Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bengaluru

Course Title: Manufacturing Science		Course Code:15MC41T
Mode (L:T:P) : 4:0:0	Credits:4	Core/ Elective: Core
Type of Course: Lectures & Student Activities		Total Contact Hours: 52
CIE= 25 Marks		SEE= 100 Marks

Pre-requisites: Knowledge of Applied Science

Course Objectives: Understand the various Manufacturing processes

Course Outcome: At the end of the semester, the student should be able to

1. Understand the various casting processes
2. Know the different metal forming processes
3. Understand various welding processes
4. Understand operations performed on conventional machines
5. Understand working of non-traditional machining processes
6. Know the various steps involved in manufacturing a component by powder metallurgy and additive manufacturing

Course Outcome		Cognitive Level	Linked with PO	Teaching Hours
CO1	Understand the various casting processes	*U*	1,2	9
CO2	Know the different metal forming processes	*U*	1,2	9
CO3	understand various welding processes and to select suitable process for specific applications	*U*	1,2	8
CO4	Understand operations performed on conventional machines	*U*	1,2	12
C05	Understand working of non-traditional machining processes	*U*	1,2	8
C06	Know the various steps involved in manufacturing a component by powder metallurgy and additive manufacturing	*U*	1,2	6
		Total sessions		**52**

Legend: R; Remember, U: Understand A: Application

Mapping of Course Outcomes with Program Outcomes

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
Manufacturing Science	**3**	**3**	-	-	-	-	-	-	-	-

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.

Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.
If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3
If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2
If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1
If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

Course Content and Weightage For SEE

Unit No	Unit Name	CO	Hour	Marks allocated for different Cognitive level Questions			Marks weightage (%)
				R	U	A	
1	Casting Technology	1	9	-	30	-	20.69
2	Metal forming process	2	9	-	20	-	13.79
3	Welding technology	3	8	-	15	-	10.34
4	Conventional machining	4	12	-	40	-	27.6
5	Non traditional machining	5	8	-	25	-	17.24
6	Powder metallurgy and Additive manufacturing	6	6	-	15	-	10.34
	Total		**52**	**145 Marks**			**100**

Contents

Unit-I

Casting Technology

Introduction to pattern, core, mould, moulding, types of patterns-solid piece, split, match plate, gated and sweep, pattern allowances, types of moulding-cope & drag type, pit type, shell moulding, investment moulding. Advantages & disadvantages of casting process

9 Hours

Unit-II

Metal forming process

Hot working –rolling- two ball mill, three high , drawing, deep drawing, direct extrusion and indirect extrusion, cold working-rolling, wire drawing, tube drawing, differentiate hot working and cold working, forging-upsetting, drawing down, punching & fullering,

9 Hours

Unit-III

Welding technology

Arc welding-metal arc welding, TIG, MIG, spot welding, seam welding, Gas welding, Brazing.

8 Hours

Unit-IV

Conventional machining

Function of Engine Lathe parts, Lathe operations-turning, knurling, facing, drilling, thread cutting, function of radial drilling machine parts, drilling operations-drilling, reaming, boring, counter boring, counter sinking, tapping, function of column and knee type milling machine parts, milling process-up milling and down milling, milling operations-plain milling, angular milling, form milling, end milling, milling of slots and grooves

12 Hours

Unit-V

Non Traditional machining

Constructional details working principle and application of Ultra Sonic Machining, Abrasive Jet Machining, Electro Chemical Machining, Electron Beam Machining, Laser Beam Machining and Electric Discharge Machining

8 Hours

Unit-VI

Powder metallurgy and Additive manufacturing

Stages involved in the manufacturing of powder metallurgy components-manufacturing of powder, blending, compacting, presintering and sintering, introduction to additive manufacturing, types of additive manufacturing processes-selective laser sintering & fused deposition method

6 Hours

Reference

1. Elements of Workshop technology by Hajra and chowdary Vol-1
2. Elements of Workshop technology by Hajra and chowdary Vol-2,
2. Production Technology by R.K.Jain
3. Production Technology by O P Khanna
4. A text book on Workshop Technology by R S Khurmi and J K Gupta

e-Reference

1. http://thelibraryofmanufacturing.com/metalcasting_basics.html
2. http://www.iitg.ernet.in/engfac/ganu/public_html/Metal%20casting%20processes_full.pdf
3. http://www.scribd.com/doc/23201282/forging-ppt#scribd
4. http://yunus.hacettepe.edu.tr/~selis/teaching/WEBkmu479/Ppt/kmu479Presentations2010/ConMach_SawingReamingShapingTappingPlaning.pdf
5. http://universe.bits-pilani.ac.in/uploads/5-Lathe.pdf
6. http://www.ignou.ac.in/upload/bme059unit-1.pdf
7. http://fmcet.in/MECH/ME2026_uw.pdf
8. http://www.niceindia.com/qbank/ucmt.pdf
9. https://en.wikipedia.org/wiki/Selective_laser_sintering
10. http://www.slideshare.net/rajanpagotra/3-d-printingppt
11. https://en.wikipedia.org/wiki/Fused_deposition_modeling
12. https://www.solidconcepts.com/technologies/fused-deposition-modeling-fdm/

