SRI KRISHNA INSTITUTE OF TECHNOLOGY, BENGALURU

COURSE PLAN

Academic Year 2019–20

Program:	B E – MECHANICAL
Semester :	IV
Course Code:	18ME45B
Course Title:	METAL CASTING &WELDING
Credit / L-T-P:	3 / 3-0-0
Total Contact Hours:	40
Course Plan Author:	SAGAR H N

Academic Evaluation and Monitoring Cell

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Prepared by	Checked by	Approved
(Mr. Sagar H N)	(Mr. Shankare Gowda KC)	(Prof. Sreenivasan A)

Table of Contents

Note : Remove “Table of Content” before including in CP Book
Each Course Plan shall be printed and made into a book with cover page
Blooms Level in all sections match with A.2, only if you plan to teach / learn at higher levels

ME

18ME45PC : Metal Casting and Welding

A. COURSE INFORMATION

1. Course Overview

Degree:	BE	Program:	ME
Year / Semester :	2/IV	Academic Year:	2019-20
Course Title:	METAL CASTING AND WELDING	Course Code:	18ME45
Credit / L-T-P:	3/3-0-0	SEE Duration:	03 Hours
Total Contact Hours:	40	SEE Marks:	100 Marks
CIA Marks:	40	Assignment	2 / Module
Course Plan Author:	Mr. SAGAR H N	Sign	Dt:
Checked By:	SHANKAREGOWDA K C	Sign	Dt:

2. Course Content

Module	Module Content	Teaching Hours	Module Concepts	Blooms Level
1	**Introduction & Basic Materials Used In Foundry** **Introduction:** Definition, Classification of manufacturing processes, Metals cast in the foundry-classification, factors that determine the selection of a casting alloy, Introduction to casting process & steps involved. Patterns: Definition,Classification, materials used for pattern, various pattern allowances and their importance **Sand molding:** Types of base sand, requirement of base sand. Binder, Additives definition, need and types **Preparation of sand molds:** Molding machines- Jolt type, squeeze type and Sand slinger,Study of important molding process: Green sand, core sand, dry sand, sweep mold, CO2 mold,Shell mold, Investment mold, plaster mold, cement bonded mold. Cores: Definition, need, types. Method of making cores concept of gating (top, bottom, parting line, horn gate) and risering (open, blind) Functions and types.	10	Sand moldings	L2 understand
2	**Melting & Metal Mold Casting Methods.** **Melting furnaces:** Classification of furnaces Gas fired pit furnace Resistance furnace Coreless induction furnace electric arc furnace Constructional features & working principle of cupola furnace. **Casting using metal molds:** Gravity die casting,pressure die casting, centrifugal casting squeeze casting, slush casting Thixo casting and continuous casting processes.	10	Metal moldings	L2 understand
3	**Solidification & Non Ferrous Foundry Practice.** **Solidification**: Definition, Nucleation, solidification variables Directional solidification-need and methods.	10	Non ferrus metal castings	L2 understand

	Degasification in liquid metals-Sources of gas, degasification methods. **Fettling and cleaning of castings:** Basic steps involved. Sand Casting defects- causes, features and remedies. Advantages & limitations of casting process **Nonferrous foundry practice**: Aluminum castings - Advantages, limitations,Melting of aluminum using lift-out type crucible furnace. Hardeners used, drossing, gas absorption, fluxing and flushing, grain refining, pouring temperature Stir casting set up, procedure, uses, advantages and limitations.			
4	**Welding Process:** Definition, Principles, Classification, Application, Advantages & limitations of welding, Arc welding Arc welding: Principle, Metal arc welding (MAW), Flux Shielded Metal Arc Welding (FSMAW),Inert Gas Welding (TIG & MIG),Submerged Arc Welding (SAW) and Atomic Hydrogen Welding (AHW). **Special type of welding:** Resistance welding principles. Seam welding, Butt welding, Spot welding,Friction welding, Explosive welding, Projection welding, Thermit welding, Laser welding,Electron beam welding.	10	Joining process	L2 underst and
5	**SOLDERING, BRAZING AND METALLURGICAL ASPECTS IN WELDING:** Introduction, Structure of welds, Formation of different zones during welding, Heat Affected Zone (HAZ), Parameters affecting HAZ. Effect of carbon content on structure and properties of steel Shrinkage in welds& Residual stresses, Concept of electrodes, filler rod and fluxes. Welding defects-Detection, causes & remedy. **Soldering, brazing, gas welding:** Soldering, Brazing, Gas Welding Gas Welding: Principle, oxy-Acetylene welding, oxy-hydrogen welding, Air-acetylene welding, Gas cutting, powder cutting. **Inspection methods:** Methods used for inspection of casting and welding Visual, magnetic particle, fluorescent particle, ultrasonic, Radiography, Eddy current, holography methods of inspection.	10	Inspection of casted metals	L2 underst and

3. Course Material

Module	Details	Available
1	"Manufacturing Process-I", Dr.K.Radhakrishna, Sapna Book House,5th Revised Edition 2009.	In Lib
	"Manufacturing & Technology": Foundry Forming and Welding,P.N.Rao, 3rd Ed., Tata McGraw Hill, 2003.	In Lib
2	"Process and Materials of Manufacturing", Roy A Lindberg, 4th Ed.Pearson Edu. 2006.	In Lib
	"Manufacturing Technology", SeropeKalpakjian, Steuen. R. Sechmid,Pearson Education Asia, 5th Ed. 2006.	In Lib
3	Nptel	

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4. Course Prerequisites

SNo	Course Code	Course Name	Module / Topic / Description	Sem	Remarks	Blooms Level
1	17ME14	Elements of Mechanical Engineering	Module -4/Joining Process	I		L2understand

Note: If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.

