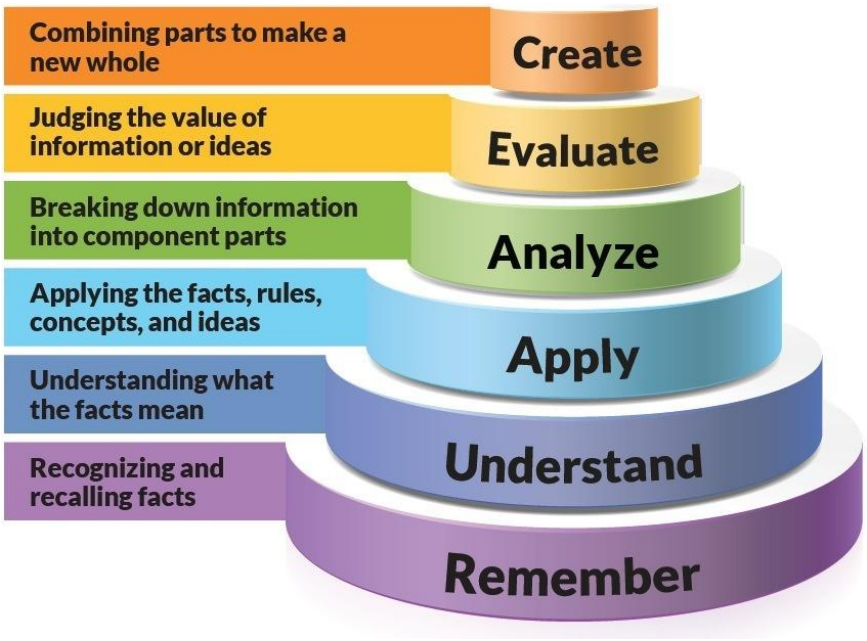
COURSE DESCRIPTOR BOOKLET

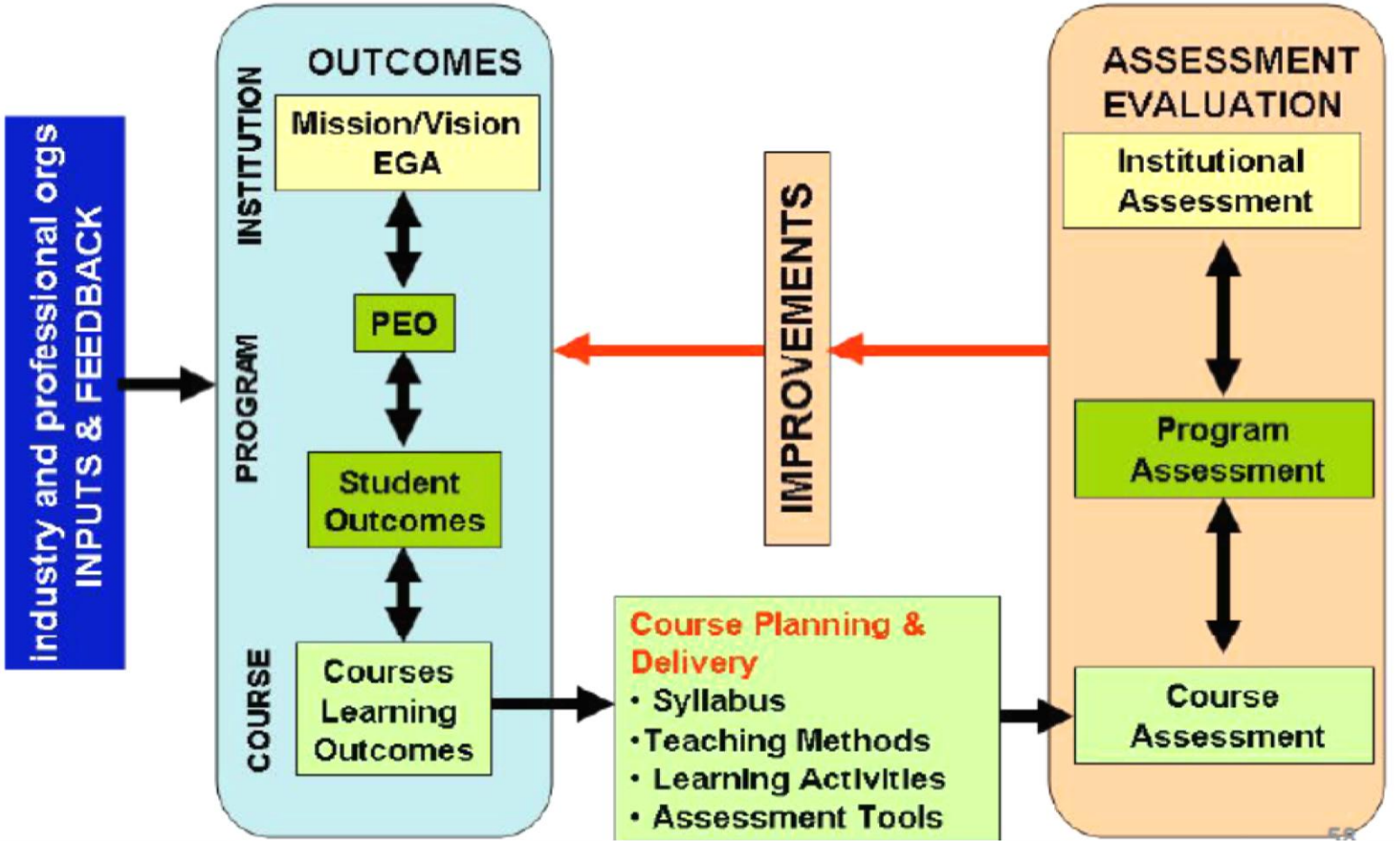
M.Tech CAD/CAM
Mechanical Engineering

For the batch of students admitted during
2018 - 2019 Academic Year



INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Approved by AICTE; Affiliated to JNTUH and Accredited by NAAC with 'A' Grade
Dundigal, Hyderabad – 500 043

The OBE Framework



Vision

The Department of Mechanical Engineering envisions value based education, research and development in the areas of Manufacturing and Computer Aided Engineering as an advanced center for Mechanical Engineering, producing graduates of world-class competence to face the challenges of global market with confidence, creating effective interface with various organizations.

Mission

The mission of the Mechanical Engineering Department is to prepare effective and responsible engineers for global requirements by providing quality education and to improve pedagogical methods employed in delivering the academic programs to the needs of the industry and changing world by conducting basic and applied research and to generate intellectual property.

Part – I

I. Program Educational Objectives and Assessment Criteria:

Program Educational Objectives, Program Outcomes and Assessment Criteria (Approved by DAC MECH on 30/01/2018):

Mechanical Engineering Department Advisory Council: The Mechanical Engineering Department Advisory Council (MECHDAC) includes a diverse group of experts from academic and industry, as well as alumni representation. The Advisory Board meets annually, or as needed, for a comprehensive review of the Mechanical Engineering Department strategic planning and programs. The Advisory Council meets with administration, faculty and students and prepares a report, which is presented to principal. In each visit, the Department of Mechanical Engineering responds to the report indicating improvements and amendments to the program.

Program educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.
Outcomes — Program outcomes are narrower statements that describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students acquire in their matriculation through the program.

II. Program Educational Objectives (PEO'S)

A graduate of Institute of Aeronautical Engineering College, Mechanical Engineering should enjoy a successful career in Mechanical Engineering or a related field after graduation. The program aims to:

Program Educational Objective 1

Impart essential knowledge in the latest technological topics on computer aided engineering and to prepare them for taking up further **research** in the areas

Program Educational Objective 2

Create congenial environment that promotes learning, growth and imparts ability to work with **inter-disciplinary** groups

Program Educational Objective 3

Broaden and deepen the capabilities in **analytical and experimental methods**, analysis of data, and draw relevant conclusions for scholarly writing and presentation

These Program Educational Objectives are broad by intention, permitting the Mechanical Engineering CAD/CAM post graduates to seek further research or work in diverse areas. To make these objectives meaningful, they may be demonstrated by performance, actions, or achievements.

1. To impart essential knowledge in the latest technological topics on computer aided engineering and to prepare them for taking up further research in the areas:
   - Impart knowledge of various computerized tools for performing geometry and dimensional tolerance in different technical drawings.
   - Impart knowledge of software for modeling and analysis of various systems and sub systems.
   - Develop the knowledge of using multi physics tools to gain research knowledge and develop further mathematical and experimental models in engineering
2. To create congenial environment that promotes learning, growth and imparts ability to work with inter-disciplinary groups:
   - Knowledge of robotic systems and subsystems to work with electronic engineers in development of new products and assembly lines.
   - Knowledge of research methodology to work in any of the inter-disciplinary group to develop standard research.
   - Factual reporting in engineering journals which may further lead to publishing inter-departmental white papers for technology transfer.
3. To broaden and deepen the capabilities in analytical and experimental methods, analysis of data and draw relevant conclusions for scholarly writing and presentations:
   - Broad spectrum of project work included in two phases encompasses the importance of raw data collection from previous scholarly articles, conversion of raw data to scientific data by numerical, mathematical and experimental analysis.
   - Specified subjects for writing technical reports and publishing research and scholarly articles in renowned journals.
   - Encouragement to publish scholarly articles in journals in hand with the faculty and mentoring for overall improvement.

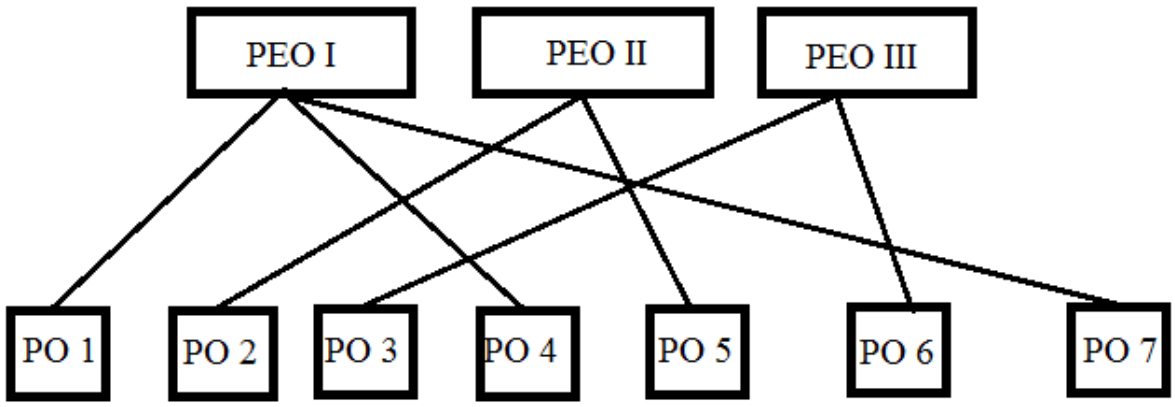
III. Program Outcomes (PO'S):

1. **Engineering Knowledge:** Apply advanced level knowledge, techniques, skills and modern tools in the field of computer aided engineering to critically assess the emerging technological issues.
2. **Develop Novel Designs:** Have abilities and capabilities in developing and applying computer software and hardware to mechanical design and manufacturing fields.
3. **Analyze Complex Systems:** Conduct experimental and analytical study and analyzing results with scientific methods and use of software tools.
4. **Development of Solutions:** Independently carry out research / investigation and development work to solve practical problems.
5. **Teamwork and Project Management:** Function on multidisciplinary environments by working cooperatively, creatively and responsibly as a member of a team.
6. **Technical Presentation Skills:** Write and present a substantial technical report / document.
7. **Lifelong Learning:** Design and validate technological solutions to improve the defined problems and engage in lifelong learning through continuing education.

IV. PEO's Vs PO's

S. No	Program Educational Objectives	Program Outcomes
PEO - I	To impart essential knowledge in the latest technological topics on computer aided engineering and to prepare them for taking up further research in the areas.	1. Apply advanced knowledge, techniques, skills and modern tools in the field of computer aided engineering to critically assess the emerging technological issues 4. Independently carry out research / investigation and development work to solve practical problems 7. Design and validate technological solutions to improve the defined problems and engage in lifelong learning through continuing education
PEO - II	To create congenial environment that promotes learning, growth and imparts ability to work with inter-disciplinary groups.	2. Have abilities and capabilities in developing and applying computer software and hardware to mechanical design and manufacturing fields. 5. Function on multidisciplinary environments by working cooperatively, creatively and responsibly as a member of a team
PEO - III	To broaden and deepen the capabilities in analytical and experimental methods, analysis of data and draw relevant conclusions for scholarly writing and presentations.	3. Conduct experimental and analytical study and analyzing results with scientific methods and use of software tools. 6. Write and present a substantial technical report / document.

V. Mapping of Program Outcomes to Program Educational Objectives



VI. MAPPING OF PO's Vs PEO's

Program Outcomes	PEO-I	PEO-II	PEO-III
1. **Engineering Knowledge:** Apply advanced level knowledge, techniques, skills and modern tools in the field of computer aided engineering to critically assess the emerging technological issues.	✔		
2. **Develop Novel Designs:** Have abilities and capabilities in developing and applying computer software and hardware to mechanical design and manufacturing fields.		✔	

3. **Analyze Complex Systems:** Conduct experimental and analytical study and analyzing results with scientific methods and use of software tools.			✔
4. **Development of Solutions:** Independently carry out research / investigation and development work to solve practical problems.	✔		
5. **Teamwork and Project Management:** Function on multidisciplinary environments by working cooperatively, creatively and responsibly as a member of a team..		✔	
6. **Technical Presentation Skills:** Write and present a substantial technical report / document			✔
7. **Lifelong Learning:** Design and validate technological solutions to improve the defined problems and engage in lifelong learning through continuing education.	✔		

Note:

- The assessment process can be direct or indirect.
- The direct assessment will be through interim assessment by the faculty or by industry / technology experts.
- The indirect assessment on the other hand could be by students through course outcomes, lab evaluation, department associations, exit interviews, engineering services, GATE examination etc.
- Frequency of assessment can be once in a semester and justified by the programme coordinator.

VII. Table-1 Relation between the Program Educational Objectives and Program Outcomes:

A broad relation between the program objective and the outcomes is given in the following table:

	(PEO-I) Research	**(PEO-II) Inter-disciplinary groups**	**(PEO-III) Analytical and Research Skills**
1. **Engineering Knowledge:** Apply advanced level knowledge, techniques, skills and modern tools in the field of computer aided engineering to critically assess the emerging technological issues.	3	2	3
2. **Develop Novel Designs:** Have abilities and capabilities in developing and applying computer software and hardware to mechanical design and manufacturing fields.	3	3	3
3. **Analyze Complex Systems:** Conduct experimental and analytical study and analyzing results with scientific methods and use of software tools.	3	3	3
4. **Development of Solutions:** Independently carry out research / investigation and development work to solve practical problems.	3	2	2
5. **Teamwork and Project Management:** Function on multidisciplinary environments by working cooperatively, creatively and responsibly as a member of a team..	2	3	3
6. **Technical Presentation Skills:** Write and present a substantial technical report / document	2	2	2

7. **Lifelong Learning:** Design and validate technological solutions to improve the defined problems and engage in lifelong learning through continuing education.	2	2	2

Table - Relationships between program objectives and program outcomes
Key: 3 = Strong relationship; 2 = Moderate relationship

Note:

- The assessment process can be direct or indirect.
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I SEMESTER

INSTITUTE OF AERONAUTICAL ENGINEERING

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Dundigal, Hyderabad -500 043

MECHANICALENGINEERING

COURSE DESCRIPTOR

Course Title	**ADVANCED CAD**				
Course Code	BCCB01				
Programme	M.Tech				
Semester	I	ME			
Course Type	Core				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Chief Coordinator	Dr.CH V K N S N Moorthy, Professor, ME				
Course Faculty	Dr.CH V K N S N Moorthy, Professor, ME				

I. COURSE OVERVIEW:

Advanced CAD encompasses the concepts and principles of computer graphics, CAD tools, surface modelling, parametric representation of synthetic surfaces and 3D geometric modelling. The principles of computer graphics include the detailed concepts from graphic primitives to the transformations both in 2D and 3D. The fundamentals of CAD tools cover the concepts from CAD/CAM system evaluation criteria to the geometric modelling techniques like types of mathematical representations and rational curves. The mathematical representation of surfaces and their parametric representations are covered in detail with surface modelling. Parametric representation of synthetic surfaces and corresponding transformations both in 3D and 2D are discussed consequently. 3D geometric modelling along with solid and boundary representation techniques, STEP architecture and collaborative engineering concepts are discussed to complete the course.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	A70328	VII	CAD/CAM	4

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Advanced CAD	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
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Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz / Alternative Assessment Tool (AAT):

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO1	Independently carry out research / investigation and development work to solve practical problems	3	Presentation on Real-world problems
PO2	Write and present a substantial technical report / document.	1	Assignments
PO3	Abilities and capabilities in developing and applying computer software and hardware to mechanical design and manufacturing fields.	2	Seminar
PO4	Apply advanced level knowledge, techniques, skills and modern tools in the field of computer aided engineering to critically assess the emerging technological issues.	1	Assignments
PO5	Conduct experimental and/or analytical study and analyzing results with modern mathematical / scientific methods and use of software tools.	2	Presentation on Real-world problems
PO6	Design and validate technological solutions to defined problems and recognize the need to engage in lifelong learning through continuing education.	3	Presentation on Real-world problems
PO7	Function on multidisciplinary environments by working cooperatively, creatively and responsibly as a member of a team	2	Assignments

3 = High; 2 = Medium; 1 = Low

VII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Understand of basic trends in design and modeling applicable to CAD/CAM.
II	Applying the CAD tools for designing.
III	Create surface and geometric models.