Student Activity

Activity No	Description of the Student Activity
1	Visit nearest fabrication shop and study the fabrication process of a particular component, prepare a drawing, list the sequence of operation, tools and machineries used. A hand written report of 2 to 3 pages has to be submitted

Note:

1. Group of max four students should do any one of the above activity or any other similar activity related to the course COs and get it approved from concerned Teacher and HOD.
2. No group should have activity repeated or similar
3. Teacher should ensure activities by group must cover all COs
4. Teacher should asses every student by using suitable **Rubrics** approved by HOD

Rubrics

Dimension	Exemplary	Accomplished	Developing	Beginning	Roll No. of the Student				
	5/4	3	2	1	1	2	3	4	5
Organization	Information presented in logical, interesting sequence	Information in logical sequence	Difficult to follow presentation--student jumps around	Cannot understand presentation--no sequence of information	Ex: 2				
Subject Knowledge	Demonstrates full knowledge by answering all class questions with explanations and elaborations	At ease with expected answers to questions but does not elaborate	Uncomfortable with information and is able to answer only rudimentary questions	Does not have a grasp of the information. Cannot answer questions about subject	4				
Graphics	Explain and reinforce screen text and presentation	Relate to text and presentation	Occasionally uses graphics that rarely support text and presentation	Uses superfluous graphics or no graphics	5				
Oral Presentation	Maintains eye contact and pronounces all terms precisely. All audience members can hear	Maintains eye contact most of the time and pronounces most words correctly. Most audience members can hear presentation	Occasionally uses eye contact, mostly reading presentation, and incorrectly pronounces terms. Audience members have difficulty hearing	Reads with no eye contact and incorrectly pronounces terms. Speaks too quietly	3				
Total Score=2+3+4+5=14/4=3.5=4									

Institutional Activity

Activity No	Description of the Institutional Activity
1	Organize seminar, workshop, lecture from eminent person in the following domain: a) Industrial safety b) manufacturing and its impact on environment c) Use of alternate material for manufacturing d) Modern trends in manufacturing e) Role of professional bodies in manufacturing such as institute of Engineers. f) Relevance of International Labor Organization g) Indian factories act h) Entrepreneurship development i) estimation of job order
2	Organize nearby industrial visit
3	Motivate student to take case study on particular manufacturing activity to inculcate self and continues learning

Course Assessment Pattern

Particulars			Max Marks	Evidence	Course outcomes
Direct Assessment	**CIE**	Three test (Average of three tests)	20	Blue books	1,2,3,4,5,6
		Student Activity	05	Student Activity Sheets	1,2,3,4,5,6
	SEE	End of the course	100	Answer scripts at BTE	1,2,3,4,5,6
Indirect Assessment	**Student Feedback on course**	Middle of the course		Feedback forms	1, 2&3
		End of the course		Feedback forms	1,2,3, 4, 5&6

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

FORMAT OF I A TEST QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks
Ex: I test/6 th weak of sem 10-11 Am	I/II SEM		20
	Year:		
Name of Course coordinator : CO's:____			Units:__

Question no	Question	MARKS	CL	CO	PO
1					
2					
3					
4					

Note: Internal Choice may be given in each CO at the same cognitive level (CL).

Model Question Paper (CIE)

Date and Time	Semester	Course	Max Marks
1Test(6 th weak of sem) 10-11 Am	IV SEM	Manufacturing Science	20
	Year: 2015-16	Course code:15MC41T	
Name of Course coordinator : All questions carries equal marks			Units:1,2 Co: 1,2

Question No	Question	CL	CO	PO
1	Explain the importance of cores in casting process OR Describe pattern allowances	U	1	1,2
2	Describe shell moulding process. OR Describe with application solid and split piece pattern	U	1	1,2
3	Describe rolling operation in two ball mills OR Describe forward extrusion	U	2	1,2
4	Differentiate between hot working and cold working OR Explain punching and fullering with application	U	2	1,2

Model Question Paper
IV Semester Diploma in Mechatronics Engineering
Manufacturing Science

Instructions: Answer any six questions from part A and Seven full questions from part B