B. OBE PARAMETERS

1. Course Outcomes

Student able to

#	COs	Teach. Hours	Concept	Instr Method	Assessment Method	Blooms' Lev18ME45A.1
18ME45A.1	Understand the different types of patterns used in sand moldings	10	Patterns	Lecture	Assignment ,IA ,unit test	L2 understand
18ME45A.2	Understand the different metal molding casting process by heat.	10	Metal moldings	Lecture	Assignment ,IA ,unit test	L2 understand
18ME45A.3	To study the state of the metal by solidification process and non ferrous foundry practice.	10	Heat treatment	Lecture & ppt	Assignment ,IA ,unit test	L2 understand
18ME45A.4	Understand the different joining process of metals by welding	10	Joining process	Lecture and ppt	Assignment ,IA ,unit test	L2 understand
18ME45A.5	Understand the inspection methods of welding process.	10	Inspection methods	Lecture and ppt	Assignment ,IA ,unit test	L2 understand
-	**Total**	**50**	-	-	-	-

Note: Identify a max of 2 Concepts per Module. Write 1 CO per concept.

2. Course Applications

SNo	Application Area	CO	Level
1	Used to prepare the sand models like dolls and other objects.	CO1	L2
2	Methods used to manufacture the different sand molding status, gaming objects,etc..	CO1	L2
3	Automotive,aircraft ,railroad electrical spring, tube pipe fitting	CO2	L2
4	In all automobile parts manufacturing,railroad, electrical spring, tube pipe fitting,in all industries	C2	L2
5	Heat treatment are useful to improve the mechanical properties	CO3	L2
6	Welding of auto parts, aero planes,marine,machine parts,statues,etc..	CO4	L2
7	Used to find the accuracy of casted metals,quality control.	CO5	L2

Note: Write 1 or 2 applications per CO.

3. Articulation Matrix

(CO – PO MAPPING)

-	Course Outcomes	Program Outcomes	

ME

#	COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	Level
18ME45A.1	Understand the different types of patterns used in sand moldings	√	-	-	-	-	-	-	-	-	-	-	-	L2
18ME45A.2	Understand the different metal molding casting process by heat.	√	-	-	-	-	-	-	-	-	-	-	-	L2
18ME45A.3	To study the state of the metal by solidification process and non ferrous foundry practice.	√	-	-	-	-	-	-	-	-	-	-	-	L2
18ME45A.4	Understand the different joining process of metals by welding	√	-	-	-	-	-	-	-	-	-	-	-	L2
18ME45A.5	Understand the inspection methods of welding process.	√	-	-	-	-	-	-	-	-	-	-	-	L2
CS501PC.	Average													
Note: Mention the mapping strength as 1, 2, or 3														

3. Mapping And Justification

CO – PO Mapping with mapping Level along with justification for each CO-PO pair.
To attain competency required (as defined in POs) in a specified area and the knowledge & ability required to accomplish it.

Modules	Mapping		Mapping Level	Justification for each CO-PO pair	Level
-	**CO**	**PO**	**-**	**'Area': 'Competency' and 'Knowledge' for specified 'Accomplishment'**	**-**
1	CO1	PO1	2	'Engineering Knowledge:' - Acquisition of Engineering Knowledge of different types of patterns used in sand moldings is essential to accomplish solutions to complex engineering problems in Mechanical Engineering.	L2
2	CO2	PO1	2	'Engineering Knowledge:' - Acquisition of Engineering Knowledge of different metal molding casting process by heat is essential to accomplish solutions to complex engineering problems in Mechanical Engineering.	
3	CO3	PO1	2	'Engineering Knowledge:' - Acquisition of Engineering Knowledge of solidification process is essential to accomplish solutions to complex engineering problems in Mechanical Engineering.	
4	CO4	PO1	2	'Engineering Knowledge:' - Acquisition of Engineering Knowledge of joining process is essential to accomplish solutions to complex engineering problems in Mechanical Engineering.	
5	CO5	PO1	2	'Engineering Knowledge:' - Acquisition of Engineering Knowledge of inspection methods is essential to accomplish solutions to complex engineering problems in Mechanical Engineering.	

Note: Write justification for each CO-PO mapping.

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5. Curricular Gap and Content

SNo	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1					

Note: Write Gap topics from A.4 and add others also.

6. Content Beyond Syllabus

SNo	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1					

Note: Anything not covered above is included here.

C. COURSE ASSESSMENT

1. Course Coverage

Module #	Title	Teaching Hours	No. of question in Exam						CO	Levels
			CIA-1	CIA-2	CIA-3	Asg	Extra Asg	SEE		
1	Introduction & Basic Materials Used In Foundry	10	2	-	-	1	1	2	CO1, CO2	L2
2	Melting & Metal Mold Casting Methods	10	2	-	-	1	1	2	CO3, CO4	L2
3	Solidification & Non Ferrous Foundry Practice	10	-	2	-	1	1	2	CO5	L2
4	Welding Process	10	-	2	-	1	1	2	CO6,CO7	L2
5	Metallurgical Aspects in Soldering, Brazing and welding	10	-	-	4	1	1	2	CO8,CO9	L2
-	**Total**	**50**	**4**	**4**	**4**	**5**	**5**	**10**	**-**	**-**

Note: Distinct assignment for each student. 1 Assignment per chapter per student. 1 seminar per test per student.