VIII. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
BCCB01.01	CLO 1	Understand the principles of computer graphics	PO 1	3
BCCB01.02	CLO 2	Understand the coordinate systems and transformations in graphics	PO 1	3
BCCB01.03	CLO 3	Integrate various concepts of CAD tools	PO 1,PO 2	3
BCCB01.04	CLO 4	Prepare mathematical and geometric models	PO 1,PO 2	2
BCCB01.05	CLO 5	Represent parametrically various curves and splines	PO 2	2
BCCB01.06	CLO 6	Represent mathematically the surface models	PO 1,PO 2,PO 3	2
BCCB01.07	CLO 7	Represent parametrically various plane surfaces	PO 2	1
BCCB01.08	CLO 8	Represent parametrically various synthetic surfaces	PO 2, PO 3	1
BCCB01.09	CLO 9	Evaluate surface manipulation and transformations	PO 2	2
BCCB01.10	CLO 10	Understand 3D geometric modelling techniques	PO 1,PO 2	2
BCCB01.11	CLO 11	Distinguishes CAD/CAM exchange and formats	PO 1,PO 2,PO 3	3
BCCB01.12	CLO 12	Describe various design applications and collaborative engineering	PO 3, PO 6	3

3 = High; 2 = Medium; 1 = Low

IX. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CLO 1	3						
CLO 2	3						1
CLO 3	3	3					
CLO 4	3	2					
CLO 5		2					2
CLO 6	2	2	2				
CLO 7		1					
CLO 8		1	1				
CLO 9		2					
CLO 10	2	2					3
CLO 12			3			3	

3 = High; 2 = Medium; 1 = Low

X. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO1,PO2 PO3,PO6	SEE Exams	PO1,PO2, PO3,PO6	Assignments	PO 2	Seminars	PO 2
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO 3						

XI. ASSESSMENT METHODOLOGIES-INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XII. SYLLABUS

UNIT-I	PRINCIPLES OF COMPUTER GRAPHICS
Principles of computer graphics : Introduction, graphic primitives, point plotting, lines, Bresenham's circle algorithm, ellipse, transformation in graphics, coordinate systems, view port, 2D and 3D transformation, hidden surface removal, reflection, shading and generation of character.	
UNIT-II	CAD TOOLS

Definition of CAD Tools, Types of system, CAD/CAM system evaluation criteria, brief treatment of input and output devices. Graphics standard, functional areas of CAD, Modeling and viewing, software documentation, efficient use of CAD software; Geometric modeling: Types of mathematical representation of curves, wire frame models wire frame entities parametric representation of synthetic curves hermite cubic splines Bezier curves Bezier splines rational curves.	
UNIT-III	**SURFACE MODELING**
Mathematical representation surfaces, surface model, surface entities surface representation. Parametric representation of surfaces, plane surface, rule surface, surface of revolution, tabulated cylinder.	
UNIT-IV	**PARAMETRIC REPRESENTATION OF SYNTHETIC SURFACES**
Parametric representation of synthetic surfaces: : Hermite Bicubic surface, Bezier surface, Bezier Spline surface, COONs surface, Blending surface Sculptured surface, Surface manipulation; Displaying, Segmentation, Trimming, Intersection, Transformations (both 2D and 3D).	
UNIT-V	**GEOMETRIC MODELING – 3D**
Geometricmodelling-3D: Solid modeling, solid representation, boundary representation (13-rep), Constructive solid geometry (CSG). CAD/CAM exchange: Evaluation of data, exchange format, IGES data representations and structure, STEP Architecture, implementation, ACIS and DXF; Design applications: Mechanical tolerances, mass property calculations, finite element modeling and analysis and mechanical assembly; Collaborative engineering: Collaborative design, principles, approaches, tools, design systems.	
Text Books:	
1. Ibrhim Zeid, "Mastering CAD/CAM", Tata McGraw Hill, 2nd Edition, 2013. 2. P. N. Rao, "CAD/CAM Principles and Applications", Tata McGraw Hill, 3 rd Edition, 2010. 3. M. P. Groover, E. Zimmers, "CAD/ CAM Computer- Aided Design and Manufacturing", Pearson, 1st Edition, 2003. 4. R. Alavala Chennakesava, "CAD/ CAM Concepts and Applications", PHI, 1st Edition, 2013.	
Reference Books:	
1. Farid Amirouche, "Principles of Computer-Aided Design and Manufacturing, Pearson, 2nd Edition, 2004. 2. P. Radha Krishnan, "CAD/ CAM/ CIM", New Age International, 4th Edition, 2016. 3. Warren. S. Seames, "Computer Numerical Control Concepts and Programming", Delmar Cengage Learning, 4 th Edition, 2013	
E-Text Books:	
1. http://sbmpme.blogspot.in/2011/01/cad-cam-cim-p-radhakrishnan.html 2.https://www.scribd.com/doc/228624725/cad-cam-text-book-by-P-N-RAO	

XIII. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-2	**Classify** principles of computer graphics	CLO 1	T1:28.7 R1:2.6
3	**Explain** graphic primitives, plotting lines	CLO 1	T1:27.5 R1:2.7
4-5	**Explain** the Bresenham's circle algorithm, ellipse	CLO 1	T1:29.6 R1:2.6
6-7	**Compare** transformations in graphics, coordinate systems, view port, 2D and 3D transformations	CLO 1, 2	T1:29.7 R1:2.7
7	**Illustrate** hidden surface removal, reflection	CLO 2	T1:29.8 R1:4.4
8-9	**Illustrate** shading and generation of character.	CLO 2	T1:29.7 R1:2.7

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
10-11	**Describe** the CAD tools, types of system, CAD/CAM evaluation criteria, i/p and o/p devises	CLO 3	T1:30.7 R1:4.10
12-13	**Explain** Graphics standard, functional areas of CAD, modelling and viewing, software documentation	CLO 3	T1:29.8 R1:4.4
14-15	**Compare** geometric modeling and mathematical representation of curves, wire frame models and entities	CLO 4	T1:30.7 R1:4.10
16	**Explain** the parametric representation of synthetic curves	CLO 5	T2:33.9 R1:7.5
17-18	**Categorize** hermite cubic xplines, Bezier curves and splines rational curves	CLO 5	T2:35.10 R3:8.1
19-20	**Explain** mathematical representation of surfaces	CLO 6	T2:34.10 R2:7.5
20	**Explain** mathematical representation of surface model	CLO 6	T2:35.12 R1:9.2
21-22	**Explain** mathematical representation of surface entities and representation	CLO 6	T2:36.1 R2:9.4
23-24	**Describe** parametric representation of surfaces, plane surface	CLO 7	T2:37.1 R2:9.9
25-26	**Explain** parametric representation of surfaces, rule surface, surface of revolution	CLO 7	T2:37.1 R2:9.9
27	**Explain** parametric representation of surfaces, tabulated cylinder	CLO 7	T2:27.12 R1:11.9
28	**Explain** the Hermite bicubic surface	CLO 8	T2:27.12 R1:11.9
29	**Explain** beizer surface	CLO 8	T2:27.5 R1:10.2
30	**Explain** beizer spline surface	CLO 8	T2:27.5 R1:10.2
31-32	**Explain** COONs surface, Blending, sculptured surfaces	CLO 8	T2:27.7 R1:11.3
33	**Explain** Surface manipulation, displaying, segmentation	CLO 9	T2:27.8 R1:11.6
34-35	**Explain** trimming, intersection	CLO 9	T2:27.12 R1:11.7
36-37	**Illustrate** transformations – both 2D and 3D, solid modeling and representation and boundary representation	CLO 9, 10	T2:27.12 R1:11.8
38	**Illustrate** CSG, evaluation of data, exchange format	CLO 10	T2:27.12 R1:11.8
39-40	**Compare** IGES data representations and structure, STEP architecture, implementation ACIS, DXF	CLO 10	T2:27.12 R1:11.10
41-42	**Explain** Design applications, mechanical tolerances, mass property calculations	CLO 11	T2:27.12 R1:11.10
43	**Distinguish** FEM analysis and mechanical assembly	CLO 11	T3:27.14 R1:12.3
44	**Explain** collaborative design, principles and approaches	CLO 12	T2:27.12 R1:11.10
45	**Explain** the collaborative tools and design systems	CLO 12	T2:27.14 R1:12.3

XIV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed Actions	Relevance with POs
1	Encourage students to solve real time applications of CAD	Industrial Visits	PO 2,PO 6

Prepared by:
Dr.CH V K N S N Moorthy, Professor **HOD, ME**

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MECHANICALENGINEERING

COURSE DESCRIPTOR

Course Title	**ENGLISH FOR RESEARCH PAPER WRITING**				
Course Code	BCSB32				
Programme	M.Tech				
Semester	I	ME			
Course Type	Core				
Regulation	**IARE - R18**				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Dr. P Srinivasa Rao, Professor				
Course Faculty	Dr. P Srinivasa Rao				

I. COURSE OVERVIEW:

The purpose of this course is to accomplish the goal that each student will write during the term a research paper. From the initiation of a thesis statement to the editing of the final draft, the student will compose research paper under the direction of the course instructor. Depending on the topic under development, the student may also work with a faculty advisor in the pertinent discipline at research place or from his/her home institution. Students pursuing independent research projects may develop fundamental papers to fulfill academic requirements. The course is also available to creative writing students working on projects requiring extended research

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AHS001	II	English for Communication	4
UG		VII	Mini Project	
UG		VIII	Project work	

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
English for research paper writing	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

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Quiz / Alternative Assessment Tool (AAT):
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awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO1	Independently carry out research / investigation and development work to solve practical problems	1	Seminar
PO2	Write and present a substantial technical report / document.	3	Assignments
PO3	Abilities and capabilities in developing and applying computer software and hardware to mechanical design and manufacturing fields.	2	Seminar
PO4	Apply advanced level knowledge, techniques, skills and modern tools in the field of computer aided engineering to critically assess the emerging technological issues.	1	Assignments
PO5	Conduct experimental and/or analytical study and analyzing results with modern mathematical / scientific methods and use of software tools.	1	Seminar
PO6	Design and validate technological solutions to defined problems and recognize the need to engage in lifelong learning through continuing education.	2	Assignments
PO7	Function on multidisciplinary environments by working cooperatively, creatively and responsibly as a member of a team.	1	Seminar

3 = High; 2 = Medium; 1 = Low

VII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Develop the basic understanding of technical writing and tools that help with emphasis on modern writing skills.
II	Solve problems with techniques with advanced Probability and differential equations and numerical methods
III	Develop skill to think quantitatively and analyze problems critically

VIII. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
BCCB02.01	CLO 1	Critically read and analyse written texts	PO 2	3
BCCB02.02	CLO 2	Reflect on their previous writing experiences to enhance their current and future learning	PO 3	3
BCCB02.03	CLO 3	Interpret, summarise and critique academic texts	PO 2	3
BCCB02.04	CLO 4	Gather, evaluate and synthesise information from different academic sources	PO 6	2
BCCB02.05	CLO 5	Use a process writing approach: from planning to drafting and revising, to create different genres of academic texts	PO 3	2

BCCB02.06	CLO 6	Identify the elements of good academic writing and apply revision and editing strategies to improve their own and others' written texts	PO 2, PO 3	2
BCCB02.07	CLO 7	Identify good academic writing practices and adopt such practices to maintain academic honesty and avoid plagiarism during the writing process	PO 2	2
BCCB02.08	CLO 8	Elicit and respond to constructive peer feedback during the writing process and provide constructive feedback on the writing of their peers	PO 6	2
BCCB02.09	CLO 9	Identify the elements of good academic writing and apply revision and editing strategies to improve their own and others' written texts	PO 2	3
BCCB02.10	CLO 10	Identify writing practices and adopt better academic with honesty and avoid plagiarism during the writing process	PO 1, PO 2	2

3 = High; 2 = Medium; 1 = Low

IX. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CLO 1		3					
CLO 2			3				
CLO 3			3				
CLO 4		2				2	
CLO 5							
CLO 6		2	3				
CLO 7		2					
CLO 8						2	
CLO 9		2					
CLO 10	2	2					3

3 = High; 2 = Medium; 1 = Low

X. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO1, PO2PO3, PO6	SEE Exams	PO1, PO2, PO3, PO6	Assignments	PO 2	Seminars	PO 2
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO 3						

XI. ASSESSMENT METHODOLOGIES-INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XII. SYLLABUS

UNIT-I	
Planning and Preparation, word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	
UNIT-II	
Clarifying Who Did What, Highlighting Your Findings, Hedging And Criticizing, Paraphrasing And Plagiarism, Sections of a Paper, Abstracts, Introduction.	
UNIT-III	
Review of the Literature, Methods, Results, Discussions, Conclusions, The Final Check.	
UNIT-IV	
Key Skills are needed when writing a Title, Key Skills are needed when writing an Abstract, Key Skills are needed when writing an Introduction, Key Skills are needed when writing a Review of the Literature	
UNIT-V	
Skills are needed when writing the Methods, Skills are needed when writing the Results, Skills are needed when writing the Discussion, Skills are needed when writing the Conclusion	
UNIT-VI	
Useful Phrases, how to ensure paper is as good as it could possibly be the first time submission.	

XIII. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-2	**Classify** The methods of professional writing	CLO 1	T1:28.7 R1:2.6
3	**Explain** the methods of professional writing without vague meanings	CLO 1	T1:27.5 R1:2.7
4-5	**Explain** the Basic structure of technical paper writing	CLO 1	T1:29.6 R1:2.6
6-7	**Compare** Standard writing strategy of native English technical writers	CLO 1, 2	T1:29.7 R1:2.7
7	**Illustrate** key skills of narration and presentation of abstract idea with a kind of discussion.	CLO 2	T1:29.8 R1:4.4
8-9	**Illustrate** useful phases of communication in technical paper writing and communication	CLO 2	T1:29.7 R1:2.7

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
10-11	**Describe** the Standard discrete Normal	CLO 3	T1:30.7 R1:4.10
12-13	**Explain** the process of English writing for technical presentations	CLO 3	T1:29.8 R1:4.4
14-15	**Compare** the technical English paper writing with the professional course of communication	CLO 4	T1:30.7 R1:4.10
16	**Explain** the concept of academic paper writing	CLO 5	T2:33.9 R1:7.5
17-18	**Categorize** the article writing, thesis writing and reflective writing	CLO 5	T2:35.10 R3:8.1
19-20	**Explain** the concept of cohesive writing and structural integration of English writing	CLO 6	T2:34.10 R2:7.5
20	**Explain** Some sample research papers	CLO 6	T2:35.12 R1:9.2
21-22	**Explain** critical writing in the technical presentations	CLO 6	T2:36.1 R2:9.4
23-24	**Describe** steps and stages of conducting research and its method of documentation and presentation	LO 7	T2:37.1 R2:9.9
25-26	**Explain** the concept of citation and acknowledgment of referring the articles	LO 7	T2:37.1 R2:9.9
27	**Explain** the sample for technical reading skills	CLO 7	T2:27.12 R1:11.9
28	**Explain** the sample for technical writing skills	LO 8	T2:27.12 R1:11.9
29	**Explain** the process of good academic writing practices	CLO 8	T2:27.5 R1:10.2
30	**Explain** the process of peer review and constructive criticism and writing the same	LO 8	T2:27.5 R1:10.2
31-32	**Explain** the research paper interactions	CLO 8	T2:27.7 R1:11.3
33	**Explain** the structure of various types of technical presentations	CLO 9	T2:27.8 R1:11.6
34-35	**Explain** the structural paraphrasing	CLO 9	T2:27.12 R1:11.7
36-37	**Compare** technical abstract preparation with synopsis making	CLO 9, 10	T2:27.12 R1:11.8
38	**Illustrate** the formal communication and its form changes from last few years	CLO 10	T2:27.12 R1:11.8
39-40	**Compare** the structurally redundant technical paper with non redundant one	CLO 10	T2:27.12 R1:11.10
41-42	**Explain** the technical research and its presentation at various levels of exhibits	CLO 11	T2:27.12 R1:11.10
43	**Distinguish the** literature review and bibliography	CLO 11	T3:27.14 R1:12.3
44	**Explain** the potential of duplication of presentation	LO 12	T2:27.12 R1:11.10
45	**Explain** the process of final check and identifying key words	CLO 12	T2:27.14 R1:12.3
46-48	**Explain** the method of giving right title.	LO 12	T2:27.12 R1:11.10
49-50	**Explain** the complete idea of technical writing and conclude	LO 12	T2:27.12 R1:11.10

XIV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed Actions	Relevance with POs
1	Encourage students to read and write research content and prepare atleast one such document to communicate for publication	Seminars / NPTEL	PO 2

Prepared by:
Dr. P Srinivasa Rao, Professor

HOD, ME

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

MECHANICAL ENGINEERING

COURSE DESCRIPTOR

Course Title	**COMPUTER AIDED DESIGN LABORATORY**			
Course Code	BCCB09			
Programme	M.Tech (CAD/CAM)			
Semester	I	ME		
Course Type	Core			
Regulation	**IARE - R18**			
	Lectures	**Tutorials**	**Practical**	**Credits**
	-	-	3	2
Course Faculty	Dr. K CH APPARAO, Associate Professor			

I. COURSE OVERVIEW:

The course is aimed at giving exposure to and enhancing the knowledge and skills of fresh graduate engineers and engineers involved in the operational use of CNC machines. CAD helps the user to design and build simple or complex products, assemblies, and plants. At first they were very expensive and hard to learn. Nowadays, with the advent of fast personal computers, user friendly GUI interfaces, and much more efficient calculation algorithms, CAD/CAM has become a household name in the engineering and manufacturing field. In fact, because of these tools, an engineer has become a designer, eliminating the need for a full time drafter.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
PG	BCCB09	I	Computer Aided Design Laboratory	2

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Computer Aided Design Laboratory	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✘	CHALK & TALK	✔	VIVA	✘	ASSIGNMENTS	✘	Moocs
✔	LCD / PPT	✘	SEMINARS	✘	MINI PROJECT	✘	VIDEOS
✘	OPEN ENDED EXPERIMENTS						

V. EVALUATION METHODOLOGY:

Continuous internal assessment (CIA):
The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, with 20 marks for day to day evaluation and 10 marks for Internal Examination (CIE).

