on specifications, sketches and list of instrument used in chemical laboratory for quantitative analysis.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of Publication, ISBN Number
1	Text Book Of Metallurgical Analysis	B.C.Agarwal ,S.P. Jain	Khanna Publisher, N. Delhi. ISBN-10:8174091351 ISBN-13:9788174091352
2	Physical and Analytical Chemistry	Dr. S.B. Salunke, Dr. B.B. Deogadkar, Dr. C.M. Bhavasar	Nirali Prakashan, Pune
3	Quantitative Analysis	V. Alexeyev	MIR Publisher, Moscow ISBN-10: 812390293X ISBN-13: 9788123902937

13. SOFTWARE/LEARNING WEBSITES

1. http://nptel.ac.in/courses/112107144/10
2. https://www.youtube.com/watch?v=mUyzb1fzWKs
3. https://www.youtube.com/watch?v=5VmeIunoyKw

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	1	2	1	1	1
CO2	3	3	2	3	1	1	2
CO3	3	2	2	2	1	1	2

	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1	1
CO2	3	3	2	1
CO3	3	2	2	1

Sign: Name: Shri.P.B. Kamble (Course Expert)	Sign: Name: Smt. N.S. Kadam (Head of Department)
Sign: Name: Smt. N.S. Kadam (Program Head) (Metallurgical Engineering Department)	Sign: Name: Shri. A.S.Zanpure (CDC In charge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme Code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19**/21/22/23/24/26
Name of Course	**Iron Making**
Course Code	**MT3104**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	**ESE**	**PA**	
03	00	00	03	**Marks**	80	20	--	--	100
				Exam Duration	3 Hrs	1 Hr	--	--	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. 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 on study of blast furnace, pig iron production and sponge iron production.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Understand the working of blast furnace and chemical reactions occurs in blast furnace.**

4. COURSE OUTCOMES (COs)

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 above mentioned competency**:**

1. Study the development of iron making.
2. Notify the role of charging materials and importance of agglomeration.
3. Explain the working of Blast Furnace and necessary equipments with neat sketch.
4. Write down various reactions in Blast Furnace.
5. Suggest the suitable remedies for varies irregularities in Blast Furnace.
6. Understand the importance of modern practices in Blast Furnace and alternative route of iron production.

5. SUGGESTED PRACTICALS/ EXERCISES
NA

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED
NA

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit I. Introduction (04 hrs, 06 marks)	
1a. Write about ancient iron making processes. 1b. Describe developments in iron making. 1c. Describe modern iron making. 1d. Enumerate alternative methods of iron production. 1e. 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.
Unit II. Raw Materials and Burden Preparation (10 hrs, 16 marks)	
2a. Enumerate types of iron ores. 2b. State the properties and functions of coke. 2c. State types and functions of flux. 2d. State the purpose and methods of beneficiation of iron ore. 2e. State the purpose and classification of agglomeration. 2f. State the principle and advantages of sintering and pelletisation. 2g. Describe the process of sintering and pelletisation. 2h. Enumerate burden qualities. 2i. State 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
Unit III. Blast Furnace Construction (12 hrs, 20 marks)	

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
3a. Draw neat sketch of Blast furnace. 3b. Describe constructional details of various parts of Blast furnace. 3c. State functions of each part of Blast furnace. 3d. Select appropriate refractories for Blast furnace. 3e. Recommend suitable charging system. 3f. State functions of gas cleaning system. 3g. Explain working of various parts of gas cleaning system. 3h. Describe construction and working of hot blast stove.	3.1 Constructional 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, refractories used, working.
Unit IV. Blast Furnace Operation (10 hrs, 16 marks)	
4a. State working principle of blast furnace. 4b. Describe operational steps of Blast furnace. 4c. Write down chemical reactions in different zones of Blast Furnace. 4d. Draw temperature profile in Blast Furnace. 4e. State composition of Blast Furnace products. 4f. Describe the behavior of S, P, Zn and alkali metals. 4g. Write down the average quantity of charge required per ton of pig iron.	4.1 Working principle of blast furnace. 4.2 Operations of 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 Behavior of S, P, Zn and alkali metals. 4.6 Average quantity of charge per ton of pig iron.
Unit V. Irregularities & Modern Trends in Blast Furnace (06 hrs, 10 marks)	
5a. State the causes and remedies of various irregularities in Blast furnace. 5b. Describe varies modern trends in blast furnace.	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,

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	c. Humidification of blast, d. Higher blast temperature.
Unit VI. Sponge Iron Production (06 hrs, 12 marks)	
6a. Define Sponge Iron. 6b. Describe physical chemistry of Sponge Iron processes. 6c. Explain HyL, Midrex and Rotary Kiln processes with neat sketch. 6d. Enlist the Sponge Iron making areas in India. 6e. 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.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction	04	02	04	00	06
II	Raw Materials and Burden Preparation	10	02	08	06	16
III	Blast Furnace Construction	12	02	10	08	20
IV	Blast Furnace Operation	10	04	06	06	16
V	Irregularities & Modern Trends in Blast Furnace	06	02	02	06	10
VI	Sponge Iron Production	06	02	06	04	12
	Total	**48**	**14**	**36**	**30**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Gather the data of an intergrated steel plant in India.
b. Prepare the sheet of schematic arrangement for various sections of a Blast Furnace plant.
c. Write in detail about any one sintering or pellitisation process.
d. Prepare the poster of neat sketch of Blast Furnace with reactions.
e. Write down the causes and remedies of irregularities in Blast Furnace.
f. Write down in detail about the modern trends in Blast Furnace practice.
g. Collect information of alternative routes of iron production.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. Prepare and use power point presentation to understand the topics.
e. Use videos to explain various concepts.

11. SUGGESTED MICRO-PROJECTS

NA

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of Publication, ISBN Number
1	An Introduction to Modern Iron Making	Dr. R.H. Tupkary, V.R. Tupkary.	Khanna Publication, 4th Edition, 2016. 978-81-7409-021-5
2	An Introduction to Modern Steel Making	Dr. R.H. Tupkary, V.R. Tupkary.	Khanna Publication, 7th Edition, 2017 978-81-7409-026-6
3	General Metallurgy	Boris Kuznestsov	Mir Publishers, Moscow, 2nd Edition,1979 5-03-000026-7

13. SOFTWARE/LEARNING WEBSITES

1. https://nptel.ac.in/courses/113/108/113108079/
2. https://www.youtube.com/watch?v=ysLqUDa5GEA
3. https://www.youtube.com/watch?v=hBqhGHfzQFQ

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	2	1	3	2	2
CO2	3	1	2	1	1	2	2
CO3	2	1	2	1	1	1	1
CO4	3	1	1	1	2	1	1
CO5	3	3	2	2	1	3	3
CO6	3	2	3	2	1	3	3

	PSO1	PSO2	PSO3	PSO4
CO1	3	--	--	2
CO2	3	--	--	2
CO3	3	--	--	2
CO4	2	--	--	1
CO5	3	1	2	3
CO6	3	--	--	1

Sign: Name: Shri. R.G. Injewar (Course Expert)	Sign: Name: Smt. N.S. Kadam (Head of Department)
Sign: Name: Smt. N.S. Kadam (Program Head) (Metallurgical Engineering Department)	Sign: Name: Shri. A.S.Zanpure (CDC In charge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme Code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19**/21/22/23/24/26
Name of Course	**Steel Making**
Course Code	**MT3105**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	**T**	**P**	**C**		**ESE**	**PA**	**ESE**	**PA**	
03	00	00	03	**Marks**	80	20	--	--	100
				Exam Duration	3 Hrs	1 Hr	--	--	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

Steel is one of the most important material. Applications of steel are much more. Use of steel is much more for construction as well as manufacturing industries. Because of this, knowledge of various methods of steel making is very much essential for metallurgists. In this course, the emphasis is given on the principles of steelmaking and different processes of steel making.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Understand the principle of steel making and monitor this in various steel making processes.**

4. COURSE OUTCOMES (COs)

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 above mentioned competency**:**

1. Understand the necessity of conversion of pig iron into steel.
2. Understand the principles of steel making to obtain quality steel.
3. Select proper raw materials for steel production.
4. Recommend suitable method of production for different types of steels.
5. Understand the importance of oxygen addition in steel production and role of secondary steel making.
6. Identify various components of various continuous casting machines.

5. SUGGESTED PRACTICALS/ EXERCISES

NA

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

NA

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit I. Introduction (06 hrs, 10 marks)	
1a. Write down the history of steel making. 1b. Give classification of steels. 1c. State the necessity of conversion of pig iron into steel. 1d. Enumerate various raw materials for steel making. 1e. State status of different iron and steel industries in India.	1.1 History of steel making. 1.2 Classification of steels. 1.3 Necessity of conversion of pig iron into steel. 1.4 Raw materials for steel making: a. Sources of metallic iron, b. Oxidizing agent, c. Fluxes, d. Sources of heat, e. Deoxidisers and alloying additions, f. Furnace Refractories. 1.5 Present status of iron and steel industries in India.
Unit II. Principles of Steel Making (08 hrs, 10 marks)	
2a. State the principle of steel making. 2b. Understand the reactions occur during steel making. 2c. Compare acid steel making with basic steel making. 2d. Calculate efficiency of steel making process.	2.1 Principles of steel making: a. Carbon reaction, b. Phosphorous reaction, c. Silicon reaction, d. Manganese reactions, e. Sulphur reaction, f. De-oxidation of steel. 2.2 Types of steel making processes- Acid and basic steel making. 2.3 Efficiency of steel making processes.
Unit III. Steel Making Processes (12 hrs, 22 marks)	

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
3a. Describe bessemer process and open hearth process. 3b. Describe the operation of electric arc and induction furnace. 3c. Draw neat sketch of bessemer, open hearth, electric arc and induction furnace. 3d. Describe constructional details of bessemer, open hearth and electric arc furnace. 3e. Compare characteristics of steel produced by bessemer process with open hearth process.	3.1 Bessemer process - Principle, constructional details, process details, merits and demerits, characteristics of steel produced. 3.2 Open - hearth process - Principle, constructional details, process details, merits and demerits, characteristics of steel produced, twin hearth furnace. 3.3 Electric steel making processes: a. Electric arc furnace: Principle, constructional details, charge materials, process detail, outline, merits and demerits, characteristics of steel produced. b. Induction furnace: Principles, charge materials, merits and demerits of process, characteristics of steel produced.
Unit IV. Oxygen Steel Making (08 hrs, 14 marks)	
4a. State the principle of steel making in L.D. converter, Kaldo process, Rotor process and OBM process. 4b. Describe constructional details of L.D. converter. 4c. Describe the operation of L.D. converter, Kaldo process, Rotor process and OBM process. 4d. Draw the sketches of L.D. converter, Kaldo process, Rotor process and OBM process. 4e. State merits, demerits and characteristics of steel produced by L.D. converter, Kaldo process, Rotor process and OBM process. 4f. Draw plant layout of primary steel making.	4.1 L.D. Converter - Principle, constructional details, process details, outline, merits and demerits, characteristics of steel produced. 4.2 Kaldo process - Principle, process, merits and demerits, characteristics of steel produced. 4.3 Rotor Process - Principle, process, merits and demerits, characteristics of steel produced. 4.4 OBM Process - Principle, process, merits and demerits, characteristics of steel produced. 4.5 Plant layout of primary steel making.
Unit V. Secondary Steel Making (08 hrs, 14 marks)	
5a. State the merits of secondary steel making. 5b. Describe various decarburizing techniques. 5c. Describe VAR, ESR. 5d. Draw ladle furnace and explain its working.	5.1 Introduction and merits of secondary steel making process. 5.2 Decarburization techniques - AOD, VOD, CLU. 5.3 VAR and ESR processes. 5.4 Ladle furnace. 5.5 Vacuum Treatment of Steel – Functions, principles, Degassing techniques:

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
5e. Explain the various degassing techniques with neat sketch. 5f. Draw plant layout of secondary steel making.	a. Ladle degassing b. Stream degassing c. Recirculation degassing –R.H. and D-H degassing processes. 5.6 Plant layout of secondary steel making.
Unit VI. Continuous Casting of Steel (06 hrs, 10 marks)	
6a. State principle of continuous casting. 6b. Describe the essential details of continuous casting machine. 6c. Compare different continuous casting machines. 6d. State the merits and demerits of continuous casting.	6.1 Principle of continuous casting. 6.2 Essential details of continuous casting machine. 6.3 Types of continuous casting machines : a. Vertical type, b. Vertical-mould horizontal-discharge type, c. Curved mould. 6.4 Merits, Demerits.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction	06	04	06	00	10
II	Principles of Steel Making	08	02	06	02	10
III	Steel Making Processes	12	02	10	10	22
IV	Oxygen Steel Making	08	02	06	06	14
V	Secondary Steel Making	08	02	06	06	14
VI	Continuous Casting of Steel	06	02	04	04	10
	Total	**48**	**14**	**38**	**28**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare the poster of layout of modern steel plant.
b. Gather the data of modern techniques of steel making.
c. Prepare the sheets of various steel making furnaces.
d. Write in detail about continuous casting.
e. Collect the information of present scenario of steel industries in India.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Use powder point presentation to understand the topics.
e. Use videos to explain various concepts.

11. SUGGESTED MICRO-PROJECTS

NA

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of Publication, ISBN Number
1	An Introduction to Modern Iron Making	Dr. R.H. Tupkary, V.R. Tupkary	Khanna Publication, 4th Edition, 2016. 978-81-7409-021-5
2	An Introduction to Modern Steel Making	Dr. R.H. Tupkary, V.R. Tupkary	Khanna Publication, 7th Edition, 2017. 978-81-7409-026-6
3	General Metallurgy	Boris Kuznestsov	Mir Publishers, Moscow, 2nd Edition, 1979. 5-03-000026-7

13. SOFTWARE/LEARNING WEBSITES

1) https://nptel.ac.in/courses/113/104/113104013/
2) https://nptel.ac.in/courses/113/107/113107096/
3) https://www.steel.org/steel-technology/steel-production

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	1	2	1	2
CO2	3	1	2	1	1	1	1
CO3	3	2	2	1	1	2	2
CO4	3	1	2	2	2	2	2
CO5	2	2	2	1	1	1	2
CO6	3	1	2	1	1	1	2

	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	2
CO2	3	-	-	2
CO3	3	-	-	3
CO4	3	-	-	3
CO5	3	-	-	2
CO6	3	-	-	2

Sign: Name: Shri. R.G. Injewar (Course Expert)	Sign: Name: Smt. N.S. Kadam (Head of Department)
Sign: Name: Smt. N.S. Kadam (Program Head) (Metallurgical Engineering Department)	Sign: Name: Shri. A.S.Zanpure (CDC In charge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme Code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19**/21/22/23/24/26
Name of Course	**Extraction of Non Ferrous Metals**
Course Code	**MT3106**
Pre-Requisite course code & name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical / Oral		Total Marks
L	T	P	C		ESE	PA	ESE	PA	
03	00	00	03	Marks	80	20	--	--	100
				Exam Duration	3 Hrs	1 Hr	--	--	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

This course provides information about mineral dressing, extraction of non ferrous metals, and refining thereafter for various metals, which will be useful for effective management in industry. The basic principles and methods involved in extraction and refining of non-ferrous metals can be implemented by students for engineering and commercial applications.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Apply the knowledge for selection and application of various methods and flow sheet for metal extraction and refining processes for the production of various non-ferrous metals**.

4. COURSE OUTCOMES (COs)

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 above mentioned competency:

1. Select Pyrometallurgical, Hydrometallurgical methods of extraction of Non-ferrous metals.
2. Select appropriate ore dressing process for extraction of metal.
3. Apply knowledge to select suitable processes of extraction depending on Non-ferrous metals to be extracted.
4. Draw flow sheet for various extraction processes of different Non ferrous metals.

5. SUGGESTED PRACTICALS/ EXERCISES - NA

6. MAJOR EQUIPMENTS / INSTRUMENTS REQUIRED - NA

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit – I Ore Dressing (08 hrs, 12 marks)	
1a. Define ore, gangue and concentrate. 1b. Define Pyrometallurgy, Hydrometallurgy and Electrometallurgy. 1c. Write down the general sequence in extraction of metals from their ores. 1d. Explain various comminution processes with sketch. 1e. Describe various ore dressing processes.	1.1 Definitions: Ore, gangue, concentrate etc. 1.2 Introduction to Pyrometallurgy, Hydrometallurgy and Electrometallurgy. 1.3 General sequence of operations involved in the extraction of metals from their ores. 1.4 Comminution: Crushing and grinding with jaw crusher, cone crusher, gyratory crusher and ball mill etc. 1.5 Classification, jigging, tabling, floatation, magnetic separation, electrostatic separation.
Unit - II Metallurgy of Copper (10 hrs, 14 marks)	
2a. List uses of copper. 2b. State types of sources of copper. 2c. State properties of copper. 2d. Draw flow sheet for pyrometallurgical extraction of copper. 2e. Describe Hydrometallurgical extraction of copper. 2f. Select proper refining process of copper extraction. 2g. Describe ferric chloride leaching of copper. 2h. State the merits and demerits	2.1 Properties and uses of copper 2.2 Ores/minerals of copper - oxides, sulphide and native copper, ore dressing processes to obtain concentrate particularly from sulphide ores, current status of copper production in India. 2.3 Production of copper by pyrometallurgy - production flow sheet (by conventional and newer route), stages of pyrometallurgy. 2.4 Flash smelting of copper. 2.5 Refining of Copper- fire and electrolytic refining. 2.6 Hydrometallurgy of copper- ferric chloride leaching of copper ore, advantages and disadvantages. 2.7 OFHC copper and its applications.

of Hydrometallurgical extraction of copper. 2i. State applications of OFHC copper.	
Unit - III Metallurgy of Titanium and Lithium (08 hrs, 12 marks)	
3a. State properties and uses of Titanium. 3b. Select sources of Titanium. 3c. Describe the Kroll's process for extraction of titanium. 3d. Describe refining of titanium by Van Arkel process. 3e. State properties and uses of lithium. 3f. Draw flow sheet for the extraction of titanium. 3g. Describe electrolysis of lithium chloride for extraction of lithium.	3.1 Properties and uses of Titanium. 3.2 Ores/minerals of Titanium and preparation of ore. 3.3 Extraction of Titanium : Flowsheet – Kroll's process, magnesium reduction, refining by Van Arkel process. 3.4 Properties and uses of Lithium. 3.5 Extraction of Lithium - Minerals of lithium, Preparation of lithium chloride, electrolysis of lithium chloride.
Unit - IV Metallurgy of Zinc (04 hrs, 10 marks)	
4a. State properties and uses of zinc. 4b. List various sources of zinc. 4c. Describe Pyrometallurgical extraction of zinc. 4d. State current status of zinc production in India. 4e. Draw flow sheet for extraction of zinc.	4.1 Properties and uses of zinc. 4.2 Ores/minerals of zinc. 4.3 Roasting of zinc concentrates, suspension roasting and fluidized-bed roasting processes, current status of zinc production in India. 4.4 Pyrometallurgical extraction of zinc with flow sheet extraction of metallic zinc by distillation in horizontal and vertical retort. 4.5 Hydrometallurgical processes for zinc extraction. Flow sheets of various processes. 4.6 Refining of zinc by liquation and redistillation.
Unit – V Metallurgy of Aluminum (12 hrs, 16 marks)	
5a. State properties and uses of aluminum. 5b. Select sources of aluminum. 5c. Describe Bayer's process for extraction of aluminum. 5d. Describe Hall Heroult process of aluminum extraction. 5e. Explain refining process to obtain pure aluminum. 5f. Describe manufacturing of carbon electrodes in extraction of aluminum. 5g. Describe anode effect in the electrolyte. 5h. Explain method of refining	5.1 Properties and uses of aluminum. 5.2 Ores/minerals of aluminum. 5.3 Bayer's process- flow sheet, stages involved, factors affecting Bayer's process, reduction of alumina. 5.4 Preparation of cryolite- flow sheet and description with reactions involved. 5.5 Production of metallic aluminum by electrolysis, construction and working of aluminum reduction cells, composition of bath and its properties, anode effect, modern practices in the design of electrolytic cells. 5.6 Refining of aluminum by chlorination and electrolytic processes.

aluminum.	
Unit - VI Metallurgy of Gold and Silver (03 hrs, 08 marks)	
6a. State sources of gold. 6b. Describe methods of gold recovery. 6c. Describe the production of silver. 6d. Explain refining of gold and silver bullion.	6.1 Sources of gold. 6.2 Methods of gold recovery: Gravity concentration, amalgamation, cyanidation and gold precipitation from cyanide solutions, typical flow sheets. 6.3 A brief introduction to production of silver. 6.4 Refining of gold and silver bullion.
Unit – VII Metallurgy of Tungsten (03 hrs, 08 marks)	
7a. State the sources of tungsten. 7b. Explain the method of production of tungsten powder and ductile tungsten.	7.1 Sources of tungsten, concentration of ores. 7.2 Treatments to wolframite and scheelite concentrates. 7.3 Production of tungsten powder and ductile tungsten.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	**U Level**	**A Level**	**Total Marks**
I	Ore Dressing	08	06	04	02	12
II	Metallurgy of Copper	10	04	06	04	14
III	Metallurgy of Titanium and Lithium	08	02	06	04	12
IV	Metallurgy of Zinc	04	02	04	04	10
V	Metallurgy of Aluminum	12	02	08	06	16
VI	Metallurgy of Gold and Silver	03	02	02	04	08
VII	Metallurgy of Tungsten	03	02	04	02	08
	Total	**48**	**20**	**34**	**26**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Make survey and prepare presentation on Copper extraction companies operating in India and their annual production capacities, equipments / technology used.
b. Search, collect information and make a report on locations of major Zinc ores / minerals found in India / other countries; write down minerals found at particular locations.
c. Make a presentation on worldwide reserves of Titanium and Lithium ores / minerals.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with metallurgical process equipments / technology.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash /Animations to explain various components, operations, processes.
h. Teacher should ask the students to go through instruction and technical manuals.

11. SUGGESTED MICRO-PROJECTS - NA

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of Publication, ISBN Number
1	Extraction of Non-Ferrous Metals by	K. S.Ray, R.Sridhar & K.P. Abraham	Affiliated East-west Press Pvt Ltd, 2008. 13: 9788185095639
2	Non-ferrous Extractive Metallurgy - Industrial Practices: Industrial Practices: 1 (Non-Ferrous Metallurgy)	Roger Rumbu	Create Space Independent Publishing Platform, September 2014. 13: 9781483952420
3	Mineral dressing	A.M. Gaudin	McGraw-Hill Inc., US, December 1939. 13: 9780070230309

13. SOFTWARE / LEARNING WEBSITES

1. http://nptel.ac.in/courses/113105021
2. https://youtu.be/KBPv2p7T1wo
3. https://youtu.be/eGdXxFjqFsg
4. http://www.digimat.in/nptel/courses/video/113105021/L18.html
5. http://www.digimat.in/nptel/courses/video/113105021/L21.html
6. http://www.digimat.in/nptel/courses/video/113105021/L25.html

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	1	2	2	1	2
CO2	3	2	1	1	3	2	1
CO3	2	3	3	2	3	2	2
CO4	3	2	1	1	2	3	2

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1
CO2	3	1	1	1
CO3	3	1	1	1
CO4	3	2	2	3

Sign: Name: Shri. R. S. Tuljapurkar (Course Expert)	Sign: Name: Smt. N. S. Kadam (Head of Department)
Sign: Name: Smt. N.S. Kadam (Program Head) (Metallurgical Engineering Department)	Sign: Name: Shri. A.S.Zanpure (CDC In charge)

Government Polytechnic, Pune

Department of Metallurgical Engineering

180 OB Curriculum

Level-4A: Auxiliary Courses

(One Compulsory@ and Any One Optional)

Sr. No.	Course Code	Course Name
1	AU4101	Environmental Science@
2	AU4102	Renewable Energy Technologies
3	AU4103	Engineering Economics
4	AU4104	Ethical Sources & Sustainability
5	AU4105	Digital Marketing

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in CE/EE/ET/ME/MT/CM/IT/DDGM**
Programme Code	**01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26**
Name of Course	**Environmental Science**
Course Code	**AU4101**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

<table>
<tr><th colspan="3" rowspan="2">Teaching Scheme (In Hours)</th><th rowspan="2">Total Credits (L+T+P)</th><th rowspan="2"></th><th colspan="5">Examination Scheme</th></tr>
<tr><th colspan="2">Theory</th><th colspan="2">Practical</th><th>Total Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>C</th><th></th><th>ESE</th><th>PA</th><th>ESE</th><th>PA</th><th rowspan="2">50</th></tr>
<tr><td rowspan="2">00</td><td rowspan="2">00</td><td rowspan="2">02</td><td rowspan="2">02</td><td>Marks</td><td>--</td><td>--</td><td>--</td><td>50</td></tr>
<tr><td>Exam Duration</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
</table>

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

This is an interdisciplinary course, introduced with an aim to create awareness about environmental issues among the diploma students. The rate Industrialization and Urbanization is very fast, and the country/world is facing the issues like draught, flood, deforestation, increase in earth temperature, pollution and depletion of resources. In view of this the management of resources' and dilution of pollutants is of prime need to keep the environment safe and clean.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **To create environmental awareness for sustainable development.**

4. COURSE OUTCOMES (COs)

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 above-mentioned competency**:**

1. Create awareness for conservation of natural resources and preserving the Environment.
2. Perform/Contribute in sustainable development.
3. Undertake preventive measures to control different pollutions.
4. Differentiate between Conventional and Non-conventional energy sources.
5. Identify the role of SPCB/CPCB and EPA in Environment protection.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	**Practical Exercises** (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	NA	Visit to "Kachara Depot (dumping yard) and write a report.	1, 3,5	04*
2.		Identify the Environmental issues and group discussion on the efforts made to increase public awareness and prepare a report.	1,2,3	04*
3.		Assignment/Report on ecosystem and its components.	2	02
4.		Expert lecture on Role of NGOs and Government in Conserving Environment and write a report on it.	2,3,5	04
5.		Visit to a local area -Environmental assets such as river / forest / grassland / hill / mountain and writing report on it.	1,3	04
6.		Activity based on – "Best out of Waste" (use of waste paper, Plastic, glass bottles, clothes, scrap.)	3	02*
7.		Video Demonstration /Expert Lecture Report on Climate Change and Global warming.	1,2,3, 4,5	02
8.		Write a report on E-waste - 1. Describing E-waste and its type. 2. State its impact/hazards on environment. 3. State importance of E-waste disposal and disposal methods. 4. Comments on how E-waste is handled globally. (Role play can be enacted by each group	1,2,3	04

		representing different countries) 5. Description of how India handles e-waste. (Role play can be enacted by a group)		
9.		Visit to nearby site, using nonconventional energy source (e.g. solar/wind)	4	04
10.		Visit to nearby Poly house and write a report. (Product, financial assistance, limitations, difficulties in operating, any other related information)	2	04
11.		Individual Presentation on Environmental issues and his/her Contribution towards Environment.	12,3, 4,5	04*
12.		Write an assignment on Green House effect, carbon Footprint, carbon trading.	2,3,4	02
13.		Assignment on disposal of medical waste. (To study Incineration.)	3	02
14.	NA	Identify the issues related to the programmes in the institute and write the report. (Here disciplinary or interdisciplinary activity can be carriedout)	2,3	04*
15.		Write an assignment on role of Ministry of Environment and Forest Organizational Structure (MOEF) and Central Pollution Control Board (CPCB), State Pollution Control Board (SPCB), Environment Protection Act.	5	04*
16		Complete a micro project based on guidelines provided in Sr.no. 11	1 to 5	04*
		Total Hrs.		**32**

Practical marked with* are compulsory.

Sr.No.	Performance Indicators	Weightage in %
a.	Observation, collection, and analysis of data	40
b.	Preparation of report	30
c.	Interpretation of result/ observation and conclusion	10
d.	Answer to questions	10
e.	Submission of report in time	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

NA

7. THEORY COMPONENTS

The curriculum is activity based. It is expected from teacher to explain to students the scientific theory behind each assignment.
For e. g. - The assignment stating best out of waste does not mean to make only Decorative items from the waste.
In this case it is expected to explain the concept of 4R i.e., Reduce, Reuse, Recycle, and Reproduce**.**

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

NA

9. SUGGESTED STUDENT ACTIVITIES

NA

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***
The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are an integration of PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain a dated work diary consisting of individual contributions to the project work and give a seminar presentation before submission. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.
A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare a report on visit to PUC Center.
b. Visit a nearby RO plant and prepare detail technical report.
c. Prepare report on Household water filtration unit
d. Prepare a list of polluted natural resources which arc responsible for pollution and collect information on how to damage them.
e. Collection of Data from Hospital: Collect everyday information on percentage of solid hazardous and toxic waste for two months
f. Visit of Municipal Effluent Treatment Plant: Visit effluent treatment plant and prepare report on waste management.

g. Visit of Water Treatment Plant: Visit water treatment plant and prepare report on various units of water treatment and its management.
h. Preparation of report: Prepare the chart of solid waste management showing effects on environment.
i. Suggest the remedial measures for the control of pollution of local water source by conduct relevant study
j. Undertake the Impact study of vehicular pollution on environment.
k. Visit to “Kachara Depot, (dumping yard) and analyze the waste.
l. Write a report on “Best out of Waste.
m. Write a report on Green House effect,
n. Study of air quality of Pune city.
o. Study of noise pollution in Pune city.
p. Study of solid waste management of Pune city.
q. Study of E-waste management of Pune city.
r. Study of Environmental Status Report of Pune city prepared by Pune Municipal Corporation.
s. And any other relevant topic related to course

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1.	Basic Civil and Environmental Engineering	S.P. Nisture, D. A. Joshi, G.S.Chhawsaria	Pearson, 978-1282531819
2.	Basics of Environmental Studies	Anindita Basak, D.L. Manjunath	Pearson, 978-8131756072
3.	Global Warming the Hard Science	L.D.Danny Harvey	Pearson, 978-8131733318
4.	Environmental Studies	Benny Joseph	Tata McGraw Hill, 978-9352605170
5.	Renewable Energy	Godfrey Boyle	Oxford Publications, 0199261784, 9780199261789
6.	Environmental studies	R. Rajagopalan	Oxford University Press, 9780199459759

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. http://www.mpcb.gov.in/
3. http://www.cpcb.nic.in/
4. http://www.envfor.nic.in/
5. http://www.neeri.res.in/

14. PO - COMPETENCY- CO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	1	2	1	3	1	3
CO2	1	1	2	1	3	1	3
CO3	1	1	2	2	2	1	3
CO4	1	1	2	1	2	1	3
CO5	1	1	2	1	2	1	3

	PSO1	PSO2	PSO3	PSO4
CO1	--	--	--	--
CO2	--	--	--	--
CO3	--	--	--	--
CO4	--	--	--	--
CO5	--	--	--	--

List of Experts & Faculties who Contributed for this Curriculum:

S.N.	Name	Designation	Institute / Industry
1.	Dr. SMS Shashidhara.	Chairman PBOS	Head Civil Engg. Dept. GOVT. POLYTECHNIC, PUNE
2	Shri. Sanjay Deshpande.	Director, Sanjivani Development	Industry person
3.	Mrs.M.U.Kokate	Faculty from Institute	Head IT. Dept. GOVT. POLYTECHNIC, PUNE
4	Mrs.SeemaV.Kolhe	Faculty from Institute	Lecturer in Civil Engg. GOVT. POLYTECHNIC, PUNE
5	Shri .M.K.Panchawate	Faculty from Institute	Lecturer in Civil Engg. GOVT. POLYTECHNIC, PUNE
6	Mrs. P.M.Zilpe	Faculty from Institute	Lecturer in Electronics Engg. GOVT. POLYTECHNIC, PUNE
7	Mrs. S.S.Chhatwani .	Faculty from Institute	Lecturer in Electronics Engg. GOVT. POLYTECHNIC, PUNE
8	Mrs. M. H. Bilgi	Faculty from Institute	Lecturer in Electrical Engg. GOVT. POLYTECHNIC,Pune

Sign: Name: Smt.S.V.Kolhe Shri.M.K.Panchawate (Course Experts)	Sign: Name: (Dr.S.M.S.Shashidhara) (Former Head of Department) Shri. V G Tambe (HOD, I Shift) Shri. V B Kondawar (HOD, II shift)
Sign: Name: Smt.N.S.Kadam (Program Head) Metallurgical Engineering Department	Sign: Name: Shri. A. S. Zanpure (CDC In charge)

Government Polytechnic, Pune

'180 OB'– Scheme

Programme	**Diploma in CE/EE/ET/ME/MT/CM/IT/DDGM**
Programme Code	**01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26**
Name of Course	**Renewable Energy Technologies**
Course Code	**AU4102**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

<table>
<tr><th colspan="3" rowspan="2">Teaching Scheme (In Hours)</th><th rowspan="2">Total Credits (L+T+P)</th><th rowspan="2"></th><th colspan="5">Examination Scheme</th></tr>
<tr><th colspan="2">Theory</th><th colspan="2">Practical</th><th>Total Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>C</th><th></th><th>#ESE</th><th>PA</th><th>ESE</th><th>PA</th><th rowspan="2">50</th></tr>
<tr><td rowspan="2">02</td><td rowspan="2">00</td><td rowspan="2">00</td><td rowspan="2">02</td><td>Marks</td><td>40</td><td>10</td><td>--</td><td>--</td></tr>
<tr><td>Exam Duration</td><td>2 Hrs</td><td>1/2 Hr</td><td>--</td><td>--</td><td></td></tr>
</table>

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

Electrical energy is an important aspect in all sectors of economic growth of India. Considering the continuously increased demand of electrical energy, the conventional sources of energy are insufficient to meet these demands and hence the use of renewable sources of energy is the need of the hour. Hence these sources must be known to electrical technicians. This course consists of construction, working principle, operation and applications of Solar, Wind, Biomass, Geothermal and Tidal power plants.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Practice of non-conventional energy as power source in electric field. Operate and maintain small Solar plants, Wind power stations, Geothermal plants etc.**

4. COURSE OUTCOMES (COs)

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 above mentioned competency**:**

1. Know the national scenario of energy production, utilization, consumption and reserves and need of non-conventional energy sources.
2. Describe construction, working principle, operation and applications of Solar power panel.
3. Describe construction, working principle, operation and applications for Wind and Biomass power plants.
4. Describe construction, working principle, operation and applications for Geothermal and Tidal energy power plants.

5. SUGGESTED PRACTICALS/ EXERCISES

NA

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

NA

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT 1: Review of Conventional Sources of Energy (02 hrs, 04 marks)	
1a. Classify the conventional energy sources and know their availability in India. 1b. Know the necessity of non-conventional energy sources. 1c. Describe the environmental impact of various energy sources and the need for sustainable development.	1.1 Types of conventional energy sources, Availability and important power plants in India. 1.2 India's production and reserves for Fossil fuels, Water power, Nuclear power. 1.3 Need for non-conventional energy sources. 1.4 Environmental impact of various energy sources, Green building, Sustainable development. Carbon credits and its significance.
UNIT 2: Solar Energy and its Applications (12 hrs, 14 marks)	
2a. Know the principle of conversion of solar energy to heat and electrical energy. 2b. Know the concept of solar radiation and define the terms used in solar radiation geometry. 2c. Explain the principle of electrical power generation by photovoltaic cell with merits and demerits of the system.	2.1 Principle of conversion of solar energy into heat and electrical energy, Solar radiation, Solar radiations at earth's surface. 2.2 Solar radiation geometry: declination, hour Angle, altitude angle, incident angle, zenith angle, solar azimuth angle. 2.3 Solar collectors and their types, Application, Advantages and Limitations. 2.4 Solar electric power generation: Solar photovoltaic cell, Solar cell Principle and Working, Application, Advantages and Disadvantages. 2.5 Solar water heating, Solar distillation, Solar cooking and furnace

2d. Identify and describe the various applications based on solar energy.	2.6 Solar pumping and Green house, Agriculture and industrial process heat. 2.7 Space heating, Space cooling.
UNIT 3: Wind Energy and Energy from Biomass (12 hrs, 14 marks)	
3a. Know the principle of conversion of wind energy to electrical energy. 3b. Describe the advantages and limitations and applications of wind energy. 3c. Explain with sketches the working of horizontal and vertical axis wind mills. 3d. Know the concept of obtaining energy from biomass through various methods. 3e. Identify and describe the various types of biomass power plants.	3.1 Basic principles of wind energy conversion, Power in wing, Available wind power formulation, Power coefficient, and Maximum power 3.2 Main considerations in selecting a site for wind mills, Advantages and Limitations of wind energy conversion 3.3 Classification of windmills, Construction and working of horizontal and vertical axis wind mills and their comparison 3.4 Main applications of wind energy for power generation and pumping 3.5 Common species recommended for biomass, methods for obtaining energy from biomass 3.6 Classification of biomass: Gasified, Fixed bed and Fluidized 3.7 Application of gasifier 3.8 Biodiesel production and application 3.9 Agricultural waste as biomass, Biomass digester, Comparison of biomass with conventional fuels
UNIT 4: Geothermal and Tidal Energy (06 hrs, 08 marks)	
4a. Know the principle of generation of energy from geothermal and tidal source. 4b. Identify and describe the variousmethods of generation of energy from geothermal and tidal source.	4.1 Availability, Forms of geothermal energy: Dry steam, Wet steam, Hot dry rock, Magnetic chamber system 4.2 Different geothermal power plants available. 4.3 Tidal power, Factors for selection of tidal power plant. 4.4 Classification: Single basin, Double basin type. 4.5 Tidal power plants in world, Ocean thermal plants

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Review of Conventional Sources of Energy	02	04	-	-	04
II	Solar Energy and its Applications	12	04	04	06	14
III	Wind Energy and Energy from Biomass	12	04	04	06	14
IV	Geothermal Energy and Tidal Energy	06	02	02	04	08
Total		**32**	**14**	**10**	**16**	**40**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a) To collect information about global and Indian energy market.
b) One field visit to be conducted to demonstrate application of Solar Energy.
c) One field visit to be conducted to Wind Mill
d) To visit a biomass/ biogas plant of municipal waste or elsewhere

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Correlate subtopics with power plant system and equipments.
e. Use proper equivalent analogy to explain different concepts.
f. Use Flash/Animations to explain various components, operation and working principle.