2. Continuous Internal Assessment (CIA)

Evaluation	Weightage in Marks	CO	Levels
CIA Exam – 1	30	CO1,CO2,CO3,CO4	L2
CIA Exam – 2	30	CO5, CO6,CO7	L2
CIA Exam – 3	30	CO8, CO9	L2
Assignment - 1	10	CO1,CO2,CO3,CO4	L2
Assignment - 2	10	CO5, CO6,CO7	L2
Assignment - 3	10	CO8, CO9	L2
Seminar - 1		CO1,CO2,CO3,CO4	L2
Seminar - 2		CO5, CO6,CO7	L2
Seminar - 3		CO8, CO9	L2
Other Activities – define – Slip test		CO1 to Co9	L2
Final CIA Marks	**40**	**-**	**-**

Note : Blooms Level in last column shall match with A.2 above.

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D1. TEACHING PLAN - 1

Module - 1

Title:	Introduction & Basic Materials Used In Foundry	Appr Time:	10 Hrs
a	***Course Outcomes***	-	**Blooms**
-	The student should be able to:	-	**Level**
1	Understand the different types of patterns used in sand moldings	CO1	L2
b	***Course Schedule***	-	-
Class No	**Module Content Covered**	**CO**	**Level**
1	Introduction & Basic Materials Used In Foundry,Introduction: Definition, Classification of manufacturing processes	C01	L2
2	Metals cast in the foundry-classification, factors that determine the selection of a casting alloy	C01	L2
3	Introduction to casting process & steps involved. Patterns: Definition	C01	L2
4	Classification, materials used for pattern, various pattern allowances and their importance	C01	L2
5	**Sand molding:** Types of base sand, requirement of base sand. Binder, Additives definition, need and types	C01	L2
6	**Preparation of sand molds:** Molding machines- Jolt type, squeeze type and Sand slinger	CO1	L2
7	Study of important molding process: Green sand, core sand, dry sand, sweep mold, CO2 mold	CO1	L2
8	Shell mold, Investment mold, plaster mold, cement bonded mold	CO1	L2
9	Cores: Definition, need, types. Method of making cores	CO1	L2
10	concept of gating (top, bottom, parting line, horn gate) and risering (open, blind) Functions and types	CO1	L2
c	**Application Areas**	**CO**	**Level**
1	To prepare a models patterns are usable	CO1	L2
2	Used to prepare sand molding objects	CO2	L2
			L2
d	**Review Questions**	-	L2
1	Briefly explain the steps involved in making a casting	CO1	L2
2	Explain with Sketches (i) Sweep pattern (ii) Match plate pattern	CO1	L2
3	What are different allowances given on a pattern Explain briefly	CO1	L2
4	With a simple flowchart, show the different steps involved in casting process	CO1	L2
5	Explain the need for additives in molding sand Mention the types of additive used for different requirement , as an example	CO1	L2
6	What is a binder ? How are they classified? Which is the common binder employed for regular casting?	CO1	L2
7	With a sketch explain the process of making a given green sand mould	CO1	L2
8	Sketch and explain a Jolt molding machine	CO1	L2
9	Sketch and explain a squeezer type of molding machine	CO1	L2
10	Explain the procedure of shell moulding highlighting its advantages	CO1	L2
11	Describe investment shell moulding process Give all the details	CO1	L2

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	with neat sketches What are the advantages of the process.		
e	**Experiences**	-	-
1			

Module – 2

Title:	Melting & Metal Mold Casting Methods	Appr Time:	10 Hrs
a	***Course Outcomes***	-	**Blooms**
-	The student should be able to:	-	**Level**
1	Understand the different metal molding casting process by heat.	CO2	L2
b	***Course Schedule***	-	-
Class No	**Module Content Covered**	**CO**	**Level**
11	Melting furnaces: Classification of furnaces	CO2	L2
12	Gas fired pit furnace	CO2	L2
13	Resistance furnace	CO2	L2
14	Coreless induction furnace	CO2	L2
15	electric arc furnace	CO2	L2
16	Constructional features & working principle of cupola furnace	CO2	L2
17	Casting using metal molds: Gravity die casting	CO2	L2
18	pressure die casting, centrifugal casting	CO2	L2
19	squeeze casting, slush casting	CO2	L2
20	Thixo casting and continuous casting processes.	CO2	L2
c	**Application Areas**	**CO**	**Level**
1	Materials used for the designing and manufacturing of any solid material	CO2	L2
2	Automotive. aircraft ,railroad electrical spring, tube pipe fitting	CO2	L2
d	**Review Questions**	-	-
1	How are melting furnaces classified? Give the basis	CO2	L2
2	With a neat sketch explain continuous casting process and mention its advantages	CO2	L2
3	Explain the working principle of gas fired pit furnace with sketch	CO2	L2
4	Explain cupola furnace, highlighting its applications	CO2	L2
5	Explain with a sketch, working of a direct arc electric furnace	CO2	L2
6	Explain the following (i) Pressure die casting (ii) Centrifugal casting	CO2	L2
7	What is die casting? Explain with sketch high pressure die casting	CO2	L2
8	Sketch and explain a centrifugal casting machine, highlighting its application	CO2	L2
9	Explain cold chamber die casting with neat sketch Include all detail on the sketch What are the limitations of the process?	CO2	L2
10	Sketch and explain a squeezer type of molding machine	CO2	L2
e	**Experiences**	-	-
1			

E1. CIA EXAM – 1

a. Model Question Paper - 1

Crs Code:	18ME45A	Sem:	IV	Marks:	30	Time:	75 minutes
Course	METAL CASTING AND WELDING						