Semester End Examination (SEE):
The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the this courses is contains 12 experiments. The question paper pattern is as follows: Two full questions with 'either' 'or' choice will be drawn from each set. Each set contains 4 questions.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 10 marks for Continuous Internal Examination (CIE), 20 marks for Day to Day Evaluation.

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Day to Day Evaluation	
CIA Marks	10	20	30

Continuous Internal Examination (CIE):
Two CIE exam shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration consisting of two sets.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		**Strength**	**Proficiency assessed by**
PO 1	Apply advanced level knowledge, techniques, skills and modern tools in the field of computer aided engineering to critically assess the emerging technological issues.	3	Lab related Exercises
PO 2	Have abilities and capabilities in developing and applying computer software and hardware to mechanical design and manufacturing fields.	3	Lab related Exercises
PO 3	Conduct experimental and/or analytical study and analyzing results with modern mathematical / scientific methods and use of software tools.	3	Lab related Exercises
PO 6	Independently carry out research/investigation and development work to solve practical problems	2	Lab related Exercises

3= High; 2 = Medium; 1 = Low

VII. COURSE OBJECTIVES:

The course should enable the students to:	
I	Understanding the basic modern trends in design and manufacturing using CAD/CAM.
II	Learn Computer application in various manufacturing process and use of computer in manufacturing.
III	Advanced aspects of enabling computer aided technologies used in design.
IV	Solve design problem of mechanical part or components
V	Understanding and application of thermal analysis software for different parts

VIII. COURSE OUTCOMES (COs):

CO Code	CO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
BCCB09.01	CO 1	w complex geometries of machine components in sketcher mode.	PO1	3
BCCB09.02	CO 2	te programs to generate analytical and synthetic curves used in engineering practice.	PO1 PO2	3
BCCB09.03	CO 3	erate Freeform shapes in party mode to visualize components.	PO1 PO3	3
BCCB09.04	CO 4	ate complex engineering assemblies using appropriate assembly constraints.	PO6	2
BCCB09.05	CO 5	erstanding and application of thermal analysis software for different parts	PO1 PO3	3

3= High; 2 = Medium; 1 = Low

IX. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcomes (COs)	Program Outcomes (POs)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3						
CO 2	3	3					
CO 3	3		3				
CO 4						2	
CO 5	3		3				

3= High; 2 = Medium; 1 = Low

X. ASSESSMENT METHODOLOGIES–DIRECT:

CIE Exams	PO 1, PO 2, PO 3	SEE Exams	PO 1, PO 2, PO 3	Assignments	-	Seminars	-
Laboratory Practices	PO 1, PO 2, PO 3	Student Viva	PO 1, PO 2, PO 3, PO 6	Mini Project	-	Certification	-
Term Paper	-						

XI. ASSESSMENT METHODOLOGIES–INDIRECT:

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XII. SYLLABUS:

S No.	Experiment
1	PART AND ASSEMBLY MODELING OF PIPEVICE Construct the Drawing of VICE BODY
2	Construct the Drawing of SCREW ROD
3	Construct the Drawing of CUP
4	Construct the Drawing of SET SCREW
5	Construct the Drawing of Movable JAW and ROD
6	Construct the Drawing of Movable ROD
7	Assembly modeling of PIPEVICE
8	Static Analysis of Thick Cylinder
9	Stress Analysis of Rotating disc
10	Buckling Analysis of Pates
11	Large Deflection Analysis of Circular plate
12	Analysis of a Composite Plate

XIII. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No.	Learning Objectives	Topics to be covered
1-3	Overview of Computer Aided Design	Creation of working drawing, creating geometry, constraining the profile.
4-6	Understanding and applying the different types of CAD tools.	Extracting a part using tools, creating pattern of holes, translating rotating, mirroring, managing the specification tree.
7-9	Describe and identify the parts, to choose the functions and operations of a CAD system and draw up specifications	Creating sheets and views, creating text and dimensions.
10-12	Understand the keypad structure and Identify the type of materials of parts	Creating an assembly, moving components, assembling existing components, creating bill of materials,
13-15	Understand the shape design and use of sweep tools	Creating wire frame and surface geometry using generative shape design and sweep tools.
16-18	Understand the types of patches	Generation of Ferguson"s cubic surface patches, Bezier surface patches. Coons patch, import and export of drawing from other software.
19-21	Understanding the application of software , import and export of drawing	Coons patch, import and export of drawing from other software

Lecture No.	Learning Objectives	Topics to be covered
22-24	Understanding and applying the different analytical modes	Linear static analysis, automatic calculation of rigid body modes, uses specified eigen value shift, lumped and consistent mass matrices.
25-27	Understand the concepts of analytical techniques.	Buckling analysis, jacobi inverse iteration techniques, steady state harmonic response, mode superposition method, overall structural and damping.
28-30	Understand the concept of different dynamic and heat transfer analysis	Linear dynamic analysis, non linear static analysis, non-linear dynamic analysis. Steady state heat transfer analysis problems.
31-33	Understand the concept thermal analysis.	Transient heat transfer analysis, Familiarity with element library.
34-36	Understand and applying the thermal analysis software for result analysis.	Defining Boundary conditions, multipoint constraint familiarity with different types of loads. Results and analysis. Design optimization.
37-39	Internal Lab Exam	CIE-I

Prepared by:
Dr. K. CH APPARAO, Professor **HOD, ME**

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

MECHANICALENGINEERING

COURSE DESCRIPTOR

Course Title	**MATHEMATICAL METHODS IN ENGINEERING**				
Course Code	BCCB02				
Programme	M.Tech				
Semester	I	CAD/CAM			
Course Type	Core				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Chief Coordinator	Dr. P Srinivasa Rao, Professor				
Course Faculty	Dr. P Srinivasa Rao, Professor				

I. COURSE OVERVIEW:

The purpose of this course is to summarise, crystallise, enhance and give a forward orientation to the mathematical methods taught in undergraduate curriculum, with projections to future requirements. It is needed as background necessary to appreciate specialised advanced subjects in engineering and science, and also to engage in professional analysis, modelling, design and research.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AHSB11	II	Mathematical Transform Techniques	4

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Mathematical Methods in Engineering	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz / Alternative Assessment Tool (AAT):

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO1	Independently carry out research / investigation and development work to solve practical problems	3	Seminar
PO2	Write and present a substantial technical report / document.	1	Assignments
PO3	Abilities and capabilities in developing and applying computer software and hardware to mechanical design and manufacturing fields.	2	Seminar
PO4	Apply advanced level knowledge, techniques, skills and modern tools in the field of computer aided engineering to critically assess the emerging technological issues.	1	Assignments
PO5	Conduct experimental and/or analytical study and analyzing results with modern mathematical / scientific methods and use of software tools.	2	Seminar
PO6	Design and validate technological solutions to defined problems and recognize the need to engage in lifelong learning through continuing education.	3	Assignments
PO7	Function on multidisciplinary environments by working cooperatively, creatively and responsibly as a member of a team	2	Seminar

3 = High; 2 = Medium; 1 = Low

VII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Develop the basic understanding of range of Mathematics tools with emphasis on engineering applications.
II	Solve problems with techniques with advanced Probability and differential equations and numerical methods
III	Develop skill to think quantitatively and analyze problems critically

VIII. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
BCCB02.01	CLO 1	Evaluate the real roots of algebraic and transcendental equations by Bisection method, False position and Newton - Raphson method	PO 1	3
BCCB02.02	CLO 2	Apply the symbolic relationship between the operators using finite differences	PO 1	3
BCCB02.03	CLO 3	Apply the Newtons forward and Backward Interpolation method to determine the desired values of the given data at equal intervals	PO 2	3
BCCB02.04	CLO 4	Apply the Gauss forward and Backward Interpolation method to determine the desired values of the given data at equal intervals	PO 2	2
BCCB02.05	CLO 5	Apply the Interpolation method to determine the desired values of the given data at unequal intervals.	PO 2	2
BCCB02.06	CLO 6	Ability to curve fit data using several linear and non linear curves by method of least squares	PO 1, PO 3	2
BCCB02.07	CLO 7	Apply numerical methods to obtain approximate solutions to Taylors, Eulers, Modified Eulers and Runge-Kutta methods of ordinary differential equations	PO 2	1
BCCB02.08	CLO 8	Apply numerical methods to obtain approximate	PO 3	1

		solutions to Taylors, Eulers, Modified Eulers and Runge-Kutta methods of ordinary differential equations		
BCCB02.09	CLO 9	Apply the nature of properties to Laplace transform and inverse Laplace transform of the given function	PO 2	2
BCCB02.10	CLO 10	Solving Laplace transforms and inverse Laplace transform of a given function using shifting theorems	PO 1, PO 2	2
BCCB02.11	CLO 11	Evaluate Laplace transforms and inverse Laplace transform using derivatives of a given function	PO 1, PO 3	3
BCCB02.12	CLO 12	Evaluate Laplace transforms and inverse Laplace transform using multiplication of a variable to a given function.	PO 3, PO 6	3

3 = High; 2 = Medium; 1 = Low

IX. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CLO 1	3						
CLO 2	3						1
CLO 3		3					
CLO 4		2					
CLO 5		2					2
CLO 6	2		2				
CLO 7		1					
CLO 8			1				
CLO 9		2					
CLO 10	2	2					3
CLO11	3		3				
CLO 12			3			3	

3 = High; 2 = Medium; 1 = Low

X. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO1, PO2PO3, PO6	SEE Exams	PO1, PO2, PO3, PO6	Assignments	PO 2	Seminars	PO 2
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO 3						

XI. ASSESSMENT METHODOLOGIES-INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XII. SYLLABUS

UNIT-I	**INTRODUCTION TO PROBABILITY**
Theory Probability, Theory and Sampling Distributions, Basic probability theory along with examples. Standard discrete and continuous distributions like Binomial, Poisson, Normal, Exponential etc. Central Limit Theorem and its significance. Some sampling distributions like X 2 , t, F.	
UNIT-II	**TESTING OF STATISTICAL HYPOTHESIS**
Testing a statistical hypothesis, tests on single sample and two samples concerning means and variances. ANOVA: One – way, Two – way with/without interactions.	
UNIT-III	**ORDINARY DIFFERENTIAL EQUATIONS**
Ordinary linear differential equations solvable by direct solution methods; solvable nonlinear ODE's.	
UNIT-IV	**PARTIAL DIFFERENTIAL EQUATIONS AND CONCEPTS IN SOLUTION TO BOUNDARY VALUE PROBLEMS**
First and second order partial differential equations; canonical forms.	
UNIT-V	**MAJOR EQUATION TYPES ENCOUNTERED IN ENGINEERING AND PHYSICAL SCIENCES**
Solution methods for wave equation, D'Alembert solution, potential equation, properties of harmonic functions, maximum principle, solution by variable separation method.	
Text Books:	
1. J. B. Doshi, "Differential Equations for Scientists and Engineers", Narosa, New Delhi. 2. Douglas C. Montgomery, "Design and Analysis of Experiments (7th Edition)", Wiley Student Edition.	
Reference Books:	
1.S. P. Gupta, "Statistical Methods", S. Chand & Sons, 37th revised edition. 2. Erwin Kreyszig," Advanced Engineering Mathematics (9th Edition)", Wiley India.	

XIII. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-2	**Classify** Theory Probability	CLO 1	T1:28.7 R1:2.6
3	**Explain** the Theory and Sampling Distributions	CLO 1	T1:27.5 R1:2.7

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
4-5	**Explain** the Basic probability theory	CLO 1	T1:29.6 R1:2.6
6-7	**Compare** Standard discrete and continuous distributions	CLO 1, 2	T1:29.7 R1:2.7
7	**Illustrate** Binomial	CLO 2	T1:29.8 R1:4.4
8-9	**Illustrate** Standard discrete Poisson,	CLO 2	T1:29.7 R1:2.7
10-11	**Describe** the Standard discrete Normal	CLO 3	T1:30.7 R1:4.10
12-13	**Explain** the continuous distributions explonential	CLO 3	T1:29.8 R1:4.4
14-15	**Compare** geometric modeling and mathematical representation of curves.	CLO 4	T1:30.7 R1:4.10
16	**Explain** the Central Limit Theorem	CLO 5	T2:33.9 R1:7.5
17-18	**Categorize** significance of Central Limit Theorem	CLO 5	T2:35.10 R3:8.1
19-20	**Explain** mathematical representation of center limit	CLO 6	T2:34.10 R2:7.5
20	**Explain** Some sampling distributions	CLO 6	T2:35.12 R1:9.2
21-22	**Explain** mathematical representation of distributions like X 2 , t, F.	CLO 6	T2:36.1 R2:9.4
23-24	**Describe** parametric representation Testing a statistical hypothesis	CLO 7	T2:37.1 R2:9.9
25-26	**Explain** the tests on single sample	CLO 7	T2:37.1 R2:9.9
27	**Explain** the two samples concerning means	CLO 7	T2:27.12 R1:11.9
28	**Explain** the two samples concerning variance	CLO 8	T2:27.12 R1:11.9
29	**Explain** the One – way without interactions	CLO 8	T2:27.5 R1:10.2
30	**Explain** the One – way with interactions	CLO 8	T2:27.5 R1:10.2
31-32	**Explain** the Two – way with interactions	CLO 8	T2:27.7 R1:11.3
33	**Explain** the Two – way without interactions	CLO 9	T2:27.8 R1:11.6
34-35	**Explain** the Ordinary linear differential equations	CLO 9	T2:27.12 R1:11.7
36-37	**Illustrate** the solvable by direct solution methods	CLO 9, 10	T2:27.12 R1:11.8
38	**Illustrate** the solvable nonlinear ODE's.	CLO 10	T2:27.12 R1:11.8
39-40	**Compare** First and second order partial differential equations	CLO 10	T2:27.12 R1:11.10
41-42	**Explain** the canonical forms	CLO 11	T2:27.12 R1:11.10
43	**Distinguish the** Solution methods for wave equation	CLO 11	T3:27.14 R1:12.3
44	**Explain** the potential equation	CLO 12	T2:27.12 R1:11.10
45	**Explain** the properties of harmonic functions	CLO 12	T2:27.14 R1:12.3

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
46-48	**Explain** the maximum principle	CLO 12	T2:27.12 R1:11.10
49-50	**Explain** the solution by variable separation method.	CLO 12	T2:27.12 R1:11.10

XIV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed Actions	Relevance with POs
1	Encourage students to solve real time applications and prepare towards competitive examinations	Seminars / NPTEL	PO 2

Prepared by:
Dr. P Srinivasa Rao, Professor **HOD, ME**

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

MECHANICAL ENGINEERING

COURSE DESCRIPTOR

Course Title	**RAPID PROTOTYPE TECHNOLOGIES**				
Course Code	BCCB03				
Programme	M.Tech				
Semester	I I				
Course Type	Core				
Regulation	**IARE - R18**				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Course Faculty	Dr. G.V.R Seshagiri Rao, Professor, ME				

I. COURSE OVERVIEW:

This course bridges gap between idea and production. Rapid prototyping is a group of methods used to rapidly manufacture a scale model of a physical part or assembly using three-dimensional computer aided design (CAD), Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) data. Construction of the part or assembly is usually done using 3D printing technology. Rapid prototyping techniques are often referred to solid free; computer automated manufacturing, form fabrication. This course covers the knowledge of rapid prototyping systems.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AME510	VI	Additive Manufacturing techniques	3

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Rapid Prototype Technologies	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	LCD / PPT	✔	Seminars	✔	Videos	✔	MOOCs
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into fiveunits and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz / Alternative Assessment Tool (AAT):

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		**Strength**	**Proficiency assessed by**
PO 1	Apply advanced level knowledge, techniques, skills and modern tools in the field of computer aided engineering to critically assess the emerging technological issues.	3	Presentation on Real-world problems
PO 2	Have abilities and capabilities in developing and applying computer software and hardware to mechanical design and manufacturing fields.	2	Projects

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 3	Conduct experimental and/or analytical study and analyzing results with modern mathematical / scientific methods and use of software tools.	2	Assignments
PO 4	Function on multidisciplinary environments by working cooperatively, creatively and responsibly as a member of a team.	1	Seminars
PO5	Write and present a substantial technical report / document.	3	Projects
PO6	Independently carry out research / investigation and development work to solve practical problems	2	projects
PO7	Design and validate technological solutions to defined problems and recognize the need to engage in lifelong learning through continuing education.	1	Seminars

3 = High; 2 = Medium; 1 = Low

VII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Describe product development, conceptual design and classify rapid prototyping systems; explain stereo lithography process and applications
II	Identify The process photopolymers, photo polymerization, layering technology, laser and laser scanning
III	Applying of measurement and scaling technique for prototype manufacturing.