PART-A

Answer any six questions. **5X6=30 marks**

1. With sketch explain solid piece pattern
2. Explain the importance of cores in casting process
3. Explain deep drawing process
4. Sketch and explain arc welding
5. With sketch explain knurling
6. With sketch explain form milling
7. Sketch and explain T-slot milling operation
8. Sketch and briefly explain ultrasonic machining process
9. Explain mechanical pulverization method of preparing metal powder

PART- B

Answer any seven full questions. **10X7=70M**

1 a) with sketch explain gated pattern
b) Explain different pattern allowance

2 a) Describe shell moulding process
b) Describe investment moulding process

3 a) Describe rolling operation in three ball mills
b) Describe forward extrusion

4 a) sketch and explain swaging operation
b) With neat sketch explain different types of flame in oxyacetylene gas welding

5 a) Describe the procedure of brazing
b) Discuss the advantages and application of EBM

6 Sketch and label engine lathe

7 Explain upmilling and downmilling with advantages and disadvantages

8 a) Explain with sketch counter boring and counter sinking
b) Sketch and briefly explain electrochemical machining process

9 a) Differentiate LBM and EBM

b) Discuss the advantages and application of AJM

10 a) Explain any one method of preparation of powder

b) Explain briefly selective laser sintering

Model Question Bank
IV Semester Diploma in Mechatronics Engineering
Manufacturing Science

Unit -1
Casting Technology
Cognitive level- Understanding

1. Explain the importance of pattern in casting process
2. Explain the importance of cores in casting process
3. Explain the importance of mould in casting process
4. Explain steps involved in moulding
5. Explain types of patterns
6. With sketch explain solid piece pattern
7. With sketch explain match plate pattern
8. With sketch explain gated pattern
9. With sketch explain sweep pattern
10. describe pattern allowances
11. Explain types of moulding
12. Explain cope and drag type moulding
13. Explain pit type moulding
14. How shrinkage in castings is compensated
15. Describe the necessity of machining allowance in castings
16. Explain taper or draft allowance
17. Explain advantages of casting process
18. Explain disadvantages of casting process
19. Describe shell moulding process
20. Describe investment moulding process
21. Explain pattern, core, mould and moulding
22. Describe with application solid and split piece pattern
23. Describe with application matchplate and gated pattern
24. Explain different pattern allowances
25. Choose and explain a suitable casting process for the manufacturing of plastic dolls
26. Choose and explain a suitable casting process for the manufacturing of intricate castings
27. Justify investment casting for casting of intricate shapes
28. Predict the various allowances to be provided in patterns
29. Illustrate a casting process to manufacture turbine blades
30. Describe steps involved in croning of C process
31. Explain advantages and disadvantages of casting process
32. Select a casting process for bed of a engine lathe and describe steps involved
33. Explain cope and drag type of moulding with sketch
34. Explain gated pattern and Justify its suitability in the manufacture of small size
35. castings in large scale.
36. Explain the advantages and disadvantages of shell and investment moulding

Unit –II
Metal forming process
Cognitive level- Understanding

1. Explain the significance of hot working
2. Describe mechanical working of metals
3. With sketch explain hot rolling
4. Describe rolling operation in two ball mills.
5. Describe rolling operation in three ball mills
6. Explain deep drawing or cupping
7. Select and explain drawing operation suitable for manufacturing seamless tubing for thick walled cylindrical tanks
8. Describe forward extrusion
9. Describe backward extrusion
10. Explain significant of cold working
11. Explain tube drawing
12. compare hot working and cold working
13. sketch and explain upsetting or heading process
14. sketch and explain drawing down or swaging
15. Explain punching and fillering
16. Explain two ball and three high hot rolling
17. Explain direct and indirect extrusion
18. with neat sketch explain cold wire drawing
19. Differentiate between hot working and cold working
20. Select and explain drawing operation suitable for manufacturing seamless tubing for thick walled cylindrical tanks
21. Sketch and explain upsetting and drawing down operation
22. Explain punching and fullering with application

Unit –III
Welding technology
Cognitive level- Understanding

1. Explain the importance of welding
2. Sketch and explain arc welding
3. Sketch and explain TIG welding
4. Explain the advantages of metal arc welding
5. Sketch and explain MIG welding
6. Explain the applications of TIG and MIG welding
7. Sketch explain seam welding
8. With neat sketch explain different types of flame
9. Describe the procedure of brazing
10. Sketch and explain spot welding
11. What are the advantages and disadvantages of arc welding
12. What are the advantages and disadvantages of gas welding
13. Explain the advantages, disadvantages and applications of brazing
14. discuss the classification of welding processes