-	-	Note:Answer any ONE FULL question from each Module	Marks	CO	Level
1	a	What is manufacturing process? Explain the different types of manufacturing process with examples.	7	CO1	L2
	b	What is pattern? List the different types of pattern. Explain any three types with sketch.	8	CO1	L2
		OR			
2	a	Explain the process of shell mould with neat drawings.(advantages & disadvantages)	8	CO1	L2
	b	Explain the process of Green sand mould with neat drawings. Mention its advantages and disadvantages.	7	CO1	L2
3	a	Explain the construction and working principle of 'CUPOLA 'furnace, with a neat sketch.	8	CO2	L2
	b	Explain the construction and working principle of direct arc electric furnace, with a neat sketch.	7	CO2	L2
		OR			
4	a	Explain the construction and working principle of cold and Hot chamber die casting.	8	CO2	L2
	b	Explain the construction and working principle of continuous casting process. Mention its advantages and disadvantages.	7	CO2	L2

b. Assignment -1

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions							
Crs Code:	18ME45A	Sem:	IV	Marks:	10	Time:	90 – 120 minutes
Course:	METAL CASTING AND WELDING						
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							

SNo	USN	Assignment Description	Marks	CO	Level
1	1KT17ME	What is manufacturing process? Explain the different types of manufacturing process with examples.	5	CO1	L2
2	1KT17ME	Briefly explain the steps involved in making a casting	5	CO1	L2
3	1KT17ME	Discuss the different materials used in making patterns	5	CO1	L2
4	1KT17ME	What are different allowances given on a pattern Explain briefly	5	CO1	L2
5	1KT17ME	With a simple flowchart, show the different steps involved in casting process	5	CO1	L2
6	1KT17ME	Explain the need for additives in molding sand Mention the types of additive used for different requirement , as an example	5	CO1	L2
7	1KT17ME	What is a binder ? How are they classified? Which is the	5	CO1	L2

		common binder employed for regular casting?			
8	1KT17ME	List the advantaged and disadvantages of casting process	5	CO1	L2
9	1KT17ME	Explain with Sketches (i) Sweep pattern (ii) Match plate pattern	6	CO1	L2
10	1KT17ME	Show the classification of molding process with a neat diagram	4	CO1	L2
11	1KT17ME	What is pattern? Explain the importance of patterns allowance	4	CO1	L2
12	1KT17ME	Explain the requirements of the molding sand for casting process.	4	CO1	L2
13	1KT17ME	With a sketch explain the process of making a given green sand mould	6	CO2	L2
14	1KT17ME	Sketch and explain a Jolt molding machine	5	CO2	L2
15	1KT17ME	With a neat diagram show how carbon dioxide core is made Give the reaction involved I bonding	5	CO2	L2
16	1KT17ME	What is core? Briefly explain the significance of them in sand molding process	4	CO2	L2
17	1KT17ME	What are different types of moulding sand? Explain its properties	4	CO2	L2
18	1KT17ME	With neat sketch explain the concept of gating and risering system	5	CO2	L2
19	1KT17ME	What are the required properties of molding sand	6	CO2	L2
20	1KT17ME	Discuss briefly how castings are cleaned	5	CO2	L2
21	1KT17ME	Sketch and explain a squeezer type of molding machine	6	CO2	L2
22	1KT17ME	Explain cupola furnace, highlighting its applications	7	CO2	L2
23	1KT17ME	How are melting furnaces classified? Give the basis	4	CO2	L2
24	1KT17ME	With a neat sketch explain continuous casting process and mention its advantages	7	CO2	L2
25	1KT17ME	Explain the working principle of gas fired pit furnace with sketch	7	CO2	L2
26	1KT17ME	Explain cupola furnace, highlighting its applications	7	CO2	L2
27	1KT17ME	Explain with a sketch, working of a direct arc electric furnace	7	CO2	L2

D2. TEACHING PLAN - 2

Module – 3

Title:	Solidification & Non Ferrous Foundry Practice.	Appr Time:	10Hrs
a	***Course Outcomes***	-	**Blooms**
-	The student should be able to:	-	**Level**
1	To study the state of the metal by solidification process and non ferrous foundry practice.	CO3	L2
b	***Course Schedule***		
Class No	**Module Content Covered**	**CO**	**Level**
21	Solidification & Non Ferrous Foundry Practice. Solidification: Definition, Nucleation, solidification variables	CO3	L2
22	Directional solidification-need and methods.	CO3	L2
23	Degasification in liquid metals-Sources of gas, degasification methods.	CO3	L2
24	Fettling and cleaning of castings: Basic steps involved.	CO3	L2

25	Sand Casting defects- causes, features and remedies.	CO3	L2
26	Advantages & limitations of casting process	CO3	L2
27	Nonferrous foundry practice: Aluminum castings - Advantages, limitations	CO3	L2
28	Melting of aluminum using lift-out type crucible furnace.	CO3	L2
29	Hardeners used, drossing, gas absorption, fluxing and flushing, grain refining, pouring temperature	CO3	L2
30	Stir casting set up, procedure, uses, advantages and limitations.	CO3	L2
c	**Application Areas**	**CO**	**Level**
1	Heat treatment are useful to improve the mechanical properties	CO3	L2
d	**Review Questions**	-	-
1	What is solidification and nucleation?	CO3	L2
2	Explain the types of nucleation with neat sketch in detail.	CO3	L2
3	What is degasification? List out the methods of it.	CO3	L2
4	Explain the methods of degasification with neat sketches.	CO3	L2
5	List out theNon ferrous meting metals.	CO3	L2
6	Explain the process of lift out type Aluminum melting furnace with neat sketch.	CO3	L2
7	Mention advantages and limitations of lift out type Aluminum melting furnace.	CO3	L2
8	Applications of Aluminum melting furnace.	CO3	L2
9	List out the casting defects?	CO3	L2
10	Explain casting defects, its causes defects and remedies	CO3	L2
e	**Experiences**	-	-
1			