VIII. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO1	Describe product development, conceptual design and classify rapid prototyping systems; explain stereo lithography process and applications.	CLO 1	Identify and understand of basic concepts of Rapid prototyping technologies
		CLO 2	Understand and Apply concepts of Rapid prototyping
		CLO 3	Understand and Apply concepts of Rapid prototyping
CO2	Identify The process photopolymers, photo polymerization, layering technology, laser and laser scanning	CLO 4	Apply the concepts of prototyping technology
		CLO 5	Apply the concepts of prototyping technology
		CLO6	Understand the selection of manufacturing method
CO3	Applying of measurement and scaling technique for prototype manufacturing.	CLO 7	Identify the Layering Technology, Applications.
		CLO 8	Understand the different models and specifications
		CLO 9	Understand the different models and specifications
CO4	Identify the Rapid Prototyping Data Formats	CLO 10	Identify the Rapid Prototyping Data Formats
		CLO 11	Identify the Rapid Prototyping Data Formats
		CLO 12	Identify the Rapid Prototyping Data Formats

CO5	Application for powder based rapid prototyping systems	CLO 13	Application for powder based rapid prototyping systems
		CLO 14	Application for powder based rapid prototyping systems
		CLO 15	Application for powder based rapid prototyping systems

3 = High; 2 = Medium; 1 = Low

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
BCCB13.01	CLO 1	To Study the Various Experimental Techniques.	PO 1	3
BCCB13.02	CLO 2	Involved forMeasuringDisplacements,Stresses, Strains in Structural Components	PO 1	3
BCCB13.03	CLO 3	Understand the shear force and bending moment diagrams of symmetrical beams	PO 1,PO 2	3
BCCB13.04	CLO 4	To Study the Various Experimental Techniques.	PO 1,PO 2	2
BCCB13.05	CLO 5	Involved forMeasuringDisplacements,Stresses, Strains in Structural Components	PO 2	2
BCCB13.06	CLO 6	To Study the Various ExperimentalTechniques.	PO 1,PO 2,PO 3	2
BCCB13.07	CLO 7	Involved for Measuring Displacements, Stresses, Strains in Structural Components	PO 2	1
BCCB13.08	CLO 8	Distinguish bending and shear stresses developed in beams of various sections	PO 2, PO 3	1
BCCB13.09	CLO 9	Involved for MeasuringDisplacements,Stresses, Strains in Structural Components	PO 2	2
BCCB13.10	CLO 10	Understand the shear force and bending moment diagrams of symmetrical beams	PO 1,PO 2	2
BCCB13.11	CLO 11	To Study the Various Experimental Techniques.	PO 1,PO 2,PO 3	3
BCCB13.12	CLO 12	Distinguish bending and shear stresses developed in beams of various sections	PO 3, PO 6	3
BCCB13.13	CLO 13	Distinguish bending and shear stresses developed in beams of various sections	PO 2, PO 6	3
BCCB13.14	CLO 14	To Study the Various Experimental Techniques	PO 3,PO 2	3
BCCB13.15	CLO 15	Distinguish bending and shear stresses developed in beams of various sections	PO 3, PO 6	1

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

(COs)	Course Outcomes						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3						
CO 2	3		2	3		3	
CO 3	3	3	2	3		3	
CO 4	3	2	1	3	3	3	3
CO 5		2			2	3	2

3 = High; 2 = Medium; 1 = Low

XI. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CLO 1	3						
CLO 2	3						
CLO 3	3	3					
CLO 4	3	2					
CLO 5		2					
CLO 6	2	2	2				
CLO 7		1					
CLO 8		1	1				
CLO 9		2					
CLO 10	2	2					
CLO 12			3			3	
CLO 13		3				3	
CLO 14		3	3				
CLO 15			1			1	

3 = High; 2 = Medium; 1 = Low

XII. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO1, PO3, PO5	SEE Exams	PO1, PO3, PO5	Seminar and Term Paper	PO1, PO2, PO3, PO5
Viva	-	Mini Project	-	Laboratory Practices	-

XIII. ASSESSMENT METHODOLOGIES-INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIV. SYLLABUS

UNIT-I	INTRODUCTION TO RAPID PROTOTYPING
Introduction: Prototyping fundamentals, Historical development, Fundamentals of Rapid Prototyping, Advantages and Limitations of Rapid Prototyping, Commonly used Terms, Classification of RP process, Rapid Prototyping Process Chain: Fundamental Automated Processes, Process Chain.	

UNIT-II	TYPES OF PROTOTYPING SYSTEMS
Liquid-based Rapid Prototyping Systems: Stereo lithography Apparatus (SLA): Models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages, case studies. solid ground curing (SGC): models and specifications, process, working principle, applications, advantages and disadvantages, case studies; solid-based Rapid Prototyping Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.	
UNIT-III	**POWDER BASED RAPID PROTOTYPING SYSTEMS AND TOOLING**
Powder Based Rapid Prototyping Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs. RT, Need for RT. Rapid Tooling Classification: Indirect Rapid Tooling Methods: Spray Metal Deposition, RTV Epoxy Tools, Ceramic tools, Investment Casting, Spin Casting, Die casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.	
UNIT-IV	**RAPID PROTOTYPING DATA FORMAT**
Rapid Prototyping Data Formats: STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Rapid Prototyping Software‟s: Features of various RP software‟s like Magic‟s, Mimics, Solid View, View Expert, 3 D View, Velocity 2 , Rhino, STL View 3 Data Expert and 3 D doctor.	
UNIT-V	**RAPID PROTOTYPING APPLICATIONS**
RP Applications: Application, Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules.	
Text Books:	
Chua C.K., Leong K.F, LIM C.S, “Rapid prototyping: Principles and Applications”,World Scientific publication Edition, 2010.	
Reference Books:	
1. D.T Pham, S. S. Dony, “Rapid Manufacturing”, Springer, 1st Edition, 2001. 2. Paul F Jacobs, “Rapid Prototyping & Manufacturing”, Wohlers Associates, 2000 ASME Press, 1st Edition, 1996	

XIV COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topic Outcomes	Topic/s to be covered	Reference
1-3	Identify and understand of basic concepts of Rapid prototyping technologies	Introduction To Rapid Prototyping, Prototyping fundamentals, Historical Development	T1, R1
4-7	Understand and Apply concepts of Rapid prototyping	Advantages And Limitations Of Rapid Prototyping, Commonly Used Terms Classification Of RP Process, Rapid Prototyping Process Chain	T1
8-11	Apply the concepts of prototyping technology	Fundamental Automated Processes, Process Chain, Types Of Prototyping Systems, Liquid-Based Rapid Prototyping Systems	T1, R2, R1
12-16	Understand the selection of manufacturing method	Stereo Lithography Apparatus (Sla): Models And Specifications, Process Working Principle, Photopolymers, Photo polymerization	T1

17-20	Identify the Layering Technology, Applications.	Layering Technology, Laser And Laser Scanning, Applications, Advantages And Disadvantages, Case Studies, Solid Ground Curing (Sgc)	T1,R2
21-25	Understand the different models and specifications	Models And Specifications, Process, Working Principle, Applications, Solid-Based Rapid Prototyping Systems	T1, R1
26-29	Understand and apply the Laminated Object Manufacturing	Laminated Object Manufacturing (Lom), Models And Specifications Process, Working Principle, Applications, Advantages And Disadvantages, Case Studies.	T1, R1
30-33	Understand and apply the Fused Deposition Modeling	Fused Deposition Modeling (Fdm) Models And Specifications, Process, Working Principle, Applications, Advantages And Disadvantages, Case Studies.	T1, R1

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed Actions	Relevance with Pos
1	To improve standards and analyze the concepts.	Seminars	PO 1
2	Concepts related to Additive Manufacturing	Seminars / NPTEL	PO 2, PO 3
3	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 2, PO 6, PO7

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INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

MECHANICAL ENGINEERING

COURSE DESCRIPTOR

Course Title	**COMPUTATIONAL TECHNIQUES LABORATORY**			
Course Code	BCCB10			
Programme	M.Tech			
Semester	I	CAD/CAM		
Course Type	Core			
Regulation	**IARE - R18**			
	Lectures	**Tutorials**	**Practical**	**Credits**
	-	-	4	2
Course Faculty				

I. COURSE OVERVIEW:

The aim of this course is to write programme for analysis of mechanical structures through mathematical modeling. It is a high-level language for numerical computation, visualization and application development. It also provides an interactive environment for iterative exploration, design and problem solving. It provides vast library of mathematical functions for linear algebra, statistics, Fourier analysis, filtering, optimization, numerical integration and solving ordinary differential equations. It provides built-in graphics for visualizing data and tools for creating custom plots. MATLAB's programming interface gives development tools for improving code quality maintainability and maximizing performance.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AME002	II	Engineering Mechanics	4
UG	AMEB04	III	Thermodynamics	4
UG	AMEB10	IV	Kinematics of Machines	4

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Computational Techniques Laboratory	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✘	CHALK &TALK	✔	VIVA	✘	ASSIGNMENTS	✘	Moocs
✔	LCD / PPT	✘	SEMINARS	✘	MINI PROJECT	✘	VIDEOS
✘	OPEN ENDED EXPERIMENTS						

V. EVALUATION METHODOLOGY:

Continuous internal assessment (CIA):

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, with 20 marks for day to day evaluation and 10 marks for Internal Examination (CIE).

Semester End Examination (SEE):

The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the this courses is contains 12 experiments. The question paper pattern is as follows: Two full questions with 'either' 'or' choice will be drawn from each set. Each set contains 4 questions.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 10 marks for Continuous Internal Examination (CIE), 20 marks for Day to Day Evaluation.

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Day to Day Evaluation	
CIA Marks	10	20	30

Continuous Internal Examination (CIE):

Two CIE exam shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration consisting of two sets.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		**Strength**	**Proficiency assessed by**
PO 1	Apply advanced level knowledge, techniques, skills and modern tools in the field of computer aided engineering to critically assess the emerging technological issues.	3	Lab related Exercises
PO 3	Conduct experimental and/or analytical study and analyzing results with modern mathematical / scientific methods and use of software tools.	2	Lab related Exercises
PO 6	Independently carry out research / investigation and development work to solve practical problems	3	Lab related Exercises
PO 7	Design and validate technological solutions to defined problems and recognize the need to engage in lifelong learning through continuing education.	1	Lab related Exercises

3= High; 2 = Medium; 1 = Low

VII. COURSEOBJECTIVES:

The course should enable the students to:	
I	Develop MAT LAB programs for simple and complex engineering problems.
II	Interpret the output graphical plots for the given governing equation.
III	Apply the MATLAB programming to real time applications.

VIII. COURSE OUTCOMES (COs):

CLO Code	CO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
BCCB10.01	CO 1	elop MAT LAB programs for simple and complex engineering problems.	PO1 PO7	3
BCCB10.02	CO 2	e to learn thermal stress anlysis on I C Engines piston	PO1 PO3	3
BCCB10.03	CO 3	nulate the ideal and real gas equations	PO1 PO6	3
BCCB10.04	CO 4	e to learn the grapghing function of one variable and two variables	PO1	2
BCCB10.05	CO 5	e to do dynamic and vibrational analysis using multi body dynamics softwears	PO1 PO6 PO7	3

3= High; 2 = Medium; 1 = Low

IX. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcomes (COs)	Program Outcomes (POs)			
	PO1	PO3	PO6	PO7
CO 1	3			3
CO 2	3	2		
CO 3	3		3	
CO 4	2			
CO 5	3		3	2

3= High; 2 = Medium; 1 = Low

X. ASSESSMENT METHODOLOGIES–DIRECT:

CIE Exams	PO 1, PO 3, PO 7	SEE Exams	PO 1, PO 3, PO 7	Assignments	-	Seminars	-
Laboratory Practices	PO 1, PO 3, PO 7	Student Viva	PO 1, PO 3, PO 7	Mini Project	-	Certification	-
Term Paper	-						

XI. ASSESSMENT METHODOLOGIES–INDIRECT:

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XII. SYLLABUS:

S No.	Experiment
1	Applications to MATLAB in Mechanical Engineering.
2	Thermal stress analysis of Piston.
3	Formulation of ideal and real gas equations.
4	Graphing-functions of one variable and two variables
5	Use of MATLAB to solve simple problems in vibration, Mechanism Simulation using multi body
6	Dynamics and vibration analysis
7	Pipe flow analysis.

XIII. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No.	Learning Objectives	Topics to be covered
1-3	Algorithm development, Scientific and engineering graphics, Modeling, simulation, and prototyping, Application development, including Graphical User Interface building, Math and computation,Data analysis, exploration, and visualization	Applications to MATLAB in Mechanical Engineering
4-6	Thermal stress analysis of piston	Thermal stress analysis of Piston.
7-9	Developing the algorithams for gas equations	Formulation of ideal and real gas equations.
10-12	Plotting the graph for sin(x), cos(x), tan(x), csc (x), Hold on command application in drawing the multiple plots	Graphing-functions of one variable and two variables
13-15	Degree of freedom, Equations of motion	Use of MATLAB to solve simple problems in vibration, Mechanism Simulation using multi body dynamic software
16-18	Kinematics, four bar mechanism, slider crank mechanism, analysis	Dynamics and vibration analysis
19-21	Wring the programme for flow analysis	Pipe flow analysis.