11. SUGGESTED MICRO-PROJECTS

NA

12. SUGGESTED LEARNING RESOURCES

Sr. No.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1	Non conventional energy resources	Dr. B.H.Khan	Tata McGraw Hill Education, New Delhi, ISBN- 9780070681033
2	Non conventional energy resources	G. D. Rai	Khanna publication, ISBN- 9788174090738
3	Solar Energy	Sukhatme S.P., Nayak J.K.	Tata McGraw, New Delhi, ISBN- 9781259081965
4	Solar Energy	Garg H., Prakash J.	McGraw Hill Education, New Delhi, ISBN- 9780074636312
5	India- The energy sector	P.H. Henderson	Oxford University Press, ISBN- 9780195606539
6	Industrial energy conservation	D. A. Ray	Pergaman Press, ISBN- 9780080232744

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. Website for AkshayUrja News Bulletinwww.mnes.nic.in
3. https://www.bioenergyconsult.com/biomass-energy-systems/
4. https://mnre.gov.in/bio-energy

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	1	1	1	1	1
CO2	2	2	2	2	2	1	3
CO3	2	2	2	2	2	1	3
CO4	2	2	2	2	2	1	3

	PSO1	PSO2	PSO3	PSO4
CO1	--	--	--	--
CO2	--	--	--	--
CO3	--	--	--	--
CO4	--	--	--	--

Sign: Name: Shri.B.R.More Mrs.M.H. Bilgi (Course Experts)	Sign: Name: Dr. S.S.Bharatkar (Head of Department) (Electrical Engineering Department)
Sign: Name: Smt.N.S.Kadam (Program Head) Metallurgical Engineering Department	Sign: Name: Shri A.S.Zanpure (CDC Incharge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in CE/EE/ET/ME/MT/CM/IT/DDGM**
Programme Code	**01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26**
Name of Course	**Engineering Economics**
Course Code	**AU4103**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

<table>
<tr><th colspan="3" rowspan="2">Teaching Scheme (In Hours)</th><th rowspan="2">Total Credits (L+T+P)</th><th rowspan="2"></th><th colspan="5">Examination Scheme</th></tr>
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Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

This course aims at equipping the students with fundamental knowledge of economics and cost analysis to make them capable of taking economically sound decisions.

3. COMPETENCY

The aim of this course is to address following industry identified competency through various teaching learning experiences:

- **Ability to analyze and decide acceptance or rejection of offers / project proposals based on economic criteria.**

4. COURSE OUTCOMES (COs)

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 above-mentioned competency**:**

1. Interpret various principles, concepts and applications of Economics in the field of Engineering and technology.
2. Analyze Market Demand.
3. Apply the principles of economics and cost analysis to proposals in engineering and Technology.
4. Read and interpret financial statements and indicators.

5. SUGGESTED PRACTICALS/ EXERCISES
NA

6. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED
NA

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT 1. Introduction to Economics (06 hrs, 08 marks)	
1a.Define the term Economics. 1b.State the objectives and importance's of engineering Economics. 1c.Differiate between Micro and macro economics. 1d.Describe the functions of Market economy and Command economy. 1e.List the elements of mixed economy.	1.1 Definitions of economics 1.1.2 Objectives and Importance of engineering economics. 1.1.3 Concept of engineering economics. 1.2 General concepts on micro and macro economics 1.2.1 Market economy, 1.2.2 Command economy 1.2.3 Mixed economy.
UNIT 2. Demand Analysis (06 hrs, 08 marks)	
2a.List the utility related demand. 2b.State the importance of total and marginal utility. 2c.Explain Law of demand. 2d.Analyasis elasticity of demand. 2e.State factors governing the elasticity of demand. 2f.Enlist the techniques and methods for forecasting of demand.	2.1 Utility related demand 2.1.1Total and marginal utility 2.1.2 Law of diminishing marginal utility 2.1.3 Cardinal and ordinal utility. 2.2 Law of demand 2.2.1 Determinants of demand 2.2.2 Elasticity of demand 2.2.3 Factors governing the elasticity of demand. 2.3 Techniques and methods for forecasting of demand
UNIT 3. Elements of Business/Managerial Economics (12 hrs, 12 marks)	
3a.Define the term cost and cost control. 3b.Enlist the types of costs. 3c.Interpret the lifecycle costs.	3.1 Cost and Cost Control –Techniques 3.1.1 Types of Costs 3.1.2 Lifecycle costs 3.1.3 Budgets

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
3d.Define the term Budgets. 3e.Determine Break even analysis. 3f.Explain in brief application of Linear Programming. 3h.Importance of Time value of money. 3j.Ellabrorate the methods of cash flow. 3k.Evaluate the Causes of depreciation.	3.1.4 Break even Analysis 3.2 Capital Budgeting 3.2.1Application of Linear Programming. 3.3 Time value of money 3.4.1 Simple and compoundinterest. 3.4.2 Principle of economic equivalence. 3.5 Evaluation of engineering projects and Cost-benefit 3.6. Cash flow- Methods of comparison of alternatives – present worth and future worth method (Revenue dominated cash flow diagram) 3.7 Depreciation-Causes of depreciation 3.8.1 Depreciation straight line method and declining balance method
UNIT 4. National Income, Finance and Banking (08 hrs, 12 marks)	
4a.Expain Balance sheet, Book Keeping and Financial reporting. 4b.Mentionmeasurement parameters ofnational income. 4c.Differiate between Gross domestic and national production (GNP, GDP). 4d.State the functions of commercial banks and Reserve Bank of India.	4.1.Concept of profit and loss account 4.1.1 opening stock, closing stock, sales, purchases,wages, creditors, debtors, gross profit, net profit 4.2. Concept of Balance sheet, &book keeping 4.2.1. Fixed asset, Current assets, share capital, current liabilities,goodwill,debt, inventories, bill receivable, overheads and expenses. 4.3.Concepts and measurement of national income 4.4. Gross domestic and national production (GNP, GDP). 4.5 Banking- Meaning and functions of commercial banks and Reserve Bank of India.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to Economics	06	02	02	04	08
II	Demand Analysis	06	02	02	04	08
III	Elements of Business/ Managerial Economics	12	04	04	04	12
IV	National Income, Finance and Banking	08	02	02	08	12
	Total	**32**	**10**	**10**	**20**	**40**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Study of datasheet of Cash flow of a firm.
b. Prepare charts of depreciation by taking different examples.
c. Case Study-Prepare a comparative statement of of two Engineering projects in respect of investment and profit.(Consider Capital Investment, over head expenses, wages, net profit)
d. Case study- Prepare a cost sheet for a small scale unit.
(In Cost sheet consider production, selling, overhead cost and profit analysis)

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
b. Guide student(s) in undertaking micro-projects.
c. Use proper equivalent analogy to explain different concepts.
d. Use Flash/Animations to explain various components, operation.
e. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

NA

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1	"Contemporary Engineering Economics",	Author-Chan S.Park,	Publisher-Prentice Hall of India, 2011 year. ISBN- 9780134105598
2	"Engineering Economics and analysis"	Author-Donald.G.Newman,	Publisher-Jerome.P.LavelleEngg. Press, Texas, 2010 year. ISBN- 0824709535
3	"Engineering Economy"	Author-Degarmo, E.P., Sullivan, W.G and Canada, J.R	Publisher- Macmillan, New York, 2011 year ISBN-9780029461396
4	"Engineering Economy"	Author-Zahid A khan: Engineering Economy .	Publisher-Dorling Kindersley, 2012 year ,ISBN-10- 8131763870 ISBN-13-978-8131763872

13. SOFTWARE/LEARNING WEBSITES-

1. https://online.nmims.edu/
2. https://www.quora.com
3. https://www.edx.org

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	-	3	3	3
CO2	3	3	3	1	3	3	3
CO3	3	2	2	-	2	3	3
CO4	3	2	2	-	2	2	3

	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	-
CO2	-	-	-	-
CO3	-	-	-	-
CO4	-	-	-	-

Sign: Name: Smt.C.M.Ambikar Smt.N.V.Gondane (Course Experts)	Sign: Name: (Head of DDGM Department)
Sign: Name: Smt.N.S.Kadam (Program Head) Metallurgical Engineering Department	Sign: Name: Shri. A. S. Zanpure (CDC In charge)

Government Polytechnic, Pune

'180 OB'– Scheme

Programme	**Diploma in CE/EE/ET/ME/MT/CM/IT/DDGM**
Programme Code	**01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26**
Name of Course	**Ethical Sources and Sustainability**
Course Code	**AU4104**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		#ESE	PA	ESE	PA	
02	00	00	02	Marks	40	10	--	--	50
				Exam Duration	2 Hrs	1/2 Hr	--	--	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

This course is aimed at creating awareness amongst the students about global level commitment towards sustainable development. The course also creates awareness on ethical manner of production, including the supply chain, the environmental and social impacts of the production process and product as well as the safety and fair deal towards the work force involved at all levels.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Adopt ethical practices and sustainable processes and products in industry.**

4. COURSE OUTCOMES (COs)

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 above mentioned competency**:**

1. Interprets the concept of ethical sourcing and fundamentals of Sustainability.
2. Practice Global Sustainable Development Goals (SDG).
3. Follow ethical and sustainable supply chain.
4. Differentiate traditional and sustainable manufacturing.

5. SUGGESTED PRACTICALS/ EXERCISES
NA

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED
NA

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT 1. ETHICAL SOURCING (06 hrs, 08 marks)	
1.1 Define Ethical Sourcing. 1.2 Explain Basic Eight Principles of Ethical Sourcing. 1.3 State the laws of industrial ethics. 1.4 Explain the policies of industrial ethics.	1.1 Definition-1.1.1 Ethical Sourcing 1.2 Basic Eight Principles 1.3 Policies 1.4 Benefits-Importance of Ethics 1.5 Challenges- Causes of Unethical Behavior 1.5Laws
UNIT 2. SUSTAINABILITY (08hrs, 10marks)	
2.1 Define Sustainability and Ethical Sourcing and Sustainability. 2.2 Explain the principles of sustainability. 2.3 Explain the need and challenges of environmental sustainability. 2.4 Compare Social sustainability and economic sustainability. 2.5 Explain the agenda of 2030 sustainable development goals.	2.1 Definition-2.1.1 Sustainability 2.1.2 Ethical Sourcing and Sustainability 2.2 Twelve green engineering principles. 2.3 Benefits and Challenges 2.4 Types- 2.4.1 Human Sustainability 2.4.2 Social Sustainability 2.4.3 Economic Sustainability 2.4.4 Environmental Sustainability 2.5 Introduction of Sustainable Development Goals (SDGs)= (Leaving no one behind- Global agenda for 2030- 17 goals, 169 Targets 231 Indicators) [17 Sustainable Development Goals (SDGs)]- Goal1:NoPoverty Goal2:ZeroHunger Goal3:GoodHealthAnd Well-Being Goal4:QualityEducation Goal5:Gender equality Goal6:Clean water and sanitation Goal7:Affordable and clean energy Goal8:Decent work and economic growth Goal9:Industry,Innovation and infrastructure Goal10:Reduced inequality Goal11:Sustainable cities and communities Goal12:Responsible consumption and production Goal13:Climate Action

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	Goal14:Life Below Water Goal15:Life On Land Goal16: Peace and justice strong institutions Goal17: Partnerships to achieve the goal.
UNIT 3. ETHICAL AND SUSTAINABLE SUPPLY CHAIN (10 hrs, 12 marks)	
3.1 State the use of three P's and E's of sustainability. 3.2 Explain the ways to reduce waste by simplifying supply chain processes with appropriate example. 3.3 Comment on existing environmental risks caused by tradition non sustainable manufacturing process. 3.4 Explain the ways decrease fossil fuel consumption by optimizing routes with appropriate example.	3.1 Three P's-3.1.1 Profit 3.1.2 Planet 3.1.3 People 3.2 Three E's- 3.2.1 Environment 3.2.2 Equity 3.3.3 Economics 3.3 Study of Six Steps for supply- 3.3.1 Reduce waste by simplifying supply chain processes 3.3.2 Ensure ethical sourcing and introduce transparency 3.3.3 Minimize overproduction through efficient supply and demand planning 3.3.4 Decrease fossil fuel consumption by optimizing routes. 3.3.5 Fully utilize containers and transportation to consolidate shipments. 3.3.6 Monitor for existing environmental risks.
UNIT 4. MATERIALS FOR SUSTAINABILITY (08 hrs, 10marks)	
4.1 Explain the impact of material selection over environment. 4.2 Explain the factors to be considered for material selection to optimize performance. 4.3 Explain Life cycle assessment with appropriate example. 4.4 Give a note on "Production of green manufacturing materials" with appropriate example. 4.5 Explain the role of 5R's in sustainable development.	4.1 Environmental impact of materials 4.2 life-cycle assessment 4.3 Material selection to optimize performance 4.4 Design 4.5Evaluation 4.6 Production of green manufacturing materials. 4.7 Role of 5R's for Sustainable Development- 4.7.1 Refuse / Reject 4.7.2 Reduce 4.7.3 Reuse / Repurpose / Rethink 4.7.4 Repair 4.7.5 Recycle

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Ethical Sourcing	06	4	2	2	08
II	Sustainability	08	4	2	4	10
III	Ethical And Sustainable Supply Chain	10	4	4	4	12
IV	Materials For Sustainability	08	2	4	4	10
Total		**32**	**14**	**12**	**14**	**40**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a.Select any topic and prepare a Power Point Presentation in a group of three to four students covering economic, social and environmental sustainability aspects and give presentation to other students and teacher.

(Example- a)Green Construction Techniques, b)Sustainable Energy solutions for manufacturing, c) Recycling, d)Waste Management e)Rainwater conservation)

OR

a. Prepare a write up in a group of three to four students and present it to other students considering Global agenda for 2030-Leaving no one behind i.e. **Sustainable Development Goals (SDGs)** and its169 Targets 231 Indicators.

b. **Case Study-**Prepare a comparative statement of two Engineering projects in respect to traditional and sustainable manufacturing process considering benefits and challenges.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with automation.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and its application
h. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

NA

12. SUGGESTED LEARNING RESOURCES

Sr.No.	Title	Author	Publisher, Edition and Year of publication. ISBN Number
1	Sustainable Construction Processes	Steve Goodhew	Wiley-Blackwell; 1 edition (13 April 2016) ISBN:140518759X
2.	Sustainable logistics Supply Chain Management	David.B.Grant	Kogan page 1st edition 3 March 2015,ISBN:9780749473860
3.	Global Value Chains, Flexibility and Sustainability	Julia Connell RenuAgarwal Sushil Sanjay Dhir	09 MAY 2018, ISBN:978-981-10-8929-9
4.	The Handbook of Ethical Purchasing:Principles and Practice	Rob Harrison	Publisher Routledge,13 oct 2021 ISBN:9781032059952

13. SOFTWARE/LEARNING WEBSITES

1. https://www.ncbi.nlm.nih.gov/books/NBK64933/
2. http://www2.econ.iastate.edu/classes/tsc220/hallam/TypesOfSustainability.pdf
3. https://www.woolworthsgroup.com.au/content/Document/Ethical%20Sourcing%20Policy.pdf
4. https://www.supplychainbrain.com/blogs/1-think-tank/post/29477-how-to-create-a-more-ethical-and-sustainable-supply-chain
5. https://h2mgroup.wordpress.com/2013/06/14/the-three-es-of-sustainability/
6. https://www.cce.ufl.edu/wpcontent/uploads/2012/08/Ethics%20of%20Sustainability%20Textbook.pdf
7. A global indicator framework for the Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development: https://unstats.un.org/sdgs/indicators/Global%20Indicator%20Framework%20after%202020%20review_Eng.pdf
8. Transforming our World: The 2030 Agenda for Sustainable Development United Nations,2015 https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	-	3	3	3
CO2	3	3	3	-	3	3	3
CO3	3	2	2	-	2	3	3
CO4	3	2	2	-	2	2	3

	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	-
CO2	-	-	-	-
CO3	-	-	-	-
CO4	-	-	-	-

Sign: Name: Smt. S.M. Waghchaure Smt. N.V. Gondane (Course-Experts)	Sign: Name: (Head of DDGM Department)
Sign: Name: Smt.N.S.Kadam (Program Head) Metallurgical Engineering Department	Sign: Name: Shri. A. S. Zanpure (CDC In charge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in CE/EE/ET/ME/MT/CM/IT/DDGM**
Programme Code	**01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26**
Name of Course	**Digital Marketing**
Course Code	**AU4105**
Prerequisite course code and name	**NA**
Class declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	$ESE	PA	
00	00	02	02	Marks	--	--	25	25	50
				Exam Duration	--	--	--	--	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

Digital marketing is advertising or promotions of products and services using digital platforms. Digital Marketing is rapidly evolving technology. And social media is ever growing marketing platform for users. The course will help students to improve skills to market their product or service in the digital media. The course will enable students to explore and create something new who wants to be a good entrepreneur or good professional in design and development.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Enhance business using various digital media channels**

4. COURSE OUTCOMES (COs)

The 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 above-mentioned competency**:**

1. Identify advertisement sections of web pages in a website.
2. Install Google analytics on a website.
3. Use Google analytics for reading analytics data.
4. Generate reports for sample web-site
5. Use e-mail marketing tool

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No	Unit No	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1	NA	Study and prepare a report of a sample web-site with strategic flow for e-commerce/publication etc. (with the use of: HTML, CSS, and JavaScript etc.)	1, 2	2
2		Set up and create account on Google Analytics and install it on a web-site. Study of Google Analytics GUI/IDE for: ● Inbound and outbound marketing ● Content marketing ● Website Content optimization	2	2
3		Study of Search Engine Optimization (SEO) using Digital marketing platform.	2	2
4		(A)Create the tracking id for web-site and track links (B) Analyze website traffic and leads using DM platform/tool	2	2
5		Read Analytics data. Read audience acquisition and behavior statistics	3	2
6		Generate different types of reports through Google Analytics	4	2
7		Study of any email marketing tool (Freeware)	5	2
8		Complete a micro project based on guidelines provided in Sr. No. 11	All Cos	2
			Total Hrs	**16**

S.No.	Performance Indicators	Weightage in %
a.	Study of web pages and web site	10
b.	Installing and setting up the tool for web site	20
c.	Observations and Recording	20
d.	Interpretation of reports, result and Conclusion	20
e.	Answer to sample questions	20
f.	Submission of term work journal in time	10
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major tools with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major tools Required	Experiment Sr. No.
1	Web browser	All
2	Any Web Server (e.g. Glassfish, Tomcat)	
3	Google Analytics	

7. THEORY COMPONENTS

NA

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

NA

9. SUGGESTED STUDENT ACTIVITIES

Other than the laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of each activity.

a. Prepare journals based on practical performed in laboratory.
b. Study of different types of web-sites (ecommerce/ publication/ social media) and advertisements on these web-sites.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through presentations.
c. Self-learning through Online tutorials to analyze business data
d. Use of freeware marketing tools to check for the effectiveness for particular type of websites

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are an integration of PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain a dated work diary consisting of individual contributions to the project work and give a seminar presentation before submission. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. The concerned faculty could add similar micro-projects:

a. Develop and deploy a sample web-site (using CSS, JavaScript, and similar techniques) for given sample commercial requirements. And identify advertising sections among these pages.
b. Create blog post for educational videos for demonstrating content marketing
c. Create an account on Google analytics and analyze traffic to the sample website
d. Create code for tracking ID for sample web site and generate reports through Google analytics

12. SUGGESTED LEARNING RESOURCES

Sr No	Title	Author	Publisher, Edition, Year of publication, ISBN Number
1	Fundamental of digital Marketing	Punneet Singh Bhatia	Pearson India, 2ndEdition(2019) ISBN_109789353434141
2	The Art of SEO	Eric Enge, Stephan Spencer, Jessie Stricchiola,	O'Reilly Media ,3 Edition (2015) ISBN_101491948965 ISBN_13 978- 1491948965

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. https://youtu.be/mXcQ7rVn3ro
3. https://youtu.be/gQe7gGGuzeQ
4. https://www.tutorialspoint.com/digital_marketing/

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	-	1	3	2	-	1	-
CO2	-	2	1	2	-	-	1
CO3	1	2	3	3	-	1	1
CO4	-	1	2	3	-	1	1
CO5	-	3	3	3	1	1	1

	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	-
CO2	-	-	-	-
CO3	-	-	-	-
CO4	-	-	-	-
CO5	-	-	-	-

Sign: Name: Smt.M.G. Yawalkar Smt.A.S. Paike Smt.K.S.Gaikwad Smt.P.K.Zade (Course Experts)	Sign: Name: Shri. U.V. Kokate Dr.S.B.Nikam (Head of Department) (Department of Computer Engineering)
Sign: Name: Smt.N.S.Kadam (Program Head) Metallurgical Engineering Department	Sign: Name: Shri. A. S. Zanpure. (CDC In charge)

Government Polytechnic, Pune

Department of Metallurgical Engineering

180 OB Curriculum

Level-4B: Management Level Courses

(One Compulsory@ and Any One Optional)

Sr. No.	Course Code	Course Name
1	MA4101	Entrepreneurship & Startups@
2	MA4102	Industrial Organisation & Management
3	MA4103	Materials Management
4	MA4104	Disaster Management
5	MA4105	Introduction to E-Commerce
6	MA4106	Information Management

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in CE/EE/ET/ME/MT/CM/IT/DDGM**
Programme Code	**01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26**
Name of Course	**Entrepreneurship and Startups**
Course Code	**MA4101**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

<table>
<tr><th colspan="3" rowspan="2">Teaching Scheme (In Hours)</th><th rowspan="2">Total Credits (L+T+P)</th><th rowspan="2"></th><th colspan="5">Examination Scheme</th></tr>
<tr><th colspan="2">Theory</th><th colspan="2">Practical</th><th>Total Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>C</th><th></th><th>#ESE</th><th>PA</th><th>ESE</th><th>PA</th><th rowspan="2">50</th></tr>
<tr><td rowspan="2">02</td><td rowspan="2">00</td><td rowspan="2">00</td><td rowspan="2">02</td><td>Marks</td><td>40</td><td>10</td><td>--</td><td>--</td></tr>
<tr><td>Exam Duration</td><td>2 Hrs</td><td>1/2 Hr</td><td>--</td><td>--</td><td></td></tr>
</table>

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

Globalization, liberalization and privatization along with revolution in information technology have opened up new opportunities transforming lives of masses. In this context, there is immense opportunity of establishing manufacturing, service, trading, marketing and consultancy enterprises by diploma engineer**.** Our fast growing economy provides ample scope for diploma engineers to succeed as an entrepreneur. Entrepreneurship requires distinct skill sets which are attempted to be developed through this course. To begin with, this course aims to develop the competency and the related outcomes in order to start small enterprises. Government of India also motivates the young engineers to come up with new idea to promote Start ups.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Develop project proposals for launching small scale enterprises and starts up.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to betaught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1 Identify entrepreneurial traits.
2 Collect information from stakeholder for starting starts up
3 Identify support systems available for Starts up
4 Execute plans for managing enterprise effectively.

5. SUGGESTED PRACTICALS/ EXERCISES

NA

6. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

NA

7. THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency**.**

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit-I Introduction to Entrepreneurship Development (08 Hrs, 10 Marks)	
1a. Describe procedure to evaluate entrepreneurial traits as a career option for given product 1b. Explain given terms related to Entrepreneurship 1c. Describe salient features of the resources required for starting the specified enterprise. 1d. Identify characteristics for a given type of enterprise.	1.1 Entrepreneurship as a career 1.2 Traits of successful entrepreneur: consistency, creativity, initiative, independent decision making, assertiveness, persuasion, persistence, information seeking, handling business communication, commitment to work contract, calculated risk taking. 1.3 Entrepreneurship: scope in local and global market. 1.4 Types of enterprises and their features: manufacturing, service and trading.
Unit-II Startup Selection Process (10 Hrs, 14 Marks)	
2a. Describe scheme(s) offered by the governmentfor starting the specified enterprise. 2b. Suggest suitable place for setting up the specified enterprise on the basis of given data/circumstances with justification. 2c. Suggest steps for the selection process of an enterprise for the specified product or service with justification. 2d. Describe market study procedure of the specified enterprise.	2.1 Product/Service selection: Process, core competence, product/service life cycle, new product/ service development process, mortality curve, creativity and innovation in product/ service modification / development. 2.2 Process selection: Technology life cycle forms and cost of transformation, factors affecting process selection, location for an industry, material handling. 2.3 Market study procedures: questionnaire design, sampling, market survey, data analysis 2.4 Getting information from concerned stakeholders such as Maharashtra Centre for Entrepreneurship Development[MCED], National Institute for Micro, Small and Medium Enterprises [NI-MSME], Prime Minister Employment Generation Program [PMEGP], Directorate of Industries[DI], Khadi Village Industries Commission[KVIC]
Unit-III Support System for Startup (08 Hrs, 10 Marks)	

3a. Describe support system required for the specified enterprise. 3b. Describe help provided by the government agencies for the specified product/service. 3c. Describe help provided by the non-governmental agencies for the specified product/service. 3d. Compute breakeven point for the specified business enterprise, stating the assumptions made.	3.1 Categorization of MSME, ancillary industries 3.2 Support systems- government agencies: MCED, NI-MSME, PMEGP,DI, KVIC 3.3 Support agencies for entrepreneurship guidance, training, registration, technical consultation, technology transfer and quality control, marketing and finance. 3.4 Breakeven point, return on investment and return on sales.
Unit-IV Managing Enterprise (06 Hrs, 06 Marks)	
4a. Explain key elements for the given business plan with respect to their purpose/size. 4b. Justify USP of the given product/ service from marketing point of view. 4c. Formulate business policy for the given product/service. 4d. Choose relevant negotiation techniques for the given product/ service with justification. 4e. Identify risks that you may encounter for the given type of business/enterprise with justification. 4f. Describe role of the incubation centre for the given product/service.	4.1 Sources of Product for Business : Feasibility study 4.2 Ownership, Capital, Budgeting, Matching entrepreneur with the project , feasibility report preparation and evaluation criteria 4.3 Unique Selling Proposition [U.S.P.]: Identification, developing a marketing plan. 4.4 Preparing strategies of handling business: policy making, negotiation and bargaining techniques. 4.5 Risk Management: Planning for calculated risk taking, initiation with low cost projects, integrated futuristic planning, angel investors, venture capitalist. 4.6 Incubation centers: Role and procedure.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to EDP	08	2	2	6	10
II	Entrepreneurial Opportunities and selection Process	10	2	4	8	14
III	Support System	08	2	4	4	10
IV	Managing Enterprise	06	2	2	2	06
Total		**32**	**8**	**12**	**20**	**40**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Download product development and innovative films from internet.
b. Invite entrepreneurs, industry officials, bankers for interaction.
c. Identify your hobbies and interests and convert them into business idea.
d. Convert you project work into business.
e. Choose a product and design a unique selling preposition, brand name, logo, advertisement (print, radio, and television), jingle, packing, packaging, and label for it.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipment.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and Technical manuals.

11. SUGGESTED MICRO-PROJECTS-

NA

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of publication ISBN Number
1	Reading Material of Entrepreneurship Awareness Camp	Gujral, Raman	Entrepreneurship Development Institute of India (EDI), GOI, 2016 Ahmedabad, ISBN: 9946302512012
2	Product Design and Manufacturing	Chitale, A K	PHI Learning, New Delhi, 2014; ISBN: 9788120348738
3	Entrepreneurship Development Small Business Entrepreneurship	Charantimath, Poornima	Pearson Education India,New Delhi; ISBN: 9788131762264
4	Entrepreneurship Development: Special edition for MSBTE	CPSC, Manila	Tata Mc-Graw Hill, New Delhi, ISBN: 9789432961123
5	Entrepreneurship and Small Business Management	Khanka, S.S.	S.Chand and Sons, New Delhi, ISBN: 978-93-5161-094-6

13. SOFTWARE/LEARNING WEBSITES

1. MCED Books links: http://www.mced.nic.in/UdyojakSpecial.aspx?linktype=Udyojak
2. MCED Product and Plan Details: http://www.mced.nic.in/allproduct.aspx
3. The National Institute for Entrepreneurship and Small Business Development Publications: http://niesbud.nic.in/Publication.html
4. Courses : The National Institute for Entrepreneurship and Small Business Development: http://niesbud.nic.in/docs/1standardized.pdf
5. Entrepreneur.com: https://www.entrepreneur.com/lists
6. Govt. Sponsored Schemes:https://www.nabard.org/content1.aspx?id=23andcatid=23andmid=530
7. NABARD - Information Centre: https://www.nabard.org/Tenders.aspx?cid=501andid=24
8. NABARD – What we Do: http://www.nabard.org/content1.aspx?id=8andcatid=8andmid=488
9. Market Review: http://www.businesstoday.in/markets
10. Start Up India: http://www.startupindia.gov.in/pdffile.php?title=Startup%20India%20Action%20Planandtype=Actionandq=Action%20Plan.pdfandcontent_type=Actionandsubmenupoint=action
11. About - Entrepreneurship Development Institute of India (EDII): http://www.ediindia.org/institute.html
12. NSTEDB – Training: http://www.nstedb.com/training/training.htm
13. Tata Exposures: http://www.tatasocial-in.com/project-exposure
14. Ministry Of Micro, Small And Medium Enterprises: http://www.dcmsme.gov.in/schemes/TEQUPDetail.htm
15. List of Business Ideas for Small Scale Industry: https://smallb.sidbi.in/%20/thinking-starting-business/big-list-business-ideas-small-business
16. Thinking of Entrepreneurship: https://smallb.sidbi.in/entrepreneurship-stage/thinking-entrepreneurship
17. List of services for Small Scale Industry: http://www.archive.india.gov.in/business/Industry_services/illustrative.php
18. NSIC Schemes and Services: http://www.nsic.co.in/SCHSERV.ASP

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	-	-	-	2	2	2
CO2	1	-	-	-	2	2	2
CO3	-	-	-	-		1	3
CO4	-	-	-	1	-	1	2

PSO - CO MAPPING (MECH)

	PSO1	PSO2
CO1	-	-
CO2	-	1
CO3	-	1
CO4	-	1

***NOTE:-** The department which will run this course please do the PSO - competency- CO mapping according to your PSOs as this mapping is done according to Mechanical Engg. PSOs

Sign: Name: Shri.S. S. Harip (Course Expert)	Sign: Name: Dr. N. G. Kulkarni (Head of Mechanical Department)
Sign: Name: Smt.N.S.Kadam (Program Head) Metallurgical Engineering Department	Sign: Name: Shri. A. S. Zanpure (CDC In charge)

Government Polytechnic, Pune.

'180OB' – Scheme

Programme	**Diploma in CE/EE/ET/ME/MT/CM/IT/DDGM**
Programme Code	**01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26**
Name of Course	**Industrial Organization and Management**
Course Code	**MA4102**
Prerequisite course code and name	**NA**
Class Declaration	**NO**

1. TEACHING AND EXAMINATION SCHEME

<table>
<tr><th colspan="3" rowspan="2">Teaching Scheme (In Hours)</th><th rowspan="2">Total Credits (L+T+P)</th><th rowspan="2"></th><th colspan="5">Examination Scheme</th></tr>
<tr><th colspan="2">Theory</th><th colspan="2">Practical</th><th>Total Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>C</th><th></th><th>#ESE</th><th>PA</th><th>ESE</th><th>PA</th><td rowspan="2">50</td></tr>
<tr><td rowspan="2">02</td><td rowspan="2">00</td><td rowspan="2">00</td><td rowspan="2">02</td><th>Marks</th><td>40</td><td>10</td><td>--</td><td>--</td></tr>
<tr><th>Exam Duration</th><td>2 Hrs</td><td>1/2 Hr</td><td>--</td><td>--</td><td></td></tr>
</table>

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

The industrial organization is a structured organization which has different levels of management. There are different sections / divisions of industry in which, a diploma engineer is expected to work. There are various roles of diploma engineers at different levels of technical and administration departments in an industry. They must be aware of financing agencies, Market survey, marketing techniques, human relations management and different acts by which the industries are governed.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Ability to work with various levels of management in industry, develop awareness about different departments of industry, acts by which, industries are governed, industrial ethics and leadership qualities.**

4. COURSE OUTCOMES (COs)

The theory experiences and behavioral skills associated with this course are to be taught and implemented, so the student will able to exhibit the following CO'S.

1. Understand different levels of Industry Organization and entrepreneurship.
2. Implement skills for organizing Market Survey and Managements technique.
3. Implement various Financial & Material Management techniques.
4. Use the relevant acts applicable for factories.

5. SUGGESTED PRACTICALS/ EXERCISES

NA

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

NA

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit-I: Overview of Business and Organizational Management (06 hrs, 08 marks)	
1.a. Students can describe types of business. 1.b Students can classify types of industries. 1.c Students can describe Organizational Structure of Industry. 1.d Students can describe forms of ownerships.	1.1 Classification of Industries: Engineering, IT, ITeS Banking, Retail. Small Scale, Large Scale, Pvt. Ltd, India Ltd, Multi-National, MSME. 1.2 Role of engineer in Manufacturing, Service-sector, Trade , Consultancy. 1.3 Introduction to Types of business: Manufacturing, service, Trade, Consultancy. 1.4 definition of Organization. Types : Line, Functional, Line and staff, Project. 1.5 Authority and delegation of power at different levels of organization. 1.6 Forms of Ownerships : Proprietorship, Partnership, Joint Stock, Cooperative Society, Government Sector.
Unit-II: Fundamentals of Management (06 hrs, 08 marks)	
2.a Describe concept of Management. 2.b. Describe different levels of Management. 2.c Describe different functions of Management.	2.1 Definition of Management. 2.2 Role of management. 2.3 Levels of Management: Higher, Middle and Lower Level management. 2.4 Scientific management by FW Taylor. 2.5 Function of Management : Planning, Organizing, Directing, Coordinating, Controlling. 2.6.Role of Management with respect to feedback & Corrective actions.
Unit-III: Financial Management, Accounting and Material Management (10 hrs, 12 marks)	

<table>
<tr><th>Unit Outcomes (UOs)
(in cognitive domain)</th><th>Topics and Sub-topics</th></tr>
<tr><td>3.a . Describe different types of capital generation.

3.b Describe different types of budgets.

3.c Describe advantage of balance sheet to calculate Profit / Loss.
.
3.d Describe concept of Inventory management.</td><td>3.1 Overview of : Capital generation and Management, Fixed & Working Capital.
3.2 Sources of raising Capital.
3.3 Budget & Accounts : Types of Budget viz. Production budget, fixed and variable budget (concept level)
3.4 (MRP)-function of MRP, input to MRP, benefit of MRP.
3.5 Basic concepts Enterprise resource planning (ERP)-concepts, advantages and disadvantages of ERP .
3.6 Accounts : Profit & Loss accounts, rules for debits & credits, books of accounts.
3.7 Balance Sheet : definition, sample format, various fields.
3.8 Material Management : Inventory (Concept, classification, functions.), Necessity of ABC analysis.
3.9 Standard steps in purchasing. Direct Purchase , tender method, E- Tendering.</td></tr>
<tr><td colspan="2">Unit-IV:
Marketing, Industrial Safety and various Acts (10 hrs, 12 marks)</td></tr>
<tr><td>4.a Describe the concept of Market Survey and types of survey.

4.b List different techniques of increasing sales of product.

4.c List and Describe various types of accidents in industry.

4.d List and Describe various acts with respect to industry.</td><td>4.1 Market Survey: Need, Advantages and Types of market survey.
4.2 Different techniques of increasing sales of product.
4.3 Packaging of goods.
4.4 Industrial Safety: Types of accidents in industry, Causes of accidents, Preventive measures to avoid accidents.
4.5 Industrial legislation : Indian Factory Act, Minimum Wages Act, Workmen Compensation Act. (Main provisions in the acts).
4.6 Penal actions on violation of Acts. (provisions)</td></tr>
</table>

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

<table>
<tr><th rowspan="2">Unit No.</th><th rowspan="2">Unit Title</th><th rowspan="2">Teaching Hours</th><th colspan="4">Distribution of Theory Marks</th></tr>
<tr><th>R Level</th><th>U Level</th><th>A Level</th><th>Total Marks</th></tr>
<tr><td>I</td><td>Overview of Business and Organizational Management.</td><td>06</td><td>02</td><td>06</td><td>00</td><td>08</td></tr>
<tr><td>II</td><td>Fundamentals of Management.</td><td>06</td><td>02</td><td>06</td><td>00</td><td>08</td></tr>
<tr><td>III</td><td>Financial Management, Accounting and Material Management.</td><td>10</td><td>04</td><td>06</td><td>02</td><td>12</td></tr>
<tr><td>IV</td><td>Marketing, Industrial Safety and various Acts.</td><td>10</td><td>02</td><td>06</td><td>04</td><td>12</td></tr>
<tr><td colspan="2">Total</td><td>32</td><td>10</td><td>24</td><td>06</td><td>40</td></tr>
</table>

9. SUGGESTED STUDENT ACTIVITIES:

1) Prepare/download information about different industrial acts.
2) Visit to manufacturing Industry and Prepare Report on...
   i) Structure of Organization/Department
   ii) Safety Measures taken in Organization
   iii) Procedure adopted for quality control
   iv) Any Specific observation you have noticed
3) Prepare the Technical details of 5 (Electronics Product like mobile phone, TV ,Laptop, Home Theatre, Projector etc. of different company including cost and Suggest which is cost effective to buy.
4) Prepare Project report which includes financial Viability of any product of your choice.
5) Prepare a questioner for market survey of electronic product of your choice.
6) Write detailed Processes to start the Partnership firm.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

a. To arrange a Visit to an Industry and observe industrial safety norms followed in the industry. Students should submit a report based on their observations regarding the safety norms to be followed in the industry.

b. Arrange an Expert Lecture by a Lawyer to update the students regarding Amendments in Different acts (Factory act, Minimum Wages Act, Workmen Compensation Act) and Penal actions on violation of the acts.