Module – 4

Title:	Welding Process	Appr Time:	10 Hrs
a	***Course Outcomes***	-	**Blooms**
-	The student should be able to:	-	**Level**
1	Understand the different joining process of metals by welding	CO4	L2
b	***Course Schedule***		
Class No	**Module Content Covered**	**CO**	**Level**
31	**Welding Process:** Definition, Principles, Classification,	CO4	L2
32	Application, Advantages & limitations of welding, Arc welding	CO4	L2
33	Arc welding: Principle, Metal arc welding (MAW), Flux Shielded Metal Arc Welding (FSMAW)	CO4	L2
34	Inert Gas Welding (TIG & MIG)	CO4	L2
35	Submerged Arc Welding (SAW) and Atomic Hydrogen Welding (AHW).	CO4	L2
36	Special type of welding: Resistance welding principles.	CO4	L2
37	Seam welding, Butt welding, Spot welding	CO4	L2
38	Friction welding, Explosive welding, Projection welding.	CO4	L2
39	Thermit welding, Laser welding	CO4	L2
40	Electron beam welding.	CO4	L2

c	Application Areas	CO	Level
1	Knife blades: brake fade ,ball bearing gas turbine engine	CO4	L2
2	All automobile parts, aerospace, constructions etc..	CO4	L2
d	**Review Questions**	-	-
1	Write a detailed classification of welding.	CO4	L2
2	List out the advantages and disadvantages of welding process.	CO4	L2
3	Explain the construction and working principle of FSMAW with a neat sketch.	CO4	L2
4	Explain the construction and working principle of MAW with a neat sketch.	CO4	L2
5	Explain the construction and working principle of Atomic Hydrogen Welding with neat sketch.	CO4	L2
6	List out the advantages and disadvantages	CO4	L2
7	Explain the construction and working principle of Metal inert Gas (MIG) Welding with neat sketch.	CO4	L2
8	List out the advantages and disadvantages	CO4	L2
9	Explain the construction and working principle of LBM Welding with neat sketch.	CO4	L2
10	Explain the construction and working principle of EBM Welding with neat sketch.	CO4	L2
e	**Experiences**	-	-
5			

E2. CIA EXAM – 2

a. Model Question Paper - 2

Crs Code:	18ME45A	Sem:	IV	Marks:	30	Time:	75 minutes
Course:	METAL CASTING AND WELDING						

-	-	**Note: Answer any 2 questions, each carry equal marks.**	**Marks**	**CO**	**Level**
1	a	What is solidification and nucleation? Explain the types of nucleation with neat sketch in detail.	7	CO3	L2
	b	Explain the methods of degasification with neat sketches.	8	CO3	L2
		OR			
2	a	Explain the process of lift out type Aluminum melting furnace with neat sketch and mention its advantages, limitations.	8	CO3	L2
	b	Explain the following.1) Pouring temperature 2)Drossing 3)Flushing 4)Mould Box	7	CO3	L2
		OR			
3	a	Explain the construction and working principle of FSMAW with a neat sketch.	8	CO4	L2
	b	Write a detailed classification of welding. List out the advantages and disadvantages of welding process.	7	CO4	L2
		OR			
4	a	Explain the construction and working principle of Atomic Hydrogen Welding with neat sketch. List out the advantages and disadvantages	5	CO4	L2
	b	Explain the construction and working principle of Metal inert Gas (MIG) Welding with neat sketch. List out the advantages and disadvantages	5	CO4	L2

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b. Assignment – 2

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions							
Crs Code:	18ME45A	Sem:	IV	Marks:	10	Time:	90 – 120 minutes
Course:	METAL CASTING AND WELDING						
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							

SNo	USN	Assignment Description	Marks	CO	Level
1	1KT17ME	What is solidification?explain in brief.	7	CO3	L2
2	1KT17ME	What is nucleation?explain in brief.	5	CO3	L2
3	1KT17ME	Explain the types of nucleation with sketch	5	CO3	L2
4	1KT17ME	What is degassification?Explain in brief.	5	CO3	L2
5	1KT17ME	List out the degassification methods.	5	CO3	L2
6	1KT17ME	Explain the egassification methods with sketch.	5	CO3	L2
7	1KT17ME	Explain the variables of solidification process.	4	CO3	L2
8	1KT17ME	Explain the Directional solidification-need and methods	7	CO3	L2
9	1KT17ME	Explain the basic steps involved Fettling and cleaning of castings.	4	CO3	L2
10	1KT17ME	Explain the process of lift out type Aluminum melting furnace with neat sketch.	5	CO3	L2
11	1KT17ME	Mention advantages and limitations of lift out type Aluminum melting furnace.	6	CO3	L2
12	1KT17ME	Applications of Aluminum melting furnace.	5	CO3	L2
13	1KT17ME	List out the casting defects?	6	CO3	L2
14	1KT17ME	Explain casting defects, its causes defects and remedies	5	CO3	L2
15	1KT17ME	Explain the process of Stir casting melting furnace with neat sketch.	6	CO3	L2
16	1KT17ME	Explain the principle of welding process with sketch.	5	CO4	L2
17	1KT17ME	Explain the classification of welding process.	6	CO4	L2
18	1KT17ME	List out the advantages limitations and use of welding process.	6	CO4	L2
19	1KT17ME	Explain the construction and working principle of FSMAW with a neat sketch.	5	CO4	L2
20	1KT17ME	Explain the construction and working principle of MAW with a neat sketch.	6	CO4	L2
21	1KT17ME	Explain the construction and working principle of Atomic Hydrogen with a neat sketch.	6	CO4	L2
22	1KT17ME	Explain the construction and working principle of submerged Arc welding with a neat sketch.	6	CO4	L2
23	1KT17ME	Explain the construction and working principle of TIG welding with a neat sketch.	6	CO4	L2
24	1KT17ME	Explain the construction and working principle of MIG welding with a neat sketch.	6	CO4	L2
25	1KT17ME	Explain the construction and working principle of SEAM and SPOT welding with a neat sketch.	6	CO4	L2
26	1KT17ME	Explain the construction and working principle of Electric arc and BUTT welding with a neat sketch.	6	CO4	L2
27	1KT17ME	Explain the construction and working principle of LBM welding with a neat sketch.	6	CO4	L2
28	1KT17ME	Explain the construction and working principle of EBM welding with a neat sketch.	6	CO4	L2