Prepared by:
Mr. M Prashanth Reddy, Assistant Professor

HOD, ME

II SEMESTER

INSTITUTE OF AERONAUTICAL ENGINEERING

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MECHANICALENGINEERING

COURSE DESCRIPTOR

Course Title	**ADVANCED FINITE ELEMENT METHOD**				
Course Code	BCCB11				
Programme	M.Tech				
Semester	II	CAD/CAM			
Course Type	Core				
Regulation	**IARE - R18**				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Chief Coordinator	Dr. P. Rao Srinivas, Professor, ME				
Course Faculty	Dr. P. Rao Srinivas, Professor, ME				

I. COURSE OVERVIEW:

The Finite Element Method (FEM) is widely used in industry for analyzing and modeling structures and continua, whose physical behavior is described by ordinary and partial differential equations. The FEM is particularly useful for engineering problems that are too complicated to be solved by classical analytical methods. The standard discrete system, Finite elements of an elastic continuum displacement approach, Generalization of finite element concepts- weighted residual and variational approaches. Element types: triangular, rectangular, quadrilateral, sector, curved, iso-parametric elements and numerical integration. Application to structural mechanics problems: plane stress and plane strains. Axisymmetric stress analysis, introduction to three dimensional stress analysis. The main objective of this course is to introduce the mathematical concepts of the advanced Finite Element Method for obtaining an approximate solution of ordinary and partial differential equations.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AME014	VI	FEM	4
UG	AME004	III	Mechanics of Solids	4

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Advanced Finite Element Method	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into fiveunits and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz / Alternative Assessment Tool (AAT):

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be

awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO1	**Engineering Knowledge**: Capability to apply the knowledge of mathematics, science and engineering in the field of mechanical engineering.	**3**	Assignments
PO2	**Problem Analysis:** An ability to analyze complex engineering problems to arrive at relevant conclusion using knowledge of mathematics, science and engineering.	**2**	Assignments
PO3	**Design/development of solutions:** Competence to design a system, component or process to meet societal needs within realistic constraints.	**2**	Seminars
PO5	**Modern tool usage:** An ability to formulate solve complex engineering problem using modern engineering and information Technology tools.	**2**	Videos

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO1	**Professional Skills:** To produce engineering professional capable of synthesizing and analyzing mechanical systems including allied engineering streams.	**2**	Assignments
PSO2	**Problem solving skills**: An ability to adopt and integrate current technologies in the design and manufacturing domain to enhance the employability.	**3**	Seminars
PSO3	**Successful career and Entrepreneurship**: To build the nation, by imparting technological inputs and managerial skills to become technocrats.	**2**	Guest Lectures

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Introduce basic concepts of finite element methods including domain discretization, polynomial interpolation and application of boundary conditions.
II	Understand the theoretical basics of governing equations and convergence criteria of finite element method.
III	Use the commercial Finite Element packages to build Finite Element models and solve a selected range of engineering problems.
IV	Understand to improve or refine the approximate solution by spending more computational effort by using higher interpolation continuities unlike expensive experimental methods/exact solutions.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
BCCB11.01	CLO 1	Understand the numerical methods and development of mathematical models for physical system	PO 1	3
BCCB11.02	CLO 2	Identify mathematical model for solution of common engineering problems in the field of aeronautical, mechanical and civil	PO 1	3
BCCB11.03	CLO 3	Understand the concepts of shape functions for one dimensional and quadratic elements, stiffness matrix and boundary conditions	PO 1	3
BCCB11.04	CLO 4	Remember the steps involved in finite element methods while solving the model of physical problem	PO 2	2
BCCB11.05	CLO 5	Apply numerical methods for solving one dimensional bar problems	PO 2	2
BCCB11.06	CLO 6	Identify the mathematical models for two-dimensional, three-dimensional truss and beam elements	PO 2	2
BCCB11.07	CLO 7	Solve the equations of truss and beam elements	PO 2	1
BCCB11.08	CLO 8	Calculate stress strain and strain energy for common engineering problems	PO 3	1
BCCB11.09	CLO 9	Derive element matrix by different methods by applying basic laws in mechanics and integration by parts	PO 3	2
BCCB11.10	CLO 10	Demonstrate the ability to evaluate and interpret FEA analysis results for design and development purposes	PO 3	2
BCCB11.11	CLO 11	Formulate simple and complex problems into finite elements and solve structural and thermal problems	PO 1	3
BCCB11.12	CLO 12	Derive the element stiffness matrices for triangular elements and axisymmetric solids and estimate the load vector and stresses	PO 5	3
BCCB11.13	CLO 13	Understand the concepts of steady state heat transfer analysis for one dimensional slab, fin and thin plate	PO 5	3
BCCB11.14	CLO 14	Understand the concepts of mass and spring system and derive the equations for various structural problems	PO 1	3
BCCB11.15	CLO 15	Calculate the mass matrices; Eigen values Eigen vectors and natural frequency for dynamic problems	PO 5	2
BCCB11.16	CLO 16	Model multi-dimensional structural and heat transfer problems by using automatic and fully automatic software such as ANSYS, NISA, NASTRAN	PO 5	2

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CLOs	Program Outcomes (POs)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CLO 1	3						
CLO 2	3						
CLO 3	3						
CLO 4		2					
CLO 5		2					
CLO 6		2					
CLO 7		1					
CLO 8			1				
CLO 9			2				
CLO 10			2				
CLO 11	3						
CLO 12					3		
CLO 13					3		
CLO 14	3						
CLO 15					2		
CLO 16					2		

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO1, PO2, PO3, PO5	SEE Exams	PO1, PO2, PO3, PO5	Assignments	PO 1, PO 2	Seminars	PO 3, PO 5
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES-INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

Unit-I	FINITE ELEMENT METHODS – A REVIEW
Governing differential equations of one – and two dimensional problems, Library of one dimensional and two dimensional elements; Gauss Quadrature and iso parametric elements- Stress calculation and Gauss points convergence requirements and patch test.	
Unit-II	**BENDING OF PLATES AND SHELLS**
Bending of plates and shells- Finite element formulations of plates and shell elements – Thin and thick plates – Conforming and non conforming elements –C0 and C1 continuity elements –Shell elements as de generate 3D stress elements and Applications	
Unit-III	**THREE DIMENSIONAL SOLIDS**
Introduction- Tetrahedral elements hexahedron elements Linear and Higher order elements- Elements with curved surfaces.	
Unit-IV	**SPECIALPURPOSE ELEMENTS**
Crack tip elements- Transition elements – Finite strip elements – Strip element method – Method of infinite domains – nodeless elements	
Unit-V	**NON LINEAR ANALYSIS**
Introduction to non linear analysis Material Non linearity and non linearity –plasticity creep visco-plasticity Non Linear constitutive problem in solid mechanics- Various yield considerations – solution procedures and direct Iteration method Newton Rapson method and modified newton rapson method , application in any one manufacturing process.	
Text Books:	
1. Robert D. Cook David S. Malkus, Michel E. Plesha Robert J. Whitt Concepts and applications of Finite element analysis John Whiley & Sons,	
2. O.C. Zienkowitz, ―The Finite Element Method in Engineering Science‖, McGraw-Hill, 1st Edition, 2013.	
Reference Books:	
Bathe .K. J, ―Finite Element procedures, Printicehall,, 2006.	
S. S. Rao, ―The Finite Element Methods in Engineering, Elsevier, 4th Edition, 2013.	
J. N. Reddy, ―An Introduction to Finite Element Methods, McGraw-Hill, 1st Edition, 2013.	

XIV. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-2	Governing differential equations of one – and two dimensional problems	CLO 1	T1:1.4 R1:1.2
3-5	Derivation of differential equations of one – and two dimensional problems,	CLO 1	T1:1.5 R1:2.4
6-7	Library of one dimensional and two dimensional elements	CLO 2	T1:2.5 R1:2.5
7-8	Library of one dimensional and two dimensional elements; Gauss Quadrature and iso parametric elements-	CLO 3	T1:2.5 R1:2.6
9-11	Stress calculation and Gauss points convergence requirements and patch test.	CLO 4	T1:22.7
12-13	Application of stress calculation and Gauss points convergence requirements and patch test.	CLO 4	T1:6.3 R1:5.3
14-16	Bending of plates and shells- Finite element formulations of plates and shell elements	CLO 5	T1:6.6 R1:5.3.6

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
17-19	Thin and thick plates – Conforming and non conforming elements	CLO 6	R1:6.2
20-22	C0 and C1 continuity elements –Shell elements as de generate 3D stress elements and Applications	CLO 7	T1:7.5 R1:6.3
23-25	Finite element-formulation to 3D problems in stress analysis convergence requirements, mesh generation	CLO 8	T1:8.5 R1:6.8
26-29	Techniques such as semi-automatic and fully automatic use of softwares	CLO 9	T1:12.2 R1:13.1
30-31	Introduction- Tetrahedral elements hexahedron elements Linear and Higher order elements- Elements with curved surfaces.	CLO 10	T1:12.3 R1:13.2
32-34	Crack tip elements- Transition elements – Finite strip elements –	CLO 11	T1:12.10 R1:13.7
35-36	Strip element method – Method of infinite domains – nodeless elements	CLO 12	T1:11.2 R1:10.2
37-38	Introduction to non linear analysis Material Non linearity and non linearity	CLO 13	T1:11.5 R1:10.3
39-41	plasticity creep visco-plasticity Non Linear constitutive problem in solid mechanics	CLO 14	T1:11.12 R1:11.9
42-43	Various yield considerations – solution procedures and direct Iteration method	CLO 15	T1:11.8 R1:11.5
44-45	Newton Rapson method and modified Newton rapsonmethod , application in any one manufacturing process.	CLO 16	T1:9.9

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S NO	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Gain information about space frames used in the modeling of carbody and bicycle frames.	Seminars	PO1, PO2	PSO3
2	Encourage students to perform analysis on composite materials using FEM applications.	Guest Lectures	PO1, PO3, PO5	PSO2

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MECHANICALENGINEERING

COURSE DESCRIPTOR

Course Title	**COMPUTER INTEGRATED MANUFACTURING**				
Course Code	BCCB12				
Programme	M.Tech				
Semester	II	CAD/CAM			
Course Type	Core				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Chief Coordinator	Dr. K. Raghu Ram Mohan Reddy, Professor				
Course Faculty	Dr. K. Raghu Ram Mohan Reddy, Professor				

I. COURSE OVERVIEW:

Computer Integrated Manufacturing (CIM) encompasses the entire range of product development and manufacturing activities with all the functions being carried out with the help of dedicated software packages. The data required for various functions are passed from one application software to another in a seamless manner. For example, the product data is created during design. This data has to be transferred from the modeling software to manufacturing software without any loss of data. CIM uses a common database wherever feasible and communication technologies to integrate design, manufacturing and associated business functions that combine the automated segments of a factory or a manufacturing facility. CIM reduces the human component of manufacturing and thereby relieves the process of its slow, expensive and error-prone component. CIM stands for a holistic and methodological approach to the activities of the manufacturing enterprise in order to achieve vast improvement in its performance.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	A70328	VII	CAD/CAM	4

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Computer Integrated Manufacturing	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz / Alternative Assessment Tool (AAT):

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Capability to apply the knowledge of mathematics, science and engineering and Mechanical Engineering principles related to combustion engines.	3	Presentation on Real-world problems
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complexengineering problems reaching substantiated conclusions using Thermodynamics concepts and principles.	2	Seminar
PO 3	**Design/ development of solutions:** Design, implement, and evaluate a Mechanical Engineering component, to meet desired needs within realistic constraints	1	Assignments
PO 6	**The engineer and society**: Maintaining the engineering practices such as time, efficiency, as well as appropriate constraints related to economic, environmental, ethical, health and safety, manufacturability, and sustainability considerations	1	Seminars

3 = High; 2 = Medium; 1 = Low

VII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	The basic components of CIM and its hardware and software
II	CAD/CAM and its integration with CIM
III	FMS and its applications
IV	Principles of computer aided process planning, JIT and GT

VIII. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
BCCB12.01	CLO 1	Understand the components of CIM	PO 1	3
BCCB12.02	CLO 2	Understand the needs and benefits of CIM	PO 1	3
BCCB12.03	CLO 3	Study the NC,CNC,DNC working	PO 1,PO 2	3
BCCB12.04	CLO 4	To Study the CIM soft ware and hardware	PO 1,PO 2	2
BCCB12.05	CLO 5	Involve in correlating the Data base for CIM	PO 2	2
BCCB12.06	CLO 6	Study the integration of CAD, CAM and CIM.	PO 1,PO 2,PO 3	2
BCCB12.07	CLO 7	Understand the FMS concepts	PO 2	1
BCCB12.08	CLO 8	Distinguish conventional manufacturing and FMS layouts	PO 2, PO 3	1
BCCB12.09	CLO 9	Involved for choosing the fixtures for FMS	PO 2	2
BCCB12.10	CLO 10	Understand material handling systems of FMS	PO 1,PO 2	2
BCCB12.11	CLO 11	Study the concepts of Group Technology (GT)	PO 1,PO 2,PO 3	3
BCCB12.12	CLO 12	Study the CAPP	PO 3, PO 6	3
BCCB12.13	CLO 13	Study the inventory management and JIT	PO 2, PO 6	3
BCCB12.14	CLO 14	Study the various production monitoring systems	PO 3,PO 2	3
BCCB12.15	CLO 15	Distinguish contact and non contact inspection methods	PO 3, PO 6	1
BCCB12.16	CLO 16	Understand the integration of CAQC with CIM	PO 6	1

3 = High; 2 = Medium; 1 = Low

IX. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CLO 1	3						
CLO 2	3						
CLO 3	3	3					
CLO 4	3	2					
CLO 5		2					
CLO 6	2	2	2				
CLO 7		1					
CLO 8		1	1				
CLO 9		2					
CLO 10	2	2					
CLO 12			3			3	
CLO 13		3				3	
CLO 14		3	3				
CLO 15			1			1	
CLO 16						1	

3 = High; 2 = Medium; 1 = Low

X. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO1,PO2 PO3,PO6	SEE Exams	PO1,PO2, PO3,PO6	Assignments	PO 2	Seminars	PO 2
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO 3						

XI. ASSESSMENT METHODOLOGIES-INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XII. SYLLABUS

UNIT-I	INTRODUCTION TO CIM
Manufacturing - Types, Manufacturing Systems, CIM Definition, CIM wheel, CIM components, Evolution of CIM, needs of CIM, Benefits of CIM, basic components of NC system, NC motion control system, applications of NC, advantages and disadvantages of NC, computer Numerical control, advantages of CNC, functions of CNC, Direct Numerical Control, components of a DNC system, functions of DNC, advantages of DNC.	
UNIT-II	**CAD**
Development of computers, CIM Hardware & Software, Data-Manufacturing data, types, sources, Structure of data models, Data base and DBMS requirement, RDBMS, SQL, Computer Aided Design - benefits, Graphic Standards, Interfaces, CAD software, Integration of CAD/CAM/CIM.	
UNIT-III	**FLEXIBLE MANUFACTURING SYSTEMS**
FMS concept, Components of FMS, FMS Layouts, FMS planning and implementation, Tool Management systems-Tool monitoring, Work holding devices- Modular fixturing, flexible fixturing, flexibility, quantitative analysis of flexibility, application and benefits of FMS, automated material handling system –AGVs, Guidance methods, AS/RS.	
UNIT-IV	**AUTOMATED PROCESS PLANNING**
Group Technology, Part families, Part classification and coding, Production flow analysis, Machine cell design, Applications and Benefits of Group Technology, Structure of a Process Planning, Process Planning function, CAPP - Methods of CAPP, CAD based Process Planning, Inventory management - Materials requirements planning - basics of JIT	
UNIT-V	**MONITORING AND QUALITY CONTROL**
Types of production monitoring system, process control & strategies, direct digital control - Supervisory computer control - computer aided quality control - objectives of CAQC, QC and CIM, contact, non-contact inspection methods, CMM and Flexible Inspection systems. Integration of CAQC with CIM.	
Text Books:	
1. Kant Vajpayee. S., “Principles of Computer Integrated Manufacturing”, Prentice Hall of India, 1999. 2. Radhakrishnan.P, Subramanyan. S, “CAD/CAM/CIM”, New Age International publishers, 2000.	
Reference Books:	
1. Scheer.A.W., 'CIM- Towards the factory of the future' Springer - Verlag, 1994. 2. Daniel Hunt.V., 'Computer Integrated Manufacturing Hand Book', Chapman & Hall, 1989.	