11. SUGGESTED MICRO-PROJECTS:

NA

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of Publication, ISBN Number
1	Industrial Engineering and Management.	O.P. Khanna,	Dhanpat Rai and Sons ISBN-10:818992835X
2	Project Planning and Entrepreneurship.	T.R.Banga, Indu Banga,	CBS Publishers
3	Behavioral Process in Organizations.	Uday Parikh, T.V. Rao and D.M. Pestonjee,	Tata McGrawhill. ISBN-13: 9788120400313

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. www.slideshare.net

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	-	-	-	-	2	3	2
CO2	-	-	-	-	2	3	2
CO3	-	-	-	-	1	3	2
CO4	-	-	-	-	2	3	2

	PSO1	PSO2	PSO3
CO1	-	1	-
CO2	-	1	-
CO3	-	1	-
CO4	-	1	-

***NOTE:-**The department which will run this course please do the PSO - competency- CO mapping according to your PSOs as this mapping is done according to E&TC Engg. PSOs

Sign: Name: Shri. G.W. Sonone (Course Expert)	Sign: Name: (Head of Department) (Electronics &Telecommunication Dept.)
Sign: Name: Smt.N.S.Kadam (Program Head) Metallurgical Engineering Department	Sign: Name: Shri. A.S.Zanpure (CDC In charge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in CE/EE/ET/ME/MT/CM/IT/DDGM**
Programme Code	**01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26**
Name of Course	**Materials Management**
Course Code	**MA4103**
Pre-requisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		#ESE	PA	ESE	PA	
02	00	00	02	Marks	40	10	--	--	50
				Exam Duration	2 Hrs	1/2 Hr	--	--	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

This course deals with management of materials. Smooth running of any industry depends upon the interdepartmental relations and planning for execution of work jointly. Efficiency of the production department also depends upon the availability of raw material of required quality and quantity. Therefore there should be proper coordination between the production department, production planning, stores department and purchase department. Incorrect materials planning can also lead to higher inventories & high cost.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **To acquaint with the latest techniques in materials management and inventory management.**

4. COURSE OUTCOMES (COs)

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 above mentioned competency**:**

1. State the importance of materials and inventory management.
2. Describe different aspects of buying procedure and price forecasting.
3. To acquaint with latest techniques in materials management.

5. SUGGESTED PRACTICALS/ EXERCISES - NA

6. MAJOR EQUIPMENTS / INSTRUMENTS REQUIRED - NA

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit – I Importance of Materials Management (08 hrs, 10 marks)	
1a. State needs of material management. 1b. List the fields of material management. 1c. State the objectives and functions of material management. 1d.Describe methods for organization of materials 1e. Explain importance of specifications in material management.	1.1 Growing importance of materials management. 1.2 Materials management: - Scope - Objectives - Functions 1.3 Organizing for materials management. 1.4 Introduction to materials planning. 1.5 Importance of specifications in materials management.
Unit – II Inventory Management (08 hrs, 10 marks)	
2a. Describe concept of inventory, ABC analysis. 2b. State advantages of ABC analysis mechanics.	2.1 Selective control – ABC analysis, purpose and objectives, advantages and limitations of ABC analysis. 2.2 Order point, lead time, safety stock, reorder point, standard order, economic order. 2.3 Economic order quantity concept, graphical representation, determination of EOQ.
Unit – III Buying & Inventory Control (08 hrs, 10 marks)	
3a. Describe purchase functions & procedures. 3b. State significance and approaches of price forecast 3c. Describe coding techniques for inventory. 3d. State importance of standardization.	3.1 Sourcing, buy or lease and purchase systems. 3.2 Value analysis framework, implementation methodology. 3.3 Ethics in purchasing. 3.4 Price forecasting- Importance & approaches. 3.5 Inventory turns ratios. 3.6 Standardization- need & importance. 3.7 Codification- concept, benefits.
Unit - IV Latest Techniques in Materials Management (08 hrs, 10 marks)	
4a. Explain Just in Time (JIT) inventory concept. 4b. State importance and applications of SAP.	4.1 Inventory concept - Just in Time (JIT). 4.2 Introduction to SAP - importance and applications of SAP. 4.3 Introduction to Supply chain management. 4.4 Objectives, importance, forecasting and applications of supply chain management.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Importance of Materials Management	8	6	2	2	10
II	Inventory Management	8	2	4	4	10
III	Buying & Inventory control	8	2	2	6	10
IV	Latest Techniques in Materials Management	8	2	4	4	10
	Total	**32**	**12**	**12**	**16**	**40**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Do survey and make a report on actual difficulties faced in materials management in different segments of industries.
b. Study and make a presentation on different Inventory management practices followed in industries.
c. Collect information and make a report on benefits achieved by maintaining good / optimum levels of inventory on the shop floor.
d. Study and make a report on different factors affecting the purchase cost in industrial materials management.
e. Do survey and make presentation on different classes of materials observed w.r.t materials management practices.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/subtopics.
b. About ***15-20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for co-curricular activities.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with concerned equipments / technology.
f. Use the proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operations, processes.
h. Teacher should ask the students to go through instruction and technical manuals.

11. SUGGESTED MICRO PROJECTS

NA

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of Publication, ISBN Number
1	Materials Management	Ammer Deans S	R.D. Irwin Hellions Publisher. ISBN10: 0210226765 ISBN13: 9780210226766
2	Materials Management An Integrated Approach	P. Gopalakrishnan and M. Sundaresan	Prentice – Hall of India Pvt. Ltd. New Delhi ISBN978-81-203-0027-9
3	An Integrated Concept of Materials Management	M.M. Shah	Tata McGraw Hill Publisher Co. Ltd. New Delhi. ISBN: 007451749X 9780074517499
4	Supply chain management strategy, planning and operation	Sunil Chopra	Kellogg School of Management Peter MeindlKepos Capital- Pearson Education, Inc., publishing as Prentice Hall. ISBN-13:978-0-13-274395-2 (alk. paper)

13. SOFTWARE/LEARNING WEBSITES

1. https://youtu.be/raqi4gjMLm8
2. https://youtu.be/abBvHqf26H8
3. https://nptel.ac.in/courses/110/105/110105095/
4. https://www.digimat.in/nptel/courses/video/110105095/L02.html
5. https://www.digimat.in/nptel/courses/video/110105095/L06.html

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	1	2	1	2	3	2
CO2	1	2	1	1	3	3	1
CO3	2	1	3	2	2	3	3

	PSO1	PSO2	PSO3	PSO4
CO1	1	-	-	1
CO2	1	-	-	2
CO3	1	-	-	1

***NOTE:-**The department which will run this course please do the PSO - competency- CO mapping according to your PSOs as this mapping is done according to Metallurgical Engg. PSOs.

Sign: Name: Shri. R. S. Tuljapurkar (Course Expert)	Sign: Name: Smt. N. S. Kadam (Head of Department)
Sign: Name: Smt. N.S.Kadam (Program Head) Metallurgical Engineering Department	Sign: Name: Shri. A.S.Zanpure (CDC In charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in CE/EE/ET/ME/MT/CM/IT/DDGM**
Programme Code	**01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26**
Name of Course	**Disaster Management**
Course Code	**MA4104**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		#ESE	PA	ESE	PA	
02	00	00	02	Marks	40	10	--	--	50
				Exam Duration	2 Hrs	1/2 Hr	--	--	--

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

Sensitization of every citizen of the country regarding disaster management is of utmost importance. A diploma holder in any discipline has a greater role in disaster management owing to the technical skill sets possessed by him/her. The course is an attempt to sensitize the students pursuing diploma programme in Engineering / Technology about various aspects of Disaster management.

3. COMPETENCY

The aim of this course is to address following Society / Industry identified competency through various teaching learning experiences:

- **Exhibit capability to contribute in Disaster management related activities through the technical skillsets possessed.**

4. COURSE OUTCOMES (COs)

On completion of the course through theory and relevant soft skills, the student shall demonstrate the following tangible outcomes;

1. Define and emphasize the significance of various terms associated with disaster and disaster management.
2. Classify and distinguish various types of disasters.
3. Interpret and elaborate features of the disaster management setup in India
4. Elaborate on the disaster mitigation, disaster preparedness and relief operations.

5. SUGGESTED PRACTICALS/ EXERCISES

The teaching and examination scheme for the course does not mandate any practical for the course.

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

NA

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
UNIT 1. Disaster and Disaster Management Concepts (6 hrs, 6 marks)	
1a. Definedisaster and disaster management. 1b. Define terms associated with disaster and disaster management. 1c. Correlates the effect of Vulnerability and Coping capacity on disaster management.	**1.1 Disaster and Disaster management:** Definitions of Disaster and disaster management. **1.2 Definition of terms associated with disaster and disaster management:** Definitionof terms Vulnerability to disaster, Hazard, Risk, Risk management, Coping capacity **1.3 Correlation of Vulnerability and Coping capacity in Disaster management:** Effect of vulnerability to disaster on the effect of disaster and disaster management.Influence of coping capacity on disaster assessment and mitigation.
UNIT 2. Types of disasters (6 hrs, 8 marks)	
2a. Classify disasters based on source. 2b. Classify Natural and Manmade disasters in to further categories. 2c. Further classification of disasters based on sequence of occurrence, Pace and scale.	2.1 Classification of disaster based on source as Natural and Manmade. 2.2 Classification of Natural disasters as atmospheric, Terrestrial, Aquatic and Biological. 2.3 Classification of manmade disasters as Industrial, Chemical, Technological, Nuclear, Gas leaks, Oil spills, Dam failures and canal breaches, Wars, Terrorist attacks, Biological, Transportation accidents. 2.4 Primary and secondary, Slow on set and rapid onset, simple and complex disasters.

UNIT 3. Disaster management in India (12 hrs, 16 marks)	
3a. Elaborates the provisions of Disaster management Act 2005. 3b. Signifies the role of National Institute of Disaster Management (NIDM) and elaborates on its activities. 3c. Describes the evolution of disaster management set up at national / state / district levels.	3.1 Disaster scenario in India, its vulnerabilities, review of some of the notable disasters in Indian history. 3.2 National disaster management Act 2005, its provisions, authorities at different levels and their roles/ responsibilities. 3.3. National Institute of Disaster Management (NIDM) – the need for its establishment, activities, contributions to disaster management in India. 3.4. National disaster management policy 2009, National Disaster management plan 2016 and 2019, Maharashtra state disaster management plan 2016. Provisions, features and role in strengthening national disaster management.
UNIT 4. Disaster mitigation and relief (8 hrs, 10 marks)	
4a.Describes various stages involved in disaster mitigation. 4b.Elaborates disaster risk reduction strategies. 4.c.Signifies the need for disaster preparedness in disaster management. 4.d.ElaboratesDisaster relief and rehabilitation activities.	4.1 Disaster mitigation strategies as per national disaster management plan provisions. 4.2 Disaster risk reduction strategies and study of factors contributing to disaster vulnerability. 4.3 Study of disaster preparedness strategies and early warning systems to anticipate occurrences of disaster to improve preparedness.4.4 Disaster relief activities as per the provisions of statutes and the action plans and procedures for disaster relief. Stake holders in disaster relief management. 4.5 Capacity building rehabilitation measures and long term reconstruction.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Disasterand Disaster Management Concepts	06	02	04	00	06
II	Types of disasters	06	04	04	00	08
III	Disaster management in India	12	04	12	00	16
IV	Disaster mitigation and relief	08	02	06	02	10
Total		**32**	**12**	**26**	**02**	**40**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom, following student-related ***co-curricular*** activities are suggested which reinforce the cognitive learning and aid in attainment the course outcomes;

a. Individual student shall prepare a report on one natural and one manmade disaster that has occurred in India (Preferably in Maharashtra) in the last 10 years. The report shall highlight classification of the disaster, magnitude, vulnerability of the disaster location/ site, mitigation measures, relief activities undertaken and long-term measures and their effect.
b. Individual student shall prepare a report on a successful disaster preparedness exercise executed in India in the near past. The report shall highlight the risk reduction strategies adopted, early warning systems used and reduction of vulnerability to hazard measures adopted.
c. Each individual student undergoing this course shall complete "Course 1 – Basics of disaster management under the self-study programme of National Institute of Disaster Management (NIDM) and secure certification for the same.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

a. All the units of curriculum are supported by selective MOOCS prepared by Educational Multimedia Research Centre (EMRC) Osmania University on Disaster management. The Urls of the earmarked videoclips for the course are listed as reference material in the curriculum. The students can access them.
b. The course teacher shall prepare study material to the students based on the MOOCs, reference materials listed.

11. SUGGESTED MICRO-PROJECTS

The scope of the course does not mandate any micro projects. However, suggested student activities suffice as micro projects.

12. SUGGESTED LEARNING RESOURCES

Sr.No.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	The Disaster Management Act, 2005	Government of India	N A (pdf of the bare act is enclosed with curriculum)
2	National Disaster Management Plan (NDMP) 2016	Government of India	N A (pdf of the bare act is enclosed with curriculum)
3	Maharashtra State Disaster Management Plan 2016	Government of Maharashtra	N A (pdf of the bare act is enclosed with curriculum)
4	National Disaster Management Plan 2019	Government of India	N A (pdf of the bare act is enclosed with curriculum)
5	Draft National Disaster Management Plan Part II Disaster mitigation and response function plans	Government of India	N A (pdf of the bare act is enclosed with curriculum)

13 SOFTWARES / ONLINE LEARNING RESOURCES

The students and faculty can visit following earmarked urls for MOOCs of EMRC Osmania University without indulging in any acts violating copyright.

1. https://youtu.be/DExlZTfKZAM?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG(Disaster and Disaster management concepts)
2. https://youtu.be/7ZhS_HrivqA?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Types of Disaster)
3. https://youtu.be/BI38KKij9Nc?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Natural Disasters)
4. https://youtu.be/cijSod44Q2g?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Manmade Disaster)
5. https://youtu.be/zwIQVKqytD4?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Slow onset and Rapid onset Disasters)
6. https://youtu.be/zBqvJkzbk-w?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Simple and Complex Disaster)
7. https://youtu.be/e3MwwrRMfZ8?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Evolution of Disaster in India)
8. https://youtu.be/iFPMSRCswG0?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Disaster and disaster management in India)
9. https://youtu.be/u9ch6eqjG-Y?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Disaster management act 2005)
10. https://youtu.be/e5KV2exJTeE?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (National Institute of Disaster Management)
11. https://youtu.be/6zFOS1VVGLw?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (National Policy on disaster management)
12. https://youtu.be/PHUf3WFtGfc?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (National disaster management plan 2016)
13. https://youtu.be/mgb7bs4Yv1g?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Stake holders in disaster management)
14. https://youtu.be/GtFO-FaUwbM?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Central Government as stake holder in disaster management)
15. https://youtu.be/J4oMdAOuUFQ?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (State Government as stake holder in disaster management)
16. https://youtu.be/7TFTXqOtARo?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (District administration as stake holder in disaster management)
17. https://youtu.be/rUziSTV2l9o?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Armed forces as stake holder in disaster relief management)
18. https://youtu.be/lv80bN26KeE?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Paramilitary forces as stake holder in disaster relief management)
19. https://youtu.be/lDhM8Co1pEs?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Fire services as stake holder in disaster relief management)
20. https://youtu.be/ueqXlFC5bg0?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Disaster risk reduction strategies)
21. https://youtu.be/VQ6tMdBZARM?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Disaster preparedness plan)
22. https://youtu.be/TFLwWMcQll4?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Early warning system in disaster preparedness)

23. https://youtu.be/972scfiEPtw?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Factors contributing to disaster vulnerability)
24. https://youtu.be/9e-iiKwQ3I4?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Disaster risk reduction master plan for the future)
25. https://youtu.be/y0qui7QWTQU?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Components of disaster relief)
26. https://youtu.be/9EWZvwE2548?list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG (Capacity building rehabilitation measures and long term reconstruction)

14 PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	-	-	-	-	-	-	1
CO2	-	-	-	-	1	-	1
CO3	-	1	2	1	2	1	2
CO4	1	1	2	1	2	2	2

	PSO1	PSO2	PSO3
CO1	--	--	--
CO2	1	--	--
CO3	1	1	1
CO4	2	2	2

***NOTE:-**The department which will run this course please do the PSO - competency- CO mapping according to your PSOs as this mapping is done according to Civil Engg. PSOs

Sign: Dr. S. M. S. Shashidhara Shri. V. B. Kondawar (Course Experts)	Sign: Name: (Dr. S.M.S.Shashidhara) (Former Head of Department) Shri. V. G. Tambe (HOD I Shift) Shri. V. B. Kondawar (HOD II shift)
Sign: Name: Smt.N.S.Kadam (Program Head) Metallurgical Engineering Department	Sign: Name: Shri. A.S.Zanpure (CDC In charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in CE/EE/ET/ME/MT/CM/IT/DDGM**
Programme Code	**01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26**
Name of Course	**Introduction to E-Commerce**
Course Code	**MA4105**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
L	T	P	C		#ESE	PA	ESE	PA	
02	00	00	02	Marks	40	10	--	--	50
				Exam Duration	2 Hrs	1/2 Hr	--	--	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

This course is aimed at providing the students with modules on the use of the Internet and e-commerce. It also includes all aspects of deploying e-business and e-commerce within an organization. It also provides theories and concepts and questions the validity of these models in the light of the differences between the Internet and other media.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Understand real time problem solving and relevant soft skills.**

4. COURSE OUTCOMES (COs)

The theory, real time problem solving 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 above-mentioned competency:

1. Define E-commerce and various business models.

2. Describe fundamental sales process.
3. Recognise the variants of the process of B2C and B2B.
4. Identify ethical aspects of ICT.

5. SUGGESTED PRACTICALS/ EXERCISES

NA

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

NA

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit- I Introduction to E-Commerce (04 hrs, 06 marks)	
1a. Define E-commerce. 1b. Differentiate between various business models. 1c. Explain technical challenges. 1d. Explain economic challenges.	1.1 Basics and definitions – E-Commerce. 1.2 Business models related to E-Commerce. 1.3 Technical and economic challenges.
Unit-II Frameworks and Architectures (08 hrs, 10 marks)	
2a. Explain fundamental sales process. 2b. List out Technological elements.	2.1 Actors and Stakeholders. 2.2 Fundamental sales process. 2.3 Technological elements.
Unit-III B2C Business (08 hrs, 10 marks)	
3a. Explain the variants of the process of B2C. 3b. Differentiate between various challenges. 3c. Understand CRM.	3.1 The process model and its variants. 3.2 The pricing challenges. 3.3 The fulfilment challenges. 3.4 The payment challenges. 3.5 B2C-business and CRM. 3.6 B2C software systems.
Unit-IV B2B Business (06 hrs, 08 marks)	
4a. Explain the variants of the process of B2B. 4b. Identify B2B software systems.	4.1 The process model and its variants. 4.2 B2B software systems.
Unit-V Impact of E-Commerce (06 hrs, 06 marks)	
5a. Identify ethical aspects of ICT. 5b. List out different impacts of E-Commerce.	5.1 Ethics, morale and technology. 5.2 Ethical aspects of ICT. 5.3 Overall impacts of E-Commerce. 5.4 Specific impacts of E-Commerce.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction To E-Commerce	04	02	02	02	06
II	Frameworks and Architectures	08	02	04	04	10
III	B2C Business	08	02	04	04	10
IV	B2B Business	06	02	02	02	08
V	Impact of E-Commerce	06	02	04	02	06
Total		**32**	**10**	**16**	**14**	**40**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews: -Student can study and prepare report on any application in which e-commerce they used.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are strategies, which can be used to accelerate the attainment of the various outcomes in this course:

Sr. No.	Topic	Instructional Strategy
1	Introduction To E-Commerce	Class room teaching
2	Frameworks and Architectures	Class room teaching
3	B2C Business	Class room teaching
4	B2B Business	Class room teaching
5	Impact of E-Commerce	Class room teaching

11. SUGGESTED MICRO-PROJECTS

NA

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publisher, Edition and Year of publication ISBN Number
1	Introduction to E-Commerce: Combining Business and Information Technology	Prof. Dr. Martin Kutz	1st Edition Jan 2020 ISBN 9788740315202

13. SOFTWARE/LEARNING WEBSITES

NA

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	-	-	-	-	1	3	2
CO2	1	1	-	1	1	3	2
CO3	1	-	-	1	1	3	3
CO4	1	1	-	1	1	3	3

	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2

***NOTE:-**The department which will run this course please do the PSO - competency- CO mapping according to your PSOs as this mapping is done according to Computer Engg. PSOs

Sign: Name: Smt. H. S. Pawar Smt. N. R. Wagh Smt. P. N. Yewale Smt. S. S. Ingavale Smt. S. J. Siraskar Smt. S. R. Hande (Course Experts)	Sign: Name: Mr. U.V. Kokate Dr. S. B. Nikam. (Head of Department) (Department of Computer Engineering)
Sign: Name: Smt.N.S.Kadam (Program Head) Metallurgical Engineering Department	Sign: Name: Shri. A.S. Zanpure (CDC In-charge)

Government Polytechnic, Pune

'180OB' – Scheme

Program Name	**Diploma in CE/EE/ET/ME/MT/CM/IT/DDGM**
Program Code	**01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26**
Name of Course	**Information Management**
Course Code	**MA4106**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		#ESE	PA	ESE	PA	
2	0	0	2	Marks	40	10	--	--	50
				Exam Duration	2 Hrs	1/2 Hr	--	--	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

Organizations of all sizes generate and work on information. Collection and management of Information becomes an important aspect in each and every field. This course is aimed at providing the students with the basics of Information Management.

3. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Use information management system in industries.**

4. COURSE OUTCOMES (COs)

The theory, real time problem solving 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 above-mentioned competency:

1. Recognize information system in any organization.
2. Enlist types of Information Systems.
3. Identify the competitive environment of business.
4. Identifying challenges in Information management.
5. State Social and Ethical issues with Information Management.

5. PRACTICALS/ EXERCISES

NA

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

NA

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit-I Organizations and Information Systems (06 hrs, 08 marks)	
1a. List different types of modern organizations. 1b. Explain IT interaction model. 1c. Identify challenges for the manager.	1.1 Modern Organization- IT enabled, Net-worked, Dispersed, Knowledge Information Systems in Organisations. 1.2 Managing Information Systems in Organization. 1.3 Challenges for the manager. 1.4 The Role of Internet. 1.5 Managing the Internet era.
Unit-II Concepts of Management Information Systems (06 hrs, 08 marks)	
2a. Enlist types of Information Technology. 2b. Enlist types of Information Systems. 2c. Differentiate between various decisions. 2d. Explain communication in organizations.	2.1 Data and Information, Information as a re-source. 2.2 Information in organizational functions. 2.3 Types of Information Technology, Types of Information Systems. 2.4 Decision making with MIS. 2.5 Communication in organization.
Unit-III Information Systems and Management Strategy (08 hrs, 10 marks)	
3a. Identify the competitive environment of business. 3b. Find out the properties of Information Goods. 3c. Explain value chain.	3.1 The competitive environment of business. 3.2 Using IT for competing. 3.3 Information Goods. 3.4 Information Systems and Competitive strategy.
Unit-IV Managing Information Systems (06 hrs, 08 marks)	

4a. Understand the challenges of managing the IT function. 4b. Identify vendor. 4c. Explain the role of CIO.	4.1 Challenges of managing the IT function. 4.2 Vendor Management. 4.3 The Role of CIO.
Unit-V Ethical and Social Issues (06 hrs, 06 marks)	
5a. Explain Ethical issues. 5b. Explain Social issues.	5.1 Ethical issues- Privacy, Workplace Monitoring, Power over Users. 5.2 Social issues- Workplace behaviour and Health, De-skilling and Alienation, Tele- commuting, E-Waste.

8. SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Organizations and Information Systems	6	4	2	2	08
II	Concepts of Management Information Systems	6	4	2	2	08
III	Information Systems and Management Strategy	8	4	4	2	10
IV	Managing Information Systems	6	2	4	2	08
V	Ethical and Social Issues	6	2	2	2	06
Total		**32**	**16**	**14**	**10**	**40**

9. STUDENT ACTIVITIES

Other than the classroom learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for the activity mentioned, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:-

Student can study and prepare report on information management as done in any small setup like cyber café, canteen, medical or grocery shops etc.

10. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are strategies, which can be used to accelerate the attainment of the various outcomes in this course:

Sr. No.	Topic	Instructional Strategy
1	Organizations and Information Systems	Class room teaching
2	Concepts of Management Information Systems	Class room teaching
3	Information Systems and Management Strategy	Class room teaching
4	Managing Information Systems	Class room teaching
5	Ethical and Social Issues	Class room teaching
6	Organizations and Information Systems	Class room teaching

11. SUGGESTED LIST OF MICROPROJECTS:-
Not Applicable

12. LEARNING RESOURCES

Sr. No.	Title	Author	Publisher, Edition, Year of publication, ISBN Number
1	Managing Information Systems in Business, Government and Society.	Rahul De	Wiley Publication, Second Edition 2018 ISBN-9788126571222

13. SOFTWARE/LEARNING WEBSITES

1. https://en.wikipedia.org/wiki/Information_system

14. PO - COMPETENCY- CO MAPPING

CO/PO → ↓	Basic and Discipline Specific	Problem Analysis	Design/Development of Solutions	Engineering Tools, Experimentations and	Engineering Practices for Society ,Sustainability and Environment	Project Management	Life Long Learning
Recognize information system in any organization.	-	-	-	-	2	2	3
Enlist types of Information Systems	-	-	-	-	1	2	3
Identify the competitive environment of business.	-	-	-	-	2	2	3
Identifying challenges in Information management	-	-	-	-	1	3	3
State Social and Ethical issues with Information Management.	-	-	-	-	3	2	3
Summary	**-**	**-**	**-**	**-**	**2**	**3**	**3**

PSO - COMPETENCY- CO MAPPING

	Hardware and Networking	**Database Technologies**	**Software Development**
CO1	1	1	1
CO2	-	2	2
CO3	-	1	2
CO4	-	1	1
CO5	1	1	2
Summary	**1**	**1**	**2**

***NOTE:-**The department which will run this course please do the PSO - competency- CO mapping according to your PSOs as this mapping is done according to IT dept. PSOs

Sign : Smt. P. N. Yewale Smt.G.B.Garud Smt. A.S.Paike Smt.P.K.Zade Smt.S.R.Hande (Course Experts)	Sign : Name: Smt.M. U. Kokate (Head of Department) (Department of Information Technology)
Sign: Name: Smt.N.S.Kadam (Program Head) Metallurgical Engineering Department	Sign: Name: Shri. A.S. Zanpure (CDC In-charge)

Government Polytechnic, Pune

Department of Metallurgical Engineering

180 OB Curriculum

Level-4C: Programme Specific Courses

(All Compulsory)

Sr. No.	Course Code	Course Name
1	MT4101	Industry In-plant Training
2	MT4102	Project (In-house / Industry)
3	MT4103	Seminar
4	MT4104	Elements of Physical Metallurgy
5	MT4105	Foundry Engineering
6	MT4106	Powder Metallurgy
7	MT4107	Metal Working Processes
8	MT4108	Heat Treatment of Metals & Alloys

Government Polytechnic, Pune

'180 OB'– Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme Code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19**/21/22/23/24/26
Name of Course	**Industry In-plant Training**
Course Code	**MT4101**
Prerequisite course code and name	**Level 1 & Level 2 courses Term grant**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			**Total Credits (L+T+P)**		**Examination Scheme**				
					Theory		**Practical**		**Total Marks**
L	T	P	C		**ESE**	**PA**	**$ESE**	**PA**	
00	00	06	06	Marks	--	--	50	50	100
				Internship Duration	6 weeks duration				

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

Note: Both ESE and PA part of assessment will be carried out by institute faculty and industry training mentor as explained in Table 1 and Table 2, Table 3.

2. RATIONALE :

Employability competencies can be enhanced by exposing students to the actual real time working environment in industry. The industrial skills like, soft skills, life skills and hands-on will be inculcated among the students. In-plant training is the only way students learn application of acquired knowledge to fulfill market demand and develop skills and competencies required to become employable.

3. COMPETENCY:

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Develop soft skills and hands-on practices in the industrial environment.**

4. COURSE OUTCOMES:

Industry In-plant Training is intended to acquire the competencies as mentioned above to supplement those attained through several courses up to fourth semester of the program:

1. Communicate effectively (verbal as well as written) to execute the work.
2. Prepare the report of the executed work at the industry.
3. Exercise time management and safety in the work environment.
4. Work in teams for successful completion of projects assuring quality.

5. GENERAL GUIDELINES FOR INDUSTRIAL TRAINING

a) **Period of Industrial Training:** Between 4^{th} and 5^{th} semester (Summer Vacation).

b) **Duration of the training:** Six weeks

c) The Industries/Organizations can be Government/Public limited/or Private family enterprises.

- **Training Area:** Students should be placed in large and medium scale Industry / Organization. However, despite the best efforts by the institute, if large and medium scale Industry / Organization are not available to all students then, students can also be placed in small scale Industry / Organization.

  Industry/ Organization can be it fabrication, foundry (ferrous/non ferrous, forging, rolling, extrusion, galvanizing, powder metallurgy, heat treatment, iron making, steel making, material testing laboratory (destructive/non destructive), metallography.

6. ROLE OF PARENT DEPARTMENT & THE INSTITUTE:

A. Formation of Placement cell for IIP at institute level: (one time activity)

It will be consisting of Training& Placement Officer (TPO), CDC In charge, and one Faculty from each program.

Activities to be carried by Institute IIP Cell:

A.1 Collecting information about Industry / Organization available for training along with the capacity.

A.2 Communication with Industry / Organization available for training along with capacity and its confirmation.

A.3 Issue letter to the Industry / Organization for the training along with details of students and mentors.

B. Formation of IIP Cell at program level:(one time activity)

It will be consisting of a faculty from Institute IIP cell, one faculty per division for examiners coordination, orientation, mentors, letters initialization.

Activities to be carried by Program level IIP Cell:

B.1 Student and mentor allocation as per the slots available for In-plant Training.

B.2 Obtaining consent letter from parents / guardian. (Undertaking on Rs.100 stamp, Insurance).

B.3 Orientation and selection of Students in industries before start of Industry In-plant training through counseling.
B.4 Mentors to carry out progressive assessment of the students during the In-plant training.
B.5 End of training assessment by mentor along with Industry / Organization expert as external.

- **Scheduling for Implant Training placements –**

Sr. no.	Activity	Period	Responsibility
1	Industries to be identified	6^{th}-8^{th} week of 4^{th} Semester	Departmental In-plant training coordinator
2	Communication and coordination with industry	8^{th}-10^{th} week of 4^{th} Semester	Departmental In-plant training coordinator
3	Allocation of faculty / Mentor	8^{th}-10^{th} week of 4^{th} Semester	Departmental In-plant training coordinator
4	Acquire undertaking from students and parents.	10^{th} – 12^{th} week of 4^{th} Semester	Allocated faculty / Mentor
5	Finalize and prepare letter of placements	12^{th} – 16^{th} week of 4^{th} Semester	Allocated faculty / Mentor
6	Organize orientation and guidance and counseling Session for respective students	12^{th} – 16^{th} week of 4^{th} Semester	Allocated faculty / Mentor
7	Progressive assessment of the students during the in-plant training	Each week of training	Allocated faculty / Mentor
8	End of training assessment by mentor along with Industry / Organization expert	Before 5^{th} semester ESE	Allocated faculty / Mentor

- Faculty will be visiting the industry **at least once** during training phase after third week for assessment in coordination with industry personnel and for taking feedback. Weekly assessment can be done through online mode.

7. FORMAT FOR TRAINING REPORT

Following is the suggestive format for the training report. Actual format may differ slightly depending upon the nature of Industry / Organization. The training report may contain the following

- Title page
- Certificate
- Abstract
- Acknowledgement
- Content Page

Chapter 1. Organizational structure of Industry / Organization and General Lay Out
Chapter 2. Introduction of Industry / Organization (Type of products and services, history, turn over and number of employees etc.)
Chapter 3. Types of major equipment/instruments/machines/hardware and software used in industry with their specification, approximate cost and specific use and their routine maintenance.
Chapter 4. Manufacturing Processes/Models along with planning, handling and control methods.
Chapter 5. Testing of raw materials, components and finished products along with quality assurance procedures.
Chapter 6. Safety procedures followed and safety gear used (includes Preventive maintenance schedule and breakdown maintenance procedures).
Chapter 7. Particulars of Practical Experiences in Industry / Organization if any in Production/ Assembly/ Testing/Maintenance.
Chapter 8. Detailed report of the Task. (if any done during the training)
Chapter 9. Special/challenging experiences encountered during training if any (may include students liking & disliking of work places)
Chapter 10. Conclusion
Chapter 11. References /Bibliography

8. SUGGESTED LEARNING & EVALUATION STRATEGIES/GUIDELINES

- Students should visit the website of the industry where they are undergoing training to collect information about products, processes, capacity, number of employees, turnover etc.
- They should also refer the handbooks of the major machinery, software (if any) and operation, testing, quality control and testing manuals used in the industry.
- Students may also visit websites related to other industries wherein similar products are being manufactured as their learning resource.
- Both the industry supervisor and the faculty supervisor are responsible to assess the students' performance and soft-skills.
- To assess the students, the scoring rubric, scoring schemes and rating scales are developed. The components to be assessed are :
  - Industrial training Report,
  - Logbook (Diary),
  - Industrial training Oral Presentation,
  - Student Performance Evaluation by Organization Supervisor, and
  - Student Performance Evaluation by Faculty Supervisor
- Industrial Training report writing require students to produce a substantial report to explain about the organization's background, the overall training that have been performed and the specific projects that they have conducted along with specific conclusions /solutions.

- The students must apply the skills of communicating using written language, outlining, organizing, and planning a report, as well as using reference materials and sources and follow the above format.
- The student plays important role in deciding what should be included in the log book and learn to understand and evaluate her own progress.
- In exceptional case, on line training can also be considered as an option, provided, the contents and the assessment schemes are approved from the concerned authorities.
- Student performance evaluation focuses on a student's work performance and the personality. The scoring rubric forms are used that relates assessment item to the learning outcome. The work performance is the ability to complete the given tasks within the specified time frame independently using their knowledge and skills with good quality of work. The soft skills include the socialization, communication, initiative and motivation, discipline, cooperation and teamwork.

9. TENTATIVE WEEK-WISE SCHEDULE OF INDUSTRIAL TRAINING

Industrial training is a common course to all programs; therefore the industry / Organization selection will depend upon the nature of program and its related industry. The training activity may vary according to nature and size of Industry / Organization. The following table details suggestive schedule for industrial training for all programs.