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D3. TEACHING PLAN - 3

Module – 5

Title:	Soldering, Brazing and Metallurgical Aspects in Welding	Appr Time:	Hrs
a	***Course Outcomes***	-	**Blooms**
-	The student should be able to:	-	**Level**
1	Understand the properties & inspection methods of metal castings and welding process.	CO5	L2
b	***Course Schedule***		
Class No	**Module Content Covered**	**CO**	**Level**
41	Introduction, Structure of welds, Formation of different zones during welding	CO5	L2
42	Heat Affected Zone (HAZ), Parameters affecting HAZ. Effect of carbon content on structure and properties of steel	CO5	L2
43	Shrinkage in welds& Residual stresses, Concept of electrodes, filler rod and fluxes.	CO5	L2
44	Welding defects- Detection, causes & remedy.	CO5	L2
45	Soldering, brazing, gas welding: Soldering, Brazing, Gas Welding	CO5	L2
46	Gas Welding: Principle, oxy-Acetylene welding, oxy-hydrogen welding,	CO5	L2
47	Air-acetylene welding, Gas cutting, powder cutting.	CO5	L2
48	Inspection methods: Methods used for inspection of casting and welding	CO5	L2
49	Visual, magnetic particle, fluorescent particle, ultrasonic, Radiography,	CO5	L2
50	Eddy current, holography methods of inspection.	CO5	L2
c	**Application Areas**	**CO**	**Level**
1	Space craft,Aircraft Miscellaneous,Automobile parts	CO5	L2
d	**Review Questions**	-	-
1	What is soldering?Explain the principle of it.	CO5	L2
2	What is Brazing?Explain the principle of it.	CO5	L2
3	Explain the types of soldering process with sketch.	CO5	L2
4	What is gas welding?Explain the principle of it.	CO5	L2
5	Explain the construction and working principle of oxy-Acetylene gas welding with a neat sketch.	CO5	L2
6	List out the advantages and limitation of oxy-Acetylene gas welding.	CO5	L2
7	Explain the construction and working principle of oxy-hydrogen gas welding with a neat sketch.	CO5	L2
8	List out the advantages and limitation of oxy-hydrogen gas welding.	CO5	L2
9	What is drossing?explain in brief.	CO5	L2
10	List out the different Inspection method.	CO5	L2
e	**Experiences**	-	-
1			

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E3. CIA EXAM – 3

a. Model Question Paper - 3

Crs Code:	18ME45A	Sem:	IV	Marks:	30	Time:	75 minutes
Course:	METAL CASTING AND WELDING						

-	-	**Note: Answer any 2 questions, each carry equal marks.**	**Marks**	**CO**	**Level**
1	a	Explain the effect of Carbon and Steel metals during welding process	8	CO5	L2
	b	Explain the different flames of Oxy Acetylene welding with neat sketches	7	CO5	L2
		OR			
2	a	Explain with a neat sketch, working principle of oxy Hydrogen gas Welding.	7	CO5	L2
	b	With a neat sketch, Explain different weld defects and its causes and remedies.	8	CO5	L2
		OR			
3	a	What is Heat affected Zone (HAZ)? Explain parameters affecting HAZ	7	CO5	L2
	b	Explain the Following. i) Electrodes ii) Types of Fluxes.	8	CO5	L2
4	a	Explain the different zones formed during Welding process with sketch.	5	CO5	L2
	b	Explain the following with neat sketches. i) Ultrasonic ii) Magnetic particle	7	CO5	L2
	c	Explain the types of soldering process in brief.	3	CO5	L2

b. Assignment – 3

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions							
Crs Code:	17ME32	Sem:	IV	Marks:	10	Time:	90 – 120 minutes
Course:	Material Science						

Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.

SNo	**USN**	**Assignment Description**	**Marks**	**CO**	**Level**
1	1KT17ME	What are the different joining process?	4	CO5	L2
2	1KT17ME	Explain the soft soldering in brief?	4	CO5	L2
3	1KT17ME	Explain the hard soldering in brief?	4	CO5	L2
4	1KT17ME	Explain the process of brazing?	4	CO5	L2
5	1KT17ME	List out the different types of brazing process and explain it	4	CO5	L2
6	1KT17ME	List out the advantages and limitations of brazing process.	4	CO5	L2
7	1KT17ME	Distinguish B/W soldering and brazing	4	CO5	L2
8	1KT17ME	Distinguish B/W soldering and welding	4	CO5	L2
9	1KT17ME	Explain the different flames of gas welding	6	CO5	L2
10	1KT17ME	Explain the Application areas of gas welding	4	CO5	L2
11	1KT17ME	Explain the structure of welding	5	CO5	L2
12	1KT17ME	Explain the Carbon-steel effect on weld metals.	6	CO5	L2
13	1KT17ME	What is heat affected zone(HAZ).Explain the different weld zones formed after welding	5	CO5	L2
14	1KT17ME	Explain the parameters of HAZ.	5	CO5	L2