XIII. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-2	**Classify** manufacturing systems	CLO 1	T1:28.7 R1:2.6
3	**Explain** the needs and benefits of CIM	CLO 2	T1:27.5 R1:2.7
4-5	**Explain** the working principle of NC,CNC,DNC	CLO3	T1:29.6 R1:2.6
6-7	**Compare** functions of NC, CNC,DNC	CLO3	T1:29.7 R1:2.7
7	**Illustrate** CIM wheel	CLO 2	T1:29.8 R1:4.4
8-9	**Illustrate** CAD, CAM &CIM integration	CLO3	T1:29.7 R1:2.7

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
10-11	**Describe** the Data base models associated to CIM	CLO 6	T1:30.7 R1:4.10
12-13	**Explain** CIM integration methodology.	CLO6	T1:29.8 R1:4.4
14-15	**Compare** RDBMS, SQL	CLO 5	T1:30.7 R1:4.10
16	**Explain** the Graphics standards	CLO 5	T2:33.9 R1:7.5
17-18	**Categorize** CAD & CAM softwares	CLO 6	T2:35.10 R3:8.1
19-20	**Explain** the FMS components	CLO 7	T2:34.10 R2:7.5
20	**Explain** the FMS layouts	CLO 8	T2:35.12 R1:9.2
21-22	**Explain** the tool management systems of FMS	CLO 8	T2:36.1 R2:9.4
23-24	**Describe** the work holing devises of FMS	CLO 9	T2:37.1 R2:9.9
25-26	**Explain** the applications and benefits of FMS	CLO 9	T2:37.1 R2:9.9
27	**Explain** automated material handling system –AGVs	CLO 10	T2:27.12 R1:11.9
28	**Explain** the benefits of AS/RS.	CLO 10	T2:27.12 R1:11.9
29	**Explain** Group Technology	CLO 11	T2:27.5 R1:10.2
30	**Explain** Part families, Part classification and coding	CLO 12	T2:27.5 R1:10.2
31-32	**Explain** Opitz parts classification system	CLO 12	T2:27.7 R1:11.3
33	**Explain** MICLASS parts classification system	CLO 12	T2:27.8 R1:11.6
34-35	**Explain** Applications and Benefits of Group Technology	CLO 12	T2:27.12 R1:11.7
36-37	**Illustrate** the Process Planning function, CAPP - Methods of CAPP	CLO 13	T2:27.12 R1:11.8
38	**Illustrate** the Inventory management	CLO 13	T2:27.12 R1:11.8
39-40	**Compare** various Production monitoring systems	CLO 14	T2:27.12 R1:11.10
41-42	**Explain** process control & strategies, direct digital control	CLO 14	T2:27.12 R1:11.10
43	**Distinguish** contact and non contact inspection methods	CLO 15	T3:27.14 R1:12.3
44	**Explain** the objectives of CAQC	CLO 16	T2:27.12 R1:11.10
45	**Explain** the integration of CAQC with CIM	CLO 16	T2:27.14 R1:12.3

XIV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed Actions	Relevance with POs	Relevance with PSOs
1	Encourage students to solve real time applications of CIM.	Industrial Visits	PO 2,PO 6	PSO 1

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MECHANICALENGINEERING

COURSE DESCRIPTOR

Course Title	**EXPERIMENTAL STRESS ANALYSIS**				
Course Code	BCCB13				
Programme	M.Tech				
Semester	II	CAD/CAM			
Course Type	Core				
Regulation	**IARE - R18**				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Course Faculty	Dr.G.V.R.Seshagiri Rao, Professor, ME				

I. COURSE OVERVIEW:

Experimental methods exploit a particular physical phenomenon to make measurements and hence only certain information that can be recorded by an experimental technique. The course introduces the physical principle used by various experimental techniques and also provides a guideline to select an experimental technique for a given application.The role of analytical, numerical and experimental methods in solving a problem in solid mechanics is discussed. Stress and strain at a point is discussed in most courses on solid mechanics but little attention is paid on the variation of these quantities over the field of the model. Attention is drawn on the richness of whole field information provided by most of the optical techniques.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AME004	III	Mechanics of Solids	4

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Experimental Stress Analysis	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	LCD / PPT	✔	Seminars	✔	Videos	✔	MOOCs
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 9th and 17th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration, consisting of 5 one mark compulsory questions in part-A and 4 questions in part-B. The student has to answer any 4 questions out of five questions, each carrying 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Technical Seminar and Term Paper:
Two seminar presentations and the term paper with overview of topic are conducted during II semester. The evaluation of Technical seminar and term paper is for maximum of 5 marks. Marks are awarded by taking average of marks scored in two Seminar Evaluations.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		**Strength**	**Proficiency assessed by**
PO 1	Apply advanced level knowledge, techniques, skills and modern tools in the field of computer aided engineering to critically assess the emerging technological issues.	3	Assignments
PO 2	Have abilities and capabilities in developing and applying computer software and hardware to mechanical design and manufacturing fields.	2	Seminar
PO 3	Conduct experimental and/or analytical study and analyzing results with modern mathematical / scientific methods and use of software tools.	2	Assignments

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 4	Function on multidisciplinary environments by working cooperatively, creatively and responsibly as a member of a team.	2	Seminar
PO 5	Write and present a substantial technical report / document.	1	Seminar
PO 6	Independently carry out research/investigation and development work to solve practical problems	1	Assignments
PO 7	Design and validate technological solutions to defined problems and recognize the need to engage in lifelong learning through continuing education.	-	Assignments

3 = High; 2 = Medium; 1 = Low

VII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	To Study the Various Experimental Techniques Involved for Measuring Displacements, Stresses, Strains in Structural Components.
II	Understand the shear force and bending moment diagrams of symmetrical beams
III	Distinguish bending and shear stresses developed in beams of various sections

VIII. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Understand the types of strain gauges, mounting techniques and strain gauge circuits explain the measurement of strain under static and dynamic loads.	CLO 1	To Study the Various Experimental Techniques.
		CLO 2	InvolvedforMeasuringDisplacements,Stresses , Strains in Structural Components
		CLO 3	Understand the shear force and bending moment diagrams of symmetrical beams
CO 2	Explain the Mechanical, optical, pneumatic and electrical strain gauges for strain measurement. Analysis of measuring circuits and strains of different strain gauge rosettes.	CLO 4	To Study the Various Experimental Techniques.
		CLO 5	Involved forMeasuringDisplacements,Stresses, Strains in Structural Components
		CLO 6	To Study the Various Experimental Techniques.
CO 3	Explain different methods of 2 D photo-elasticity along with properties of different materials for strain measurement	CLO 7	Involved for Measuring Displacements, Stresses, Strains in Structural Components
		CLO 8	Distinguish bending and shear stresses developed in beams of various sections
		CLO 9	Involved for Measuring Displacements Stresses, Strains in Structural Components
CO 4	Identify the different types of coatings, test strain data using brittle coating and birefringent coating	CLO 10	Understand the shear force and bending moment diagrams of symmetrical beams
		CLO 11	To Study the Various Experimental Techniques.
		CLO 12	Distinguish bending and shear stresses developed in beams of various sections
CO 5	Understand the Fundamentals Of NDT, Acoustic Emission Techniques.	CLO 13	Distinguish bending and shear stresses developed in beams of various sections
		CLO 14	To Study the Various Experimental Techniques
		CLO 15	Distinguish bending and shear stresses developed in beams of various sections

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
BCCB13.01	CLO 1	To Study the Various Experimental Techniques.	PO 1	3
BCCB13.02	CLO 2	Involved forMeasuringDisplacements,Stresses, Strains in Structural Components	PO 1	3
BCCB13.03	CLO 3	Understand the shear force and bending moment diagrams of symmetrical beams	PO 1,PO 2	3
BCCB13.04	CLO 4	To Study the Various Experimental Techniques.	PO 1,PO 2	2
BCCB13.05	CLO 5	Involved forMeasuringDisplacements,Stresses, Strains in Structural Components	PO 2	2
BCCB13.06	CLO 6	To Study the Various ExperimentalTechniques.	PO 1,PO 2,PO 3	2
BCCB13.07	CLO 7	Involved for Measuring Displacements, Stresses, Strains in Structural Components	PO 2	1
BCCB13.08	CLO 8	Distinguish bending and shear stresses developed in beams of various sections	PO 2, PO 3	1
BCCB13.09	CLO 9	Involved forMeasuringDisplacements,Stresses, Strains in Structural Components	PO 2	2
BCCB13.10	CLO 10	Understand the shear force and bending moment diagrams of symmetrical beams	PO 1,PO 2	2
BCCB13.11	CLO 11	To Study the Various Experimental Techniques.	PO 1,PO 2,PO 3	3
BCCB13.12	CLO 12	Distinguish bending and shear stresses developed in beams of various sections	PO 3, PO 6	3
BCCB13.13	CLO 13	Distinguish bending and shear stresses developed in beams of various sections	PO 2, PO 6	3
BCCB13.14	CLO 14	To Study the Various Experimental Techniques	PO 3,PO 2	3
BCCB13.15	CLO 15	Distinguish bending and shear stresses developed in beams of various sections	PO 3, PO 6	1

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes (COs)	Program Outcomes (PO)					
	PO 1	PO 2	PO 3	PO 5	PO 6	PO 7
CO 1	3	1	1		1	
CO 2		2	1		3	
CO 3	2		2			
CO 4	3			3	2	
CO 5				2	1	2

XI. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CLO 1	3						
CLO 2	3						
CLO 3	3	3					
CLO 4	3	2					
CLO 5		2					
CLO 6	2	2	2				
CLO 7		1					
CLO 8		1	1				
CLO 9		2					
CLO 10	2	2					
CLO 12			3			3	
CLO 13		3				3	
CLO 14		3	3				
CLO 15			1			1	
CLO 16						1	

3 = High; 2 = Medium; 1 = Low

XII. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO1,PO3, PO5	SEE Exams	PO1,PO3, PO5	Seminar and Term Paper	PO1,PO2,PO3, PO5
Viva	-	Mini Project	-	Laboratory Practices	-

XIII. ASSESSMENT METHODOLOGIES-INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIV. SYLLABUS

UNIT-I	EXTENSOMETERS AND DISPLACEMENT SENSORS
Principles of Measurements, Accuracy, Sensitivity and Range of Measurements, Mechanical, Optical, Acousticaland Electrical Extensometers and Their Uses, Advantages and Disadvantages, Capacitance Gauges, LaserDisplacement Sensors.	

UNIT-II	ELECTRICAL RESISTANCE STRAIN GAUGES
Principle Of Operation And Requirements, Types And Their Uses, Materials For Strain Gauges, Calibration AndTemperature Compensation, Cross Sensitivity, Wheatstone Bridge And Potentiometer Circuits For Static AndDynamic Strain Measurements, Strain Indicators, Rosette Analysis, Stress Gauges, Load Cells, Data Acquisition,Six Component Balance.	
UNIT-III	**PHOTOELASTICITY**
Two Dimensional Photo Elasticity, Photo Elastic Materials, Concept Of Light – Photoelastic Effects, Stress OpticLaw, Transmission Photoelasticity, Jones Calculus, Plane And Circular Polariscopes, Interpretation Of FringePattern, Calibration Of Photoelastic Materials, Compensation And Separation Techniques, Introduction To ThreeDimensional Photo Elasticity.	
UNIT-IV	**BRITTLE COATING AND MOIRE TECHNIQUES**
Relation Between Stresses In Coating And Specimen, Use Of Failure Theories In Brittle Coating, Moire MethodOf Strain Analysis	
UNIT-V	**NON – DESTRUCTIVE TESTING**
Fundamentals Of NDT, Acoustic Emission Technique, Radiography, Thermography, Ultrasonics, Eddy CurrentTesting, and Fluorescent Penetrate Testing.	
Text Books:	
1. Dally, J.W., And Riley, W.F., "Experimental Stress Analysis", McGraw Hill Inc., New York 1998.	
2. Srinath, L.S., Raghava, M.R., Lingaiah, K., Garagesha, G., Pant B., And Ramachandra, K., "Experimental Stress Analysis", Tata McGraw Hill, New Delhi, 1984.	
Reference Books:	
1.Abdul Mubeen "Experimental Stress Analysis" Dhanpat Rai & Co (P) Ltd.	
2. U. C. Jindal"Experimental Stress Analysis"Pearson India Publishers.	

XIV COURSE PLAN:

The course plan is meant as a guideline. There may probably be changes.

Lecture No	Topic Outcomes	Topic/s to be covered	Reference
1-2	**Classify** Principles of Measurements	Classify Principles of Measurements	T1:1.1, 1.2
3	Accuracy, Sensitivity and Range of Measurements,	Accuracy, Sensitivity and Range of Measurements	T1:2.1
4-6	**Illustrate** Mechanical, Optical, Acousticaland Electrical Extensometers and Their Uses, Advantages and Disadvantages,	Illustrate Mechanical, Optical, Acoustical and Electrical Extensometers and Their Uses, Advantages and Disadvantages,	T2:2.2, 2.3
7-8	**Analyze** Capacitance Gauges, Laser Displacement Sensors.	Analyze Capacitance Gauges, Laser Displacement Sensors.	T1:4.1, 4.2, 4.3
9-10	**List** Laser Displacement Sensors.	List Laser Displacement Sensors	T1:4.2, 4.4
11	**Explain**Principle Of Operation And Requirements.	Explain Principle Of Operation And Requirements	T2: 5.1, 5.2
12-13	**Compare** Relation Between Stresses In Coating And Specimen, Use Of Failure Theories In Brittle Coating, Moire Method Of Strain Analysis	Compare Relation Between Stresses In Coating And Specimen, Use Of Failure Theories In Brittle Coating, Moire Method Of Strain Analysis	T2:6.1, 6.2, 6.4

Lecture No	Topic Outcomes	Topic/s to be covered	Reference
14	**Illustrate** Types And Their Uses, Materials For Strain Gauges,	Illustrate Types And Their Uses, Materials For Strain Gauges	T2:7.2, 7.3, 7.4
15	**Categorize & Describe** Calibration AndTemperature Compensation, Cross Sensitivity,	Classify Wheatstone Bridge And Potentiometer Circuits For Static And Dynamic Strain Measurements	T2:8.1, 8.3
16	**Classify** Wheatstone Bridge And Potentiometer Circuits For Static AndDynamic Strain Measurements,	Explain Strain Indicators, Rosette Analysis, Stress Gauges, Load Cells, Data Acquisition, Six Component Balance Two Dimensional Photo Elasticity	T1:5.3
17-18	**Explain** Strain Indicators, Rosette Analysis, Stress Gauges, Load Cells, Data Acquisition,Six Component Balance Two Dimensional Photo Elasticity,	Describe Photo Elastic Materials, Concept Of Light – Photo elastic Effects	T1:5.5, 5.6, 5.7
21-22	**Describe** Photo Elastic Materials, Concept Of Light – Photo elastic Effects,	Describe Stress Optic Law, Transmission Photo elasticity, Jones Calculus, Plane And Circular Polariscopes	T2:6.1, 6.2, 6.4
23-24	**Describe** Stress OpticLaw, Transmission Photoelasticity, Jones Calculus, Plane And Circular Polariscopes,	Define Interpretation Of Fringe Pattern	T2:7.2, 7.3, 7.4
25-26	**Define** Interpretation Of Fringe Pattern, Calibration Of Photo elastic Materials, Compensation And Separation Techniques, and Introduction To Three Dimensional Photo Elasticity.	Calibration Of Photo elastic Materials Compensation And Separation Techniques Introduction To Three Dimensional Photo Elasticity.	T2:8.1, 8.3
27	**Compare** Relation Between Stresses In Coating And Specimen, Use Of Failure Theories In Brittle Coating, Moire MethodOf Strain Analysis	Compare Relation Between Stresses In Coating And Specimen, Use Of Failure Theories In Brittle Coating, Moire Method Of Strain Analysis	T1:5.3
28	**Explain**Strain Indicators, Rosette Analysis, Stress Gauges, Load Cells, Data Acquisition, Six Component Balance Two Dimensional Photo Elasticity.	Explain Strain Indicators, Rosette Analysis, Stress Gauges, Load Cells, Data Acquisition, Six Component Balance Two Dimensional Photo Elasticity	T1:5.5, 5.6, 5.7
29	**Explain**Two Dimensional Photo Elasticity, Photo Elastic Materials, and Concept Of Light – Photo elastic Effects.	Explain Two Dimensional Photo Elasticity, Photo Elastic Materials, and Concept Of Light – Photo elastic Effects.	T2:6.1, 6.2, 6.4
30	**Explain**Stress OpticLaw, Transmission Photoelasticity, Jones Calculus, Plane And Circular Polariscopes.	Explain Stress Optic Law, Transmission Photo elasticity, Jones Calculus, Plane And Circular Polariscopes.	T2:7.2, 7.3, 7.4
31-32	**Explain**Interpretation Of FringePattern.	Explain Interpretation Of Fringe Pattern	T2:8.1, 8.3

Lecture No	Topic Outcomes	Topic/s to be covered	Reference
33-34	**Describe** Calibration Of Photoelastic Materials.	Describe Calibration Of Photo elastic Materials	T1:5.3
35-37	**Describe** Compensation And Separation Techniques, and Introduction To ThreeDimensional Photo Elasticity.	Describe Compensation And Separation Techniques, and Introduction To Three Dimensional Photo Elasticity	T1:5.5, 5.6, 5.7
38	**Describe**Relation Between Stresses In Coating And Specimen, Use Of Failure Theories In Brittle Coating, Moire MethodOf Strain Analysis	Describe Relation Between Stresses In Coating And Specimen. Use Of Failure Theories In Brittle Coating, Moire Method Of Strain Analysis	T2:6.1, 6.2, 6.4
39-40	**Explain** Fundamentals Of NDT	Fundamentals Of NDT,	T2:7.2, 7.3, 7.4
41-43	**Explain**Acoustic Emission Technique,	Acoustic Emission Technique,	T2:8.1, 8.3
44	**Explain** Radiography, Thermography,	Radiography, Thermography,	T1:5.3
45	**Explain**Ultrasonics, Eddy CurrentTesting,	Ultrasonics, Eddy CurrentTesting	T1:5.5, 5.6, 5.7
46	**Explain** and Fluorescent Penetrate Testing.	Fluorescent Penetrate Testing	T1:5.5, 5.6, 5.7

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed Actions	Relevance with POs
1	To improve standards and analyze the concepts.	Seminars	PO 1
2	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 2,PO 6

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MECHANICALENGINEERING

COURSE DESCRIPTOR

Course Title	Personality Development Through Life Enlightenment Skills				
Course Code	BCSB39				
Programme	M.Tech				
Semester	II	COMMON FOR ALL (ST |EPS |CC |ES |CS| AE)			
Course Type	Audit				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	2	-	Nil	-	Nil
Course Faculty	Mr. G. Sarat Raju, Assistant Professor , ME				

I. COURSEOVERVIEW:

Our aim is to improve the ones positive attitude. Personality development also is said to have a positive impact on one's communication skills and the way he sees the world. Individuals tend to develop a positive attitude as a result of personality development on Every individual has his own characteristic way of behaving, responding to emotions, perceiving things and looking at the world. No two individuals are similar. You might like going out for parties but your friend might prefer staying back at home reading his/her favorite book. It is really not necessary that if you like partying around, your friend will also like the same. Here comes the role of personality. Personality development is defined as a process of developing and enhancing one's personality. Personality development helps an individual to gain confidence and high self esteem.