Table 1: Guidelines for generalized week schedule and PA Marks distribution

S. No.	Week No.	Details of activities to be completed during Industrial training	Marks distribution/ week for PA
1	Week No. 1	Induction to industry and its departments or study of assigned job.	04
2	Week No. 2	Study of layout and specifications of major machines, equipment and raw materials / components / software and models used.	04
3	Week No. 3	Execute/study Task. **(Execution may start from first week as per job assigned and nature of industry)**	04
4	Week No. 4	Study of QA/QC/Testing procedures.	04
5	Week No. 5	Study safety and maintenance procedure in an industry/organization.	04
		Total	**20**
6.	Week No. 6	Report Writing (PA marks to be given by faculty based on report writing)	10
PA marks to be given by industry supervisor based on student involvement and quality of job performed or job assigned.			20
		Total PA marks for training	**50**

Table 2: <u>Suggested Rubric for PA Assessment of Internships/In-plant Training</u>

Note: Allot the marks in the appropriate cell given based on Presentations done

Week No	Task to be assessed	Outcome Achievement – Poor	Outcome Achievement- Moderate	Outcome Achievement – High		Total week wise Marks
		Poor (Marks 1)	Average (Marks 2)	Good (Marks 3)	Excellent (Marks 4)	
Week 1 : Industry Induction	Induction to industry and its departments or study of assigned job.	Minimal knowledge of departments, processes, products & work culture of the company	Moderate knowledge of departments, processes, products & work culture of the company	Good knowledge of all departments, processes, products & work culture of the company	Extensive knowledge of all departments, processes, products & work culture of the company	
Week 2 : Study of Existing Systems	Study of layout and specifications of major machines, equipment and raw materials / components / software and models used.	Minimal Explanation of existing systems & Objectives of the proposed work are not identified	Moderate Explanation of existing systems & Objectives of the proposed work are not well defined	Good Explanation of existing systems & Some objectives of the proposed work are well defined	Detailed Explanation of existing systems & All objectives of the proposed work are well defined	
Week No. 3: Execution of task	Execute/study Task. (Execution may start from first week as per job assigned and nature of industry)	Minimal efforts and participation and poor understanding	Moderate efforts and participation and preliminary understanding	Good efforts and participation and fair understanding	Extensive efforts and participation and well understanding	

Week 4 : Testing Procedures	Study of QA/QC/Testing procedures.	Applications are not appropriate	Applications are Appropriate but not well delivered	Applications are appropriate and well delivered Student cannot apply his/her knowledge on top of assessing what he/she knows	Applications are appropriate and well delivered Student can apply his/her knowledge on top of assessing what he/she knows	
Week 5 : Study Safety & Maintenance Procedure	Study safety and maintenance procedure in an industry/organization.	Not very appropriate	Appropriate but not well delivered	Appropriate and well delivered Student cannot apply his/her knowledge on top of assessing what he/she knows	Appropriate and well delivered Student can apply his/her knowledge on top of assessing what he/she knows	
					Total Marks out of 20	
		Poor (Marks 5)	**Average (Marks 6)**	**Good (Marks 8)**	**Excellent (Marks 10)**	
Week 6 : Report Writing	Description of concepts and technical details Conclusions and Discussion	Results are not presented properly Project work is not summarized and concluded Future extensions in the project are not specified	Results are presented in good manner Project work is not well summarized and concluded Future extensions in the project are not properly specified	Results are presented in good manner Project work is well summarized and concluded Future extensions in the project are not properly specified	Results are presented in very appropriate manner Project work is well summarized and concluded Future extensions in the project are well specified	
					Total Marks out of 10	
PA marks to be given by industry supervisor based on student involvement and quality of job performed or job assigned. **Total Marks out of 20**						
					Grand Total Marks out of 50	

Table 2.1: PA of Industrial training

Academic year: 20   -20

Name of the industry:

Sr. No.	Enrolment Number	Name of student	Marks from above Rubrics (Mapped to 4 marks for each week)						PA Marks by Industry Supervisor	PA based on Report by mentor faculty (Week 6)	Total
			Week 1	Week 2	Week 3	Week 4	Week 5	**Total out of 20 (A)**	**Out of 20 (B)**	**Out of 10 (C)**	**Out of 50 (A)+(B)+(C)**

Marks for PA are to be awarded out of 4 for each week considering the level of completeness of activity observed, from the daily diary maintained and feedback from industry supervisor.

Signature of Mentor

Name of Mentor:

Table 3: Assessment Scheme ESE

		Contents (20 marks)	Presentation (30 marks)			Total Out of (50)
Enrollment No.	Title of Industrial project	Report writing	Presentation Skill (15)	Slide preparation (05)	Answering skills (10)	

10. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	-	-	2	2	3	3
CO2	1	-	-	2	2	3	3
CO3	1	-	-	3	3	3	3
CO4	1	-	-	3	2	3	2

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	3
CO2	3	2	2	3
CO3	2	3	2	3
CO4	2	2	2	3

Sign: Name: Shri.R.G.Injewar (Course Expert)	Sign: Name: Smt.N.S.Kadam (Head of Department)
Sign: Name: Smt.N.S.Kadam (Program Head) (Metallurgical Engineering Department)	Sign: Name: Shri.A.S.Zanpure (CDC In charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme Code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19/**21/22/23/24/26
Name of Course	**Project**
Course Code	**MT4102**
Prerequisite Course Code and Name	**90 credits & Level 1 passed**
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	$ESE	PA	
00	00	04	04	**Marks**	--	--	50	50	100

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

A diploma technician has to face a number of problem solving situations in his professional life while working in changing industrial environments. A scientific approach is necessary to plan and execute a given engineering task. Interacting with people, obtaining information from different sources and presenting the same in the form of a project report are some of the skill sets that a diploma engineer should possess. This course aims to inculcate these attributes in the students and encourages the process of independent thinking.

3. COMPETENCY

The course should be taught and implemented with the aim to develop the required course outcomes (COs) so that students will acquire following competency needed by the industry:

- **Execute an engineering task by systematic planning, organizing, and managing the available resources.**

4. COURSE OUTCOMES (COs)

After undergoing this course, the student will demonstrate the following Course Outcomes:

1. Analyze the real life problem from a project development point of view.
2. Apply appropriate design methodology by using different design tools.
3. Select the appropriate production tool/ process.
4. Prepare a technical project report (including production drawings, process charts, costing and estimation, etc.).
5. Communicate effectively as a member /and leader of the project team.

5. GUIDELINES FOR UNDERTAKING A PROJECT :

I. During the guidance and supervision of the project work, faculty should ensure that students acquire following ***learning outcomes*** (depending upon the nature of the project work some of these learning outcomes may not be applicable):

a) Identify the problems in the area related to their programme based on the competencies acquired since inception into the programme.
b) Identify the information suggesting the cause of the problem and possible solutions.
c) Assess the feasibility of different solutions and the financial implications.
d) Collect relevant data from different sources (books/internet/market/suppliers/experts etc. through surveys/interviews).
e) Prepare required drawings and detailed plan for execution of the work.
f) Prepare seminar presentations to present findings/features of the project.

II. In case of Industry sponsored/guided project, implementation stages may vary as per industry requirements but same format of project report, diary, demonstration and RUBRICs will be required to be fulfilled.

Sr. No.	General Guidelines
1.	The project can be industry sponsored, maintenance based, or design and fabrication type, involving multidisciplinary technologies.
2.	Project has to be done in a group of 3-4 students under the guidance of allotted faculty.
3.	Faculty/ students may form groups for the completion of the project work. Each group is assigned a guiding faculty, and project titles must be decided in coordination with the faculty.
4.	Students are required to present their project work in the form of a working model/simulation work, if any.
5.	Students must submit one hard copy and one soft copy of the project report in the prescribed format.

6.	Generally, the Project Report should be as per the guidelines mentioned in Annexure 1.
7.	Student should maintain a project diary and note down all the progress steps and details in the diary. Faculty should check the diary each week and accordingly interact with students based on the progress shown and keep proper notings.Impart proper guidance. This will assist in proper evaluation of students. Format of project diary may be as per Annexure II. Project diary may contain 5-10 pages.

Course Implementation Stages:

1. **Orientation Session:** Portfolio Incharge faculty has to coordinate conduction of Project orientation session during last week of fifth semester.
2. **Problem Search and problem statement finalization:** Students have to undergo survey activity under the guidance of faculty. This activity maybe started during earlier semester in parallel with Seminar activity and completed during first week of sixth semester**.**
3. **Data Collection:** The reference material for the project should be collected through various sources such as books, the internet, industry, manuals etc. One week is to be utilized for this activity, and the same should be presented to the faculty.
4. **Requirement Gathering:** One week to be utilized for gathering detailed project requirements including human resource, technical requirements/resources, feasibility study and cost requirements, under the guidance of faculty.
5. **Planning:** Next week must be utilized towards preparing a detailed project proposal and plan which must be executed or implemented within the time allocated. Planning includes diagrams, flow charts, resources required, work allocation, time estimations and cost estimations.
6. **Material procurement and process planning:** Procure the required raw material and prepare process charts for the parts to be manufactured or processed.
7. **Manufacturing/Processing:** Parts should be produced as per the drawings or processed as per flow charts. The parts produced or processed should confirm the designed specifications to obtain the optimum performance of the product.
8. **Assembly and Testing:** After all the parts are manufactured and procured or processed, various components should be assembled, and trials should be carried out to evaluate the performance**.** All the required tests should be performed and test reports to be maintained.
9. **Project Demonstration:** The project would have to go through minimum two demonstrations :
    a. Preliminary demonstration (Given to faculty guide)
    b. Final Demonstration: During ESE final demonstration of working model is to be presented.

Note: Students must maintain a project diary and prepare a project report, which should be periodically monitored and assessed by the faculty guide as provided by RUBRICS.

6. ASSESSMENT OF PROJECT WORK

A. Progressive Assessment (PA) Guidelines and criteria

The assessment of the students for Progressive Assessment (PA) of 50 marks is to be done based on following criteria.

Sr. No.	Criteria	Marks
1	Topic selection & problem definition	10
2	Data collection & requirement gathering	10
3	Stage wise progress as per discussion	10
4	Involvement in project activities	10
5	Report writing	10

B. End Semester Exam Assessment (ESE) criteria

The assessment of the students for End-Semester-Examination (ESE) of 50 marks is to be done based on following criteria.

Sr. No.	Criteria	Marks
1	Project selection process	5
2	Project content	10
3	Project Execution	10
4	Quality of project report	10
5	Question-Answer	15

7. THEORY COMPONENTS
NA

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN
NA

9. SUGGESTED STUDENT ACTIVITIES
NA

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

As per the guidelines mentioned in Annexure-I or any other guidelines given by faculty.

11. SUGGESTED MICRO-PROJECTS

NA

12. SUGGESTED LEARNING RESOURCES

As per the guidelines mentioned in Annexure-I or any other guidelines given by faculty.

13. SOFTWARE/LEARNING WEBSITES

NA

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3
CO4	2	-	-	-	-	-	3
CO5	2	2	1	1	-	2	3

	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	2
CO2	3	2	2	2
CO3	3	2	1	2
CO4	3	1	1	2
CO5	2	-	1	3

Annexure-I

Guidelines for the preparation of Project Report

After completion of the project work, every student will submit a project report which should contain the following:

a) Cover Page (refer sample)
b) Certificate (refer sample)
c) Acknowledgment (refer sample)
d) Abstract (It should be in one page and include the purpose of the study, the methodology used.)
e) Contents (List of abbreviation, list of figures, list of tables, list of symbols etc. followed by all the topics, subtopics with page numbers)
f) Detailed description of the project (This should be split in various chapters/sections with each chapter/section describing a project activity in totality and should contain all relevant diagrams, tables, flow charts, which are properly labeled.).E.g.
    1) Introduction
        1a. Objective of the study
        1b. Relevance
    2) Present status of technology
    3) Proposed work
    4) Principle of working/process/construction (as applicable)
    5) Experimental work
    6) Testing procedures
    7) Future scope of work
g) Conclusion
h) References (The listing of references should be typed 2 spaces below the heading "REFERENCES" in alphabetical order in single spacing left – justified. It should be numbered consecutively (in square [ ] brackets, throughout the text and should be collected together in the reference list at the end of the report. The references should be numbered in the order they are used in the text. The name of the author/authors should be immediately followed by the year and other details). For book, Title should be italicized (See Ref [3] below) whereas, for journal/conference papers, Journal/Conference name should be italicized (See Ref [1] and [2] below). While referencing websites, specify the exact web link followed by the date on which it is referred to. Avoid mentioning search engines like www.google.com, etc., but mention the actual web page referred to. See Ref [4] below.

    [1] Singh, S. and Shan, H. S, "Development of Magneto Abrasive Flow Machining Process", *International Journal of Machine Tools & Manufacturing*, vol. 42, 2, pp. 953-959, 20.

[2] Laroiya, S.C. and Adithan, M, "Precision Machining of Advanced Ceramics" *Proceeding of the International Conference on Advanced Manufacturing Technology* (ICMAT - 94), University Teknologi Malaysia, Johor Bahru, Malaysia, pp 203-210, 29-30 August1994.
[3] Adithan, M. and Gupta, A.B., *"Manufacturing Technology",* New Age, International Publishers, New Delhi, 1996.
[4] http://www.datasheetarchive.com/IC%20566%20vco-datasheet.html [1 Feb2012]

Note: These are the indicative titles of chapters of Project Report. Students may revise/ modify the report as per the need of the project work in consultation with the guide.

Report Specifications:

1. Project Report's Cover Type: Hard-bound
2. Color of Project Report Cover: Black only with golden alphabets (as per annexure 1)
3. Number of Copies: Individual copies (each per student) + 2 Departmental Copies ()
4. Paper Size (orientation): A4 (portrait)
5. Margins: 1" top / bottom / right and 1.5" left
6. Font Type: Times New Roman
7. Font Size: 16 bold for chapter names, 14 bold for headings and 12 for normal text
8. Line Spacing: 1.5 throughout
9. Page Numbering: Bottom center of page in the format – Page 1 of N

(Sample - Cover Page)

‘Project Title’

PROJECT REPORT

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF DIPLOMA IN

METALLURGICAL ENGINEERING

SUBMITTED BY

1) Name of Student	**Enrollment Number**
2) Name of Student	**Enrollment Number**
3) Name of Student	**Enrollment Number**
4) Name of Student	**Enrollment Number**

GUIDE

NAME OF FACULTY

DEPARTMENT OF METALLURGICAL ENGINEERING

GOVERNMENT POLYTECHNIC PUNE

(Academic Year)

(Sample - Certificate)

Government Polytechnic, Pune

(An Autonomous Institute of Government of Maharashtra)

CERTIFICATE

This is to certify that

1) Name of Student	**Enrollment Number**
2) Name of Student	**Enrollment Number**
3) Name of Student	**Enrollment Number**
4) Name of Student	**Enrollment Number**

of third year Metallurgical Engineering have submitted their project report on

"Project Title"

during academic year 20 -20 as a part of project work described by Government Polytechnic, Pune for partial fulfilment for the Diploma in Metallurgical Engineering in the sixth semester.

(-- Name of Guide--) **(-- Name of Head--)**

Guide **Head**

Department of Metallurgical Engineering

Principal

Government Polytechnic, Pune

(Sample - Acknowledgement)

ACKNOWLEDGEMENT

I/we would like to place on record my/our deep sense of gratitude to Prof. --------, Dept. of-
------------ for his/her generous guidance, help and useful suggestions.

I/we express my/our sincere gratitude to Prof. --------, Dept. of -------------, for his/her stimulating guidance, continuous encouragement and supervision throughout the course of present work.

I am/we are extremely thankful to Prof. , Principal, for providing me infrastructural facilities to work in, without which this work would not have been possible.

(Students Name and Signature)

(**Note:** This is sample acknowledgement. Students have the flexibility to express/ acknowledge in thier words)

(Sample – Contents)

CONTENTS Page No.

Annexure-II

PROJECT DIARY

Name of the Student: ______________________________ Name of Guide (Faculty): ________________________________

Enrolment Number: ____________________ Semester: ________________ Project batch Number: ____________________

Date	Discussion Topics/Activity Details	Work Allotted Till Next Session/Corrections Suggested/Faculty Remarks	Dated Signature of Faculty

Dated Signature of Faculty **Dated Signature of HOD**

Annexure-III

Rubrics

Progressive Assessment (PA)					Project Presentation (ESE)				
Topic Selection & Problem definition (10)	**Data collection & requirement gathering (10)**	**Stage wise progress as per discussion (10)**	**Involvement in project activities (10)**	**Report Writing (10)**	**Project selection process (5)**	**Project content (10)**	**Project Execution (10)**	**Quality of project report (10)**	**Question-Answer (15)**

Sign: Name: Shri.A.V.Mehtre (Course Expert)	Sign: Name: Smt.N.S.Kadam (Head of Department)
Sign: Name: Smt.N.S.Kadam (Program Head) (Metallurgical Engineering Department)	Sign: Name: Shri.A.S.Zanpure (CDC In charge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme Code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19/**21/22/23/24/26
Name of the Course	**Seminar**
Course Code	**MT4103**
Prerequisite course code and name	**90 credits & Level 1 passed**
Class Declaration	**YES**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	$ESE	PA	
00	00	02	02	**Marks**	--	--	25	25	50

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

This course tends to mould students towards integrating the knowledge acquired throughout and applying it to understand and interpret evolving technologies in order to strengthen the confidence over acquired Engineering skills and thus fulfill the objective of Diploma Programme. Seminar mainly serves the purpose of developing learning-to-learn skills with an aim to develop the following attributes in the students:

3. COMPETENCY

The course should be taught and implemented with the aim to develop the required course outcomes (COs) so that students will acquire following competency needed by the industry:

- **Interpret innovative/new technologies independently.**

4. COURSE OUTCOMES (COs)

After undergoing this course, the student will demonstrate the following Course Outcomes

1. Analyze new technologies/tools.
2. Apply technical knowledge.
3. Write a Seminar report.
4. Work independently, prepare and deliver presentations.

5. GUIDELINES FOR UNDERTAKING A SEMINAR :

1. Department must organize a Seminar Orientation session for all the registered students.
2. The process of conducting a Seminar includes allocating a topic to individual student who should perform the required search, decide on the topic objectives, design and prepare an appropriate method of presentation, and present the topic to their fellow students and teachers with all of the necessary explanation and discussion. Faculty assigned to student should be providing necessary guidance.
3. Students would individually prepare the Seminar report with the following sub-titles:
    a. Acknowledgement
    b. Abstract
    c. Index
    d. List of Figures
    e. Introduction
    f. Information/Chapters related to Seminar topic
    g. Advantages and Disadvantages
    h. Conclusion
    i. References
4. Seminar topic shall be approved by the respective guide.
5. The student will begin to maintain a dated Seminar Diary for the whole semester. This diary should be assessed by respective guide timely. Format of diary is as given in Annexure IV.

Suggested Seminar Activities to be performed:-

- Collection of at least three Seminar topics on recent technologies and presentation of their abstract to faculty guide.
- Finalization of Seminar topic.
- Submission of final abstract on selected topic.
- Weekly interaction of students in group with seminar guide.
- Weekly assessment of seminar and work is labeled as Progressive Assessment.
- Group of Students should prepare and submit Report writing and presentation slides of Seminar in consultation with Seminar guide.
- Presentation of Seminar in well defined manner within specified time.
- Submission of Seminar report with the permission of faculty and Head of the Department.

6. ASSESSMENT OF SEMINAR WORK

- Like other courses, assessment of Seminar work also has two components, first is Progressive Assessment (PA), while another is End Semester Exam (ESE).
- The faculty will undertake the Progressive Assessment to develop the COs in the students. They can give oral informal feedback about their performance and their interpersonal behavior while guiding them on their seminar work every week.
- There will be regular Progressive Assessment by the teacher.

A. Progressive Assessment (PA) Guidelines and criteria :

The assessment of the students in the fifth semester for Progressive Assessment (PA) of 25 marks is to be done based on following criteria.

Sr. No.	Criteria	Marks
1	Topic Selection	5
2	Regularity in Seminar work as mentioned in Diary	5
3	Overall understanding capability	5
4	Progress in work and efforts displayed (Interactions with Q & A)	10
	Total	25

B. End Semester Assessment (ESE) criteria:

The assessment of the students in the fifth semester End Semester Examination (ESE) of 25 marks are to be done as per RUBRICS given below. This assessment shall be done by the faculty.

Sr. No.	Criteria	Marks
1	Seminar Topic and Contents	5
2	Seminar Delivery (Speech clarity and body language)	5
3	Overall understanding capability	5
4	Quality of presentation (Slides and Time management)	5
5	Interactions with Questions & Answers	5
	Total	25

7. THEORY COMPONENTS
NA

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN
NA

9. SUGGESTED STUDENT ACTIVITIES
NA

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)
As per the guidelines mentioned in Annexure-I or any other guidelines given by faculty.

11. SUGGESTED MICRO-PROJECTS
NA

12. SUGGESTED LEARNING RESOURCES

As per the guidelines mentioned in Annexure-I or any other guidelines given by faculty.

13. SOFTWARE/LEARNING WEBSITES

NA

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	-	-	-	1	3
CO2	3	2	-	-	-	1	3
CO3	1	-	-	-	-	1	3
CO4	1	-	-	-	-	1	3

	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	3
CO2	3	2	2	2
CO3	2	1	1	3
CO4	1	1	1	3

Annexure-I

Seminar Report Guideline

1. All students should submit their seminar report to their respective guide on or before ____________.
2. Seminar report must include
    i. Cover Page
    ii. Certificate
    iii. Acknowledgement
    iv. Index
    v. Abstract
    vi. Chapters (as per discussion with guide)
    vii. References/Bibliography
3. The page size of the seminar report should be in A4 size.
4. The seminar report should be Spiral bonded.
5. Two copies of the report (hard copy only). One for self and one to be submitted to department.
6. Page Numbering (Centered having format Page No__ of __)
7. Paper Size: A- 4 size paper
    1. Margins :
        Top: 1” (1 inch=2.54cm)
        Bottom: 1.15” (2.86cm)
        Left: 1.5”
        Right: 0.6”
    2. Line Spacing: 1.5 line
    3. Title of Chapter
        Font: Times New Roman (Bold face)
        Size: 14 point
        Alignment: Centre
8. Text
    Font: Times New Roman
    Size: 12 point
    Alignment: Justified (Full Text)
9. Figures and Tables:
    a. Font: Times New Roman (Bold)
    b. Size: 12 point
    c. Alignment: Centered
    d. Figure Caption must be below the figure and centered
    e. Table caption must be above the table and centered

Annexure-II

(Sample – Cover)

Government Polytechnic, Pune-16

(An Autonomous Institute of Government of Maharashtra)

A
Seminar Report
On

“SEMINAR TITLE”

SUBMITTED BY:

<Name of the student>

Under the Guidance of

<Guide Name>

DEPARTMENT OF METALLURGICAL ENGINEERING
(Academic Year: 20 -20)

(Sample – Certificate)

Government Polytechnic, Pune-16

(An Autonomous Institute of Government of Maharashtra)

Department of Metallurgical Engineering

CERTIFICATE

This is to certify that Ms/Mr.______________ with Enrollment No.__________, of Third Year Diploma in Metallurgical Engineering has successfully completed the seminar titled "_____________" as part of his/her diploma curriculum in academic year 2019-20.

Seminar Guide	**Head of Department**
(Shri/Smt. Name of Guide)	(Shri/Smt. Name of HOD)

Principal
(Shri/Smt. Name of Principal)

ACKNOWLEDGEMENT

Acknowledgement should be prepared by the students in their words expressing their gratitude towards the Department.

Annexure-III

Department of Metallurgical Engineering

GENERAL SEMINAR GUIDELINES

Purpose of carrying out Seminars is to develop self learning capability of students wherein they will be able to apply the knowledge gathered to a new technology, understand it and deliver the presentations accordingly. All students must follow the guidelines given below :

- Seminar Presentation should be on Technical Topic only. The topic (technology) chosen may be related to perspective project.
- Seminar topic contents cannot be the contents of their Diploma course.
- Evaluation of Seminar should be based on Topic Selection, Technical Contents, Content Understanding, Content Delivery and Response to the Questions.
- Seminar topics across all students must not be repeated.
- Seminar Topics of last year should not be repeated.
- Each student has to collect 3-4 topics, present their abstract to guide, discuss with guides and finalise topics through number of discussions. Abstract must also contain key terms in topics.
- Each abstract should not exceed 200 words.
- Abstract must be written with grammatically correct statements. Shortcuts must not be used for any words and should not contain spelling mistakes with neat and clean handwriting.
- Each student must prepare and attach the seminar diary to their Seminar Report.
- Every student must report to respective guide as per timetable, perform necessary work and submit as per plan, get necessary attestations on activities done in seminar diary on due dates and time as per Time Table.

Annexure-IV

SEMINAR DIARY

Name of the Student: ______________________________ **Name of Guide (Faculty):** ______________________________

Enrollment Number: ____________________ **Semester:** ________________ **Batch Number:** ____________________

Date	Discussion Topics/Activity Details	Work Allotted Till Next Session/ Corrections Suggested/Faculty Remarks	Dated Signature of Faculty

Dated Signature of Faculty **Dated Signature of HOD**

Annexure-V

Rubrics

Progressive Assessment (PA)				Seminar Presentation (ESE)				
Topic Selection (5)	**Regularity in Seminar Work (5)**	**Overall understanding capability (5)**	**Progress in work (10)**	**Seminar Topic and Contents (5)**	**Seminar Delivery - Speech clarity and body language (5)**	**Overall understanding capability (5)**	**Quality of presentation (5)**	**Question -Answer (5)**

Sign: Name: Shri. R. S. Tuljapurkar (Course Expert)	Sign: Name: Smt. N. S. Kadam (Head of Department)
Sign: Name: Smt. N. S. Kadam (Program Head) Department of Metallurgical Engineering	Sign: Name: Shri. A. S. Zanpure (CDC In charge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme Code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19**/21/22/23/24/26
Name of Course	**Elements of Physical Metallurgy**
Course Code	**MT4104**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	ESE	PA	
04	00	04	08	Marks	80	20	50	50	200
				Exam Duration	3 Hrs	1 Hr	--	--	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. 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 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 the equilibrium diagrams, and metallography from the point of view of producing structures of metals that gives the best properties. The study of these concepts of physical metallurgy will develop skills in students to indentify and interpret microstructures, grades and properties of steel, cast iron and non ferrous metals where the emphasis is laid on the application of these metals and alloys.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Identify and interpret microstructures, grades and properties of steel, cast iron and non ferrous metals.**

4. COURSE OUTCOMES (COs)

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 above mentioned competency**:**

1. Plot various binary equilibrium diagrams and calculate amount of phases using Lever Rule.
2. Interpret Fe- Fe_3C Phase equilibrium diagram, T.T.T. diagram.
3. Select appropriate non-ferrous alloys for given applications and Interpret various non ferrous metals phase equilibrium diagram.
4. Prepare specimen for macro and micro examination and operate Metallurgical microscope for microstructures analysis.
5. Determine hardenability of steels.

5. SUGGESTED PRACTICALS / EXERCISES

Sr. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Relevant CO**	**Approximate Hours Required.**
1	3	Identify and label various parts of metallurgical microscope.	4	06
2		Prepare micro-specimen for metallographic observation.	3, 4	08
3		Prepare etching reagent and do etching of specimen.	2, 4	06
4		Observe prepared micro-specimen under microscope.	1, 4	08
5		Determine Phosphorous distribution by Phosphorous printing and Sulphur distribution by Sulphur printing.	4	06
6		Determine oxide distribution by oxide printing.	1, 4	06
7	5,6	Draw microstructures of various steels and cast iron by microscopic observation.	2	06
8	8	Determine hardenability of steel by Jominy end quench test.	5	08
9	10	Draw microstructures of various non ferrous metals by microscopic observation.	1, 3	06
10	All	Micro Project - Complete a micro project based on guidelines provided in Sr. No. 11	1 to 5	04
			Total Hrs	**64**

S.No.	**Performance Indicators**	**Weightage in %**
a.	Arrangement of available equipment	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Microstructure drawn on Observations	10
e.	Interpretation of properties and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
	Total	**100**

6. MAJOR EQUIPMENTS / INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	Standard Fe-Fe3C equilibrium diagram, Equilibrium diagram Chart.	4,7,8,9,10
2	Metallurgical Microscope with Image Analyser software.	1,2,4,5,6,7,9,10
3	Standard specimens (for steels and Cast irons)	2,3,4,5,6,7,8,9
4	Mounting press	2,4,7,9,10
5	Emery papers of different grades and Etching reagents.	2,3,7,9,10
6	Grinder	2,7,9,10
7	Polishing /Lapping machine	2,7,9,10
8	Jominy End Quench test equipment.	8,10
9	Brinell/Rockwell Hardness tester.	8,10
10	Cutting machine	2,5,6,7,9,10

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit – I. Solidification of Metals (06 hrs, 09 marks)	
1a. Describe solidification. 1b. Define grain and grain boundary. 1c. Describe the nucleation and growth process during solidification. 1d.Compare solidification of pure metal with alloy. 1e. Draw cooling curves for pure metal and alloy. 1f. Define Solid Solution. 1g. Describe different solid solutions. 1h. Differentiate between substitutional and interstitial solid solutions. 1i. State and apply Hume-Rothery's principles for formation of solid solutions. 1j. Describe different compounds.	1.1 Concept of solidification- Transformation of liquid in to solid. 1.2 Nucleation and growth, dendrite formation. 1.3 Grain and grain boundaries. 1.4 Cooling curves for pure metals and binary alloys. 1.5 Solid solutions - Substitutional solid solution, Interstitial solid solution & Intermediate solid solution. 1.6 Hume- Rothery's rules for formation of solid solution. 1.7 Intermediate compounds, electron compounds, their examples.
Unit – II. Equilibrium Diagram (06 hrs, 09 marks)	

<table>
<tr><th>Unit Outcomes (UOs)
(in cognitive domain)</th><th>Topics and Sub-topics</th></tr>
<tr><td>2a. Define phase.
2b. Derive Gibbs phase rule for metallurgical systems.
2c. Construct binary equilibrium diagram.
2d. Derive Lever Rule.
2e. Determine proportions of phases by applying lever rule.
2f. Interpret the micro structural changes with respect to equilibrium diagram.</td><td>2.1 Definition of phase.
2.2 Gibbs's phase rule and its application, its modification for metallurgical systems.
2.3 Construction of equilibrium diagrams; viz. monotectic, peritectic, eutectoid, peritectoid reactions.
2.4 Numerical based on construction of Binary equilibrium diagram.
2.5 Lever Rule: Its derivation and application to equilibrium diagram, numericals based on Lever rule.
2.6 Identification of microstructural changes with respect to equilibrium diagram.</td></tr>
<tr><td colspan="2">Unit – III. Micro and Macroscopic Examination (05 hrs, 06 marks)</td></tr>
<tr><td>3a. Describe steps for microscopic and macroscopic examination.
3b. Describe etching techniques.
3c. Name etching reagents.
3d. Select proper etchant.
3e. Draw microstructures of steels and cast irons.
3f. Use optical principle to operate microscope.
3g. Sketch metallurgical microscope.
3h. Determine sulphur, phosphorous and oxides in steel by macroscopic examination.
3i. Draw structure of forged components.</td><td>3.1 Microscopic Examination, preparation, techniques & methods of sampling, mechanical and electrolytic polishing, etching techniques and etching reagents, analysis and interpretation of phases related to steel and cast iron, principle and working of simple metallurgical microscope, optical principles of metallurgical microscope, optical system, objectives, eye pieces and properties etc. microphotography, films properties, exposing, developing and printing.
3.2 Macroscopic Examination, principles and procedure of macroscopic examinations, sulphur printing, phosphorus printing, and oxide printing, etching reagents, grain / fibre flows of forged components, hydrogen flakes and its determination.</td></tr>
<tr><td colspan="2">Unit – IV. Quantitative Metallography (03 hrs, 04 marks)</td></tr>
<tr><td>4a. Describe the method to measure grain size with microscope.
4b. Describe the method to measure case depth with microscope.
4c. Calculate ASTM grain size number.</td><td>4.1 ASTM grain size number and method for measurement of grain size.
4.2 Measurement of case depth, plating, thickness, etc.</td></tr>
<tr><td colspan="2">Unit – V. Iron Carbon Equilibrium Diagram (10 hrs, 12 marks)</td></tr>
<tr><td>5a. Define allotropy.
5b. Draw iron –Carbon diagram.
5c. Write reactions in iron carbon diagram.
5d. Classify steel based on iron carbon diagram.</td><td>5.1 Allotropic transformation of iron.
5.2 Reactions in Iron- Carbon diagram.
5.3 Critical temperatures in Iron- carbon diagram.
5.4 Classifications of plain carbon steel with reference to iron carbon diagram.
5.5 Microstructure and properties of plain carbon steels on cooling with reference to iron carbon diagram.</td></tr>
</table>

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
5e. Draw microstructures of different steels. 5f. Describe microstructure and properties of plain carbon steels on cooling with reference to iron carbon diagram.	5.6 Specification of steels: AISI, SAE, EN, IS etc.
Unit – VI. Cast Iron (10 hrs, 12 marks)	
6a. Define Cast Iron 6b. State different types of cast iron on basis of microstructure. 6c. Describe graphitization in cast iron. 6d. Draw microstructure of white, gray, malleable and nodular cast iron. 6e. State applications and properties of white, gray, malleable and nodular cast iron.	6.1 Cast iron: Definition, classification of cast iron, graphitization in cast iron, morphology of graphite, Maurer's diagram. 6.2 Gray Cast Iron: Forms of graphite- A, B, C, D & E, flake size of graphite, ASTM size, relationship between microstructure & mechanical properties, phosphide eutectic, composition, microstructure, properties and applications of gray cast iron. 6.3 Nodular Cast Iron: Composition, microstructure, properties and applications of nodular cast iron. 6.4 Types of cast iron; Composition, microstructure, properties and applications of- White CI, chilled CI, malleable CI, high duty CI (Meehanite), alloy CI.
Unit – VII. T.T.T Diagram (06 hrs, 06 marks)	
7a. Draw T.T.T. diagram for typical alloys. 7b. Interpret T.T.T. diagram. 7c. Describe C.C.T. diagram. 7d. State applications of T.T.T. and C.C.T. diagram.	7.1 Definition and its importance. 7.2 Construction of T.T.T. diagram. 7.3 T.T.T. diagram for different types of steel. 7.4 Factors affecting T.T.T. diagram and its limitations. 7.5 C.C.T. diagram.
Unit – VIII. Hardenability Of Steel (06 hrs, 06 marks)	
8a. Define hardenability, critical, ideal critical diameter, severity of quenchant. 8b. State factors affecting hardenability. 8c. Describe Grossman method to determine hardenability. 8d. Describe Jominy end quench test to determine hardenability. 8e. Select proper quenchant.	8.1 Quenching: Cooling curve after quenching, stages in cooling curve, severity of quench, types and characteristics of quenching mediums. 8.2 Hardenability - factors affecting hardenability. 8.3 Hardness vs hardenability. 8.4 Determination of hardenability of steel by Grossman method and Jominy end quench test. 8.5 Determination of ideal critical diameter. 8.6 Use of hardenability data in industry.
Unit – IX. Effect Of Alloying Elements (03 hrs, 04 marks)	
9a. State the effect of alloying elements on Iron-Carbon diagram and T.T.T. curve.	9.1 Alloying elements. 9.2 Effect of alloying elements on Iron-Carbon diagram and T.T.T. curve.
Unit – X. Metallurgy Of Nonferrous Alloys (09 hrs, 12 marks)	

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
10a. Draw Cu-Zn equilibrium diagram. 10b. Compare single phase brass with double phase brass. 10c. State properties and applications of brasses. 10d.Draw Cu-Sn equilibrium diagram. 10e. Select proper bronze for given application. 10f. Draw Al-Si equilibrium diagram. 10g. Describe Al- Si modified structure. 10h. State properties and applications of Al- Si alloys. 10i. Describe Al-Cu alloy system. 10j. Classify bearing metals. 10k. State requirements of good bearing metal. 10l. Compare lead base with tin base bearing metals. 10m. Describe effects of copper addition on properties of bearing metals.	10.1 Brasses- Cu-Zn equilibrium diagram, Brasses- single phase and double phase brass, mechanical properties and application of commonly used industrial brasses, hot working of brasses, defects - orange peel defect, season cracking, dezincification, Zn equivalent, coring and twining in microstructure. 10.2 Bronzes: Cu-Sn equilibrium diagram- cast dendrite structure, composition, microstructure, mechanical properties and application of commonly used industrial bronzes, composition and properties of gun metal and phosphor bronze. 10.3 Al alloys: Al-Si equilibrium diagram, cast and modified structures of Al-Si alloys, compositions and properties of commonly used as cast and as wrought Al-Si Alloys, LM series, Al-Cu alloy system, Duralumin. 10.4 Bearing metals: Classification of bearing metals, requirements of good bearing metal, composition, microstructure, mechanical properties and applications of lead base and tin base bearing metals, effects of copper addition on the properties of bearing metals.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Solidification of Metals	06	05	02	02	09
II	Equilibrium Diagram	06	05	02	02	09
III	Micro and Macroscopic Examination	05	04	01	01	06
IV	Quantitative Metallography	03	03	00	01	04
V	Iron carbon Equilibrium Diagram	10	08	02	02	12
VI	Cast Iron	10	08	02	02	12
VII	T.T.T. Diagram	06	04	01	01	06
VIII	Hardenability of Steel	06	04	01	01	06
IX	Effect of Alloying Elements	03	02	01	01	04
X	Metallurgy of Non Ferrous Alloys	09	08	02	02	12
	Total	**64**	**51**	**14**	**15**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on practicals performed in the laboratory.
b. Study of Iron Carbon equilibrium diagram in detail.
c. Students may be given data to draw equilibrium diagram of different alloys of metals.
d. To prepare charts of ASTM grain size for metals processed under different metal working conditions / operations and to study its effects on grain size.
e. Search information about price and specifications of various grades of steels and cast iron.
f. Collect information of various alloys like Al-Si, Cu-Sn etc. and prepare charts of the same.
g. Prepare posters to illustrate the use of etching reagents for different metals and alloys.
h. Draw and study the cooling curve for pure iron and alloys of iron (i.e. steel, cast iron).
i. Construct equilibrium diagram for different types of solid solutions. Eg. Cu-Ni system.
j. Construct equilibrium diagram for metals partially soluble in solid state from given data.
k. Prepare chart of ASTM grain size number. Determination of grain size, case depth by image analyzer.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with concerned metallurgical equipments and technology.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and technical manuals.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. (Affective Domain Outcomes). Each student will have to maintain activity chart consisting of individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Study and make report on industrial applications of different copper alloys and their mechanical properties required.
b. Search and write different grades of materials used as abrasives in polishing of specimen.
c. Prepare a report on different grades of bearing metals used in industrial applications.
d. Search and write the information on back up materials used in specimen mounting.
e. Search and write a report on various quenching mediums used in heat treatment plants.
f. Find out and make a detail report on any ten applications of different grades of cast irons.
g. Study – collect information and make a report on T.T.T. diagrams of different grades of steels.
h. Make a report on industrial applications of quantitative metallographic techniques.
i. Study and make a report on any two metals microstructural changes and mechanical property changes w.r.t. change in processing / manufacturing conditions like as cast, as rolled, as forged, after heat treating (after annealing, after hardening / tempering etc.)
j. Study and make a report on industrial applications of different aluminum alloys and their mechanical properties required for the particular application / service.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of Publication, ISBN Number
1	Introduction to Physical Metallurgy	Sidney H. Avner	Second Edition, Tata McGraw-Hill 1997 ISBN 0-07-463006-7
2	Physical Metallurgy Volume I	Robert W. CAHN, Peter HAASEN	Fourth Edition, 1996, North Holland ISBN 0 444 89875 1
3	Material Science and Metallurgy	Dr.V.D. Kodgire, S.V. Kodgire	Everest Publishing House, 43rd Edition ISBN 81-86314-00-8

13. SOFTWARE/LEARNING WEBSITES

1. https://nptel.ac.in
2. https://iopscience.iop.org
3. https://www.engineeringbookspdf.com/modern-physical-metallurgy-materials-engineering

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	2	1	1	3
CO2	3	3	3	2	1	2	2
CO3	3	3	2	2	2	2	3
CO4	2	2	2	3	1	1	2
CO5	3	3	2	3	2	1	1

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2
CO2	3	2	3	2
CO3	3	3	2	2
CO4	3	3	3	3
CO5	3	3	3	3

Sign: Name: Shri. R. S. Tuljapurkar (Course Expert)	Sign: Name: Smt. N. S. Kadam (Head of Department)
Sign: Name: Smt. N. S. Kadam (Program Head) Department of Metallurgical Engineering	Sign: Name: Shri. A. S. Zanpure (CDC In charge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme Code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19**/21/22/23/24/26
Name of Course	**Foundry Engineering**
Course Code	**MT4105**
Prerequisite course code and name	**NA**
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			**Total Credits (L+T+P)**		**Examination Scheme**				
					Theory		**Practical**		**Total Marks**
L	**T**	**P**	**C**		**ESE**	**PA**	**$ESE**	**PA**	
04	00	04	08	**Marks**	80	20	50	25	175
				Exam Duration	3 Hrs	1 Hr	--	--	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

The Metallurgical Engineer who works in foundry industries comes across specialized foundry processes. He should be able to work as a supervisor for various processes. These processes have been developed depending upon the quantity of castings to be produced, surface quality required, dimensional accuracy achieved, metals to be cast etc.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Select proper molding and casting methods to obtain castings of the desired properties.**

4. COURSE OUTCOMES (COs)

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 above mentioned competency:

1. Enlist various pattern materials and identify different types of patterns.
2. Explain various sand molding processes.
3. Select a casting method for producing a sound and defect free casting.
4. Draw and explain different types of melting furnaces.
5. Select a molding process for a given application.