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15	1KT17ME	Explain the properties of Steel.	5	CO5	L2
16	1KT17ME	Explain the properties of Carbon	5	CO5	L2
17	1KT17ME	Explain in brief. a)Shrinkage in welds b)Residual stresses	6	CO5	L2
18	1KT17ME	What is electrode. List out the different types	6	CO5	L2
19	1KT17ME	Explain the different types of electrodes used in welding	6	CO5	L2
20	1KT17ME	What is flux? explain the fluxes used	6	CO5	L2
21	1KT17ME	Differentiate B/W consumable and non-consumable electrodes	4	CO5	L2
22	1KT17ME	What is inspection of metals. List out the different inspection methods.	4	CO5	L2
23	1KT17ME	Write a note on Gas cutting and powder cutting	4	CO5	L2
24	1KT17ME	What is powder metallurgy?how it is helped in welding process.	4	CO5	L2
25	1KT17ME	Explain the following w.r.t. inspection methods 1)Visual 2)magnetic particle,	8	CO5	L2
26	1KT17ME	Explain the process of fluorescent particle inspection method.	5	CO5	L2
27	1KT17ME	Explain the process of Radiography inspection method.	5	CO5	L2
28	1KT17ME	Explain the process of ultrasonic inspection method	5	CO5	L2
29	1KT17ME	Explain the process of Eddy current inspection method	5	CO5	L2
30	1KT17ME	Explain the process holography methods of inspection	5	CO5	L2

F. EXAM PREPARATION

1. University Model Question Paper

Course:	Material science					Month / Year	Dec/2018
Crs Code:	18ME45A	Sem:	IV	Marks:	100	Time:	180 minutes

-	Note	Answer all FIVE full questions. All questions carry equal marks.	Marks	CO	Level
1	a	What is manufacturing process? Explain the different types of manufacturing process with examples.	7	CO1	L2
	b	What is pattern?Explain with Sketches (i) Sweep pattern (ii) Match plate pattern	8	CO1	L2
		OR			
	a	Sketch and explain a Jolt molding machine and sand slinger.	8	CO1	L2
	b	Explain the steps involved the green sand molding.	7	CO1	L2
2	a	Sketch and explain a squeezer type of molding machine	7	CO2	L2
	b	Explain the working of induction type furnace. mention its advantages.	8	CO2	L2
		OR			
	a	Explain the process of shell molding method with sketch.	6	CO2	L2
	b	Explain the working of cupola furnace with neat sketch.	6	CO2	L2
3	a	What is soldering?explain the nucleation process of metals.	7	CO3	L2
	b	What is degassification ?explain any two types with neat sketch.	8	CO3	L2
		OR			
	a	Explain the Lift out type Melting method for Alumina metals with neat sketch.	8	CO3	L2
	b	List out the causes of molding. Mention its effects and remedies.	7	CO3	L2

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4	a	Explain the welding principle. Classify the welding process in detail.	7	CO4	L2
	b	Explain the working principle of Submerged ARC welding with neat sketch.	8	CO4	L2
		OR			
	a	Explain the working principle of SEAM and SPOT welding with neat sketch.	8	CO4	L2
	b	Explain the working principle of EBM welding with neat sketch.	7	CO4	L2
		OR			
5	a	Explain different zones of HAZ?What are the parameters of HAZ	7	CO5	L2
	b	Explain the working principle of oxy acetylene gas welding with neat sketch.	8	CO5	L2
		OR			
	a	Explain the process of fluorescent particle inspection method.	7	CO5	L2
	b	Explain the following 1)Radiography 2)Eddy current	8	CO5	L2

2. SEE Important Questions

Course:	Material science					Month / Year	Dec /2018	
Crs Code:	18ME45A	Sem:	IV	Marks:	100	Time:	180 minutes	
	Note	Answer all FIVE full questions. All questions carry equal marks.				-	-	
Module	Qno.	Important Question				**Marks**	**CO**	**Year**
1	1	Briefly explain the basic steps involved in Sand Casting proces				8	CO1	2017
	2	What is manufacturing process? Explain the different types of manufacturing process with examples.				8	CO1	2017
	3	What is a pattern? State the functions of a pattern and classify.				8	CO1	2017
	4	With a neat sketch, explain Shell moulding process				6	CO1	2018
2	1	Define furnace, sketch and explain the working principle, constructional feature of induction furnace (corless type).				8	CO2	2017
	2	What are the zones in cupola? With a neat sketch, explain cupola furnace				8	CO2	2017
	3	Explain the principle of squeeze casting process with a suitable figure give the setup details.				8	CO2	2017
	4	ith a neat sketch, explain the working pi inciple of Hot — Chamber die casting method				6	CO2	2018
3	1	Define Solidification.				2	CO3	2018
	2	Explain Nucleation process in Solidification of metals.				6	CO3	2018
	3	Define the term degasification. With suitable sketch explain any two methods of degasification.				8	CO3	2017
	4	Sketch and explain Stir casting setup				8	CO3	2018
4	1	Define welding process, classify it, list out the applications, advantages and limitations of it				8	CO4	2017
	2	Describe the process of spot welding with a neat sketch.				4	CO4	2017
	3	Explain how an arc is generated in arc welding. Classify it. With a neat sketch elaborate flux shielded metal arc welding process (FSMAW).				8	CO4	2017
	4	Explain the working principle of LBM process with neat sketch and mention its advantages.				8	CO4	2018

ME

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5	1	Explain different zones which are formed during welding process.	8	CO5	2013
	2	What are Welding defects? Explain the methods to detect the welding defects	6	CO5	201
	3	Draw and explain the types of flames in oxy-acetalyne welding process	8	CO5	2017
	4	Explain the methods used for Inspection of casting and welding	6	CO5	2018