II. .COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
PG	BCSB39	II	-	Nil

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Personality development through life enlightenment skills	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✘	Chalk & Talk	✔	Quiz	✔	Assignments	✔	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weight age in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1)

Table 1: Assessment pattern for CIA

Component	**Theory**	**Total Marks**
Type of Assessment	CIE Exam	
CIA Marks	30	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8thand 16thweek of the semester respectively. The CIE exam is conducted for 30 marks of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

VI. HOW PROGRAM OUTCOMES AREASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	Apply advanced level knowledge, techniques, skills and modern tools in the field of computer aided engineering to critically assess the emerging technological issues.	1	Assignments
PO 2	Have abilities and capabilities in developing and applying computer software and hardware to mechanical design and manufacturing fields.	1	Seminar
PO 3	Conduct experimental and/or analytical study and analyzing results with modern mathematical / scientific methods and use of software tools.	2	Assignments
PO 4	Function on multidisciplinary environments by working cooperatively, creatively and responsibly as a member of a team.	1	Seminar
PO 5	Write and present a substantial technical report / document.	1	Seminar
PO 6	Independently carry out research/investigation and development work to solve practical problems	2	Assignments
PO 7	Design and validate technological solutions to defined problems and recognize the need to engage in lifelong learning through continuing education.	1	Assignments

3 = High; 2 = Medium; 1 = Low

VII. COURSE OBJECTIVES(COs):

The course should enable the students to:	
I	Understand the concept of Holistic development of personality
II	understand and practice Shrimad Bhagwad Geeta by reading every day a chapter
III	Understand the basics of Spiritual Knowledge from BhagwadGeetachaper 2of some verses
IV	Exercise the role model in the bhagavathgeetha by practicing it in day to day life

VIII. COURSE OUTCOMES(COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	To understand different ways for attaining wisdom.	CLO 1	To formulate a strategy to promote holistic development of students and understand the psychosocial needs and developmental profiles of young people.
		CLO 2	Identify the various ways, which will promote holistic development in students includes physical, psychological, social,

			spiritual domains and values, morality, forgiveness, and existential qualities, such as hope and forgiveness.
CO 2	To understand the principles of working by studying Shrimad-Bhagwad-Geeta.	CLO 3	Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life.
		CLO 4	The person who has studied Geeta will lead the nation and mankind to peace and prosperity
CO 3	Explain different ways of personality development through Shrimad-Bhagwad-Geeta.	CLO 5	BhagawathGeetha will help the mankind to be free from dishonest , corrupt, unethical , lazy , dirty and improves the Approach to day to day work and duties
		CLO 6	BhagawathGeethatells that The practice of meditation helps organize our personality, awaken our inner consciousness, and expand our self-awareness
CO 4	Explain diffent statements in Bhagwad-Geeta.	CLO 7	One who remains unattached under all conditions, and is neither delighted by good fortune nor dejected by tribulation, he is a sage with perfect knowledge.
		CLO 8	One who has restrained the senses from their objects, O mighty armed Arjun, is firmly established in transcendental knowledge.
CO 5	Understand the personality of role model.	CLO 9	The Students will become conscious citizens of India aware of their duties, rights and functions of various bodies of governance and welfare; thereby well Equipped to contribute to India
		CLO 10	Good role models someone who is always positive, calm, and confident in themselves. You don't want someone who is down or tries to bring you down. Everyone likes a person who is happy with their achievements, but continues to strive for bigger and better objectives.

IX. COURSE LEARNING OUTCOMES(CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
BCSB39.01	CLO 1	To formulate a strategy to promote holistic development of students and understand the psychosocial needs and developmental profiles of young people	PO1	1
BCSB39.02	CLO 2	Identify the various ways, which will promote holistic development in students includes physical, psychological, social, spiritual domains and values, morality, forgiveness, and existential qualities, such as hope and forgiveness.	PO2	2
BCSB39.03	CLO 3	Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life.	PO2	2
BCSB39.04	CLO 4	The person who has studied Geeta will lead the nation and mankind to peace and prosperity	PO3	1

BCSB39.05	CLO 5	BhagawathGeetha will help the mankind to be free from dishonest , corrupt, unethical , lazy , dirty and improves the Approach to day to day work and duties	PO1, PO1	1
BCSB39.06	CLO 6	BhagawathGeethatells that The practice of meditation helps organize our personality, awaken our inner consciousness, and expand our self-awareness	PO4, PO2	2
BCSB39.07	CLO 7	One who remains unattached under all conditions, and is neither delighted by good fortune nor dejected by tribulation, he is a sage with perfect knowledge.	PO1, PO2	2
BCSB39.08	CLO 8	One who has restrained the senses from their objects, O mighty armed Arjun, is firmly established in transcendental knowledge.	PO1,PO2	2
BCSB39.09	CLO 9	The Students will become conscious citizens of India aware of their duties, rights and functions of various bodies of governance and welfare; thereby well Equipped to contribute to India.	PO4	1
BCSB39.10	CLO 10	Good role models someone who is always positive, calm, and confident in themselves. You don't want someone who is down or tries to bring you down. Everyone likes a person who is happy with their achievements, but continues to strive for bigger and better objectives.	PO4	1

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Learning Outcomes (CLOs)	Program Outcomes (POs)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CLO 1	1						
CLO 2	1						
CLO 3	1	2			1`		
CLO 4	1	2					
CLO 5		2					
CLO 6		2	2				
CLO 7		1					
CLO 8		1	1			1	
CLO 9		2					
CLO 10	2	2					
CLO 12			2			1	
CLO 13		2				1	
CLO 14		3	1				
CLO 15			1			1	

CLO 16						1	

XI. ASSESSMENT METHODOLOGIES -DIRECT

CIE Exams	PO1 PO2 PO 3	SEE Exams	PO1 PO2 PO 3	Assignments	-	Seminars	PO3, PO4
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES -INDIRECT

✔	Assessment of course outcomes (by feedback, once)	✔	Student feedback on faculty (twice)
✔	Assessment of mini projects by experts		

XIII. SYLLABUS:

UNIT-I	**HOLISTIC DEVELOPMENT**
Neetisatakam-Holistic development of personality, Verses- 19,20,21,22 (wisdom), Verses- 29,31,32 (pride & heroism), Verses- 26,28,63,65 (virtue),Verses- 52,53,59 (dont's),Verses- 71,73,75,78 (do's).	
UNIT-II	**BHAGWAD GEETA**
Approach to day to day work and duties. ShrimadBhagwadGeeta: Chapter 2-Verses 41, 47,48. Chapter 3- Verses 13, 21, 27, 35.	
UNIT-III	**BHAGWAD GEETA**
ShrimadBhagwadGeeta: Chapter 6-Verses 5, 13, 17, 23, 35, Chapter 18-Verses 45, 46, 48.	
UNIT-IV	**BASIC KNOWLEDGE**
Statements of basic knowledge. ShrimadBhagwadGeeta: Chapter2-Verses 56, 62, 68. Chapter 12 - Verses 13,14, 15, 16,17, 18	
UNIT-V	**ROLE MODEL**
Personality of Role model. ShrimadBhagwadGeeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39. Chapter18 – Verses 37,38,63.	
Text Books:	
1. P.Gopinath, "Bhartrihari's Three Satakam (Niti-sringar-vairagya)", Rashtriya Sanskrit Sansthanam, New Delhi.	
Reference Books:	
1. Swami Swarupananda, "Srimad Bhagavad Gita",Advaita Ashram (Publication Department), Kolkata.	
Reference Books:	
1. http://openlearningworld.com/section_personality_development.html	

E-Text Books:
1. http://persmin.gov.in/otraining/UNDPProject/undp_UNITs/Personality%20Dev%20N%20DLM.pdf

XIV. COURSEPLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No.	Topics to be covered	Reference
1-2	Learn to improve the wisdom from verses - 19,20,21,22 (wisdom),	T1:ch1:19-22 verses
2-3	study the Verses- 29,31,32 (pride & heroism)to become a good leader	T1:ch1:29-32 verses
4-5	learn the Verses- 26,28,63,65 (virtue) from BhagawathGeetha to lead a holistic life	T1:ch1:26-28
6-7	learn and understand the Verses- 52,53,59 for What not to do to live holy life	T1:ch1:52-59 verses
8	learn and understand the Verses- 71,73,75,78 for what to do to become holistic person	T1:ch1:71-78 verses
9-10	study and understand the ShrimadBhagwadGeeta: Chapter 2-Verses 41, 47,48 to do day to day activities	T1:ch2:41-48
11-12	Gain the insight in chapters of ShrimadBhagwadGeeta Chapter 3- Verses 13, 21, 27, 35.for day to day work and duties.	T1:ch3:13,21,27 & 35 verses
13-14	Study and explain importance of ShrimadBhagwadGeeta the: Chapter 6-Verses 5, 13, 17, 23 & 35.	T1:ch6: 5, 13, 17, 23 & 35verses
15-16	Study and learn the importance of geetha of Chapter 18-Verses 45, 46, and 48 for technical students.	T1:ch18:45
17-18	Gain the basic knowledge of ShrimadBhagwadGeeta: Chapter2-Verses 56, 62, 68	T1:ch1
19-20	understanding of more basic fundamentals of geetha Chapter 12 -Verses 13,14, 15, 16,17, 18	T1:ch1
21-22	understand the Personality of Role model. ShrimadBhagwadGeeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42,	T1:ch1
23-24	understand the different characteristics of role model in Chapter 4-Verses 18, 38,39 and Chapter18 – Verses 37,38,63.	T1:ch1

Prepared by:

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MECHANICALENGINEERING

COURSE DESCRIPTOR

Course Title	**SPECIAL MANUFACTURING PROCESS**				
Course Code	BCCB17				
Programme	M.Tech				
Semester	II	CAD/CAM			
Course Type	Elective				
Regulation	**IARE - R18**				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	3	2
Chief Coordinator	Dr. G. Naveen Kumar, Associate Professor, ME				
Course Faculty	Dr. G. Naveen Kumar, Associate Professor, ME				

I. COURSE OVERVIEW:

The primary objective of this course is to introduce the concept of manufacturing technology with the help of various processes widely employed in industries. This *course* is designed to provide students with an *overview* of a wide variety of *manufacturing processes*. The fundamental principles behind the *processes* will be discussed with the intent of providing a working knowledge of a broad range of *manufacturing processes*.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AME006	IV	Production Technology	3

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Special Manufacturing Process	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into fiveunits and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz / Alternative Assessment Tool (AAT):

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	Independently carry out research / investigation and development work to solve practical problems	3	Presentation on real-world problems
PO 2	Write and present a substantial technical report / document	2	Seminar
PO 3	Abilities and capabilities in developing and applying computer software and hardware to mechanical design and manufacturing fields.	2	Assignments
PO 4	Apply advanced level knowledge, techniques, skills and modern tools in the field of computer aided engineering to critically assess the emerging technological issues.	2	Seminar
PO 5	Conduct experimental and/or analytical study and analyzing results with modern mathematical / scientific methods and use of software tools.	1	Seminar
PO 6	Design and validate technological solutions to defined problems and recognize the need to engage in lifelong learning through continuing education.	2	Assignments
PO 7	Function on multidisciplinary environments by working cooperatively, creatively and responsibly as a member of a team	2	Assignments

3 = High; 2 = Medium; 1 = Low

VII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Comprehensive understanding of different manufacturing processes for product development.
II	Apply casting, metal joining and forming processes for various industries.
III	Select process parameters, equipment for material processing

VIII. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO1	Student should be able to select appropriate manufacturing processes for advanced components with characterization of work pieces.	CLO 1	Understand various manufacturing processes used in various industries.
		CLO 2	Explain the steps involved in casting processes
		CLO 3	Use design principles to incorporate sprue, runner, gates, and risers in foundry practice.
CO2	Student should be able to understand Various Advanced manufacturing metal forming processes	CLO 4	Evaluate properties of sand for use in sand casting.
		CLO 5	Solve problems and find methods to rectify casting defects.
		CLO6	Demonstrate the preparation of moulds for various casting processes
CO3	Student should be able to understand various material processing techniques for critical components	CLO 7	Describe applications of various casting processes
		CLO 8	Explain principles of welding, brazing and soldering processes.

		CLO 9	Demonstrate use of welding equipment for various industrial applications.
CO4	Student should be able to understand and select various measurement techniques in micro machining processes	CLO 10	Demonstrate use of Brazing and soldering equipment for various industrial applications.
		CLO 11	Explain design of welded joints, residual stresses, distortion and control.
		CLO 12	Explain causes and remedies of welding defects.
CO5	To capture the inter0tio0l market with latest mechanical industry needs with the knowledge and support of advanced manufacturing techniques, so student with this judgment will be absorbed in any mechanical industry	CLO 13	Compare destructive and non-destructive testing techniques.
		CLO 14	Understand the effect of heat input in welds.
		CLO 15	Understand the importance of sheet metal forming, bending, and deep drawing.

3 = High; 2 = Medium; 1 = Low

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
BCCB17.01	CLO 1	Understand various manufacturing processes used in various industries.	PO 1	3
BCCB17.02	CLO 2	Explain the steps involved in casting processes	PO 1	3
BCCB17.03	CLO 3	Use design principles to incorporate sprue,runner,gates, and risers in foundry practice.	PO 1	3
BCCB17.04	CLO 4	Evaluate properties of sand for use in sand casting.	PO 2	2
BCCB17.05	CLO 5	Solve problems and find methods to rectify casting defects.	PO 2	2
BCCB17.06	CLO 6	Demonstrate the preparation of moulds for various casting processes	PO 2	2
BCCB17.07	CLO 7	Describe applications of various casting processes	PO 4	1
BCCB17.08	CLO 8	Explain principles of welding, brazing and soldering processes.	PO 4	1
BCCB17.09	CLO 9	Demonstrate use of welding equipment for various industrial applications.	PO 5	2
BCCB17.10	CLO 10	Demonstrate use of Brazing and soldering equipment for various industrial applications.	PO 5	2
BCCB17.11	CLO 11	Explain design of welded joints, residual stresses, distortion and control.	PO 3	3
BCCB17.12	CLO 12	Explain causes and remedies of welding defects.	PO 6	3
BCCB17.13	CLO 13	Compare destructive and non-destructive testing techniques.	PO 6	3
BCCB17.14	CLO 14	Understand the effect of heat input in welds.	PO 1, PO 4	3
BCCB17.15	CLO 15	Understand the importance of sheet metal forming, bending, and deep drawing.	PO 5	2

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

(COs)	Program Outcomes (POs)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2					
CO 2	3	2					
CO 3		3	2				
CO 4			2		2		
CO 5		1	3				

3 = High; 2 = Medium; 1 = Low

XI. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

(CLOs)	Program Outcomes (POs)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CLO 1	3	2					
CLO 2	3	2					
CLO 3		3	2				
CLO 4			2		2		
CLO 5		1	3				
CLO 6		1			2		
CLO 7			3	2			
CLO 8	3		3	2	3		
CLO 9		3					
CLO 10	3			3			
CLO 11	2	2		3			
CLO 12	3				2	3	
CLO 13	3		3			3	
CLO 14				3	2		
CLO 15	3	2	3	3			

3 = High; 2 = Medium; 1 = Low

XII. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO 1, PO 2, PO 3, PO 4, PO 5, PO 6, PO 7	SEE Exams	PO 1, PO 2, PO 3, PO 4, PO 5, PO 6, PO 7	Assignments	PO 3, PO 6, PO 7	Seminars	PO 2, PO 4, PO 5
Laboratory Practices	PO 3	Student Viva	PO 3	Mini Project	-	Certification	-

XIII. ASSESSMENT METHODOLOGIES-INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✔	Assessment of Mini Projects by Experts		