5. SUGGESTED PRACTICALS/ EXERCISES /ASSIGNMENTS

Sr. No.	Unit No.	**Practical Exercises** (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	1	Study of various molding tools.	1	04
2.	2	Study of different types of patterns.	1	04
3.	3	Study of various sand control tests.	2	08
4.	3	Study of green sand molding.	2	08
5.	4	Study of CO_2 sand molding.	2	04
6.	5	Study of shell molding.	2	08
7.	6	Study of stack molding.	2	04
8.	7	Casting aluminum in gravity die casting.	3	08
9.	8	Study of cupola furnace.	4	04
10.	9	Visit to various foundries to see induction and direct arc furnace.	4	04
11	**7**	Assignment- To select molding process for particular application e.g. lathe bed, manhole cover, piston ring, gear box housing, motor body, turbine housing etc.	5	04
12	All	Complete a micro project based on guidelines provided in Sr. No. 11	1 to 5	04
		Total Hrs		**64**

S.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	20
b.	Setting and operation	20
c.	Safety measures	20
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	10
f.	Answer to sample questions	10
g.	Submission of report in time	10
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	Patterns, molding equipments	1,2,4,5.6
2	Sand testing equipments	3,4,5,6
3	Sand molding equipment	1-6
4	Shell molding equipment	5
5	Gravity die casting equipment	7

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Section I	
Unit I. Introduction (02 hrs, 04 marks)	
1a. State the importance of foundry engineering. 1b .Compare casting process with other manufacturing processes.	1.1 Importance of foundry engineering. 1.2 Comparison of casting process with other manufacturing processes.
Unit II. Pattern Making (12 hrs, 14 marks)	
2a. Enlist types of pattern material. 2b. Explain different types of patterns. 2c. Design and construct a pattern. 2d. Design and construct of various types of core boxes. 2e. Explain purpose of core venting.	2.1 Pattern materials: Material for patterns and core boxes such as metal, wood, epoxy resin, wax, thermocol etc. 2.2 Types of patterns: One piece, split, loose piece, matchplate, gated, skeleton etc. Comparison of various patterns. Pattern plates for hand and machine molding, master pattern. 2.3 Pattern design and construction: Pattern allowances, pattern joints, parting line selection, core prints, loose pieces, location of pins on pattern, pattern-lifting devices, color codes for pattern. 2.4 Design and construction of various types of core boxes, core venting.
Unit III. Sand Molding Process (18 hrs, 22 marks)	

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
3a. Explain the principal ingredients of molding sand. 3b. Explain the role of additives in molding sand. 3c. Explain the necessity of mold coatings. 3d. Explain the need for and explain various sand control tests. 3e. Explain the principle, ingredients, pattern and equipments, casting size, alloy range, application, advantages and limitations of; green sand, dry sand, loam sand, CO_2 sand, shell molding, investment casting processes.	3.1 Molding sand: Principal ingredients, sand grains, moisture, binders- inorganic and organic. 3.2 Additives in molding sand: Role of additives commonly used additives such as; Coal dust, Iron oxide, Dextrin, Molasses etc. 3.3 Mold washers/coatings, sand preparation and treatment. 3.4 Molding sand testing: Need for sand testing, various sand control tests; Moisture content, clay content, grain fineness, permeability, strengths, refractoriness, mold hardness. 3.5 Types of sand molding processes: Principle, ingredients, pattern and equipments, casting size, alloy range, application, advantages and limitations of: green sand, dry sand, loam sand, CO_2 sand, shell molding, investment casting processes.
Section II	
Unit IV. Molding Process using Metal Moulds (12 hrs, 14 marks)	
4a. Explain the principle, equipments, casting size, alloy range, application, advantages and limitations of Die casting – Gravity, low pressure, high pressure.	4.1Principle, equipments, casting size, alloy range, application, advantages and limitations of: Die casting –Gravity, low pressure, high pressure. 4.2 Centrifugal casting. 4.3 Continuous casting.
Unit V. Miscellaneous Molding Processes (06 hrs, 08 marks)	
5a. Explain miscellaneous molding processes: plaster molding, ceramic molding, slush casting, pit and floor molding, stack molding.	5.1 Study of miscellaneous molding processes such as: plaster molding, ceramic molding, slush casting, pit and floor molding, stack molding.
Unit VI. Melting Furnaces (10 hrs, 12 marks)	
6a. Explain the principle, construction, melting procedure, types of cupola furnace. 6b. Explain the principle, construction, melting procedure of Electric furnace-Coreless, Induction furnace, Duplexing. 6c. Explain the principle, construction, melting procedure of Oil fired furnace.	6.1 Cupola furnace: Principle, construction, melting procedure, types of cupola furnace. 6.2 Electric furnace- Coreless, Induction furnace, Duplexing. 6.3 Oil fired furnace

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit VII. Selection of Molding Process (04 hrs, 06 marks)	
7a. Select a molding process with respect to quantity and weight of metal e.g. lathe bed, manhole cover, piston ring, gear box housing, motor body, turbine housing.	7.1 Selection of molding process with respect to quantity and weight of metal e.g. lathe bed, manhole cover, piston ring, gear box housing, motor body, turbine housing.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
Section I						
I	Introduction	02	02	02	00	04
II	Pattern Making	12	02	06	06	14
III	Sand Molding Process	18	02	10	10	22
	Total	32	06	18	16	40
Section II						
IV	Molding Process using Metal Moulds	12	02	06	06	14
V	Miscellaneous Molding Processes	06	02	04	02	08
VI	Melting Furnaces	10	04	04	04	12
VII	Selection of Molding Process	04	00	00	06	06
	Total	32	08	14	18	40
	Total	**64**	**14**	**32**	**34**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on practical performed in laboratory.
b. Draw charts showing steps of greensand molding and shell molding processes.
c. Draw charts showing gravity-low pressure, high pressure casting, centrifugal casting, continuous casting.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Prepare and use power point presentations related to different topics.
f. Use Videos/Flash/Animations to explain various topics and subtopics.
g. Industrial visit of students to ferrous and non ferrous foundries.
h. Expert lectures related to topics.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***
The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.
A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare a chart comparing the various molding processes- Sand molding, shell molding on the basis of: Principle, ingredients, pattern and equipments, casting size, alloy range, application, advantages and limitations.
b. Prepare a chart comparing low pressure and high pressure Die casting.
c. Prepare a chart comparing induction furnaces-core and coreless type.
d. Prepare a chart showing details of Cupola.
e. Prepare report of any one non ferrous foundry.
f. Prepare report of any one ferrous foundry.
g. Prepare visit report on a visit to a nonferrous foundry.
h. Prepare visit report on a visit to a ferrous foundry.

12. SUGGESTED LEARNING RESOURCES

Sr. No.	Title	Author	Publisher, Edition and Year of Publication, ISBN Number
1	Metal Casting Principle and Practice	T. V. Ramana Rao	New Age International (P) Ltd,Publishers. 1996 978-8122408430
2	Principle of Metal Casting	Richard W.Heine, Carl R Loper, Philip C Rosenthal	Tata MacGraw Hill Publishing Comp. 1976. 0-07-099348-3
3	Foundry Technology	O.P.Khanna, Lal	Dhanpatrai and sons 1996. 978-81-89928-34-6

13. SOFTWARE/LEARNING WEBSITES

1. https://www.digimat.in/nptel/courses/video/112107215/L01.html
2. https://www.youtube.com/watch?v=8WF7GegwPJI&feature=emb_rel_pause
3. https://www.youtube.com/watch?v=4rzEGeiC7Zw

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	1	1	2	1	2
CO2	3	1	2	3	2	2	2
CO3	3	3	3	3	3	3	3
CO4	2	1	1	1	2	1	2
CO5	3	3	2	3	3	2	2

	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	2
CO2	3	2	1	2
CO3	3	3	3	3
CO4	3	1	1	1
CO5	3	2	2	3

Sign: Name: Smt.N.S.Kadam (Course Expert)	Sign: Name: Smt.N.S.Kadam (Head of Department)
Sign: Name: Smt. N. S. Kadam (Program Head) Department of Metallurgical Engineering	Sign: Name: Shri A. S. Zanpure (CDC In charge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme Code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19**/21/22/23/24/26
Name of Course	**Powder Metallurgy**
Course Code	**MT4106**
Prerequisite course code and name	**NA**
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	$ESE	PA	
03	00	02	05	Marks	80	20	50	25	175
				Exam Duration	3 Hrs	1 Hr	--	--	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

Powder metallurgy is one of the important techniques of manufacturing metallic components used in several fields of engineering like automotive, atomic energy, defense, high temperature technology etc. This course deals with the production, testing, blending, compaction of metal powders and sintering. It also included the manufacturing of various powder metallurgical products.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences.

- **Perform different tests on metal powders for determination of various properties and select appropriate compaction process and sintering furnace for particular powder metallurgical application.**

4. COURSE OUTCOMES (COs)

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 above mentioned competency:

1. Compare the powder metallurgy method with other manufacturing processes.
2. Produce the metal powder with some metal powder production processes.
3. Measure different properties of powders using various tests.
4. Select the appropriate compaction process for particular application.
5. Understand the mechanism of sintering.
6. Draw the flowsheet for manufacturing of various powder metallurgical products.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Relevant CO**	**Approximate Hours Required.**
1	2	Study various metal powder manufacturing processes.	2	06
2	3	Measure size distribution of metal powder by sieving method.	3	02
3		Calculate apparent density of metal powder.	3	02
4		Calculate tap density of metal powder.	3	02
5		Calculate flow rate of metal powder.	3	02
6	4	Study various types of die compaction techniques.	4	04
7	5	Study sintering of compacted products.	5	04
8	6	Draw the flow-sheets for production of bearings, friction materials and Sintered Cemented Carbides.	6	06
9	All	Complete a micro project based on guidelines provided in Sr. No. 11	1 to 6	04
		Total Hrs		**32**

S.No.	**Performance Indicators**	**Weightage in %**
a.	Arrangement of available equipment / test rig or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	Sieves Shaker, Metal Powder, Stop Watch, Weighing Machine	2
2	Hall-Flow Meter, Density Cup, Stand, Weighing Machine	3,4,5
3	Stop watch	5

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Section I	
Unit I Introduction (04 hrs, 06 marks)	
1a. State the principle of powder metallurgy. 1b. State the applications, advantages and limitations of powder metallurgy. 1c. Compare powder metallurgy method with other manufacturing process. 1d. Enlist five powder metallurgical companies in India.	1.1 Principle of powder metallurgy, its applications, advantages and limitations. 1.2 Comparison of powder method with other shaping or forming methods of production. 1.3 Scope of powder metallurgy in industry.
Unit II Metal Powder Production (10 hrs, 16 marks)	
2a.Enumerate metal powder production methods. 2b. Explain the working principle of mentioned powder production methods. 2c. Draw the sketch of milling and atomization processes.	2.1 Classification of metal powder production methods. 2.2 Various methods of metal powder production such as: a. Machining, b. Crushing, c. Milling, d. Atomization, e. Condensation, f. Thermal Decomposition, g. Reduction, h. Electrodeposition, i. Intergranular Corrosion.
Unit III Characteristics and Testing of Metal Powders (10 hrs, 18 marks)	

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
3a. Explain coning and quartering. 3b.Explain particle size measurement techniques with neat sketch. 3c. State the importance of particle shape, size, and size distribution. 3d. Draw Hall Flow meter. 3e. Measure apparent and tap densities. 3f. Measure flow rate. 3g. Define Compressibility, compactibility, specific surface, green strength.	3.1 Sampling – Coning and Quartering. 3.2 Particle size measurement – Sieving method, Sedimentation and decantation method, Elutriation method. 3.3 Particle shape and size distribution, its measurement, Hall flow meter. 3.4 Density of metal powders- Apparent density and its measurement, tap density and its measurement. 3.5 Flow rate and its measurement. 3.6 Definitions – Compressibility, compactibility, specific surface, green strength.
Section II	
Unit IV Powder Conditioning and Compaction (12 hrs, 20 marks)	
4a. Describe the role of powder conditioning and blending. 4b. State the purpose of powder compaction. 4c.Classify powder compaction methods. 4d. Describe the various pressureless shaping techniques. 4e. Describe the mechanism of cold pressure shaping technique. 4f. State roles of lubrication. 4g. Enlist properties of dies and materials for dies. 4h. Describe working of presses. 4i. Explain the working of different types of cold compaction and pressure shaping technique with heat. 4j. Explain the principle of additive manufacturing. 4k. Describe Metal Injection Moulding of Ti Powder.	4.1 Powder conditioning – Preliminary heat treatment, blending process. 4.2 Powder compaction : Classification of powder compaction- a. Pressureless shaping techniques: Loose sintering, slip casting, slurry casting. b. Cold pressure shaping techniques : Mechanism, role of lubrication, die materials and its properties, Presses- mechanical press, hydraulic press, die compaction techniques, types – isostatic pressing, explosive forming, powder rolling, cycle compation, powder extrusion. c. Pressure shaping technique with heat: Hot pressing, sinter forging, hot rolling, hot isostatic compation. 4.3 Additive Manufacturing – Introduction, principle, advantages, limitations. 4.4 Metal Injection Moulding of Ti Powder.
Unit V Sintering (08 hrs, 12 marks)	
5a. State the principle and purpose of sintering. 5b. Explain stages of sintering and its mechanism. 5c. Define liquid phase sintering. 5d. Describe the stages of liquid phase sintering, 5e. Describe construction of sintering furnace and its atmosphere. 5f. Classify sintering furnaces.	5.1 Sintering – Principle, purpose. 5.2 Stages of sintering. 5.3 Mechanism of sintering. 5.4 Liquid phase sintering – Definition, stages, advantages. 5.5 Sintering Furnace – Construction, classification, atmosphere. 5.6 Post sintering operations- sizing, coining, impregnation.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
5g. Describe sizing, coining and impregnation.	
Unit VI Applications (04 hrs, 08 marks)	
6a. State the applications and properties of bearing, friction and tool materials. 6b. State the applications of ferrites. 6c. Describe the production of bearing, friction, tool and ferrites materials.	6.1 Bearing Materials – Applications, properties, methods of production, oil impregnated bearings. 6.2 Friction Materials - Applications, properties, methods of production, formulation. 6.3 Tool Materials - Applications, properties, production of cemented carbide. 6.4 Ferrites – Applications, production.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
Section I						
I	Introduction	04	02	02	02	06
II	Metal Powder Production	10	02	08	06	16
III	Characteristics and Testing of Metal Powders	10	02	10	06	18
	Total	24	06	20	14	40
Section II						
IV	Powder Conditioning and Compaction	12	02	08	10	20
V	Sintering	08	04	06	02	12
VI	Applications	04	02	02	04	08
	Total	24	08	16	16	40
	Total	**48**	**14**	**36**	**30**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course. Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on practical performed in laboratory. Journal consists of write ups, diagrams, observations, required tools, equipment and date of performance with teacher signature.
b. Prepare the flowsheet for the production of particular application by powder metallurgy process.
c. Search information about presses for compaction.
d. Collect information of new development in powder metallurgy.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Use videos to explain different concepts.
f. Read ASM handbook for further study of the various topics.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***
The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.
A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Production of metal powder by any one method.
b. Compaction of powder with any one method of pressureless technique.
c. Compaction of powder with any one method of cold pressure shaping technique.
d. Compaction of powder with any one method of pressure shaping technique with heat.
e. Construction, working and atmospheres of sintering furnace.
f. Draw the detailed flow sheet of production of any one powder metallurgy application and explain it.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of Publication, ISBN Number
1	Powder Metallurgy	A.K. Sinha	Dhanpat Rai Publications, 2nd Edition Reprint 2013.
2	Material Science and Metallurgy for Engineers	V.D. Kodgire	Everest Publishing House, 43rd Edition 2018. 9788186314008
3	Powder Metallurgy Technology	G. S. Upadhyaya	Cambridge International Science Publishing Ltd., 1998. 13: 9781898326403
4	ASM Handbook, Volume 7: Powder Metallurgy	--	ASM International 13: 9781627080873

13. SOFTWARE/LEARNING WEBSITES

1. https://www.youtube.com/watch?v=uRVaLUQUmA8
2. https://www.youtube.com/watch?v=oDA3aIDmkv8
3. https://www.youtube.com/watch?v=22ytR__l22g

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	1	1	2	2
CO2	3	1	2	2	1	2	2
CO3	3	3	3	3	1	2	2
CO4	3	1	2	1	2	2	2
CO5	3	2	2	1	1	1	1
CO6	3	2	2	1	1	3	2

	PSO1	PSO2	PSO3	PSO4
CO1	3	--	1	1
CO2	3	1	1	2
CO3	3	3	1	2
CO4	3	1	1	2
CO5	3	--	1	1
CO6	3	--	1	2

Sign: Name: Shri. R.G. Injewar (Course Expert)	Sign: Name: Smt. N.S. Kadam (Head of Department)
Sign: Name: Smt.N.S.Kadam (Program Head) (Metallurgical Engineering Department)	Sign: Name: Shri. A. S. Zanpure (CDC In charge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme Code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19**/21/22/23/24/26
Name of Course	**Metal Working Processes**
Course Code	**MT4107**
Prerequisite course code and name	**NA**
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			**Total Credits (L+T+P)**		**Examination Scheme**				
					Theory		**Practical**		**Total Marks**
L	**T**	**P**	**C**		**ESE**	**PA**	**$ESE**	**PA**	
04	00	02	06	**Marks**	80	20	50	25	175
				Exam Duration	3 Hrs	1 Hr	--	--	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

A number of metallic engineering products are used in construction, fabrication and transportation industries. Most of the metallic products can be manufactured by various methods of metal forming such as rolling, forging, extrusion, drawing, sheet metal working etc. A Diploma engineer is expected to work at supervisory level in various production units. Therefore, the student must be conversant with metallurgical aspects of metal forming processes, along with the basic knowledge of equipments and production of various components by suitable process. This course aims to equip the student with the knowledge of various metal working operations that leads to get the best metallurgical qualities and economic products.

3. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency

- **Select appropriate metal working process for a given application.**

4. COURSE OUTCOMES (COs)

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 above mentioned competency**:**

1. Analysis and apply corrective measures for various defects in forged, rolled, extruded components.
2. Perform wire drawing operation.
3. Apply knowledge to perform rolling, forging operations on metals /alloys.
4. Carry out forming operation in sheet metal working of metals /alloys.
5. Perform various sheet metal processes.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	**Practical Exercises** (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	1	Draw the sketch of Rolling mill and its tools/accessories and operate it to prepare metallic job.	1, 3	02
2.	2	Draw the sketch of Draw bench machine and its tools/accessories and operate it to prepare wire.	2	02
3.	3	Draw the sketch of spinning lathe and spinning tools and write specifications.	4, 5	04
4.	3	Draw the sketch of vertical shearing machine, write specifications.	4, 5	04
5.	4	Draw the sketch of power press and hydraulic press, write specifications.	3,4,5	04
6.	4	Watch a video on the steps for production of connecting rod by closed die forging and production of bolt by upset forging and write a report.	1,3	04
7.	5	Explain the types of extrusion processes through industrial visit/video programs.	1,3	04
8.	6	Explain various processes of cold working of sheet metals through videos.	4,5	04
9.	All	Micro Project - Complete a micro project based on guidelines provided in Sr. No. 11	1 to 5	04
			Total Hrs	**32**

S.No.	Performance Indicators	Weightage in %
a.	Drawing of Sketches/Diagrams	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
	Total	**100**

6. MAJOR EQUIPMENTS/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	Rolling Mill Model	1,8,9
2	Anvil, Hammer, Heating unit	6,9
3	Sheet metal working equipment models	3,8,9
4	Extrusion unit model	5,7,9
5	Draw bench with attachments	2,9

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topic**
Section I	
Unit - I Rolling of Metal (12 hrs, 16 marks)	
1a. Describe rolling as a mechanical working process. 1b. Enlist the products of rolling. 1c. Explain construction and working of rolling mills. 1d. Classify rolling mills. 1e. Select the relevant rolling mill for the given application. 1f. Describe in brief different parameters in rolling. 1g. Classify rolling processes. 1h. Describe rolling plant layout. 1i. Identify different defects in rolled products. 1j. Describe defects in rolled products and suggest their remedies. 1k. Classify rolling mills. 1l. Write the roll pass sequence for bloom, billets, rods and flats. 1m. Describe various processes of tube making.	1.1 Schematic representation of Rolling process. 1.2 Theory of rolling: Entry and exit zone, neutral plane neutral angle, coefficient of draught, zone of deformation, angle of bite, contact arc, roll bite condition, distribution of draught in the passes, open and close roll pass, neutral line, roll parting line, top pressure and bottom pressure, roll redressing coefficient, steady conditions of rolling, forward slip, spread, effect of various parameters on spread. 1.3 Classification of rolling processes- Hot rolling and cold rolling, elastic deformation of rolls. 1.4 Rolling mills: Classification of rolling mills- Longitudinal, cross and helical rolling, main features of each type with their sketches, construction of rolling mill in brief. 1.5 Types of rolled products, typical roll pass sequence for blooms, billets, rods and flats. 1.6 Tube making by rolling, Mannesmann's process, Pilger process, Plug rolling, defects in rolled products and their remedies.
Unit - II Drawing of Wire and Rod (10 hrs, 12 marks)	

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topic
2a. State principle of Drawing. 2b. Classify drawing processes. 2c. Compare Wire drawing and Rod drawing. 2d. Describe detail procedure for preparation of wire drawing. 2e. State the need for preparation of wire drawing. 2f. Select the raw material required for wire drawing. 2g. Explain deformation pattern of metal in drawing die. 2h. Select Die material for wire drawing. 2i. Describe principle and description of wire drawing machines. 2j. State functions of lubricants used in wire drawing. 2k. Describe patenting heat treatment of wires. 2l. Interpret the defects in wire drawn products and describe remedies. 2m. Compare tube drawing and tube making.	2.1 Principle of drawing. 2.2 Classification of drawing processes. 2.3 Comparison of wire drawing and rod drawing. 2.4 Raw materials for wire/rod drawing. 2.5 Sequential procedure for preparation of wire, rod for drawing - Cleaning, rinsing, coating; lime, borax, phosphate coating, baking, flash baker, need for preparation for wire drawing. 2.6 Deformation pattern of metal in drawing die. 2.7 Drawing die – Effects of friction and die angle on energy required for drawing. 2.8 Selection of wire drawing die material. 2.9 Wire / rod drawing machines- Principle and description - Draw Bench - Bull block - Motor blocks - Multiple draft machines - Cumulative and non-cumulative continuous machines. 2.10 Lubrication in wire drawing- Function and types of lubricants. 2.11 Heat treatment of wires- annealing and patenting. 2.12 Defects in wire/rod. 2.13 Concept of tube drawing and tube making.
Unit - III Spinning of Metal (10 hrs, 12 marks)	
3a. Define Spinning. 3b. Compare spinning with sheet metal working. 3c. List various parts produced by spinning. 3d. Describe various spinning tools. 3e. State lubricants used for manual and power spinning operation. 3f. Describe working of power spinning in a vertical machine. 3g. State advantages of power spinning. 3h. Describe defects in spinning.	3.1 Concept and principle of spinning, comparison of spinning with sheet metal working, accuracy of spinning. 3.2 Parts produced by spinning. 3.3 Collapsible mandrel, various spinning operations, optimum speeds for spinning. 3.4 Shear spinning (Power spinning): Power spinning in vertical machines, materials for mandrels used, lubrication, shear spin ability. 3.5 Advantages of power spinning. 3.6 Defects in spinning.
Section II	
Unit - IV Forging of Metal (12 hrs, 16 marks)	
4a. Define Forging. 4b. Enumerate Different forging operations. 4c. Compare Hot, Cold and Warm	4.1 Forging: definition, principle, structure of forgings. 4.2 Types of forgings -Principle of cold, hot and warm forging, comparison of cold, hot and warm forging, applications of cold and hot forging, Ring rolling, Near

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topic
forging. 4d. Describe principle and working of ring rolling. 4e. Describe different Hammers and presses for forging operations. 4f. Identify different Forging defects. 4g. Describe various heating methods for forging. 4h. List various forging equipments. 4i. Select suitable forging operations for particular application.	net shape forgings, Selection of steel for forging. 4.3 Forgings die - die materials, properties of die materials. 4.4 Forging temperatures and time for Heating. 4.5 Heating methods for forgings, principle and description: a) Furnace heating, b) Induction heating, c) Resistance heating, various fuels used for heating raw material, changes in properties of metals on heating, oxidation and decarburization of steel, overheating and burning of steel. 4.6 Different forging operations. 4.7 Press forgings and hammer forgings. 4.8 Forging defects- causes and remedies. 4.9 Forgings design considerations. 4.10 Forging equipments, working principles- Steam hammer, Pneumatic hammer, Board drop hammer, Spring hammer, Single and double acting air hammer, Mechanical press, Hydraulic press. 4.11 Cooling of forgings.
Unit - V Extrusion of Metal (10 hrs, 12 marks)	
5a. Define extrusion. 5b. Describe Deformation in extrusion. 5c. List types of extrusion. 5d. Describe extrusion of tapered and stepped sections. 5e. Differentiate direct and indirect extrusion. 5f. Identify Extrusion defects. 5g. Describe Extrusion defects in brief and suggests their remedies. 5h. Describe Extrusion equipments /machineries. 5i. Select Lubricants for extrusion process. 5j. Describe parameters affecting extrusion pressure. 5k. Describe extrusion defects. 5l. State applications of extrusion.	5.1 Extrusion - Principle and definition 5.2 Deformation in extrusion. 5.3 Types of extrusion, direct extrusion, indirect extrusion Hydrostatic extrusion- extrusion of tapered and stepped sections, impact extrusion. 5.4 Extrusion equipments/machineries: extrusion dies, profile of dies, mandrels, heating of the container, heating of billets before extrusion. 5.5 Lubricants used in extrusion. 5.6 Variables in extrusion, extrusion ratio, working temperature, speed of deformation and frictional conditions. 5.7 Applications of extrusion and extrusion defects.
Unit - VI Sheet Metal Working (10 hrs, 12 marks)	
6a. State parts made by sheet metal. 6b. Describe various Forming operations. 6c. Describe Shear action in die cutting. 6d. Define principle of bending.	6.1 Parts made by sheet metal working. 6.2 Various cutting operations like shearing, blanking, piercing, trimming, shaving, notching or slitting. 6.3 Various types of shears like Guillotine shears, shears with inclined blades, circular shears. 6.4 Bending operation, spring back, Stretch forming,

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topic**
6e. Describe geometry and dimensions of bending punches. 6f. Define Drawing. 6g. Analyze the effect of clearance on cut edge. 6h. Identify defects in sheet metal products. 6i. Analyze various defects in sheet metal products, their causes and suggest suitable remedies.	Geometry and dimensions of bending punches and dies rubber pad bending, lubrication in bending. 6.5 Drawing operation, draw reduction ratio, determine need for blank holder or clamp plate, determining dimensions and shape of blanks, determining allowance for edge trimming, Erichsen cupping test. 6.6 Defects in sheet metal working.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	**Unit Title**	**Teaching Hours**	**Distribution of Theory Marks**			
			R Level	**U Level**	**A Level**	**Total Marks**
	Section II					
I	Rolling of Metal	12	08	04	04	16
II	Drawing of Wire and Rod	10	06	03	03	12
III	Spinning of Metal	10	06	03	03	12
	Total	32	20	10	10	40
	Section II					
IV	Forging of Metal	12	08	04	04	16
V	Extrusion of Metal	10	06	03	03	12
VI	Sheet Metal Working	10	06	03	03	12
	Total	32	20	10	10	40
	Total	**64**	**40**	**20**	**20**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journal based on practicals performed in metal working laboratory.
b. Study and make a report of industrial applications of rolled and forged components.
c. Study and make a report on metal grades generally used for metal spinning processes.
d. Search information about quality specifications available in the market for raw materials like rods, bars, wires of copper, steel.etc
e. Study and make a report on different quality standards / specifications followed in industries for controlling the quality of forged components.
f. Search and make a report on metal grades commonly used in different extrusion process.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with concerned metallurgical equipments.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation / working details.
h. Teacher should ask the students to go through instruction and technical manuals.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. (Affective Domain Outcomes) .Each student will have to maintain activity chart consisting of individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs. A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare flow sheet / flow chart for hot rolling, closed die forging, direct extrusion.
b. Prepare flow sheet / flow chart for spinning, impact extrusion, wire and tube drawing.
c. Collect - study - present any one research paper related to wire / tube drawing process.
d. Collect – study - present any one research paper related to closed die forging process.
e. Collect – study - present any one research paper related to metal extrusion processes.
f. Prepare demonstration model of forging hammers & presses, wire draw machines.
g. Prepare demonstration model of different types of metal rolling mills used in industry.
h. Prepare working model of direct and indirect metal extrusion machine / set up.
i. Analysis (causes & remedies) of defects in the products manufactured by different metal working processes.
j. Prepare report on industrial and domestic applications of different extruded products / profiles.
k. Prepare demonstration model of sheet metal punching / blanking machine.
l. Collect & study different IS standards related to hot rolling and cold rolling of different grades of steels.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of Publication, ISBN Number
1	Engineering Metallurgy	Higgins	R.A. ELBS, New Delhi 3. ISBN 10: 0340568305 ISBN 13: 9780340568309
2	Mechanical Metallurgy	George, E. Dieter	McGraw Hill, New Delhi ISBN 0-07-100406-8
3	Metal Forming- Mechanics and Metallurgy	William F. Hosford Robert M. Caddell	Cambridge University Press ISBN-13 978-0-511-35453-3

13. SOFTWARE/LEARNING WEBSITES

1. https://nptel.ac.in
2. https://steeluniversity.org/learn/courses/
3. https://www.asminternational.org/learning/courses

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	2	3	2	3
CO2	2	1	2	2	3	2	2
CO3	3	3	3	3	3	3	3
CO4	2	2	1	2	2	3	2
CO5	2	1	2	3	3	3	2

	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3
CO2	3	2	2	2
CO3	3	3	2	3
CO4	2	2	2	2
CO5	3	3	3	2

Sign: Name: Shri. R. S. Tuljapurkar (Course Expert)	Sign: Name: Smt. N. S. Kadam (Head of Department)
Sign: Name: Smt. N. S. Kadam (Program Head) Department of Metallurgical Engineering	Sign: Name: Shri. A. S. Zanpure (CDC In charge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme Code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19**/21/22/23/24/26
Name of Course	**Heat Treatment of Metals and Alloys**
Course Code	**MT4108**
Prerequisite course code and name	**MT4104- Elements of Physical Metallurgy**
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	*ESE	PA	
04	00	04	08	Marks	80	20	50	25	175
				Exam Duration	3 Hrs	1 Hr	--	--	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

The subject includes study of transformation systems, TTT diagram, hardenability of steel. The mechanical properties of metals and alloys are important from design point of view. After selection of material and alloys the mechanical properties such as tensile strength, ductility, fatigue, hardness can still be further improved by various types of heat-treatment given to ferrous and non -ferrous alloys. Hence, the course has its own value in metallurgical field.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Select proper heat treatment/s for the given alloy, as per the required properties.**

4. COURSE OUTCOMES (COs)

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 above mentioned competency:

1. Relate different cooling rates with the transformation products and properties of steels.
2. Select appropriate heat treatment for steels and cast irons to achieve required properties for particular application.
3. Select appropriate heat treatment for Al-Cu, Ti and Mg-Li alloys.
4. Use safety measures in heat treatment shop.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	**Practical Exercises** (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	1	Study of heat treatment furnace.	2,3,4	04
2.	3	Perform Annealing heat treatment on steel specimen.	1,2,4	08
3.	3	Perform Normalizing heat treatment on steel specimen.	1,2,4	08
4.	4	Perform Hardening & Tempering heat treatments on steel specimen.	1,2,4	08
5.	5	Study of heat treatments based on TTT diagram of steels.	1,2,4	08
6.	6	Study of Carburizing & Nitriding treatments of steel.	1,2,4	08
7.	7	Study of surface hardening treatments of steel.	1,2,4	08
8.	8	Study of heat treatments of Cast Irons.	1,2,4	04
9.	9	Study of precipitation hardening of Al-Cu alloys.	3,4	04
10.	All	Complete a micro project based on guidelines provided in Sr. No.11	1 to 4	04
			Total Hrs	**64**

S.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned.