G. Content to Course Outcomes

1. TLPA Parameters

Table 1: TLPA – Example Course

Module-#	Course Content or Syllabus (Split module content into 2 parts which have similar concepts)	Content Teaching Hours	Blooms' Learning Levels for Content	Final Blooms' Level	Identified Action Verbs for Learning	Instruction Methods for Learning	Assessment Methods to Measure Learning
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*
1	**Introduction & Basic Materials Used In Foundry** **Introduction:** Definition, Classification of manufacturing processes, Metals cast in the foundry-classification, factors that determine the selection of a casting alloy, Introduction to casting process & steps involved. Patterns: Definition,Classification, materials used for pattern, various pattern allowances and their importance **Sand molding:** Types of base sand, requirement of base sand. Binder, Additives definition, need and types **Preparation of sand molds:** Molding machines- Jolt type, squeeze type and Sand slinger,Study of important molding process: Green sand, core sand, dry sand, sweep mold, CO2 mold,Shell mold, Investment mold, plaster mold, cement bonded mold. Cores: Definition, need, types. Method of making cores concept of gating (top, bottom, parting line, horn gate) and risering (open, blind) Functions and types.	5	- L2	L2	Understand	- Lecture - -	- Slip Test - -
		5	-L2	L2	Understand		
2	**Solidification & Non Ferrous Foundry Practice.** **Solidification**: Definition, Nucleation, solidification variables Directional solidification-need and methods. Degasification in liquid metals-Sources of gas, degasification methods. **Fettling and cleaning of castings:** Basic steps involved. Sand Casting defects- causes, features and remedies.	5	- L2	L2	Understand	- Lecture - Tutorial -	- Assignment - -
		5	L2	L2	Understand		

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	Advantages & limitations of casting process **Nonferrous foundry practice**: Aluminum castings - Advantages, limitations,Melting of aluminum using lift-out type crucible furnace. Hardeners used, drossing, gas absorption, fluxing and flushing, grain refining, pouring temperature Stir casting set up, procedure, uses, advantages and limitations.						
3	**Melting & Metal Mold Casting Methods.** **Melting furnaces:** Classification of furnaces Gas fired pit furnace Resistance furnace Coreless induction furnace electric arc furnace Constructional features & working principle of cupola furnace. **Casting using metal molds:** Gravity die casting,pressure die casting, centrifugal casting squeeze casting, slush casting Thixo casting and continuous casting processes.	5	L2	L2	Understand	- Lecture -	- Assignment -
		5	L2	L2	Understand		
4	**Welding Process:** Definition, Principles, Classification, Application, Advantages & limitations of welding, Arc welding Arc welding: Principle, Metal arc welding (MAW), Flux Shielded Metal Arc Welding (FSMAW),Inert Gas Welding (TIG & MIG),Submerged Arc Welding (SAW) and Atomic Hydrogen Welding (AHW). **Special type of welding:** Resistance welding principles. Seam welding, Butt welding, Spot welding,Friction welding, Explosive welding, Projection welding, Thermit welding, Laser welding,Electron beam welding.	5	L2	L2	Understand	- Lecture -	- Slip Test -
		5	- L2	L2	Understand		
5	**SOLDERING, BRAZING AND METALLURGICAL ASPECTS IN WELDING:** Introduction, Structure of welds, Formation of different zones during welding, Heat Affected Zone (HAZ), Parameters affecting HAZ. Effect of carbon content on structure and properties of steel Shrinkage in welds& Residual stresses, Concept of electrodes, filler rod and fluxes. Welding defects-Detection, causes & remedy. **Soldering, brazing, gas welding:** Soldering, Brazing, Gas Welding Gas Welding: Principle, oxy-Acetylene welding, oxy-hydrogen welding, Air-	5	L2	L2	Understand	- Lecture -	- Slip Test -
		5	L2	L2	Understand		

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	acetylene welding, Gas cutting, powder cutting. **Inspection methods:** Methods used for inspection of casting and welding Visual, magnetic particle, fluorescent particle, ultrasonic, Radiography, Eddy current, holography methods of inspection.						

2. Concepts and Outcomes:

Table 2: Concept to Outcome – Example Course

Module-#	Learning or Outcome from study of the Content or Syllabus	Identified Concepts from Content	Final Concept	Concept Justification (What all Learning Happened from the study of Content / Syllabus. A short word for learning or outcome)	CO Components (1.Action Verb, 2.Knowledge, 3.Condition / Methodology, 4.Benchmark)	Course Outcome **Student Should be able to ...**
A	*I*	*J*	*K*	*L*	*M*	*N*
1	Understand the different types of patterns used in sand moldings	Sand moldings	Sand moldings	Understand the concept of Sand moldings	Understand the different types of patterns used in sand moldings	Understand the different types of patterns used in sand moldings
2	Understand the different metal molding casting process by heat.	Metal moldings	Metal moldings	Understand the concept of Metal moldingss	Understand the different metal molding casting process by heat.	Understand the different metal molding casting process by heat.
3	To study the state of the metal by solidification process and non ferrous foundry practice.	Non ferrus metal castings	Non ferrus metal castings	Understand the concept of Non ferrus metal castings	To study the state of the metal by solidification process and non ferrous foundry practice.	To study the state of the metal by solidification process and non ferrous foundry practice.
	Understand the different joining process of	Joining process	Joining process	Understand the concept of Joining process	Understand the different joining process of metals by welding	Understand the different joining process of metals by welding

4	metals by welding					
5	Understand the inspection methods of welding process.	Inspection of casted metals	Inspection of casted metals	Understand the I concept of nspection of casted metals	Understand the inspection methods of welding process.	Understand the inspection methods of welding process.