XIV. SYLLABUS

UNIT-I	SURFACE TREATMENT	Classes:09
Surface treatment: Scope, cleaners, methods of cleaning, surface coating types, and ceramic and organic methods of coating, economics of coating, electro forming, chemical vapor deposition, thermal spraying, ion implantation, diffusion coating, diamond coating and cladding.		
UNIT-II	**PROCESSING OF CERAMICS**	**Classes: 09**
Processing of ceramics: Applications, characteristics, classification, processing of particulate ceramics, powder preparations, consolidation, drying, sintering, hot compaction, area of application, finishing of ceramics; Processing of composites: Composite layers, particulate and fiber reinforced composites, elastomers, reinforced plastics, metal matrix composites, ceramic matrix composites, polymer matrix composites.		
UNIT-III	**FABRICATION OF MICROELECTRONIC DEVICES**	**Classes: 09**
Fabrication of microelectronic devices: Crystal growth and wafer preparation, film deposition oxidation, lithography, bonding and packaging, reliability and yield. Printed Circuit boards, computer aided design in micro electronics, surface mount technology, integrated circuit economics.		
UNIT-IV	**E-MANUFACTURING**	**Classes: 09**
E-manufacturing: Nano manufacturing techniques and micromachining, high Speed machining and hot machining.		
UNIT-V	**RAPID PROTOTYPING**	**Classes: 09**
Rapid prototyping: Working principles, methods, stereo lithography, laser Sintering, fused deposition method, applications and limitations, rapid tooling, techniques of rapid manufacturing		
Text Books:		
1. Kalpakijian, "Manufacturing Engineering and Technology", Adisson Wesley,1995. 2. R. A. Lindburg, "Process and Materials of Manufacturing",PHI, 1st Edition,1990. 3. Rao. R. Thummala, Eugene, J. Rymaszewski,Van Nostrand Renihold, "Microelectronicpackaging handbook", 1st Edition, 2013.		
Reference Books:		
1. Rao. R. Thummala, Eugene, J. Rymaszewski,Van Nostrand Renihold, "Microelectronicpackaging handbook", 1st Edition, 2013. 2. Tai-Run Hsu, "MEMS & Micro Systems Design and manufacture", Tata McGraw Hill, 1stEdition, 2002		

XV. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-4	What are the operating temperatures for treated surfaces?	CLO 1	T1:3.1 R1:3.1
5-7	What is Siltek Deactivation?	CLO 1	T1:3.2.5 R1:3.3.4
8-10	What are the unique benefits of Siltek deactivation?	CLO 1	T1:3.1.5 R1:3.1.3
11-14	Does anyone else offer an equivalent to Siltek deactivation?	CLO 2	T1:9.1 R1:5.1
15-16	What is the maximum temperature limit for Siltek deactivated glass?	CLO 2	T1:9.2.1 R1:5.2.3
17-20	What materials can be surface treated?	CLO 3	T1:9.4.2 R1:5.3
21-23	What are the advantages of using negative rake on ceramic cutting tools?	CLO 3	R2:9.16 R6:27.5
24-26	What are the advantages of using negative rake on cemented carbide cutting tools?	CLO 4	R2:9.16.12 R6:27.1
27-28	Write about ceramic matrix composites?	CLO 5	R2:9.64 R6:30.2
29-30	What are the necessary conditions for the effective use of ceramic tools?	CLO 5	R2:9.55 R6:29.3
31-32	What are the three main variables to be considered in application and selection of turning tools?	CLO 6	T1:7.1.1 R1:4.6
33-34	Write about polymer matrix composites?	CLO 7	T1:7.1 R1:3.6.1
35	What is the Crystal growth?	CLO 8	T1:7.1.1 R1:4.6
36-37	How the wafer preparation method is performed?	CLO 8	T1:7.2 R1:4.2
38	What is the film deposition oxidation	CLO 9	T1:8.3 R6:6.5
39	What is the lithography?	CLO 10	T1:8.7 R1:4.8.12
40-41	What is the Fabrication of microelectronic devices?	CLO 11	T1:8.4 R1:4.5
42	What is bonding and packaging?	CLO 12	T1:8.9 R1:4.8.15
43-44	What is Nano machining?	CLO 13	T1:8.6 R1:4.8.15
45-47	What is micromachining?	CLO 14	T1:8.1 R1:4.8.6
48-49	Write process parameter for True cutting speed	CLO 15	T1:7.4 R1:4.4
50-52	Write process parameter for metal removal rate	CLO 15	T1:7.4.2 R1:4.4.1

XVI. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S NO	Description	Proposed Actions	Relevance with POs
1	Advances in manufacturing processes	Seminars / Guest Lectures / NPTEL	PO 1, PO 2, PO 3
2	Interaction of materials and manufacturing processes	Seminars / Guest Lectures / NPTEL	PO 2, PO 5
3	Recommended practices in casting, welding, and forming	Assignments / Laboratory Practices	PO 1, PO 3, PO 4, PO 6, PO 7

Prepared by:

Dr. G. Naveen Kumar, Associate, Professor **HOD, ME**

INSTITUTE OF AERONAUTICAL ENGINEERING

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Dundigal, Hyderabad -500 043

MECHANICALENGINEERING

COURSE DESCRIPTOR

Course Title	**SIMULATION& ANALYSIS LABORATORY**				
Course Code	BCCB20				
Programme	M.Tech				
Semester	II	CAD/CAM			
Course Type	Core				
Regulation	**IARE - R18**				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	-	-	-	4	2
Chief Coordinator	Mr. P.Sadanandam, Assistant Professor				
Course Faculty	---				

I. COURSE OVERVIEW:

The ANSYS software has different modulus (Ansys APDL and workbench etc...). The Workbench environment is an intuitive up-front finite element analysis tool that is used in conjunction with CAD systems and/or Design Modeler. ANSYS Workbench is a software environment for performing structural, thermal, and electromagnetic analyses. The laboratory sessions are focuses on geometry creation, meshing and how to apply the boundary conditions, attaching existing geometry, setting up the finite element model, solving, and reviewing results. The lab sessions will describe how to use the basic finite element simulation concepts and results interpretation.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
PG	BCCB01	I	Advanced CAD	3

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Fluid thermal, modelling and simulation Laboratory	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✘	Chalk & Talk	✘	Quiz	✘	Assignments	✘	MOOCs
✔	LCD / PPT	✘	Seminars	✘	Mini Project	✘	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

Continuous internal assessment (CIA):

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, with 20 marks for day to day evaluation and 10 marks for Internal Examination (CIE).

Semester End Examination (SEE):

The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the this courses is contains 12 experiments. The question paper pattern is as follows: Two full questions with 'either' 'or' choice will be drawn from each set. Each set contains 4 questions.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 10 marks for Continuous Internal Examination (CIE), 20 marks for Day to Day Evaluation.

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Day to Day Evaluation	
CIA Marks	10	20	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration consisting of two sets.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		**Strength**	**Proficiency assessed by**
PO 1	Apply advanced level knowledge, techniques, skills and modern tools in the field of computer aided engineering to critically assess the emerging technological issues.	3	Lab related Exercises
PO 3	Conduct experimental and/or analytical study and analyzing results with modern mathematical / scientific methods and use of software tools.	2	Lab related Exercises
PO 6	Independently carry out research / investigation and development work to solve practical problems	3	Lab related Exercises
PO 7	Design and validate technological solutions to defined problems and recognize the need to engage in lifelong learning through continuing education.	1	Lab related Exercises

3 = High; 2 = Medium; 1 = Low

VII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Analyze the fluid flow through plates.
II	Understand the external fluid flow.
III	Apply simulation techniques to heat flow problems.

VIII. COURSE OUTCOMES (COs):

CO Code	CO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
BCCB20.01	CO 1	lyze andexcute the fluid flow real time applications using ansys	PO1 PO7	3
BCCB20.02	CO 2	Understand and able to execute the external fluid flow using Ansys work bench.	PO1 PO3	3
BCCB20.03	CO 3	Execute the different simulation techniques to fluid flow.	PO1 PO6	2
BCCB20.04	CO 4	Analyses and execute the Evaluation of the thermal stresses.	PO1 PO3	3
BCCB20.05	CO 5	Execute the simulation process on the 3D Heat conduction for real time problems.	PO1 PO6 PO7	3

3= High; 2 = Medium; 1 = Low

IX. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcomes (COs)	Program Outcomes (POs)			
	PO1	PO3	PO6	O7
CO 1	3			3
CO 2	3	2		
CO 3	2		2	
CO 4	3	3		
CO 5	3		3	2

3= High; 2 = Medium; 1 = Low

X. ASSESSMENT METHODOLOGIES–DIRECT:

CIE Exams	PO 1, PO 3, PO 7	SEE Exams	PO 1, PO 3, PO 7	Assignments	-	Seminars	-
Laboratory Practices	PO 1, PO 3, PO 7	Student Viva	PO 1, PO 3, PO 7	Mini Project	-	Certification	-
Term Paper	-						

XI. ASSESSMENT METHODOLOGIES–INDIRECT:

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XII. SYLLABUS:

LIST OF EXPERIMENTS	
Week-1	**DYNAMIC ANALYSIS**
Introduction to dynamic analysis overview of the mode shapes for multi DOF system	
Week-2	**NATURAL FREQUENCY OF VIBRATIONS - ANSYS**
Determination of natural frequencies, for 1st six modes of vibrations .	
Week-3	**ANSYS BASICS FOR DIFFERENT MODULES**
Study of Basics in ANSYS	
Week-4	**STRESS ANALYSIS USING STRUCTURAL ANALYSIS IN ANSYS WORK BENCH**
Stress analysis of a plate with a circular hole	
Week-5	**STRESS ANALYSIS USING ANSYS**
Stress analysis of rectangular L bracket	
Week-6	**CANTILEVER BEAM ANALYSIS IN ANSYS**
Stress analysis of Cantilever beams	
Week-7	**SIMPLY SUPPORTED BEAM ANALYSIS IN ANSYS**
Stress analysis of beams (Simply supported & Fixed ends)	
Week-8	**AXI-SYMMETRIC COMPONENT**
Stress analysis of an axi-symmetric component	

Week-9	**THERMAL ANALYSIS**
Thermal stress analysis of a 2D component .	
Week-10	**CONDUCTION HEAT TRANSFER**
Conductive heat transfer analysis of a 2D component	
WeeK-11	**CONVECTIVE HEAT TRANSFER**
Convective heat transfer analysis of a 2D component	

VIII. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Week No	Topics to be covered	Course Learning Outcomes (CLOs)
1	Mode shapes for multi DOF system.	Able learn the multi DOF mode shapes
2	The natural frequencies, for 1st six modes of vibrations.	Use of free vibration governing equation and find out the natural frequency
3	Basics in ANSYS.	Different modules available in the ansys and their applications
4	Stress analysis of a plate with a circular hole	Stress distribution over a plate
5	Determination of the drag coefficient of a circular cylinder immersed in a uniform fluid stream using ANSYS/SolidWorks Flow Simulation..	Effect of drag magnitude on circular cylinder
6	Stress analysis of rectangular L bracket.	Stress distribution over a rectangular L bracket.
7	Stress analysis of Cantilever beams.	Stress distribution of Cantilever beams
8	Stress analysis of beams (Simply supported & Fixed ends)	Stress distribution of Simply supported & Fixed ends
9	Stress analysis of an axi-symmetric component	Stress distribution of an axi-symmetric component
10	Thermal stress analysis of a 2D component	Distribution of Thermal stress analysis of a 2D component
11	Conductive heat transfer analysis of a 2D component	Conductive heat transfer analysis of a 2D component

IX. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S NO	Description	Proposed actions	Relevance with POs
1	To improve standards and analyze the concepts.	Compare analysis and testing results	PO 1, PO 3
2	Encourage students to solve real time applications and prepare towards industrial needs.	NPTEL	PO 7

Prepared by:
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MECHANICAL ENGINEERING

COURSE DESCRIPTOR

Course Title	**COMPUTER AIDED MACHINING AND ROBOTICS LABORATORY**			
Course Code	BCCB12			
Programme	M. Tech (CAD/CAM)			
Semester	II	ME		
Course Type	Core			
Regulation	**IARE - R18**			
	Lectures	**Tutorials**	**Practical**	**Credits**
	-	-	3	2
Course Faculty	Mr. C. Labesh Kumar, Assistant Professor			

I. COURSE OVERVIEW:

This course provides knowledge of machining and robotic simulations. It covers the concepts for Part programing for sequence of operation, tool setting, sub routines and use of cycles. Numerical control programing for tool path generation for milling and turning operations. 3-D simulation for operations like picks and place robot

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
PG	BCC005	II	Computer Aided Manufacturing	3

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Computer Aided Machining And Robotics Laboratory	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✘	CHALK &TALK	✔	VIVA	✘	ASSIGNMENTS	✘	Moocs
✔	LCD / PPT	✘	SEMINARS	✘	MINI PROJECT	✘	VIDEOS
✘	OPEN ENDED EXPERIMENTS						

V. EVALUATION METHODOLOGY:

Continuous internal assessment (CIA):

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, with 20 marks for day to day evaluation and 10 marks for Internal Examination (CIE).

Semester End Examination (SEE):
The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the this courses is contains 12 experiments. The question paper pattern is as follows: Two full questions with 'either' 'or' choice will be drawn from each set. Each set contains 4 questions.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 10 marks for Continuous Internal Examination (CIE), 20 marks for Day to Day Evaluation.

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Day to Day Evaluation	
CIA Marks	10	20	30

Continuous Internal Examination (CIE):
Two CIE exam shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration consisting of two sets.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		**Strength**	**Proficiency assessed by**
PO 1	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineeringspecialization to the solution of complex engineering problems.	3	Lab related Exercises
PO 2	Identify, formulate, review research literature, and analyze complex engineering problemsreaching substantiated conclusions using first principles of mathematics, natural sciences, andengineering sciences	2	Lab related Exercises
PO 5	Create, select, and apply appropriate techniques, resources, and modern engineering and IT toolsincluding prediction and modeling to complex engineering activities with an understanding of thelimitations.	3	Lab related Exercises

3= High; 2 = Medium; 1 = Low

VII. COURSEOBJECTIVES:

The course should enable the students to:	
I	Create the part model using CAM software.
II	Generate computer numerically part program for computer numerically control turning and milling operation.
III	Demonstrate the tool path for turning operation using CAM software

VIII. COURSEOUTCOMES (COs):

CLO Code	CO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
BCC102.01	CO 1	Understanding the concepts of machining and robotic simulations	PO1	3
BCC102.02	CO 2	Understand Part programing for sequence of operation, tool setting, sub routines and use of cycles.	PO1 PO5	3
BCC102.03	CO 3	Numerical control programing for tool path generation for milling and turning operations	PO1 PO2	3
BCC102.04	CO 4	3-D simulation for operations like picks and place robot	PO1 PO2	2
BCC102.05	CO 5	Practice of robotic languages	PO1 PO2	2

3= High; 2 = Medium; 1 = Low

IX. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcomes (COs)	Program Outcomes (POs)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3						
CO 2	3				3		
CO 3	3	3					
CO 4	2	2					
CO5	2	2					

3= High; 2 = Medium; 1 = Low

X. ASSESSMENT METHODOLOGIES–DIRECT:

CIE Exams	PO 1, PO 2, PO 5	SEE Exams	PO 1, PO 2, PO5	Assignments	-	Seminars	-
Laboratory Practices	PO 1, PO 2, PO 5	Student Viva	PO 1, PO 2, PO 5	Mini Project	-	Certification	-
Term Paper	-						

XI. ASSESSMENT METHODOLOGIES–INDIRECT:

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XII. SYLLABUS:

S No.	Experiment
1	Tool planning and selection of sequences of operation, tool setting on machine-practice
2	Practice in part programming and operation of CNC turning machines, sub routines and use of cycles.
3	Practice in part program and operation of a machine center, joining and selection of sequence ofoperation, tool setting on machine.
4	Generate APT based NC programming and tool simulation for drilling operation.
5	Practice in APT based NC programming and tool simulation for facing operation.
6	Generate of NC code generation and tool path simulation for profile milling operation using CAMsoftware.
7	Develop NC code and tool path simulation for thread operation using CAM software.
8	Practice of robotic languages, 3-D Robot Simulation for operation of pick-place robot

XIII. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No.	Learning Objectives	Topics to be covered
1-3	Over view of Tool planning and selection of sequences of operation, tool setting on machine-practice.	Tool planning and selection of sequences of operation, tool setting on machine-practice.
4-6	Understand part programming and operation of CNC turning machines	Part programming on CNC Turning.
7-9	Understand sub routines and use of cycles	Part programming on CNC Turning.
10-12	Understand APT based NC programming and tool simulation for drilling operation.	NC programming and tool simulation for drilling operation.
13-15	Understand APT based NC programming and tool simulation for facing operation	NC programming and tool simulation for facing operation.
16-18	Understand the NC code generation and tool path simulation for profile milling operation using CAM software.	NC code generation and tool path simulation for profile milling operation using CAM software.
19-21	Understand NC code and tool path simulation for thread operation using CAM software.	NC code and tool path simulation for thread operation using CAM software.
22-24	Understand the characteristics of 3-D Robot Simulation	Demo on 3-D Robot Simulation

Lecture No.	Learning Objectives	Topics to be covered
25-27	Understand the concepts of operations in 3-D Robot.	3-D Robot Simulation operation
28-30	Understand the functionality of 3-D Robot Simulation operation	Practice of robotic languages
31-33	Understand robotic languagesfor operation of pick-place.	Designing a program for operation of pick-place.
34-36	Understand 3-D Robot operation and timers.	Designing a program to understand the operation of 3-D Robot.
37-39	Internal Lab Exam	CIE-I

Prepared by:
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