Sr.No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	Muffle furnace	1,2,3,4,10
2	Steel specimen for heat treatment	2,3,4,10
3	Standard steel & C.I. samples (heat treated)- Annealed, normalized, hardened, tempered, carburised, nitride, surface hardened etc.	2 to 8,10
4	Standard precipitation hardened samples of Al-Cu alloy	9,10
5	Metallurgical microscopes	2-10

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Section I	
Unit I. Introduction to Heat Treatments (08 hrs, 10 marks)	
1a. State the importance of heat treatments for metals & alloys. 1b. State & explain the factors governing heating rate in heat treatment. 1c. State the classification of heat treatment furnaces. 1d. Explain the need for and control of furnace atmospheres. 1e. Explain the process of Shot blasting & Shot pinning. 1f. State the causes & remedies for common defects in heat treatments.	1.1 Need for heat treatments. 1.2 Factors governing heating rate. 1.3 Heat treatment furnaces, use of vacuum in furnaces. 1.4 Furnace atmospheres: oxidation, decarburization. 1.5 Finishing operations on heat treated component: Shot blasting and Shot peening. 1.6 Defects in heat treatment: causes and remedies.
Unit II. Phase Transformations in Steels (08 hrs, 10 marks)	
2a. Explain the steps in austenitic, pearlitic, martensitic & bainitic transformations in steel. 2b. Explain the effect of grain size on the properties of various transformation products. 2c. Explain the effect of Ms/Mf temperatures, alloying elements, CCR and retained austenite on martensitic transformation.	2.1 Transformation of pearlite into austenite on slow heating: Effect of grain size, determination of austenitic grain size. 2.2 Transformation of austenite into pearlite on slow cooling: Nucleation and growth of cementite and ferrite, effect of time & grain size. 2.3 Transformation of austenite into martensite: Ms/Mf temperatures, characteristics of martensitic transformation, effect of carbon and alloying elements, retained austenite, CCR, effect of austenitic grain size, volumetric changes during martensitic transformation.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
2d. Compare the characteristics of pearlitic, martensitic & bainitic transformations.	2.4 Transformation of austenite into bainite: Characteristics, comparison with martensitic & pearlitic transformations.
Unit III. Annealing and Normalizing of Steels (08 hrs, 10 marks)	
3a. Explain the objectives, principle & process of Annealing. 3b. Describe different types of Annealing treatments. 3c. Explain the objectives, principle & process of Normalizing. 3d. Differentiate between Annealing and Normalizing.	3.1 Objectives, principle & process of Annealing. 3.2 Classification and applications of different types of Annealing- Full, partial, subcritical, isothermal, recrystallization, diffusion, process and spheroidizing annealing. 3.3 Objectives, principle & process of Normalizing. 3.4 Difference between Annealing & Normalizing.
Unit IV. Hardening and Tempering of Steels (08 hrs, 10 marks)	
4a. Explain the objectives, principle & process of different methods of Hardening. 4b. State the properties of various quenching mediums. 4c. Explain the factors of selection of quenching medium. 4e. Describe the stages in quenching. 4f. Explain the Working, advantages and applications of Sealed quench furnace. 4g. Explain the objectives, principle & stages in Tempering. 4h. Explain precipitation of carbides, temper embrittlement & secondary hardening in steels.	4.1 Objectives & principle of Hardening. 4.2 Methods of Hardening. 4.3 Quenching mediums: properties of various mediums, selection of quenching medium, stages in quenching. 4.4 Sealed Quench furnaces: Working, advantages and applications. 4.5 Objectives, principle & stages in Tempering. 4.6 Precipitation of carbides, Temper embrittlement. 4.7 Secondary hardness.
Section II	
Unit V. Heat Treatments Based on T.T.T. Diagram (06 hrs, 08 marks)	
5a. Explain the principle & applications of various heat treatments based on T.T.T. diagram of steels.	Principle and applications of following heat treatments based on T.T.T. diagram of steels, 5.1 Martempering. 5.2 Austempering. 5.3 Ausforming. 5.4 Patenting. 5.5 Isothermal annealing.
Unit VI. Case Hardening of Steel (06 hrs, 10 marks)	

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
6a. Explain the principle and process of different methods of carburizing, nitriding, carbonitriding. 6b. State the need and advantages of using vacuum in carburizing and nitriding.	6.1 Carburizing: pack, gas and liquid carburizing, heat treatments after carburizing. 6.2 Nitriding, Plasma nitriding, Sursulf process. 6.3 Cyaniding, Carbonitriding. 6.4 Diffusion metallizing. 6.5 Vacuum processes- Carburizing, Nitriding.
Unit VII. Surface Hardening of Steel (06 hrs, 08 marks)	
7a. Explain the principle & applications of surface hardening treatments like induction, flame, laser & electrolytic bath hardening.	Principle and applications of following heat treatments of steels, 7.1 Induction hardening. 7.2 Flame hardening. 7.3 Laser hardening. 7.4 Electrolytic bath hardening.
Unit VIII. Heat Treatments of Cast Irons (05 hrs, 06 marks)	
8a. Explain the principle & applications of heat treatments of different types of Cast Irons.	Principle & applications of heat treatments of 8.1 Grey C. I. 8.2 White C. I. 8.3 Malleable C.I. 8.4 S. G. Irons.
Unit IX. Heat Treatment of Non-ferrous Metals and Alloys (05 hrs, 06 marks)	
9a. Explain the effect of annealing on cold working metals. 9b. Enlist different heat treatments of Al, Cu & Mg alloys. 9c. Explain the process of precipitation hardening of Al-Cu alloys. 9d. Explain the principles of heat treatments of Ti and Mg-Li alloys.	9.1 Effect of annealing on cold working metals. 9.2 H. T. of Al, Cu and Mg alloys. 9.3 Modification of Al-Si alloys using St/Na. 9.4 Precipitation hardening of Al-Cu alloy system. 9.5 Principle of heat treatments for Ti and Mg-Li alloys.
Unit X. Safety Measures in H. T. Shop (04 hrs, 02 marks)	
10a. State the role of various safety equipment in heat treatment shop. 10b. Explain the safety measures & precautions to be taken in heat treatment shop.	10.1 Use of safety equipment in heat treatment shop. 10.2 Safety measures & precautions in heat treatment shop.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
Section I						
I	Introduction to Heat Treatments	08	06	02	02	10
II	Phase Transformations in Steels	08	06	02	02	10
III	Annealing and Normalizing of Steels	08	06	02	02	10
IV	Hardening and Tempering of Steels	08	06	02	02	10
	Total	32	24	08	08	40
Section II						
V	Heat Treatments Based on T.T.T. Diagram	06	04	02	02	08
VI	Case Hardening of Steel	06	06	02	02	10
VII	Surface Hardening of Steel	06	04	02	02	08
VIII	Heat Treatments of Cast Irons	05	04	01	01	06
IX	Heat Treatment of Non-ferrous Metals and Alloys	05	04	01	01	06
X	Safety Measures in H. T. Shop	04	01	00	01	02
	Total	32	23	08	09	40
	Total	**64**	**47**	**16**	**17**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on practical performed in laboratory. Journal consists of write ups, diagrams, observations, required tools, equipment and date of performance with teacher signature.
b. Power Point Presentation on different heat treatments by group of two/three students. (Duration:10 minutes)
c. Power Point Presentation on furnaces required for different heat treatments by group of two/three students. (Duration:10 minutes)
d. Power Point Presentation on furnace atmospheres required for different heat treatments by group of two/three students. (Duration:10 minutes)
e. Prepare charts showing before and after heat treatment microstructures for different heat treatments of alloys.
f. Prepare flow sheets for different heat treatment processes.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Prepare and use power point presentations related to different topics.
f. Use Videos/Flash/Animations to explain various topics and subtopics.
g. Industrial visit of students to heat treatment shop/s.
h. Expert lectures related to topics.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***
The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.
A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare industrial survey report of various heat treatment shops and the heat treatments performed in these shops for various materials.
b. Collect technical specifications of various heat treatment furnaces.
c. Prepare visit report on heat treatment shop.
d. Prepare display board of various heat treatment processes.
e. Prepare tabulated summary for temperature, time, furnace atmospheres etc for various heat treatment processes.
f. Prepare report on construction of various heat treatment furnaces.
g. Prepare report on working of various heat treatment furnaces.
h. Prepare report on specifications, sketches of various heat treatment furnaces.
i. Prepare detailed cycle of heat treatments for various alloys.
j. Prepare report on the effect of a particular heat treatment on the microstructure and properties of given steel.
k. Prepare metallograpical specimen of different alloys, before and after heat treatments.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of Publication, ISBN Number
1	Physical Metallurgy for Engineers	Clark & Varney	Van Nostrand Reinhold Company, 1962 ISBN10: 0442015704 ISBN13: 9780442015701
2	Introduction to Physical Metallurgy	Sydney H. Avner	Tata McGraw Hill Publishing Company Ltd, New Delhi ISBN13: 9780070024991 ISBN10: 0070024995
3	Engineering Metallurgy	Raymond A. Higgins	English University Press, London ISBN13: 9780340568309 ISBN10: 0340568305
4	Heat Treatment Principles & Techniques	T.V.Rajan, C.P.Sharma, Ashok Sharma	PHI Learning Pvt. Ltd., New Delhi ISBN: 9788120340954

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com- http://www.nptelvideos.in/2012/12/principles-of-physical-metallurgy.html
2. Virtual Lab- http://msvs-dei.vlabs.ac.in/Quenching.php

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	2	1	1	2
CO2	3	3	3	2	2	2	3
CO3	3	3	3	2	2	2	3
CO4	2	1	1	1	2	2	3

	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	2
CO2	3	3	3	2
CO3	3	3	3	2
CO4	2	3	1	2

Sign: Name: Shri.A.V.Mehtre (Course Expert)	Sign: Name: Smt.N.S.Kadam (Head of Department)
Sign: Name: Smt.N.S.Kadam (Program Head) Metallurgical Engineering Department	Sign: Name: Shri.A.S.Zanpure (CDC In charge)

Government Polytechnic, Pune

Department of Metallurgical Engineering

180 OB Curriculum

Level-5A: Diversified Courses

(Any Two)

Sr. No.	Course Code	Course Name
1	MT5101	Metallurgical Drawing & Design
2	MT5102	Selection of Materials & Failure Analysis
3	MT5103	Metal Joining Processes
4	MT5104	Computer Applications in Metallurgy

Government Polytechnic Pune

'180OB' – Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme Code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19**/21/22/23/24/26
Name of Course	**Metallurgical Drawing and Design**
Course Code	**MT5101**
Prerequisite course code and name	**NA**
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	$ESE	PA	
04	00	04	08	Marks	80	20	25	25	150
				Exam Duration	3 Hrs	1 Hr	--	--	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

Engineering drawing is a language of Engineers. Metallurgical Engineer should be in a position to read Engineering drawing & details shown on the drawing. The students should know design aspect of various metallurgical topics / Field. This course aims to make the student capable to perform work in areas of designing of furnace, fixtures of heat treatment in industry. This creates ability to analyze (reading) of various metallurgical drawings and procedure in making of designed part or assembly. It also creates awareness about need of design/drawing in various metallurgical field applications.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Perform design & drawing for metallurgical field applications in Industry.**

4. COURSE OUTCOMES (COs)

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 above mentioned competency**:**

1. Design fixture for mass heat treatment.
2. Draw and design simple heat treatment furnace or melting furnace.
3. Design dies and mold setup for a particular (given) casting.
4. Design a layout of rolling mill.
5. Design different welds joints.
6. Design dies and punches for compaction of metal powders.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	**Practical Exercises** (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	1	Drawing at least one sheet on Fixture for mass heat treatment.	1	06
2.	2	Drawing at least one sheet on Heat treatment furnace.	2	06
3.	3	Drawing at least one sheet on die & mould design for die casting.	3	06
4.	4	Drawing of one sheet on Cupola furnace.	2	06
5.	5	Layout of rolling mill	4	06
6.	6	Drawing at least one sheet on weld joints.	5	06
7.	7	Drawing at least one sheet on Compaction dies of P/M.	6	06
8.	2,3,5,7	Complete at least five design projects. The project Report should include drawing.	1 to 6	18
9.	All	Complete a micro project based on guidelines provided in Sr. No.11	1 to 6	04
			Total Hrs	**64**

S.No.	Performance Indicators	Weightage in %
a.	Arrangement of available/ calculated data in sequence	20
b.	Preparation of drawing/ design	30
c.	Interpretation of prepared drawing/ design	20
d.	Answer to sample questions	10
e.	Submission of report/ design/drawing in time	20
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specifications mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned.

Sr.No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	Models or charts, Standards designs, Drawing Setup	1,2,3,4,5,6,7,9
2	N.A.	8

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Section I	
Unit- I. Designing of Heat Treatment components/Parts (04 hrs, 08 marks)	
1a. Explain different consideration of designing heat treatment parts. 1b. Design fixture for given load in salt bath furnace.	1.1 Design considerations for heat-treated parts 1.2 Design of fixtures for the mass heat treatment of metallic parts in salt bath.
Unit- II. Designing of Heat Treatment Furnaces (12 hrs, 12 marks)	
2a. Explain various mode of heat transfer. 2b. Enlist and Explain criteria for selection & positioning of pyrometer. 2c. Calculate heating element dimensions of muffle furnace. 2d. Explain considerations for designing Muffle furnace. 2e. Draw and explain design of oil fired furnace.	2.1 Conduction, convection, radiation 2.2 Selection & positioning of pyrometers in heating & melting furnaces. 2.3 Calculations for heating elements for electrical furnace, salt bath furnaces. 2.4 Calculation and Designing of Muffle Furnace (Case Study) 2.5 Calculations of fuels, calculations for the requirements of allied machinery for oil & arc furnaces.
Unit- III. Designing of Molding in Foundry (04 hrs, 08 marks)	
3a. Design a gating system for given cast component. 3b. Explain calculation & Design dies for centrifugal castings. 3c. Draw layout of mechanized foundry.	3.1 Design of pattern, gating, risering etc. for industrial cast components. 3.2 Die & mold design for special casting processes like die casting, centrifugal casting etc. 3.3 Plant layout of mechanized foundry.
Unit- IV. Designing of melting section in Foundry (12 hrs, 12 marks)	

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
4a. Design Cupola furnace for 4ton lm per hours. 4b. Draw layout of jobbing foundry.	4.1 Design of cupola furnace from required melting rate. 4.2 Non-ferrous jobbing foundry layout.
Section II	
Unit- V. Designing of Metal Working shop (12 hrs, 16 marks)	
5a. Draw forging dies with dimensions. 5b. Design simple rolling mill passes. 5c. Calculate dimensions and power requirement for wire drawing passes. 5d. Draw layout of rolling mill. 5e. Design dies for extrusion and press work. 5f. Draw layout of Electroplating setup.	5.1 Design of forging die, forging shop layout 5.2 Simple design of rolling mill passes, sequences, Calculations. 5.3 Calculations of wire drawing passes, Power Required etc. 5.4 Rolling Mill Layout. 5.5 Design of dies used for extrusion and Press Work. 5.6 Electroplating plant Layout.
Unit- VI. Designing of Welding and Joining component (10 hrs, 12 marks)	
6a. Explain design of different weld joints.	6.1 Design of different types of Butt joint, Lap joint, Corner joint, Tee joint, Edge joint and any intricate welding joint.
Unit- VII. Designing of Powder Metallurgy parts and plant (10 hrs, 12 marks)	
7a. Design compaction dies for PM plant. 7b. Draw layout of PM Plant.	7.1 Design of different dies and punches for compaction. 7.2 Drawing of layout of Powder metallurgical plant.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
Section I						
I	Designing of Heat Treatment component/parts	04	02	02	04	08
II	Designing of Heat Treatment Furnace	12	04	04	04	12
III	Designing of Molding in Foundry	04	02	04	02	08
IV	Designing of melting section in Foundry.	12	04	04	04	12
	Total	32	12	14	14	40

Section II							
Unit No.	**Unit Title**	**Teaching Hours**	**Distribution of Theory Marks**				
			R Level	**U Level**	**A Level**	**Total Marks**
V	Designing of Metal Working Shop	12	04	04	08	16
VI	Designing of welding and joining component	10	04	04	04	12
VII	Designing of powder metallurgy part and plant	10	04	04	04	12
	Total	32	12	12	16	40
	Total	**64**	**24**	**26**	**30**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on performed in laboratory practice.
b. Draw / Design various assembly or component or parts related to all topics with supportive calculations.
c. Reading and analyze Standard design or drawing of various Metallurgical fields.
d. Prepare flow sheets for different processes for plant layout design.
e. Prepare a comparative chart overall specifications of materials, standards of designing and drawing.
f. Survey of methods used in designing of product.
g. Search information about requirement, specifications and dimensions of product or assembly designed.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipments.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations/Power point presentation to explain various components design aspects.
h. Teacher should ask the students to go through instruction and Technical manuals.
i. Expert lectures related to topics.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. (Affective Domain Outcomes) .Each student will have to maintain activity chart consisting of individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare a report of Parameter for metallurgical drawing/ design consideration for specific example.
b. Prepare report on Calculations, specifications & sketches or Draw or Design fixture for 0.5-ton load in salt bath furnace
c. Prepare tabulated summary for Electrical heating element used in electric furnace with supportive calculations.
d. Prepare report on working of fuel requirement & combustion calculations. E.g. oil fired furnace.
e. Draw Cupola design and dimensions of each part of cupola.
f. Prepare report on specifications with sketches of Rolling mill and output capacity.
g. Prepare report on specifications with sketches of die designing for press, extrusion etc.
h. Draw & label any Foundry layout with output capacity.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of Publication, ISBN Number
1	Mechanical Metallurgy	George E. Dieter	Mc Graw-Hill Book Company ISBN10:0070168938 ISBN13:9780070168930
2	Metal Casting Principle and Practices	T.V.Ramana Rao	New Age International(P) Ltd. Publishers ISBN10:8122408435 ISBN13:9788122408430
3	Principles of Foundry Technology	P.L.Jain	Mc Graw-Hill publishing Company ISBN10:0070151296 ISBN13:9780070151291
4	Principle of Metal Castings	Richard W.Heine, Carl R. Loper, PhilipC.Rosenthal	Mc Graw-Hill publishing Company ISBN10:0070278962 ISBN13:9780070278967
5	Casting Design HandBook	--	American Society Of Metals. ISBN10:1258327465 ISBN13:9781258327460

12. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. http://www.capabilitydevelopment.com

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	1	2	2	1	1
CO2	2	1	2	2	2	1	1
CO3	2	2	1	1	1	2	2
CO4	2	2	2	2	1	1	1
CO5	2	2	2	2	1	1	2
CO6	2	2	2	2	1	1	1

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1
CO2	2	2	2	1
CO3	3	2	2	1
CO4	2	2	2	1
CO5	2	2	1	1
CO6	3	2	1	1

Sign: Name: Shri. P.B. Kamble (Course Expert)	Sign: Name: Smt. N. S. Kadam (Head of Department)
Sign: Name: Smt. N. S. Kadam (Program Head) Department of Metallurgical Engineering	Sign: Name: Shri. A. S. Zanpure (CDC In charge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme Code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19**/21/22/23/24/26
Name of Course	**Selection of Materials and Failure Analysis**
Course Code	**MT5102**
Prerequisite course code and name	**NA**
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

<table>
<tr><th colspan="3">Teaching Scheme (In Hours)</th><th>Total Credits (L+T+P)</th><th rowspan="2"></th><th colspan="5">Examination Scheme</th></tr>
<tr><th colspan="3"></th><th></th><th colspan="2">Theory</th><th colspan="2">Practical</th><th rowspan="2">Total Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>C</th><th></th><th>ESE</th><th>PA</th><th>$ESE</th><th>PA</th></tr>
<tr><td rowspan="2">04</td><td rowspan="2">00</td><td rowspan="2">04</td><td rowspan="2">08</td><td>Marks</td><td>80</td><td>20</td><td>25</td><td>25</td><td>150</td></tr>
<tr><td>Exam Duration</td><td>3 Hrs</td><td>1 Hr</td><td>--</td><td>--</td><td></td></tr>
</table>

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

The subject includes study of principles involved in materials selection. The mechanical properties of metals and alloys are important from design point of view. After selection of material and alloys the mechanical properties such as tensile strength, ductility, fatigue, hardness can still be further improved by various types of heat-treatment given to ferrous and non-ferrous alloys. Hence, the course has its own value in metallurgical field.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Select proper material for a given application.**

4. COURSE OUTCOMES (COs)

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 above mentioned competency:

1. Evaluate alternatives, determine performance requirements.
2. Select a material for strength, resistance to corrosion, temperature, wear.
3. Select steels for high strength, heat resistant and corrosion resistant applications.
4. Select tool steels required for cutting, cold-working dies, hot working dies.
5. Apply knowledge of fracture toughness to predict performance of components.
6. Define failure, state its causes, correlate failure with microstructure and state categories of material stressors- Mechanical, chemical, electrochemical, thermal, radiation and electrical.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	**Practical Exercises** (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	1	Study of steps in selection of materials	1	04
2.	1	Study of different types of failures; ductile, brittle, wear, fatigue, corrosion, stress corrosion.	6	06
3.	5	Study of different types of fractures.	6	06
4.	2	Case studies of selection of materials for resistance to corrosion.	2	08
5.	2	Case studies of selection of materials for resistance to heat.	3	08
6.	2	Case studies of selection of materials for resistance to wear.	2	08
7.	3	Case studies of selection of materials for cold working dies.	4	06
8.	3	Case studies of selection of materials for hot working dies.	4	06
9.	2	Case studies of selection of non ferrous material for a given application.	2	08
10.	All	Complete a micro project based on guidelines provided in Sr. No. 11	All	04
			Total Hrs	**64**

S.No.	Performance Indicators	Weightage in %
a.	The appropriateness of data collected	20
b.	The appropriateness of evaluation of alternatives done	20
c.	The justification given for selecting a particular material for a given application.	20
d.	Overall presentation	20
e.	Answer to sample questions	10
f.	Submission of report in time	10
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned.

Sr.No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	Nil	

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Section I	
Unit I. Introduction (08 hrs, 12 marks)	
1a. Explain principles involved in the selection of materials. 1b. Explain the selection processes 1c. State the factors affecting material prices and material substitution. 1d. Explain computer's use for selection of material.	1.1 Principles involved in the selection of materials. 1.2 Selection process- determination of performance requirements, evaluation of alternatives, weighted properties, incremental return, limits on properties. 1.3 Factors affecting material prices, material substitution. 1.4 Computer's use for selection of material.
Unit II. Functional Requirement of Engineering Materials (12 hrs, 14 marks)	
2a. Select material for conditions of strength, resistance to corrosion, temperature, wear. 2b. Select non-ferrous materials for various applications. 2c. State the various lightweight materials used in battery and enlist their properties.	2.1 Selections of material for strength, resistance to corrosion, temperature, wear with practical examples 2.2 Selection of non-ferrous materials for various applications 2.3 Study of lightweight materials used in battery
Unit III. Steel Selection (12 hrs, 14 marks)	
3a. Select high strength, heat resistant alloys, corrosion resistant steels required for good weldability, formability, forgeability. 3b. Select tool steels required for cutting, cold-working dies, hot working dies. 3c. Select materials and processes for tools and a few components of automobile engines, machine tools, foundry metal-working equipment, testing machine, ore-dressing equipment.	3.1 Selection of high strength, heat resistant alloys, corrosion resistant steels required for good weldability, formability, forgeability. 3.2 Selection of tool steels required for cutting, cold-working dies, hot working dies. 3.3 Selection of materials and processes for tools and a few components of automobile engines, machine tools, foundry metal-working equipment, testing machine, ore-dressing equipment.
Section II	

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit IV. Fracture Toughness (16 hrs, 20 marks)	
4a. Apply knowledge of fracture toughness to predict performance of components. 4b. Explain plain strain fracture, critical crack size, crack growth under cyclic loads.	4.1 Use of fracture toughness to predict performance of components. 4.2 Plain strain fracture, critical crack size, crack growth under cyclic loads. (No mathematical details)
Unit V. Failure Analysis (16 hrs, 20 marks)	
5a. Define failure, state its causes and explain correlation of failure with microstructure. 5b. Explain categories of material stressors- Mechanical, chemical, electrochemical, thermal, radiation and electrical. 5c. State and explain modes of fracture. 5d. Explain factors influencing Brittle fracture. 5e. Explain Why failure investigation is performed. 5f. Explain procedure of failure analysis.	5.1 Failure- Definition, its causes, correlation of failure with microstructure. 5.2 Categories of material stressors- Mechanical, chemical, electrochemical, thermal, radiation and electrical. 5.3 Modes of fracture. 5.4 Factors influencing Brittle fracture. 5.5 Why failure investigation is performed? 5.6 Procedure of failure analysis.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
Section I						
I	Introduction	08	04	04	04	12
II	Functional Requirement of Engineering Materials	12	04	04	06	14
III	Steel Selection	12	04	04	06	14
	Total	32	12	12	16	40
Section II						
IV	Fracture Toughness	16	04	08	08	20
V	Failure Analysis	16	04	08	08	20
	Total	32	08	16	16	40
	Total	**64**	**20**	**28**	**32**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare a report of different types of failure giving their photos and give all information regarding the failure.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Prepare and use power point presentations related to different topics.
f. Use Videos/Flash/Animations to explain various topics and subtopics.
g. Expert lectures related to topics.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare a chart showing a case study on selection of ferrous materials for various applications.
b. Prepare a chart showing a case study on selection of non ferrous materials for various applications.
c. Prepare a chart showing various types of failures.
d. Prepare a chart showing comparison of different types of failure
e. Prepare chart explaining factors influencing Brittle fracture.
f. Prepare chart explaining procedure of failure analysis.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of Publication, ISBN Number
1	Mechanical Metallurgy	George Dieter	McGraw-Hill international. ISBN-13:9780070168930 ISBN-10:0070168938
2	Physical Metallurgy Principles	Reed-Hill	East-West Press Pvt. Ltd., New Delhi. ISBN-13:9780495082545 ISBN-10:0495082546

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com- https://youtu.be/09uvkUFQ26Y
2. www.nptel.com-https://youtu.be/my63D9zG7bc
3. www.nptel.com-https://youtu.be/AH3ekqeiyZ

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	1	3	1	3
CO2	3	3	3	3	3	1	3
CO3	3	3	3	3	3	1	3
CO4	3	3	3	3	3	1	3
CO5	3	3	3	3	3	1	3
CO6	3	3	3	3	3	1	3

	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	3
CO2	3	3	3	3
CO3	3	3	3	3
CO4	3	3	3	3
CO5	3	3	3	3
CO6	3	3	3	3

Sign: Name: Smt. N. S. Kadam (Course Expert)	Sign: Name: Smt.N. S. Kadam (Head of Department)
Sign: Name: Smt. N.S. Kadam (Program Head) Department of Metallurgical Engineering	Sign: Name: Shri. A. S. Zanpure (CDC In charge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme Code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19**/21/22/23/24/26
Name of Course	**Metal Joining Processes**
Course Code	**MT5103**
Prerequisite course code and name	**NA**
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	$ESE	PA	
04	00	04	08	Marks	80	20	25	25	150
				Exam Duration	3 Hrs	1 Hr	--	--	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

In the world, various parts of engineering components are required to be joined on regular basis. The growing competition & developments in the production methods create intricate problems as regards to maintenance & repairs. Metal joining is the solution for this. It is therefore necessary to impart the basic knowledge of joining to the students.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences.

- **Select and perform appropriate welding method for particular application.**

4. COURSE OUTCOMES (COs)

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 above mentioned competency:

1. Compare the welding with riveting and casting.
2. Select appropriate welding process for particular application.
3. Draw welds positions, weld joint design and microstructure of Heat Affected Zone.
4. Compare soldering with brazing.
5. Suggest suitable remedies for various welding defects.
6. Perform various destructive and non-destructive tests on welded parts.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	**Practical Exercises** (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1	1	Draw weld positions and joint design.	3	04
2	2	Draw arrangement of oxy-acetylene welding process and types of flames of it.	2	04
3		Perform Shielded Metal Arc Welding process.	2	08
4		Prepare a report on Submerged Arc Welding Process.	2	08
5	3	Conduct spot welding and seam welding.	2	08
6		Perform Thermit Welding.	2	08
7	4	Draw the Heat Affected Zone of welded part and explain it in detail for low carbon steel.	3	04
8	5	Perform soldering and brazing	4	06
9	6	Prepare a report on causes and remedies on various welding defects.	5	04
10		Perform Nick-Break Test.	6	06
11	All	Complete a micro project based on guidelines provided in Sr. No. 11	1 to 6	04
			Total Hrs	**64**

S.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	Power supply, welding electrode, electrode holder, Shield	3
2	Spot and seam welding machine.	5
3	Iron oxide powder, aluminium powder, mould, two parts for joining	6
4	Soldering and brazing equipments	8
5	Former, welded part, support	10

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Section I	
Unit I Introduction (08 hrs, 10 marks)	
1a.State the principle, advantages, limitations, applications & classification of welding. of welding methods. 1b.State the working principle of casting. 1c. Compare welding with riveting and casting. 1d.State the requirements of welding processes. 1e. Define weldability. 1f. Draw weld positions and weld joint design. 1g. Aware safety rules and regulations in welding shop.	1.1 Welding – Principle, Advantages, Limitations, Applications &Classification. 1.2 Principle of casting, comparison of welding with riveting and casting. 1.3 Requirements of welding processes. 1.4 Weldability, Factors effect on weldability. 1.5 Weld positions, weld joint design. 1.6 Safety rules and regulations in welding shop.
Unit II Welding Methods (14hrs, 18 marks)	
2a. State the principle of mentioned welding methods. 2b. Explain the chemistry of oxy-acetylene flame. 2c. State the functions of fluxes in welding. 2d. Explain the working of mentioned welding methods with neat sketch. 2e. State the advantages,	2.1 Gas Welding Process: Principle, Types of Flames, Chemistry of oxy-acetylene flame, Welding techniques– Leftward and Rightward, Fluxes and its functions, Equipments, Working, Advantages, Limitations & Applications. 2.2 Shielded Metal Arc Welding Process: Principle, Equipments, Working, Advantages, Limitations & Applications. 2.3 MIG Welding Process: Principle, Equipments, Working, Advantages, Limitations &Applications.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
limitations and applications of mentioned welding methods.	2.4 CO_2 Welding Process: Principle, Equipments, Working, Advantages, Limitations &Applications. 2.5 TIG Welding Process: Principle, Equipments, Working, Advantages, Limitations & Applications. 2.6 Submerged Arc Welding Process: Principle, Equipments, Working, Advantages, Limitations & Applications. 2.7 Flux-Cored Arc Welding: Principle, Equipments, Working, Advantages, Limitations & Applications.
Unit III Other Welding Processes (10hrs, 12 marks)	
3a. State the principle, advantages, limitations and applications of mentioned welding methods.	3.1 Principle, Working, Advantages, Limitations and Applications of : a) Resistance Welding – Spot welding & Seam welding, b) Thermit Welding, c) Cold Welding, d) Electro-slag Welding, e) Explosion Welding, f) Friction Welding, g) Electron Beam Welding, h) Laser Beam Welding.
Section II	
Unit IV Metal Transformation of Welding (08hrs, 10 marks)	
4a. Explain HAZ and structure of welded joint with neat sketch 4b. State the importance of pre and post heat treatment of welding. 4c. Recognize Metallurgical changes occur in welding.	4.1 Heat Affected Zone (HAZ). 4.2 Structure of welded joint. 4.3Pre and post heat treatment of welding. 4.4 Metallurgical changes occur in welding.
Unit V Soldering & Brazing (10hrs, 12 marks)	
5a. State the principle, advantages, limitations and applications of brazing and soldering. 5b. Describe the process of brazing and soldering. 5c. Compare brazing with soldering.	5.1 Brazing: Principle, Procedure, Filler metals, Brazing Fluxes – Functions and Requirements, Advantages, Limitations, Applications,Brazing processes. 5.2Soldering: Principle, Solders, Fluxes, Requirements of Soldering, Advantages, Limitations, Applications, Soldering Methods.
Unit VI Welding Defects and Testing of Welds (14hrs, 18 marks)	
6a. Enlist welding defects. 6b. Suggest remedies of causes for various welding defects. 6c. Inspect welded structures.	6.1 Causes & Remedies of Weld Defects – a) Cracks, b) Distortion, c) Incomplete penetration,

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
6d. Perform destructive and non-destructive tests on welded parts.	d) Inclusions, e) Porosity and Blow holes, f) Undercutting, g) Overlapping. 6.2 Inspection of welded structures. 6.3 Weld Tests – Destructive testing, Non-Destructive Tests.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
Section I						
I	Introduction	08	04	04	02	10
II	Welding Methods	14	02	08	08	18
III	Other Welding Processes	10	02	04	06	12
	Total	32	08	16	16	40
Section II						
IV	Metal Transformation of Welding	08	02	06	02	10
V	Soldering & Brazing	10	02	04	06	12
VI	Welding Defects and Testing of Welds	14	02	06	10	18
	Total	32	06	16	18	40
	Total	**64**	**14**	**32**	**34**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course. Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on practical performed in laboratory. Journal consists of write ups, diagrams, observations, required tools, equipment and date of performance with teacher signature.
b. Power Point Presentation on different welding processes by group of two/three students. (Duration:10 minutes)
c. Case study on oxy-acetylene welding defects.
d. Search information on computer aided welding.
e. Collect information of new development in welding.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Prepare and use power point presentation related to various topics.
f. Use videos to explain different concepts.
g. Expert lectures related to topics.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Collect the detail data of any one new welding process.
b. Prepare report on Defects– definition, causes & remedies for any one welding process.
c. Prepare a poster on comparison of welding, brazing and soldering.
d. Prepare a report on radiant energy welding processes.
e. Prepare a report on destructive tests on welded parts.
f. Prepare a report on non-destructive tests on welded parts.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of Publication, ISBN Number
1	Welding Technology	O.P. Khanna	Dhanpat Rai Publications, First Edition, Revised Edition 2015. 978-93-83182-55-8
2	Welding and welding technology	Little, Richard L	McGraw-Hill, January 1973. 13: 9780070380950
3	Welding Technology	N.K. Shrinivasan	Khanna Publishers, 4th Edition, 6th Reprint 2016. 978-81-7409-159-9

4	Welding, Brazing, and Soldering	--	ASM Handbook, Volume 6 13: 9780871703828

13. SOFTWARE/LEARNING WEBSITES

1) https://nptel.ac.in/courses/112/107/112107090/
2) https://nptel.ac.in/courses/113/106/113106087/
3) https://nptel.ac.in/courses/112/103/112103263/

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	1	1	1	2
CO2	3	2	2	2	1	1	2
CO3	3	1	1	1	1	1	1
CO4	3	1	1	1	1	1	2
CO5	3	2	3	3	2	2	2
CO6	3	3	2	3	1	2	2

	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	1
CO2	3	--	1	2
CO3	3	--	1	1
CO4	3	1	1	1
CO5	3	1	1	2
CO6	3	3	3	2

Sign: Name: Shri. R.G.Injewar (Course Expert)	Sign: Name: Smt. N.S.Kadam (Head of Department)
Sign: Name: Smt. N.S.Kadam (Program Head) Department of Metallurgical Engineering	Sign: Name: Shri. A.S.Zanpure (CDC In charge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme Code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19**/21/22/23/24/26
Name of Course	**Computer Applications in Metallurgy**
Course Code	**MT5104**
Prerequisite course code and name	**NA**
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

<table>
<tr><th colspan="3" rowspan="2">Teaching Scheme (In Hours)</th><th rowspan="2">Total Credits (L+T+P)</th><th rowspan="2"></th><th colspan="5">Examination Scheme</th></tr>
<tr><th colspan="2">Theory</th><th colspan="2">Practical</th><th>Total Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>C</th><th></th><th>ESE</th><th>PA</th><th>$ESE</th><th>PA</th><th rowspan="2">150</th></tr>
<tr><td rowspan="2">04</td><td rowspan="2">00</td><td rowspan="2">04</td><td rowspan="2">08</td><td>Marks</td><td>80</td><td>20</td><td>25</td><td>25</td></tr>
<tr><td>Exam Duration</td><td>3 Hrs</td><td>1 Hr</td><td>--</td><td>--</td><td></td></tr>
</table>

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

In the present times of high speed computing it is necessary to program computers with the help of structured, dynamic language like C as well as use other prevalent platforms like DBMS, SQL. Study of these tools is useful in solving problems related to various areas of Metallurgical applications such as metallography, mechanical testing, furnace operations etc.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Use computer aided tools/platforms in Metallurgical applications.**

4. COURSE OUTCOMES (COs)

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 above mentioned competency**:**

1. Use platforms like C and DBMS in metallurgical applications.
2. Prepare simple programs using C for metallurgical applications.
3. Use image analyzer for microstructural observation.
4. Measure hardness using computerized Hardness testing machine.
5. Use computerized Tensile testing machine.
6. Explain the working of computerized furnaces.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	1	Practicing creation of database, classifying, sorting and indexing records of database file.	1	08
2.	1	Practicing on dot prompt, editing, appending database files.	1	08
3.	2	Practicing use of various built in functions of database management systems.	2	08
4.	3	Prepare C program for determination of hardness value.	3	04
5.	3	Prepare C program for grading of steels according to requirements of hardness, C content, T.S.	3	04
6.	4	Use of image analyzer for grain size measurement, phase analysis, percentage phase measurement.	4	04
7.	4	Use of image analyzer for case depth and coating measurement.	4	04
8.	4	Use of image analyzer for nodule count and graphite type in Cast iron.	4	04
9.	5	Use of computerized hardness tester for effective case depth measurement and coating hardness measurement.	5	04
10.	6	Use of computerized UTM for online stress strain curve, 0.2 % proof test.	6	04
11.	7	Study of computerized furnace operation and controls.	7	08
12.	All	Complete a micro project based on guidelines provided in Sr. No.11	1 to 6	04
			Total Hrs	**64**

S.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned.

Sr.No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	Desktop PC's	1,2,3,4,5,11,12
2	Metallurgical microscope with image analyser software	6,7,8,12
3	Computerized Hardness testing machine	9,12
4	Computerized Universal testing machine	10,12

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Section I	
Unit I. Basics of 'C' Programming (10 hrs, 12 marks)	
1a. Using basic concepts of C language for writing programs.	1.1 Constants, variables, keywords 1.2 Main function 1.3 Input output operations, arithmetic operations, logical operations 1.4 Control instructions, loops 1.5 Array, structures, pointers, string handling, file handling
Unit II. Data Base Management System (10 hrs, 12 marks)	
2a.Using basic functions of DBMS for creating, classifying, sorting and indexing records of data base files. 2b. Using various built in functions of data base management system. 2c. Explain concept of Structured Query Language (SQL).	2.1 Creating data base 2.2 Classifying, sorting and indexing records of data base files. 2.3 Editing, appending database files. 2.4 Using various built in functions of data base management system. 2.5 Introduction to Structured Query Language (SQL).
Unit III. Use of DBMS in 'C' Programs (12 hrs, 16 marks)	
3a. Writing C programs based on various metallurgical areas as mentioned in 3.1 to 3.6.	C programs in Metallurgical areas like- 3.1 Calculations and graphical display of tension test results. 3.2 Charge calculations, analysis and graphical display of data for calibration of thermo-couple. 3.3 Grading of steels according to requirements of hardness, C content, T.S. 3.4 Design of gating system for casting, material management, material selection, charge calculation. 3.5 Calculation of hardness values for various hardness tests.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	3.6 Analysis of various types of data, monitoring performance of workers in foundry.
Section II	
Unit IV. Image Analyzer for Microstructure Examination (10 hrs, 12 marks)	
4a. Explain the use of image analyzer software in microstructural examination.	4.1 Introduction- Theory of image processing principles, stereological principles, formulae and standard references. 4.2 Grain size measurement. 4.3 Phase analysis, percentage phase measurement. 4.4 Case depth and coating measurement. 4.5 Inclusion rating. 4.6 Nodule count and graphite type in Cast iron.
Unit V. Computerized Hardness Testing Machine (08 hrs, 10 marks)	
5a. Explain the use of computerized hardness testing machine.	5.1 Estimation of hardness value, coating measurement. 5.2 Plotting of case depth graph. 5.3 Estimation of effective case depth through computerization / software 5.4 Single phase hardness measurement.
Unit VI. Computerized Tensile Testing Machine (06 hrs, 08 marks)	
6a. Explain the use of computerized tensile testing machine.	6.1 On line stress strain curve, 0.2 % proof test. 6.2 Different types of graph plotting.
Unit VII. Computerized Furnace operation (08 hrs, 10 marks)	
7a. Explain the working operation and control of computerized furnaces. 7b. Explain the principle and advantages of automation and PLC in furnace operation.	7.1 Working operation and control of computerized furnaces. 7.2 Introduction to furnace automation, Programmable Logic Controller (PLC), and Supervisory Control and Data Acquisition (SCADA).