15. Sketch and explain in detail arc welding process with application
16. Sketch and explain in detail TIG welding process with application
17. Sketch and explain in detail MIG welding process with application
18. Sketch and explain in detail spot welding process with application
19. Sketch and explain in detail seam welding process with application
20. Sketch and explain in detail carburizing and oxidizing flame with its application
21. Sketch and explain in detail carburizing and neutral flame with its application
22. Sketch and explain in detail neutral and oxidizing flame with its application
23. Explain the function of different apparatus used in gas welding process equipment
24. Explain the function of different apparatus used in arc welding process equipment

Unit-IV
Conventional machining
Cognitive level- Understanding

1. Summarize the advantages of conventional machining process
2. Explain the functions of any five engine lathe parts
3. Explain any two engine lathe operations
4. Explain turning in lathe
5. With sketch explain knurling
6. With sketch explain facing
7. With sketch explain drilling
8. What is the main function of a lathe? Describe in brief an engine lathe
9. What is the function of back gear
10. Explain thread cutting in lathe
11. Explain with sketch reaming and boring
12. Explain with sketch counter boring and counter sinking
13. Explain tapping
14. Explain any five parts of milling machine tool
15. Explain up milling and down milling
16. Sketch and explain plain milling
17. With sketch explain form milling
18. Explain angular milling
19. Explain any one end milling operation
20. Sketch and explain T-slot milling operation
21. Sketch and label engine lathe
22. Explain knurling and facing operations in lathe
23. Explain drilling and turning with sketch
24. Explain in detail thread cutting in lathe
25. Sketch and explain radial drilling machine
26. Sketch and explain reaming and boring
27. Sketch and explain counter boring and counter sinking
28. Explain external and internal tapping
29. With neat sketch explain column and knee type milling machining
30. Explain up milling and down milling with advantages and disadvantages
31. Explain plain milling and angular milling
32. Describe form milling and end milling operation

33. Explain milling of slots and grooves
34. Discuss the advantages and disadvantages of conventional machining

Unit-V
Non Traditional machining
Cognitive level- Understanding

1. Summarize the advantages of non traditional machining
2. Summarize the disadvantages of non traditional machining
3. What do you understand by chipless machining and what harmful effect may such machining have
4. Sketch and briefly explain ultrasonic machining process
5. Discuss the advantages and application of USM
6. Why can very hard material be cut better by USM process than softer one
7. Discuss the common materials used for USM tools
8. Sketch and briefly explain abrasive jet machining process
9. Discuss the advantages and application of AJM
10. Sketch and briefly explain electrochemical machining process
11. Discuss the advantages and application of ECM
12. Sketch and briefly explain electron beam machining process
13. Discuss the advantages and application of EBM
14. Sketch and briefly explain laser beam machining process
15. Discuss the advantages and application of LBM
16. Sketch and briefly explain electro discharge machining process
17. Discuss the advantages and application of EDM
18. Is there any limitation on the type of material that can be machined by ECM. List ECM applications
19. Explain the function of dielectric fluid in EDM. Name the common dielectric fluid used in EDM
20. Differentiate LBM and EBM
21. Sketch and explain USM with advantages, disadvantages and applications
22. Sketch and explain AJM with advantages, disadvantages and applications
23. Sketch and explain ECM with advantages, disadvantages and applications
24. Sketch and explain EBM with advantages, disadvantages and applications
25. Sketch and explain LBM with advantages, disadvantages and applications
26. Sketch and explain EDM with advantages, disadvantages and applications

Unit-VI
Powder metallurgy and Additive manufacturing
Cognitive level- Understanding

1. Describe the advantage of powder metallurgy
2. Discuss the disadvantages of powder metallurgy
3. Explain any one method of preparation of powder
4. Explain mechanical pulverization method of preparing metal powder
5. Explain chemical reduction method of preparing metal powder
6. Explain atomization method of preparing metal powder
7. Explain blending and compacting stages in powder metallurgy
8. Explain pre sintering and sintering in powder metallurgy
9. Discuss the applications of powder metallurgy
10. Discuss the limitations of powder metallurgy
11. Describe the advantages of additive manufacturing processes
12. Discuss the disadvantages of additive manufacturing processes
13. Explain briefly selective laser sintering
14. Explain briefly fused deposition method
15. Explain the significance of powder metallurgy with its applications and limitations
16. Explain various methods of preparing metal powders
17. Explain briefly stages involved in the manufacturing of components through powder metallurgy
18. With sketch explain in detail selective laser sintering with advantages and applications
19. With sketch explain in detail fused deposition method with advantages and applications
20. Describe additive manufacturing and explain any one method with its applications.