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
Section I						
I	Basics of C programming	10	04	04	04	12
II	Data Base Management System	10	04	04	04	12
III	Use of DBMS in ‘C’ Programs	12	04	04	08	16
	Total	32	12	12	16	40

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
Section II						
IV	Image Analyzer for Microstructure Examination	10	04	04	04	12
V	Computerized Hardness Tester	08	02	02	06	10
VI	Computerized Tensile Testing Machine	06	02	02	04	08
VII	Computerized Furnace operation	08	02	02	06	10
	Total	32	10	10	20	40
	Total	**64**	**22**	**22**	**36**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on practical performed in laboratory. Journal consists of write ups, diagrams, observations, required tools, equipment and date of performance with teacher signature.
b. Power Point Presentation on different applications of computer in Metallurgical Industry by group of two/three students. (Duration:10 minutes)
c. Prepare and observe different samples for microstructure using image analyzer.
d. Prepare flow sheets for operation of various types of computerized furnaces.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Prepare and use power point presentations related to different topics.
f. Use Videos/Flash/Animations to explain various topics and subtopics.
g. Industrial visit of students to Materials testing laboratory.
h. Industrial visit of students to Heat treatment shop/foundry having computerized furnace operation.
i. Expert lectures related to topics.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare C programs for various metallurgical applications.
b. Prepare database of different ferrous alloys with their mechanical properties, compositions, applications etc.
c. Prepare database of different non ferrous alloys with their mechanical properties, compositions, applications etc.
d. Prepare industrial survey report of languages/ software used for metallurgical applications.
e. Collect technical specifications of image analyzers/ software/ computerized Hardness testers/ UTM/ furnaces etc.
f. Prepare visit report on Testing laboratory/ Heat treatment shop/ Foundry.
g. Prepare detailed report on the working operation and controls of a particular computerized furnace (melting/heat treatment).

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of Publication, ISBN Number
1	Let us C	Yashavant Kanetkar,	BPB Publications, 9789387284494
2	ASM Handbook Volume 9: Metallography and Microstructures	--	ASM International, 9780871707062

13. SOFTWARE/LEARNING WEBSITES

1. https://nptel.ac.in/courses/106/104/106104128/
2. https://nptel.ac.in/courses/106/105/106105175/
3. https://nptel.ac.in/courses/106/106/106106093/

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	3	3	1	1	2	3
CO2	1	3	3	1	1	2	3
CO3	2	3	2	3	2	2	2
CO4	2	3	2	3	2	2	2
CO5	2	3	2	3	2	2	2
CO6	2	3	3	2	3	3	3

	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	3
CO2	2	1	1	3
CO3	3	3	2	3
CO4	3	3	2	3
CO5	3	3	2	3
CO6	3	2	1	3

Sign: Name: Shri. A.V.Mehtre (Course Expert)	Sign: Name: Smt. N.S.Kadam (Head of Department)
Sign: Name: Smt. N. S. Kadam (Program Head) Department of Metallurgical Engineering	Sign: Name: Shri. A. S. Zanpure (CDC In charge)

Government Polytechnic, Pune

Department of Metallurgical Engineering

180 OB Curriculum

Level-5B: Diversified Courses

(Any Two)

Sr. No.	Course Code	Course Name
1	MT5105	Advanced Physical Metallurgy
2	MT5106	Modern Foundry Engineering
3	MT5107	Corrosion & Surface Protection
4	MT5108	Non Metallic Materials

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme Code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19**/21/22/23/24/26
Name of Course	**Advanced Physical Metallurgy**
Course Code	**MT5105**
Prerequisite course code and name	**MT4108- Heat Treatment of Metals and Alloys**
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

<table>
<tr><th colspan="3">Teaching Scheme (In Hours)</th><th>Total Credits (L+T+P)</th><th rowspan="2"></th><th colspan="5">Examination Scheme</th></tr>
<tr><th colspan="3"></th><th></th><th colspan="2">Theory</th><th colspan="2">Practical</th><th rowspan="2">Total Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>C</th><th></th><th>ESE</th><th>PA</th><th>$ESE</th><th>PA</th></tr>
<tr><td rowspan="2">04</td><td rowspan="2">00</td><td rowspan="2">04</td><td rowspan="2">08</td><td>Marks</td><td>80</td><td>20</td><td>25</td><td>25</td><td>150</td></tr>
<tr><td>Exam Duration</td><td>3 Hrs</td><td>1 Hr</td><td>--</td><td>--</td><td></td></tr>
</table>

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

Metallurgical engineers often have to work in heat treatment shops or in design department to select a suitable material for required working condition. This subject deals with relationship between properties and selection of materials for such properties. This requires detailed knowledge of Physical Metallurgy, so this course will be suitable to specialize in study of material properties and their applications.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Select suitable alloy steel as per the required properties and applications.**

4. COURSE OUTCOMES (COs)

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 above mentioned competency**:**

1. Enlist and explain various methods of X-ray diffraction.
2. Correlate the effects of alloying elements on the properties and microstructures of steels.
3. Select suitable alloy steel for particular application (electrical, magnetic, machinability and wear resistance).
4. Select suitable stainless and tool steel for given application.
5. Explain the diffusion mechanism with examples.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Relevant CO**	**Approximate Hours Required.**
1.	1	Study of X-ray diffraction and Bragg's law.	1	04
2.	1	Study of Electron microscope.	1	04
3.	2	Study of alloying elements in steels.	2	04
4.	2	Study the effect of alloying elements on steels.	2	04
5.	3	Determination of electrical conductivity of metals using Ohmmeter.	3	04
6.	3	Study of machinability.	3	04
7.	3	Determination of wear-resistance of metal.	3	04
8.	4	Determination of creep and study of creep curve.	4	04
9.	4	Study of stainless steels.	4	04
10.	4	Metallography of stainless steels.	4	08
11.	5	Study of Tool steels.	4	04
12.	5	Metallography of tool steels.	4	08
13.	6	Study of Fick's first law and mechanisms of diffusion.	5	04
14.	All	Complete a micro project based on guidelines provided in Sr. No.11	1 to 5	04
			Total Hrs	**64**

S.No.	**Performance Indicators**	**Weightage in %**
a.	Arrangement of available equipment / test rig or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
	Total	**100**

6. MAJOR EQUIPMENT/INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned.

Sr.No.	Major Equipment/Instruments Required	Experiment Sr. No.
1	Charts showing X-ray production method, Bragg's law and construction of Electron microscope	1,2
2	Metallurgical microscope	2,10,12,14
3	Charts of Fe-C equilibrium diagram and TTT diagram of standard steels.	3,4
4	Ohmmeter	5
5	Wear testing machine	7,14
6	Creep testing machine	8,14
7	Samples of standard stainless steels for metallography	10,14
8	Samples of standard tool steels for metallography	12,14

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Section I	
Unit I. X-Ray Diffraction (08 hrs, 08 marks)	
1a. State the principle of production, properties and applications of X-rays. 1b. Explain Bragg's law of X-ray diffraction. 1c. Explain different X-ray diffraction methods: Lauve method, rotating crystal method and powder method for calculation of lattice parameter. 1d. Explain the principle and working of Electron microscope. 1e. Differentiate between Electron and Optical microscope.	1.1 X-rays: Principle of production, their properties and applications. 1.2 Bragg’s law of X-ray diffraction. 1.2 X-ray diffraction methods: Lauve method, rotating crystal method, powder method, calculation of lattice parameter. 1.3 Introduction to Electron microscope, differentiate between Electron and Optical microscope.
Unit II. Alloy Steels (12 hrs, 16 marks)	
2a. Describe classification of alloying elements. 2b. State the roles of different alloying elements in steel. 2c. Describe the effect of alloying elements on various parameters of steels. 2d. Explain different engineering alloy steels and other alloys w.r.t. their properties, compositions and applications.	2.1 Classification of alloying elements: (a) Austenite and Ferrite stabilizers, (b) Carbide forming, graphitizing, neutral elements. 2.2 Role of different alloying elements in steel. 2.3 Effect of alloying elements on Iron-Carbon equilibrium diagram. 2.4 Effect of alloying elements on T.T.T. diagram of steels. 2.5 Effect on the grain growth, corrosion resistance and mechanical properties of steels.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	2.6 Properties, compositions and applications of some engineering alloy steels and other alloys like- Free cutting, maraging, dual phase steels, high temperature alloys, low expansion alloys, alloys for heating elements. 2.7 Introduction to micro alloyed steels.
Unit III. Physical Properties & Selection of Materials for Various Applications (12 hrs, 16 marks)	
3a. Explain different electrical and magnetic properties. 3b. Suggest suitable materials for electrical and magnetic applications. 3c. State concept of machinability. 3d. Explain determination of machinability index of various metals and alloys. 3e. Define wear. 3f. Explain different types of wear. 3g. Suggest suitable materials for higher wear resistance.	3.1 Electrical properties: Conductivity and resistivity, selection of materials for electrical applications. 3.2 Magnetic properties: Ferromagnetism, paramagnetism and diamagnetism, selection of materials for magnetic applications. 3.3 Machinability: concept of machinability, measurement of machinability, machinability index of various metals and alloys. 3.4 Wear resistance, types of wear: Adhesive, abrasive, erosion, dry, lubricated. Selection of materials for higher wear resistance.
Section II	
Unit IV. High Temperature Properties, Corrosion Resistance & Stainless Steels (10 hrs, 16 marks)	
4a. Explain the process of creep. 4b. Suggest suitable materials for high temperature applications. 4c. Explain the role of Cr in stainless steels. 4e. Explain different stainless steels w.r.t. their properties, compositions and applications. 4f. Explain carbide precipitation and stabilization treatment of stainless steels.	4.1 High temperature properties. Creep, creep resistant steels, super alloys, selection of materials for use at elevated temperatures. 4.2 Chromium steels, role of chromium in stainless steels. 4.3 Classification of stainless steels, properties, compositions and applications of different stainless steels. 4.4 Duplex stainless steels 4.5 Carbide precipitation in stainless steels, stabilization treatment.
Unit V. Tools Steels (10 hrs, 12 marks)	
5a. Describe different types of tool steels w.r.t. their properties, compositions and applications. 5b. Explain heat treatment cycles of different tool steels. 5c. Explain spring steels with properties, compositions, and heat treatments. 5d. Describe PVD and CVD process with their parameters, stages, applications, advantages and limitations.	5.1 Tools steels, classification of tool steels, properties, compositions and applications of different tool steels. 5.2 Heat treatments of different tool steels: cold and hot working dies, cutting tools. 5.3 Spring steels: Properties, compositions, and heat treatments. 5.4 Introduction to PVD and CVD: Process, parameters, stages, applications, advantages and limitations.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit VI. Diffusion in Metals (06 hrs, 08 marks)	
6a. State the conditions required for diffusion. 6b. Describe different mechanisms of diffusion. 6c. Explain the process of growth of oxide layer in metals. 6d. Explain the variables that affect diffusion during carburizing process.	6.1 Diffusion, conditions required for diffusion, mechanisms of diffusion: Vacancy, interstitial, interstitialcy and ring. 6.2 Fick's first law. 6.3 Growth of oxide layer in metals. 6.4 Carburizing- variables that influence diffusion; temperature, concentration, crystal structure, impurities, grain size.
Unit VII. Study of Phase Transformation (06 hrs, 04 marks)	
7a. Explain the process of nucleation and growth. 7b. Explain order- disorder changes in alloys. 7c. Explain the principle of precipitation hardening solution treatment, aging treatment.	7.1 Nucleation and growth consideration, order-disorder changes. 7.2 Precipitation hardening solution treatment, aging treatment.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
Section I						
I	X-Ray Diffraction	08	04	02	02	08
II	Alloy Steels	12	08	04	04	16
III	Physical Properties & Selection of Materials for Various Applications	12	08	04	04	16
	Total	32	20	10	10	40
Section II						
IV	High Temperature Properties, Corrosion Resistance & Stainless Steels	10	08	04	04	16
V	Tools Steels	10	08	02	02	12
VI	Diffusion in Metals	06	04	02	02	08
VII	Study of Phase Transformation	06	02	02	00	04
	Total	32	22	10	08	40
	Total	**64**	**42**	**20**	**18**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on practical performed in laboratory. Journal consists of write ups, diagrams, observations, required tools, equipment and date of performance with teacher signature.
b. Prepare display boards of X-ray production method, diffraction methods, Bragg's law, construction of Electron microscope, comparison of optical microscope and electron microscope, Fe-C diagram, TTT diagram of various steels etc.
c. Collecting data of various alloy steels, their compositions, microstructures and applications.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Prepare and use power point presentations related to different topics.
f. Use Videos/Flash/Animations to explain various topics and subtopics.
g. Industrial visit of students to heat treatment shop/s.
h. Industrial visit of students to PVD/CVD treatment shop/s.
i. Expert lectures related to topics.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare industrial survey report of alloy steels used for different applications.
b. Prepare visit report on Heat treatment shop.
c. Prepare tabulated summary for various alloy steels with their compositions, properties, heat treatments, applications.
d. Prepare report on working of various PVD/CVD techniques.
e. Prepare report on the effect of a particular heat treatment on the microstructure and properties of given alloy steel.
f. Prepare metallographic specimen of different alloy steels, before and after heat treatments.
g. Prepare display board of XRD patterns of different metals.
h. Prepare detailed cycle of heat treatments for a given steel to achieve the required set of properties and/or applications.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of Publication, ISBN Number
1	Physical Metallurgy Principles	Robert E. Reed-Hill	Affiliated East-West Press , 9788176710459
2	Physical Metallurgy for Engineers	D.S.Clark	CBS Publishers and Distributors, 9789389396485
3	Introduction to Physical Metallurgy	Sydney H. Avner	Tata McGraw Hill Publishing Company Ltd, New Delhi., 9780070024991

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com-http://www.nptelvideos.in/2012/12/principles-of-physical-metallurgy.html
2. Virtual Lab-http://mrmsmtbs-iitk.vlabs.ac.in/creep.html

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	1	1	1	2
CO2	2	3	3	2	2	2	3
CO3	3	2	3	3	3	3	3
CO4	2	3	3	3	3	3	3
CO5	2	1	1	1	2	2	2

	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1
CO2	3	3	3	2
CO3	3	2	3	2
CO4	3	2	3	2
CO5	2	1	1	1

Sign: Name: Shri. A. V. Mehtre (Course Expert)	Sign: Name: Smt. N. S. Kadam (Head of Department)
Sign: Name: Smt. N. S. Kadam (Program Head) Department of Metallurgical Engineering	Sign: Name: Shri. A. S. Zanpure (CDC In charge)

Government Polytechnic Pune

'180OB' – Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme Code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19**/21/22/23/24/26
Name of Course	**Modern Foundry Engineering**
Course Code	**MT5106**
Prerequisite course code and name	**MT4105- Foundry Engineering**
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			**Total Credits (L+T+P)**		**Examination Scheme**				
					Theory		**Practical**		**Total Marks**
L	**T**	**P**	**C**		**ESE**	**PA**	**$ESE**	**PA**	
04	00	04	08	**Marks**	80	20	25	25	150
				Exam Duration	3 Hrs	1 Hr	--	--	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

To enable the Metallurgical engineer with various foundry practices such as ferrous and non-ferrous alloys, which are popularly known as castings. He should also understand the other important aspects of foundry apart from only the production processes. This course aims to make the student familiar with ferrous & non ferrous foundry engineering practices and confident in entering foundry industry to make career.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Ensure production of quality castings of various ferrous and nonferrous alloys.**

4. COURSE OUTCOMES (COs)

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 above mentioned competency**:**

1. Design, Draw and Explain gating system.
2. Choose various fettling and finishing operations over castings.
3. Identify various casting defects and enlist their causes and remedies.
4. Select proper melting practices and mould for ferrous and non-ferrous metals or alloys.
5. Enlist various aspects of foundry mechanization and planning.
6. Draw layout of foundry.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	**Unit No.**	**Practical Exercises** (Outcomes in Psychomotor Domain)	**Relevant CO**	**Approximate Hours Required.**
1.	1	Study of various types of gates.	1	08
2.	2	Study of various types of risers.	1	08
3.	1,2	Case study of design of gating system and riser.	1	08
4.	3	Study of fettling and finishing operations on castings.	2	08
5.	4,5	Study of various casting defects.	3	10
6.	9,10	Prepare casting of Al using crucible melting process.	4	10
7.	10	Drawing a layout for Ferrous and Non-ferrous Foundry.	5,6	08
8.	All	Complete a micro project based on guidelines provided in Sr. No.11	1 to 6	04
			Total Hrs	**64**

S.No.	**Performance Indicators**	**Weightage in %**
a.	Arrangement of available equipment or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specifications mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned.

Sr.No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	Gate models, Riser models, specimen castings or Models	1,2,3
2	Fettling and finishing setup	4
3	NDT setup (DPT and MPT), Microscope etc	5
4	Melting crucible, heating unit (Furnaces), temperature measuring device, Clamp, ladle, Moulding setup etc	6
5	NA	7

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Section I	
Unit- I. Flow of Metals and Gating system (06 hrs, 12 marks)	
1a Explain Bernoulli's thermo/continuity equation. 1b. Explain fluidity and test of fluidity. 1c. Calculate pouring time 1d. Compare pressurize and unpressurized gating ratio 1e. Design gating system dimensions for given castings.	1.1 Laws of fluid dynamics governing the design of gating system. Reynolds Number, Equation of Continuity Bernoulli`s theorem, Fluidity and fluidity test. 1.2 Calculation of pouring time for Ferrous and Non Ferrous alloys. 1.3 Importance and determination of dimensions of passages i.e. gating ratio, Gating system components, Requirements, calculation of gating system for particular or given castings.
Unit- II. Risering of Casting (06 hrs, 07 marks)	
2a. Explain functions of riser. 2b. Enlist and explain various types of risers. 2c. Explain any one method to determine riser. 2d. Draw and explain blind riser. 2e. State role of padding and chills.	2.1 Directional solidification, Necessity of riser, Functions, types of risers, riser shape, size and location. 2.2 Methods to determine riser e.g. Chvorinov's rule, Cain's method; NRL Method., Modulus method, Inscribed circle method etc 2.3 Use of padding, exothermic material, chills.
Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit- III. Fettling, Cleaning and H.T. of Castings (04 hrs, 04 marks)	

3a. Enlist and Explain fettling operations. 3b. Explain necessity of cleaning of castings. 3c. Explain Heat treatment of castings.	3.1 Fettling, cleaning and H.T. of castings
Unit- IV. Casting Inspection (08 hrs, 06 marks)	
4a.Enlist and Explain method of casting inspection. 4b. Compare destructive and non destructive testing of castings 4c. Explain various surface making methods.	4.1 Specifications, ISO, quality aspect, inspection procedure; destructive and non-destructive testing of casting. 4.2 Methods of surface finish measurements.
Unit- V. Casting Defect Analysis (08 hrs, 11 marks)	
5a. Enlist and Explain various casting defects. 5b. Explain dimensional error/compositional error. 5c. Explain causes and remedies for any one casting defects.	5.1 Faults arising in pouring, inclusion and sand defects, gas defect, shrinkage defect and contraction defect- free contraction and hindered contraction. 5.2 Dimensional errors, Compositional errors and segregation.
Section II	
Unit-VI. Melting Practice and Metallurgy of Cast Iron& S.G.Iron (10 hrs, 12 marks)	
6a. Classify cast iron 6b.Explain properties and uses of Grey C I 6c. Compare G C I and W C I. 6d. Explain melt making of cast iron in cupola. 6e. Explain properties and uses of S. G. iron 6f. Explain procedure to produce S.G.Iron. 6g. Explain method to mg treatment on iron melts. 6h. Explain fading effect. 6i. Explain ADI production.	6.1 Classification of C.I., chemical composition, effect on structure and properties. 6.2 Melting practice for Grey C.I and other grade 6.3 Molding practice for Grey C.I. 6.4 Chemical composition, various techniques of S.G. iron production –Sand witch Method, Convertor method and Core wire feeding method, Mg recovery. 6.5 Molding practice for S.G. iron. 6.6 Surface nodulization. 6.7 Austempered Ductile Iron.
Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit-VII. Production of Steel Castings (04 hrs, 06 marks)	

7a. State properties of steel castings 7b. Explain melting of steel. 7c. Enlist and Explain effect of alloying element on steel castings.	7.1 Specific characteristic of steel castings, melting practice, molding practice. 7.2 Alloying practice for steel casting.
Unit- VIII. Foundry Practice for Aluminum Alloys (08 hrs, 12 marks**)**	
8a. Explain procedure to produce quality melts of Al. 8b. Enlist various problems related to Al melt. 8c. Explain Grain refinement and modification of Al-Si alloys. 8d. Explain degassing method of Al melts.	8.1 Production of Al Melt ; Problems associate with melting, molding practice, alloys of Al castings, properties and application of Al casting alloys. 8.2 Grain refinement and Modification of Al-Si alloys. 8.3 Metal Treatment on Al- Degassing, fluxing, vacuum degassing, Ultrasonic treatment
Unit- IX. Production of Cu, Mg & Zn alloy Castings (04 hrs, 06 marks)	
9a. Explain melting practice of copper. 9b. Enlist properties and application of cu castings. 9c. Explain steps in production of Mg or Zn castings.	9.1 Metallurgical factors affecting foundry practice for Cu and Cu base casting alloys, melting furnaces, casting processes. 9.2 Foundry techniques, melting of Mg-alloys, production of Zn and Zn alloy castings.
Unit- X. Foundry Modernization, Mechanization, Lay out of Foundry & Planning (06 hrs, 04 marks)	
10a. Explain advantages of modernization/mechanization and layout of foundry. 10b. Explain advantages of foundry planning.	10.1 Foundry modernization, mechanization and lay out of foundry. 10.2 Introduction to foundry planning, Definition, advantages etc.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
		Section I				
I	Flow of Metals and Gating system	06	04	04	04	12
II	Risering Of Casting	06	03	03	01	07
III	Fettling, Cleaning and H.T. Of Castings	04	01	01	02	04
IV	Casting Inspection	08	01	01	04	06
V	Casting Defect Analysis	08	03	03	05	11
	Total	32	12	12	16	40
		Section II				
VI	Melting Practice and Metallurgy of Cast Iron & S.G.Iron	10	03	03	06	12
VII	Production of Steel Casting	04	01	03	02	06
VIII	Foundry Practice for Aluminum Alloys	08	03	03	06	12
IX	Production of Cu, Mg & Zn alloy Castings	04	02	02	02	06
X	Foundry, Modernization, Mechanization, Layout of Foundry & Planning	06	01	01	02	04
	Total	32	10	12	18	40
	Total	**64**	**22**	**24**	**34**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews

a. Prepare a comparative chart overall specifications of standard gating system and solve certain case studies on designing gating system for given casting dimensions.
b. Survey of meting and molding methods used in manufacturing of castings (metallurgy)
c. Search information about Ratings and specifications of melting furnace, load/ melt size, quality aspect of melt, treatment on melt, molding practice selected, and possible defect with remedial action.
d. Industrial visit to S G Iron casting industries and Cu casting manufactures.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with Foundry plant system and equipment's.
f. Use proper equivalent analogy to explain different concepts in Foundry.
g. Use Flash/Animations/Power point presentation to explain various components, operation and Testing
h. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***
The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain activity chart consisting of individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.
A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare a report on calculation and design of different parts of gating system for given casting.
b. Collect technical information on measurement and setup of fluidity of casting alloys.
c. Prepare tabulated summary for different laws of fluid behavior (liquid flow).
d. Prepare report on calculation / determination of riser dimension, size, number and location.
e. Prepare report on working of NDT method for casting defect identification.
f. Prepare tabulated summary for casting defect analysis and remedial suggestions.
g. Prepare report on properties, composition and uses of different type of C.I.Castings.
h. Prepare report on working of S.G.Iron design of mg treatment ladle.
i. Prepare display board of property enhancement in steel casting through alloying.
j. Prepare report on working of degassing technique of Al melts.
k. Prepare a report of properties & application areas of Cu, Mg and Zn castings.
l. Draw a layout of medium scale ferrous or non ferrous foundry.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of Publication, ISBN Number
1	Metal Casting Principle and Practices	T.V.Ramana Rao	New Age International (P) Ltd. Publishers. ISBN10:8122408435 ISBN13:9788122408430
2	Principles of Foundry Technology	P.L.Jain	Mc Graw-Hill publishing Company ISBN10:0070151296 ISBN13:9780070151291
3	Principle of Metal Castings	Richard W.Heine, Carl R. Loper, Philip C.Rosenthal	Mc Graw-Hill publishing Company ISBN10:0070278962 ISBN13:9780070278967
4	Casting Design Hand Book	--	American Society of Metals. ISBN10:1258327465 ISBN13:9781258327460

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. http://www.capabilitydevelopment.com

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	2	1	2	1
CO2	2	2	2	1	1	1	1
CO3	2	2	1	2	1	2	1
CO4	3	2	2	2	2	1	1
CO5	1	2	2	1	1	2	1
CO6	2	2	2	1	1	1	1

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1
CO2	2	2	2	1
CO3	2	2	2	1
CO4	2	2	1	1
CO5	2	1	1	1
CO6	1	1	1	1

Sign: Name: Shri. P.B. Kamble (Course Expert)	Sign: Name: Smt. N S. Kadam (Head of Department)
Sign: Name: Smt. N. S. Kadam (Program Head) Department of Metallurgical Engineering	Sign: Name: Shri. A. S. Zanpure (CDC In charge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme Code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19**/21/22/23/24/26
Name of Course	**Corrosion & Surface Protection**
Course Code	**MT5107**
Prerequisite course code and name	**NA**
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory		Practical		Total Marks
L	T	P	C		ESE	PA	$ESE	PA	
04	00	04	08	Marks	80	20	25	25	150
				Exam Duration	3 Hrs	1 Hr	--	--	

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

Corrosion is one of the important phenomenon occurring in nature. Corrosion leads to loss of metals & its surface properties. If due care is not taken to prevent corrosion, it lead to failure of components. Therefore it is essential to minimize the process of corrosion if prevention is not possible. It is therefore necessary to understand concepts of corrosion and surface protection methods.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences.

- **Interpret the mechanism of corrosion and select appropriate surface protection method.**

4. COURSE OUTCOMES (COs)

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 above mentioned competency**:**

1. Explain principle of corrosion and factors influencing corrosion.
2. Detect types of corrosion.
3. Select proper corrosion control process.
4. Select appropriate surface preparation process.
5. Select appropriate surface protection method for particular application.
6. Explain the concept of electroplating.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1	1	Determine the corrosion rate of different metals by weight loss method.	1	08
2	2	Prepare a report on mechanism of types of corrosion.	2	08
3	3	A case study of corrosion control.	3	08
4	4	Practical on removal of oxide scale by grinding and pickling	4	04
5	5	Perform hot dip galvanizing.	5	08
6		Measure plating thickness by weight change method of Galvanized Mild Steel.	5	08
7	6	Perform copper plating.	6	08
8		Rectify the defects in Electro-plated components and suggest remedial measures for it.	6	08
9	All	Complete a micro project based on guidelines provided in Sr. No. 11	1 to 6	04
		Total Hrs		**64**

S.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test rig or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	HNO_3, mild steel sheet, weighing machine	1,6
2	Oxidised mild steel sheet, grinder, HCl	4
3	Mild steel sheet, small Zn blocks, melting furnace	5
4	Electrolytic bath, $CuSO_4$, Cu sample, mild steel sheet	7

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Section I	
Unit I Corrosion (08 hrs, 10 marks)	
1a. Define Corrosion. 1b. State the use of electrochemical series and galvanic series. 1c. Compare galvanic series with electrochemical series. 1d. State Growth Laws. 1e. State the factors influencing corrosion.	1.1 Introduction, Definition 1.2 Electrochemical Series, its advantages and limitations & applications 1.3 Galvanic Series, its advantages, limitations and applications 1.4 Growth Laws 1.5 Factors influencing corrosion.
Unit II Types of Corrosion (16 hrs, 20 marks)	
2a. Enlist types of corrosion 2b. Explain the mechanism of dry and wet corrosion. 2c. Explain hydrogen embrittlement & hydrogen attack 2d. Explain types of corrosion mentioned in the list.	2.1 Dry Corrosion: Types, Oxidation corrosion - Mechanism, Types of films, Pilling-Bedworth rule. 2.2 Wet Corrosion: Mechanism – Hydrogen Evolution and Oxygen Absorption. 2.3 Action of Hydrogen: Hydrogen Embrittlement and Hydrogen Attack. 2.4 Other Types of Corrosion: a) Galvanic Corrosion, b) Concentration Cell Corrosion, c) Atmospheric Corrosion d) Underground Corrosion, e) Microbiological Corrosion f) Stress Corrosion, g) Season Cracking, h) Erosion corrosion i) Pitting Corrosion, j) Intergranular Corrosion
Unit III Corrosion Control (08 hrs, 10 marks)	
3a. State importance of proper selection of materials, proper design and fabrication procedure to control corrosion 3b. Illustrate various design for components to prevent from corrosion 3c. Define passivity 3d. State the uses of inhibitors for corrosion control 3e. Explain cathodic protection.	3.1 Proper selection of materials, Proper design and fabrication procedure. 3.2 Passivity 3.3 Protection by Inhibitors : Anodic and Cathodic Inhibitors 3.4 Cathodic protection

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Section II	
Unit IV Surface Preparation (08 hrs, 10 marks)	
4a. State necessity of surface preparation 4b. Describe various surface preparation methods. 4c. Enlist the factors for selection of proper cleaning methods	4.1 Necessity of surface preparation. 4.2 Types of surface preparation methods: Mechanical, chemical & electrochemical methods. a) Mechanical methods - Grinding, Polishing, Brushing, Buffing. b) Chemical methods - Degreasing, Detergent cleaning, Acid and Alkali cleaning. c) Electrolytic cleaning and ultrasonic cleaning. 4.3 Factors for selection of proper cleaning methods.
Unit V Surface Protection Methods (16 hrs, 18 marks)	
5a. State the role of pretreatments before surface coating 5b. Explain various metallic coatings with neat sketch. 5c. Compare Galvanizing with Tinning 5d. Describe non-metallic coating. 5e. Describe various chemical conversion coatings. 5f. Describe salt spray test.	5.1 Pretreatment before surface coating 5.2 Metallic coating : Hot Dipping : a) Galvanizing – Principle, Process, Advantages, Limitations, Applications. b) Tinning – Principle, Process, Advantages, Limitations, Applications. Cementation, Metal cladding, Metal spraying, Sputtering. 5.3 Non-metallic coating: Paints – Requisites of a good paint, Constituents of paints. 5.4 Chemical Conversion Coatings – Phosphate coatings, Chromate coatings, Chemical oxide coatings, Anodized coatings. 5.5 Salt spray test.
Unit VI Electroplating (08 hrs, 12 marks)	
6a. Define electroplating 6b. State faraday's law of electrolysis. 6c. Design plant layout for Electroplating 6d. Describe copper, chromium and nickel plating. 6e. Describe hard chrome plating. Describe plating thickness tests. 6f. State causes and remedial measures for defects.	6.1 Principle of electroplating, Faraday's law of electrolysis. 6.2 Electroplating equipments and plant layout, Pretreatments before plating. 6.3 Important platings a) Copper Plating : Bath Composition, Operating Conditions b) Chromium Plating : Bath Composition, Operating Conditions c) Nickel Plating : Bath Composition, Operating Conditions 6.4 Hard Chrome Plating 6.5 Plating thickness Tests 6.6 Defects in Plating : Causes and Remedies

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
Section I						
I	Corrosion	08	04	06	00	10
II	Types of Corrosion	16	04	12	04	20
III	Corrosion Control	08	02	04	04	10
	Total	32	10	22	08	40
Section II						
IV	Surface Preparation	08	00	04	06	10
V	Surface Protection Methods	16	02	06	10	18
VI	Electroplating	08	02	04	06	12
	Total	32	04	14	22	40
	Total	**64**	**14**	**36**	**30**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course. Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on practical performed in laboratory. Journal consists of write ups, diagrams, observations, required tools, equipment and date of performance with teacher signature.
b. Prepare a report on electrochemical series and galvanic series.
c. Power Point Presentation on various corrosion control methods by group of two/three students. (Duration:10 minutes)
d. Draw the plant layout of Hot Dip Galvanizing. Describe in detail about each tank.
e. Prepare a report on electroplating defects. State its causes and suggest suitable remedies.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.

d. Guide student(s) in undertaking micro-projects.
e. Prepare and use power point presentation related to different topics.
f. Use videos to explain different concepts.
g. Expert lectures related to topics.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Study of different types of corrosion in materials.
b. Study on effluents thrown out from metallurgical industries that corrode the surroundings.
c. Defects in hot dip galvanizing parts and critical analysis of that.
d. Study causes and remedies of electroplating defects.
e. Prepare report on statutory requirements (Government Regulations) for environmental control that caused corrosion.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of Publication, ISBN Number
1	Engineering Chemistry	Jain & Jain	Dhanpat Rai Publishing Company, 16 Edition, Reprint -2015 978-93-5216-000-6
2	Material Science and Metallurgy for Engineers	V.D. Kodgire	Everest Publishing House, 43 Edition 2018 9788186314008
3	Corrosion Engineering	Fontana	McGraw Hill, 3 Edition 2005 9780070607446
4	Metals Handbook – Corrosion (ASM Handbook)	--	Ninth Edition, Volume 13 1987 9780871700193

13. SOFTWARE/LEARNING WEBSITES

1. https://nptel.ac.in/courses/113/104/113104082/
2. https://nptel.ac.in/courses/113/104/113104061/
3. https://www.youtube.com/watch?v=q3c-ig5G3bA

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	2	2	3	2	2
CO2	3	3	3	2	2	2	3
CO3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3
CO6	3	2	2	2	2	2	2

	PSO1	PSO2	PSO3	PSO4
CO1	1	--	1	2
CO2	1	2	2	2
CO3	2	1	1	2
CO4	3	1	1	2
CO5	3	1	2	2
CO6	3	1	2	3

Sign: Name: Shri. R.G. Injewar (Course Expert)	Sign: Name: Smt. N.S. Kadam (Head of Department)
Sign: Name: Smt. N. S. Kadam (Program Head) Department of Metallurgical Engineering	Sign: Name: Shri. A. S. Zanpure (CDC In charge)

Government Polytechnic, Pune

'180OB' – Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme Code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19**/21/22/23/24/26
Name of Course	**Non Metallic Materials**
Course Code	**MT5108**
Prerequisite course code and name	**NA**
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

<table>
<tr><th colspan="3" rowspan="2">Teaching Scheme (In Hours)</th><th rowspan="2">Total Credits (L+T+P)</th><th rowspan="2"></th><th colspan="5">Examination Scheme</th></tr>
<tr><th colspan="2">Theory</th><th colspan="2">Practical</th><th>Total Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>C</th><th></th><th>ESE</th><th>PA</th><th>$ESE</th><th>PA</th><td rowspan="3">150</td></tr>
<tr><td rowspan="2">04</td><td rowspan="2">00</td><td rowspan="2">04</td><td rowspan="2">08</td><th>Marks</th><td>80</td><td>20</td><td>25</td><td>25</td></tr>
<tr><th>Exam Duration</th><td>3 Hrs</td><td>1 Hr</td><td>--</td><td>--</td></tr>
</table>

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

The total developments in science and technology depend to a considerable extent on materials technology. The properties and applications of non-metallic materials has been a very important topic in engineering and technology. It is often said that the rate of growth of technology is hindered by the limited availability of materials with the desired properties. The field of non-metallic materials has assured for itself the responsibility to discover and control properties of materials for fundamental research and applications.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Select various non-metallic materials based on properties, structures and application in the engineering field.**

4. COURSE OUTCOMES (COs)

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 above mentioned competency**:**

1. Select the various non-metallic materials used in engineering applications.
2. Know the basic principles necessary for understanding nature and properties of materials.
3. Correlate the relation between structure and properties of materials.
4. Classify types of composites, adhesives, and insulating materials.
5. Interpret characteristics and uses of magnetic materials.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1	1,4	Observe and study structure of silicate.	2,3	04
2	3	Measure the hardness of rubber and plastic using Shore (durometer) hardness tester.	2,3,4	08
3	2,8	Determine impact properties of polymers and composites by Izod impact test.	2,3	08
4	7	To prepare a report on types of lubricants and its properties used in cutting operation.	1,3,4	08
5	8	To measure hardness of composites by Durometers and Micro hardness tester	2,4	08
6	8	To measure density of composites by Archimedes's principle.	1,2	08
7	10	To study the magnetic materials properties and application.	1,3,5	06
8	6	To observe and study various adhesive bond joints.	2,3,4	06
9	9	To study characteristics of insulating materials.	2,3,4	04
10	All	Micro Project - Complete a micro project based on guidelines provided in Sr. No. 11	1 to 5	04
			Total Hrs	**64**

S.No.	Performance Indicators	Weightage in %
a.	Drawing of Sketches/Diagrams	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
	Total	**100**

6. MAJOR EQUIPMENTS / INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	Superficial Rockwell hardness test	2,5
2	Shore (durometer) hardness test	2,5
3	Izod Impact Tester	3
4	Micro hardness Tester	5
5	Digital Weighing Balance	7

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Section I	
Unit – I Structure of Solids (02 hrs, 04 marks)	
1a. Define crystalline structures 1b. Classify different structures 1c. Explain structures of carbon, silica, silicate, glasses	1.1 Crystalline nature. 1.2 Types of structures: Structures of carbon, silica, silicate and glasses.
Unit – II Colloids and Polymers (10 hrs, 12 marks)	
2a. Define Colloids. 2b. Classify types of colloids. 2c. Define Polymer. 2d. Classify types of polymer. 2e. Describe mechanism of polymerization. 2f. State properties, applications, advantages and disadvantages of specific polymeric materials.	2.1 Define Colloids. 2.2 Classification of colloids, intermediate systems, gels and pastes, clay-water dispersions emulsions. 2.3 Introduction and definition of Polymer, Classification of Polymer on basis of i) Molecular structure ii) monomers ii)Thermal behavior. 2.4 Concept of polymerization - Mechanism of polymerization, formations of polymers, structure of polymers, physical properties and chemical resistance. 2.5 Properties, applications, advantages and disadvantages of specific polymeric materials – poly – ethylene, resins, foamed plastics, wood, natural resins, PVC, acrylic polymers.
Unit – III Rubber (10 hrs, 12 marks)	
3a. State properties of rubbers. 3b. Differentiate between Natural rubber and Synthetic rubber. 3c. Describe fabrication techniques for rubber. 3d. State important application of Natural rubber and Synthetic rubber. 3e. Describe Vulcanization of rubber.	3.1 Rubber -Occurrence and structure, types of rubber. 3.2 Natural rubber and its property. 3.3 Natural rubber:- styrene, butadiene, bectyl rubber, nitrile rubber important applications in the engineering industry. 3.4 Vulcanization of rubber, forming and fabrication techniques for rubber. 3.5 Synthetic rubber, Synthesis, properties and uses of Buna-S Rubber, Buna-N Rubber, Neoprene Rubber. Differentiate between Natural rubber and Synthetic rubber.

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
Unit – IV Glasses (05 hrs, 06 marks)	
4a. Define Glasses. 4b. Describe Glass production methods and processes. 4c. Explain various types of glass.	4.1 Glasses: Definition of glasses, Structure of glasses. 4.2 Glass production methods and processes. 4.3 Silicate structure- composition and properties. 4.4 Important types- Vitreous fused silica-polycrystalline glass, soda lime, lead glass, borosilicate glass, glass ceramics.
Unit – V Ceramics (05 hrs, 06 marks)	
5a. Define Ceramics. 5b. State types, properties and applications of ceramics. 5c. Explain properties of ceramic lubricants.	5.1 Ceramics :Definition, types of ceramics, characteristics and applications. 5.2 Common oxides, clays, porcelain, insulating materials, abrasives carbides, enamels, ceramic lubricants and steatites - Characteristics, advantages and disadvantages and applications.
Section II	
Unit – VI Adhesives (10 hrs, 12 marks)	
6a. Define Adhesive. 6b. State properties of adhesives. 6c. Describe the mechanism of adhesive bonding. 6d. Write important applications of adhesives. 6e. State types of adhesive bonding. 6f. Write advantages and disadvantages of adhesive bonding.	6.1 Adhesive: Definition, characteristics of adhesives. 6.2 Adhesive bonding- mechanism and applications of adhesives. 6.3 Types of adhesives, use of adhesives, adhesive joints, advantages and disadvantages of adhesive bonding.
Unit – VII Lubricants (04 hrs, 06 marks)	
7a. State functions and characteristics of lubricating oil. 7b. Describe theory of lubrication. 7c. Explain various synthetic lubricating oils.	7.1 Lubricants: Definition, types and applications. 7.2 Theory of lubrication. 7.3 Function and characteristics of lubricating oils. 7.3 Organic liquids, synthetic lubricating oils– cutting fluids, lubricating greases, solid lubricants.
Unit – VIII Composite Materials (10 hrs, 12 marks)	
8a. Define Composite Materials. 8b. Describe Manufacturing process – FRP. 8c. Explain various manufacturing methods of advanced composite materials.	8.1 Composite Materials -Definition, Introduction to composite materials, classification of composites. Advantages of Composite Materials and Structures. Applications of Composite materials in the Present world, Mechanical behavior of Composite Materials. 8.2 Manufacturing processes-FRP composite, protective coating on composites. 8.3 Manufacturing of advanced composite materials –

Unit Outcomes (UOs) (in cognitive domain)	**Topics and Sub-topics**
	(a) Contact moulding, mould preparation, spray-up , hand lay-up (b) Compression moulding methods - Matched die moulding, forming methods employing gas pressure, pultrusion, (c) Filament winding.
Unit – IX Insulating Materials (04 hrs, 04 marks)	
9a. Define Insulating materials. 9b. State properties, applications and types of insulating materials. 9c. Write requirements of insulating materials.	9.1 Insulating materials -Definition, properties, applications and types of insulating materials. 9.2 Requirements of insulating materials, thermal, electrical and sound insulating materials.
Unit – X Magnetic Materials (04 hrs, 06 marks)	
10a. State magnetic properties. 10b. Differentiate between soft magnetic materials and hard magnetic materials. 10c. Describe concept of ferromagnetic, paramagnetic, diamagnetic.	10.1 Magnetism in solids. 10.2 Magnetic properties, concepts of ferromagnetic, paramagnetic, diamagnetic properties and materials. 10.3 Ferrites, soft magnetic materials and hard magnetic materials.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	**Unit Title**	**Teaching Hours**	**Distribution of Theory Marks**			
			R Level	**U Level**	**A Level**	**Total Marks**
Section I						
I	Structure of Solids	02	02	02	00	04
II	Colloids and Polymers	10	02	06	04	12
III	Rubber	10	04	06	02	12
IV	Glasses	05	02	02	02	06
V	Ceramics	05	02	02	02	06
	Total	32	12	18	10	40
Section II						
VI	Adhesives	10	02	06	04	12
VII	Lubricants	04	02	02	02	06
VIII	Composite Materials	10	04	04	04	12
IX	Insulating Materials	04	02	00	02	04
X	Magnetic Materials	04	02	02	02	06
	Total	32	12	14	14	40
	Total	**64**	**24**	**32**	**24**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on practical performed in the laboratory and study practicals.
b. Study and make a report on different grades of glasses and its applications.
c. Search, collect information and make a report on different grades of insulating materials used in metallurgical fields / manufacturing of metallurgical equipments.
d. Search and make a report on different grades of magnetic materials used in various industrial applications.
e. Prepare classification chart of various non metallic materials like composites, ceramics, polymers, cermets, ferrites etc.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/subtopics.
b. About ***15-20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with concerned equipments and technology.
f. Use the proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operations, processes.
h. Teacher should ask the students to go through instruction and technical manuals.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. (Affective Domain Outcomes). Each student will have to maintain activity chart consisting of individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Study and prepare a report on applications of Polymer matrix composite, Metal Matrix composite and Ceramic Matrix composite.
b. Prepare case study report on ceramic materials used in metallurgical fields.
c. Study different grades of polymers of industrial significance and compare their mechanical properties based on their application / service requirements.
d. Prepare case study report on manufacturing of nano composite for metallurgical applications.
e. Search, collect information and make a report on different grades of lubricants used in metal working operations.
f. Search, collect information and make a report on types of insulating materials used in the metallurgical industrial equipments.
g. Make a survey and note down any five applications of magnetic materials used in different segments of industries; also mention properties of all the materials.
h. Make a survey on current status of different glass industries in India.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of Publication, ISBN Number
1	Nature And Properties Of Engg. Materials	Zbigniew D. Jastrzebski	Toppan Printing Company, Ltd. Japan. John Wiley & Sons Inc, Published: December 1987 ISBN-13: 9780471849872 ISBN-10: 0471849871
2	Elements of Material Science	Lawerence H. Van Vlack	Addison-Wesley Pub. Co Published: January 1975 ISBN-13: 9780201080735 ISBN-10: 0201080737
3	Advanced Mechanics of Composite Materials and Structures	Vasiliev, Valery V., Morozov, Evgeny V.	Edition: 4 Publisher: Elsevier Published: June 2018 ISBN-13: 9780081022092 ISBN-10: 0081022093
4	Rubber Technology	Morton, M. (Ed.)	Publisher: Springer Published: May 1987 ISBN-13: 9780412539503 ISBN-10: 0412539500

13. SOFTWARE / LEARNING WEBSITES

1. https://www.youtube.com/8Wn0Yacth2E
2. https://nptel.ac.in/courses/112/104/112104221/
3. https://www.youtube.com/watch?v=yiXgYg17N0o
4. https://www.smithers.com/services/events/2019-training-courses/introduction-to-rubber-technology-online
5. http://www.iri.net.in/
6. https://www.youtube.com/watch?v=jSNlmOwpxYg Introduction to Polymers
7. https://www.youtube.com/watch?v=ACPDEy3evqE Basic concepts on Polymers
8. https://nptel.ac.in/courses/103/106/105106205/ Polymers, Concepts, Properties, Uses
9. https://freevideolectures.com/course/4483/nptel-introduction-materials-science-engineering/105
10. https://www.digimat.in/nptel/courses/video/112104229/L01.html Introduction to Composites

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	2	2	1	2	2
CO2	3	1	1	2	3	2	1
CO3	3	2	2	3	2	1	2
CO4	3	1	2	1	1	1	2
CO5	3	2	1	3	2	1	2

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2
CO2	3	1	1	2
CO3	3	3	2	2
CO4	3	1	1	2
CO5	3	3	2	2

Sign: Name: Shri. R. S. Tuljapurkar (Course Expert)	Sign: Name: Smt. N. S. Kadam (Head of Department)
Sign: Name: Smt. N. S. Kadam (Program Head) Department of Metallurgical Engineering	Sign: Name: Shri A. S. Zanpure (CDC In charge)

Government Polytechnic, Pune

Department of Metallurgical Engineering

180 OB Curriculum

Course offered to Diploma in Mechanical Engineering

Sr. No.	Course Code	Course Name
1	MT3108	Mechanical Engineering Materials

Government Polytechnic, Pune

'180 O.B.' – Scheme

Programme	**Diploma in Mechanical Engineering**
Programme Code	01/02/03/**04**/05/06/07/08/15/16/17/**18**/19/21/22/23/**24**/26
Name of Course	**Mechanical Engineering Materials**
Course Code	**MT3108**
Prerequisite course code and name	**SC1106- Applied Chemistry**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			**Total Credits (L+T+P)**		**Examination Scheme**				
					Theory		**Practical**		**Total Marks**
L	**T**	**P**	**C**		**#ESE**	**PA**	**ESE**	**PA**	
02	00	02	04	**Marks**	80	20	--	25	125
				Exam Duration	3 Hrs	1 Hr			

Legends : L- Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

This course in engineering materials is a part of acquiring basic and essential knowledge about materials used in engineering products and industry.

The course is useful for mechanical engineering to understand metallurgical aspects of materials, processes, and related problems encountered in industry. The course deals with classification, properties and application of materials with processes carried on them as well as testing of materials

3. COMPETENCY

This course aims to attend the following industry identified competency through various teaching-learning experiences:

- **Select appropriate materials for relevant Mechanical applications.**

4. COURSE OUTCOMES (C.O.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 C.O.s associated with the competency mentioned above**:**

1. Identify properties of different materials.
2. Select proper ferrous alloy materials, nonferrous alloys, or Nonmetallicmaterials for various mechanical components.
3. Select relevant heat treatment processes to obtain desired structure and properties.
4. Perform destructive and non-destructive testing for the given material.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	**Practical Exercises** (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1.	1	Measurement of mechanical properties such as the strength of any one ferrous alloy and nonferrous alloy using UTM.	1,4	04
2	2	Study of Iron carbon diagram of steel and cast iron	2,3	02
3		Assignment on Special Cutting Tool Materials – Diamond, Stelites& Tungsten Carbide tool steel of	2,3	02
4	3	Preparation and Examine the microstructure of steels and cast iron	2,3	04
5		Basic Heat treatment of steel and cast iron	2,3	04
6	4	Preparation and Examine the microstructure copper, aluminum alloys, bearing materials.	2	04
7	5	Assignment on other materials such as polymers, composites, Insulating, Ceramics etc.	2	02
8	6	Perform any one Non-Destructive Testing of given sample	5	04
9		Use relevant hardness tester to determine the hardness of given sample	5	02
10	All	Complete a micro project based on guidelines provided in Sr. No. 11	1 to 5	04
		Total Hrs		**32**

Sr.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment/test rig or model, Performing task, Following safety measures	50
b.	Observations, Interpretation and conclusion	30
c.	Answer to sample questions and submission in time	20
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specifications mentioned here will usher in uniformity in the conduct of practical and aid to procure equipment by authorities concerned.

Sr.No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	$Fe-Fe_3c$ Phase diagram chart, Metallurgical Microscope and sample	2
2	Muffle Furnace. Sample, hardness tester and Metallurgical microscope, sample	3,4
3	Metallurgical microscope, microstructure set of nonferrous metals	5
4	NDT Setup level 1; UTM, Hardness tester	6

7. THEORY COMPONENTS

Unit Outcomes (U.O.s) (in the cognitive domain)	Topics and Sub-topics
Unit-I Classification and Properties of Materials (04 Hrs, 10 marks)	
1a. Compare /Classify the materials 1b. Understand Mechanical and Electrical properties 1c. Explain Metallic crystal structure 1d. Explain allotropy and advantages to be allotropic. 1e. Explain solid solution as strengthening mechanism.	1.1 **Classification of material:** Metals, non-metals, ceramics and glasses, polymers, composites and semiconductors (example and application) 1.2 **Mechanical properties:** Strength, elasticity, ductility, malleability, plasticity, toughness, hardness, hardenability, brittleness, fatigue, thermal conductivity, electrical conductivity, thermal coefficient of linear expansion 1.3 **Bonding in metals:** Metallic bond crystal structures (BCC, FCC and HCP) and allotropy of metals. 1.4 **Solid solution:** types and their condition.
Unit-II Ferrous Metal (10 Hrs, 24 marks)	
2a. Draw, explain and compare Fe-Fe3c Phase diagram of steel and cast iron 2b. Explain and compare Alloy steel. 2c. Explain the effect of alloying element 2d. Explain properties and composition of tool steels 2e. Classify various cast iron 2f. Explain the properties of various grades of cast iron.	2.1 Characteristics and application of ferrous metals Phase equilibrium diagram for Iron and Iron Carbide 2.2 **Alloy Steels:** - Low alloy steel, high alloy steel, tools steel & stainless steel. Effect of various alloying elements such as – Chromium, nickel, manganese, molybdenum, tungsten, vanadium. 2.3 **Tool Steels:** - High-speed Steels (HSS), Hot & cold Working dies etc., properties & applications. 2.4 **Cast iron types:** White GCI, F.G., S.G., Malleable Alloy CI, Concept of castability& suitable production methods.
Unit-III Heat Treatment Process (04 Hrs, 12 marks)	

Unit Outcomes (U.O.s) (in the cognitive domain)	**Topics and Sub-topics**
3a. Explain the basic Heat treatments with advantages. 3b. Explain the advantages of tempering 3c. Explain surface hardening treatment with advantages. 3d. Compare nitriding with carburizing	3.1 **Heat treatment-**Introduction to Heat treatment processes such as Annealing, subcritical annealing, Normalizing, Hardening, Tempering (Austempering & Martempering) - Principle, Advantages, limitations and applications. 3.2 **Surface Hardening** - Methods of surface hardening, i) case hardening ii) Flame Hardening, iii) Induction Hardening, iv) Nitriding, v) Carburizing - Principle, advantages, limitations and applications, of Heat Treatments
Unit-IV Non-Ferrous Metals and Alloys (04 Hrs, 12 marks)	
4a. Differentiate between properties, application and composition of various nonferrous alloys. 4b. Explain heat treatment of aluminum alloys	4.1 **Properties, applications & chemical compositions** Properties, applications & chemical compositions of Copper alloys (naval brass, muntz metal, Gun metal & bronzes), Aluminum alloys (Y-alloy & duralumin) & bearing materials like white metals, leaded bronzes & copper lead alloys. 4.2 Heat treatment of Aluminum alloys
Unit-V Other Engineering Materials (06 Hrs, 12 marks)	
5a. Explain properties, advantages and uses of various polymeric materials, 5b. Explain types and properties of ceramic materials, 5c. Explain insulating materials. 5d. Explain composites	5.1 **Polymeric Materials** – Introduction to Polymers-types of polymer, Introduction, characteristics, properties and application of Thermoplastic, Thermosetting plastic, and Rubber. 5.2 **Properties and applications of following Engineering Materials** – Ceramics, Abrasive, Adhesive and Insulating materials such as Cork, Asbestos, Thermocole and Glass Wool 5.3 **Composites:**Fibre-reinforced plastics, Metal-Metrix composites, Nano-materials
Unit-VI Testing Inspection and Examination of Materials (04 Hrs, 10 marks)	
6a. Compare NDT and D.T. 6b. Explain Dye Penetrant test principle, working and applications 6c. Explain any one D.T.	6.1 **Non Destructive Testing**: Advantages of NDT, Dye penetrant test (DPT), Magnetic particle test (MPT), eddy current test, Ultrasonic, X-ray. Inspection: Visual, optical. 6.2 **Destructive Testing:** On UTM, Hardness

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Classification & properties of materials	04	2	4	4	10
II	Ferrous Metal	10	4	8	12	24
III	Heat Treatment Process	04	2	4	6	12
IV	Non Ferrous Metals and Alloys	04	2	4	6	12
V	Other Engineering Materials	06	2	4	6	12
VI	Testing, Inspection and Examination of materials	04	2	4	4	10
Total		**32**	**14**	**28**	**38**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, the following are the suggested student-related ***co-curricular*** activities that can be undertaken to accelerate the attainment of the various outcomes in this course:

Students should conduct the following activities in groups and prepare reports of about five pages for each activity, also collect/record physical evidence for their (student's) portfolio, which will be helpful in their placement interviews:

a. Prepare a comparative chart of overall specifications of materials of the same class
b. Survey of materials used in automobiles/ mechanical machines.
c. Search information about ASTM specifications of NDT or D.T. test.
d. Prepare posters to illustrate the microstructure of steels or nonferrous alloys.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics***that are relatively simpler or descriptive are to be given to the students for ***self-directed learning*** and assess the development of the C.O.s through classroom presentations (see implementation guideline for details).
c. For items No.3&6, teachers need to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Use Flash/Animations to explain various components, operations and
f. Teachers should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to them. In the first four semesters, the micro-project is group-based. However, in the fifth and sixth semesters, it should preferably be individually undertaken to build up the skill and confidence in every student to become a problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three***.

The micro-project could be industry application-based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more C.O.s that integratePrOs, U.O.s and ADOs (Affective Domain Outcomes). Each student will have to maintain a dated work diary of individual contributions to the project work and give a seminar presentation before submission. The student should submit a micro-project by the end of the semester to develop the industry-oriented C.O.s.

A suggestive list of micro-projects is given here. The concerned faculty could add similar micro-projects:

a. Comparative study: Comparative study of various materials used in previous and current generation components of mechanical engineering equipment like I.C. Engine, Compressor, turbine, pumps, refrigerator, water cooler, Lathe Machine, Milling Machine, Drilling Machine grinding machine (anyone) with proper justifications.
b. Experimentation: Determine the hardness of different metallic components (min. five), compare hardness, and plot a bar chart indicating the hardest and soft material in the given group.
c. Experimentation: Determine the microstructure of different metallic components (min. five) using a Metallurgical microscope and compare their microstructure among the group.
d. Collection: Collect a sample of various types of plastics, ceramics, composites used in day to day applications and prepare a chart containing properties applications of the samples.
e. Collect information related to Types, Properties and applications of smart materials from websites. Present the information in the form of a Chart.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author	Publisher, Edition and Year of publication, ISBN Number
1	Material Science And Metallurgy	O.P. Khanna	DhanpatRai& Sons, Delhi ISBN-13:9789383182459 ISBN-10:9383182458
2	Material Science And Metallurgy	Dr. Kodgire	Everest Publishing House ISBN-13:9788186314008
3	Material Science And Engineering	R.K. Rajput	S.K. Kataria and Sons ISBN-13:9788185749686 ISBN-10:818574968X
4	Engineering Materials Properties And Selection	Kenneth G.	Budinski And Micheal K. Budinski Prentice Hall of India Pvt. Ltd. ISBN-13:9780137128426 ISBN-10:0137128428
5	Material Science And Processes	S.K. HazraChaudhary	Indian Book Distribution Company ISBN-9780906216002
6	Engineering Materials	C.P. Sharma	Prentice-Hall of India Pvt. Ltd. ISBN-978-81-203-2448-0

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. http://www.capabiltydevelopment.org

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	-	1	1	2
CO2	3	2	3	-	2	2	2
CO3	3	3	3	1	-	2	2
CO4	3	3	1	3	2	2	3

	PSO1	PSO2
CO1	1	-
CO2	1	1
CO3	-	2
CO4	1	3

Sign: Name: Shri. P. B. Kamble Smt. V. G. Talkit (Course Experts)	Sign: Name: Smt. Namita S. Kadam (Head of Metallurgy Department)
Sign: Name: Smt. N. S. Kadam (Program Head) Department of Metallurgical Engineering	Sign: Name: Shri. A. S. Zanpure (CDC In charge)

GOVERNMENT POLYTECHNIC PUNE

Metallurgical Engineering Department

Equivalence of courses from 180 (S) credit scheme with 180 (OB) credit scheme

180 (S) Curriculum - Path GS1, GS2, PS1, PS2 | 180 (OB) Curriculum - Path GOB1, POB1

Level I - Foundation Level Courses

Course Code	Course Name	Pre-Requisite	Compulsory/ Optional	Teaching Scheme L	P	T	C	Examination Scheme PA	TH	TW	OR	PR	T.M.	Course Code	Course Name	Pre-Requisite	Compulsory/ Optional	Teaching Scheme L	P	T	C	Examination Scheme Theory ESE	Theory PA	Practical ESE	Practical PA	T.M.	Equivalance Yes/ No
HU181	English	--	Compulsory	2	2	0	4	20	80	25	0	0	125	HU1101	Communication Skills I	--	Compulsory	2	0	1	3	40	10	25	25	100	NO
HU182	Communication Skill	--	Compulsory	2	2	0	4	20	80	0	25	0	125	HU1102	Communication Skills II	--	Compulsory	2	0	1	3	40	10	0	50	100	NO
SC181	Applied Maths I	--	Compulsory	3	0	1	4	20	80	0	0	0	100	SC1101	Applied Mathematics I	--	Compulsory	3	0	2	5	80	20	0	25	125	YES
SC182	Applied Maths II	--	Compulsory	3	0	1	4	20	80	0	0	0	100	SC1102	Applied Mathematics II	--	Compulsory	3	0	2	5	80	20	0	25	125	NO
SC183	Engineering Physics	--	Compulsory	3	2	0	5	20	80	0	0	50	150	SC1103	Applied Physics	--	Compulsory	3	2	0	5	80	20	25	25	150	YES
SC184	Engineering Chemistry	--	Compulsory	3	2	0	5	20	80	0	0	50	150	SC1106	Applied Chemistry	--	Compulsory	3	2	0	5	80	20	25	25	150	YES
6			TOTAL	16	8	2	26	120	480	25	25	100	750	6			TOTAL	16	4	6	26	400	100	75	175	750	

Level - II A Core Technology Courses

Course Code	Course Name	Pre-Requisite	Compulsory/ Optional	Teaching Scheme L	P	T	C	Examination Scheme PA	TH	TW	OR	PR	T.M.	Course Code	Course Name	Pre-Requisite	Compulsory/ Optional	Teaching Scheme L	P	T	C	Examination Scheme Theory ESE	Theory PA	Practical ESE	Practical PA	T.M.	Equivalance Yes/ No
AM281	Engineering Mechanics	--	Compulsory	4	2	0	6	20	80	25	0	0	125	AM2101	Engineering Mechanics	--	Compulsory	4	2	0	6	80	20	0	25	125	YES
CM286	Computer Fundamentals	--	Compulsory	1	2	0	3	0	0	25	0	50	75	CM2102	Fundamentals of Information & Computer Technology	--	Compulsory	1	2	0	3	0	0	25	25	50	NO
EE282	Electrical Technology	--	Compulsory	3	2	0	5	20	80	25	0	0	125	EE2102	Electrical Technology	--	Compulsory	3	2	0	5	80	20	0	25	125	YES
SC283	Advanced Physics	--	Compulsory	3	2	0	5	20	80	25	0	0	125	SC2106	Advanced Physics	--	Compulsory	2	2	0	4	80	20	0	25	125	YES
ET285	Elements of Electronics Engineering	--	Compulsory GS1 & PS1 Path	3	2	0	5	20	80	25	0	0	125	ET2106	Principles of Electronics	--	Compulsory	3	2	0	5	80	20	0	25	125	YES
ET287	Basic Electronics	--	GS2 & PS2 Path	3	2	0	5	20	80	25	0	0	125	ET2106	Principles of Electronics	--	Compulsory	3	2	0	5	80	20	0	25	125	YES
ME281	Engineering Graphics	--	Compulsory	2	4	0	6	20	80	25	0	0	125	ME2103	Engineering Drawing	--	Compulsory	2	4	0	6	80	20	0	25	125	YES
ME286	Elements of Mechanical Engineering	--	Compulsory	3	2	0	5	20	80	25	0	0	125	ME2106	Elements of Mechanical Engineering	--	Compulsory	3	2	0	5	80	20	0	25	125	YES
WS281	Workshop Practice	--	Compulsory	0	4	0	4	0	0	50	0	0	50	WS2101	Workshop Practice	--	Compulsory	0	4	0	4	0	0	0	50	50	YES
8			TOTAL	19	20	0	39	120	480	225	0	50	875	8			TOTAL	21	22	0	43	560	140	25	250	850	

Level - II B Core Technology Courses (Any One)

Course Code	Course Name	Pre-Requisite	Compulsory/ Optional	L	P	T	C	PA	TH	TW	OR	PR	T.M.	Course Code	Course Name	Pre-Requisite	Compulsory/ Optional	L	P	T	C	Theory ESE	Theory PA	Practical ESE	Practical PA	T.M.	Equivalance Yes/ No
SC281	Applied Maths III	--	Optional	2	--	1	3	20	80	--	--	--	100	SC2101	Applied Mathematics III	SC1102	Optional	3	0	1	4	80	20	0	25	125	NO
MT281	Furnace Technology	--	Optional	3	--	--	3	20	80	--	--	--	100	MT2101	Furnace Technology	--	Optional	3	1	0	4	80	20	0	25	125	YES
1			TOTAL	2	0	1	3	20	80	0	0	0	100	1			TOTAL	3	0	1	4	80	20	0	25	125	

Level III – Basic Technology Courses (All Compulsory)														Level III – Basic Technology Courses (All Compulsory)													
Course Code	Course Name	Pre-Requisite	Compulsory/ Optional	Teaching Scheme				Examination Scheme						Course Code	Course Name	Pre-Requisite	Compulsory/ Optional	Teaching Scheme				Examination Scheme					Equivalance Yes/ No
																						Theory		Practical			
				L	P	T	C	PA	TH	TW	OR	PR	T.M.					L	P	T	C	ESE	PA	ESE	PA	T.M.	
MT381	Mini Project	--	Compulsory	0	2	0	2	0	0	25	25	0	50	NIL													NO
MT382	Basic Metallurgy	--	Compulsory	4	4	0	8	20	80	25	50	0	175	MT3101	Basic Metallurgy	--	Compulsory	3	2	0	5	80	20	50	50	200	YES
MT383	Material Testing & Quality Assurance	--	Compulsory	4	4	0	8	20	80	25	0	50	175	MT3102	Material Testing & Quality Assurance	--	Compulsory	3	4	0	7	80	20	50	25	175	YES
MT384	Metallurgical Analysis	--	Compulsory	4	4	0	8	20	80	25	0	50	175	MT3103	Metallurgical Analysis	--	Compulsory	2	2	0	4	40	10	50	50	150	NO
MT385	Extraction of Ferrous Metals	--	Compulsory	4	0	0	4	20	80	0	50	0	150	MT3104	Iron Making	--	Compulsory	3	0	0	3	80	20	0	0	100	NO
														MT3105	Steel Making	--	Compulsory	3	0	0	3	80	20	0	0	100	NO
MT386	Extraction of Non Ferrous Metals	--	Compulsory	4	0	0	4	20	80	0	50	0	150	MT3106	Extraction of Non Ferrous Metals	--	Compulsory	3	0	0	3	80	20	0	0	100	YES
6			TOTAL	20	12	0	32	100	400	75	150	100	825	6			TOTAL	17	8	0	25	440	110	150	125	825	

Level - IV Applied Technology Courses, Group IV - A (Any Two)														Level - IV Applied Technology Courses, Group IV - A (Any Two)													
Course Code	Course Name	Pre-Requisite	Compulsory/ Optional	Teaching Scheme				Examination Scheme						Course Code	Course Name	Pre-Requisite	Compulsory/ Optional	Teaching Scheme				Examination Scheme					Equivalance Yes/ No
																						Theory		Practical			
				L	P	T	C	PA	TH	TW	OR	PR	T.M.					L	P	T	C	ESE	PA	ESE	PA	T.M.	
AU481	Environmental Science	--	Compulsory	0	2	0	2	0	0	50	0	0	50	AU4101	Environmental Science	--	Compulsory	0	2	0	2	0	0	0	50	50	YES
AU482	Community Development	--	Optional	2	0	0	2	20	80	0	0	0	100	NIL													NO
AU483	Renewable & Sustainable Energy Management	--	Optional	2	0	0	2	20	80	0	0	0	100	AU4102	Renewable Energy Technologies	--	Optional	2	0	0	2	40	10	0	0	50	YES
AU484	Engineering Economics	--	Optional	2	0	0	2	20	80	0	0	0	100	AU4103	Engineering Economics	--	Optional	2	0	0	2	40	10	0	0	50	YES
NIL														AU4104	Ethical Sources & Sustainibility	--	Optional	2	0	0	2	40	10	0	0	50	NA
NIL														AU4105	Digital Marketing	--	Optional	2	0	0	2	40	10	0	0	50	NA
2			TOTAL	2	2	0	4	20	80	50	0	0	150	2			TOTAL	2	2	0	4	40	10	0	50	100	

Group IV - B (Any One)														Group IV - B (Any Two)													
Course Code	Course Name	Pre-Requisite	Compulsory/ Optional	Teaching Scheme				Examination Scheme						Course Code	Course Name	Pre-Requisite	Compulsory/ Optional	Teaching Scheme				Examination Scheme					Equivalance Yes/ No
																						Theory		Practical			
				L	P	T	C	PA	TH	TW	OR	PR	T.M.					L	P	T	C	ESE	PA	ESE	PA	T.M.	
MA481	Construction Management	--	Optional	3	0	0	3	20	80	0	0	0	100	NIL													NO
MA482	Industrial Organisation & Management	--	Optional	3	0	0	3	20	80	0	0	0	100	MA4102	Industrial Organisation & Management	--	Optional	2	0	0	2	40	10	0	0	50	YES
MA483	Entrepreneurship Development	--	Optional	3	0	0	3	20	80	0	0	0	100	MA4101	Entrepreneurship & Startups	--	Compulsory	2	0	0	2	40	10	0	0	50	YES
MA484	Matereials Management	--	Optional	3	0	0	3	20	80	0	0	0	100	MA4103	Materials Management		Optional	2	0	0	2	40	10	0	0	50	YES
MA485	Supervisory Management	--	Optional	3	0	0	3	20	80	0	0	0	100	NIL													NO
MA486	Total Quality Management	--	Optional	3	0	0	3	20	80	0	0	0	100	NIL													NO
MA487	Management Information System	--	Optional	3	0	0	3	20	80	0	0	0	100	MA4106	Information Management	--	Optional	2	0	0	2	40	10	0	0	50	NO
MA488	Apparel Management	--	Optional	3	0	0	3	20	80	0	0	0	100	NIL													NO
NIL														MA4104	Disaster Management	--	Optional	2	0	0	2	40	10	0	0	50	NA
NIL														MA4105	Introduction to E-Commerce	--	Optional	2	0	0	2	40	10	0	0	50	NA
1			TOTAL	3	0	0	3	20	80	0	0	0	100	2			TOTAL	4	0	0	4	80	20	0	0	100	

Course Code	Course Name	Pre-Requisite	Compulsory/ Optional	Teaching Scheme				Examination Scheme					
				L	P	T	C	PA	TH	TW	OR	PR	T.M.
Group IV - C (All Compulsory)													
NIL													
MT481	Project and Seminar (In-house / Industry)	90 Credits	Compulsory	0	8	0	8	50	0	50	50	0	150
MT482	Elements of Physical Metallurgy	--	Compulsory	4	3	0	7	20	80	0	0	50	150
MT483	Foundry Engineering	--	Compulsory	4	3	0	7	20	80	25	50	0	175
MT484	Powder Metallurgy	--	Compulsory	4	3	0	7	20	80	25	50	0	175
MT485	Metal Working Processes	--	Compulsory	4	3	0	7	20	80	25	50	0	175
MT486	Heat Treatment of Metals & Alloys	--	Compulsory	4	3	0	7	20	80	25	0	50	175
6			TOTAL	20	23	0	43	150	400	150	200	100	1000
Group IV - D (Non Credit Non Exam.)													
NC481	Development of Soft Skills I	--	Optional	0	2	0	2	0	0	25	0	0	25
NC482	Development of Soft Skills II	--	Optional	0	2	0	2	0	0	25	0	0	25
2			TOTAL	0	4	0	4	0	0	50	0	0	50
Level - V Diversified Courses													
Group V - A (Any Two)													
MT581	Metallurgical Drawing & Design	--	Optional	4	3	0	7	20	80	0	50	0	150
MT582	Selection of Materials & Failure Analysis	--	Optional	4	3	0	7	20	80	0	50	0	150
MT583	Welding & Modern Forming Processes	--	Optional	4	3	0	7	20	80	0	50	0	150
MT584	Computer Applications in Metallurgy	--	Optional	4	3	0	7	20	80	0	50	0	150
2			TOTAL	8	6	0	14	40	160	0	100	0	300
Group V - B (Any Two)													
MT585	Advanced Physical Metallurgy	--	Optional	4	3	0	7	20	80	0	50	0	150
MT586	Modern Foundry Engineering	--	Optional	4	3	0	7	20	80	0	50	0	150
MT587	Surface Protection Methods	--	Optional	4	3	0	7	20	80	0	50	0	150
MT588	Non Metallic Materials	--	Optional	4	3	0	7	20	80	0	50	0	150
2			TOTAL	8	6	0	14	40	160	0	100	0	300

Course Code	Course Name	Pre-Requisite	Compulsory/ Optional	Teaching Scheme				Examination Scheme					Equivalance Yes/ No
								Theory		Practical			
				L	P	T	C	ESE	PA	ESE	PA	T.M.	
Group IV - C (All Compulsory)													
MT4101	Industry Inplant Training	Level I & II courses Term granted	Compulsory	0	6	0	6	0	0	50	50	100	NA
MT4102	Project (In-house / Industry)	90 Credits & Level I pass	Compulsory	0	4	0	4	0	0	50	50	100	YES
MT4103	Seminar	90 Credits & Level I pass	Compulsory	0	2	0	2	0	0	25	25	50	YES
MT4104	Elements of Physical Metallurgy	--	Compulsory	4	4	0	8	80	20	50	50	200	YES
MT4105	Foundry Engineering	--	Compulsory	4	4	0	8	80	20	50	25	175	YES
MT4106	Powder Metallurgy	--	Compulsory	3	2	0	5	80	20	50	25	175	YES
MT4107	Metal Working Processes	--	Compulsory	4	2	0	6	80	20	50	25	175	YES
MT4108	Heat Treatment of Metals & Alloys	MT4104	Compulsory	4	4	0	8	80	20	50	25	175	YES
8			TOTAL	19	28	0	47	400	100	375	275	1150	
NIL													NO
NIL													NO
Level - V Diversified Courses													
Group V - A (Any Two)													Equivalance
MT5101	Metallurgical Drawing & Design	--	Optional	4	4	0	8	80	20	25	25	150	YES
MT5102	Selection of Materials & Failure Analysis	--	Optional	4	4	0	8	80	20	25	25	150	YES
MT5103	Metal Joining Processes	--	Optional	4	4	0	8	80	20	25	25	150	YES
MT5104	Computer Applications in Metallurgy	--	Optional	4	4	0	8	80	20	25	25	150	NO
2			TOTAL	8	8	0	16	160	40	50	50	300	
Group V - B (Any Two)													
MT5105	Advanced Physical Metallurgy	MT4108	Optional	4	4	0	8	80	20	25	25	150	YES
MT5106	Modern Foundry Engineering	MT4105	Optional	4	4	0	8	80	20	25	25	150	YES
MT5107	Corrosion & Surface Protection	--	Optional	4	4	0	8	80	20	25	25	150	NO
MT5108	Non Metallic Materials	--	Optional	4	4	0	8	80	20	25	25	150	YES
2			TOTAL	8	8	0	16	160	40	50	50	300	

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