



MANIPAL SCHOOL OF INFORMATION SCIENCES

MANIPAL

(A constituent unit of MAHE, Manipal)

Master of Engineering - ME (Embedded Systems)

Course File

Course Name	:	Advanced Computer Architecture
Course Code	:	ESD 5101
Academic Year	:	2024 – 25
Semester	:	I
Name of the Course Coordinator	:	Ravikala Kamath
Name of the Program Coordinator	:	Dr. Dinesh Rao

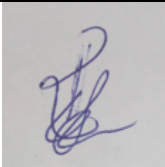
	
Signature of Program Coordinator with Date	Signature of Course Coordinator with Date 5.8.23



Table of Contents

1. Course Plan	6
1.1 Primary Information.....	6
1.2 Course Outcomes (COs)	7
1.3 Assessment Plan.....	7
1.4 Lesson Plan	10
1.5 References	13
1.6 Other Resources (Online, Text, Multimedia, etc.)	13
1.7 Course Outcomes (COs)	Error! Bookmark not defined.
1.8 Course Timetable	14
1.9 Assessment Plan.....	15
1.10 Assessment Details.....	16
1.11 Course Articulation Matrix	17
2. Assessment Details	Error! Bookmark not defined.
2.1 Student Details:	Error! Bookmark not defined.



MANIPAL SCHOOL OF INFORMATION SCIENCES

MANIPAL

(A constituent unit of MAHE, Manipal)

- 2.2 **Assessment outcomes** Error! Bookmark not defined.
- 2.3 **Analysis of Assessment outcomes**..... Error! Bookmark not defined.
- 2.4 **Attainment of Course Outcomes (Direct)** Error! Bookmark not defined.
- 2.5 **Attainment of Course Outcomes (Indirect): Course End Survey (CES) Questionnaire** Error! Bookmark not defined.
- 2.6 **Attainment of Course Outcomes (Indirect): Analysis** Error! Bookmark not defined.
- 3. **CO-PO Assessment**.....Error! Bookmark not defined.
- 4. **Observations and Comments**.....Error! Bookmark not defined.
 - 4.1 **Observations from Course Coordinator based on the direct and indirect assessments**..... Error! Bookmark not defined.
 - 4.2 **Comments/Suggestions by the Course Coordinator** Error! Bookmark not defined.



Program Education Objectives (PEOs)

The overall objectives of the Learning Outcomes-based Curriculum Framework (LOCF) for **ME (Embedded Systems)**, program are as follows.

PEO No.	Education Objective
PEO 1	Enable to draw upon fundamental and advanced knowledge to apply analytical and computational approaches to solve technological problems in embedded systems.
PEO 2	Introduce state of art technologies in the area of embedded systems and inculcate ethical practices to make industry-ready professionals.
PEO 3	Promote scientific and societal advancement through research and entrepreneurship.



Program Outcomes (POs)

By the end of the postgraduate program in **ME (Embedded Systems)**, graduates will be able to:

PO1	Independently carry out research /investigation and development work to solve practical problems.
PO2	Write and present a substantial technical report/document.
PO3	Demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.
PO4	Develop and implement embedded systems requirements based on theoretical principles and practical knowledge.
PO5	Demonstrate knowledge of the underlying principles and evaluation methods for analyzing data for decision-making.



MANIPAL SCHOOL OF INFORMATION SCIENCES

MANIPAL

(A constituent unit of MAHE, Manipal)

1. Course Plan

1.1 Primary Information

Course Name	:	Advanced Computer Architecture [ESD 5101]
L-T-P-C	:	3-0-0-3
Contact Hours	:	36 Hours
Pre-requisite	:	Basic Programming with C
Core/ PE/OE	:	Core



MANIPAL SCHOOL OF INFORMATION SCIENCES

MANIPAL

(A constituent unit of MAHE, Manipal)

1.2 Course Outcomes (COs), Program outcomes (POs) and Bloom's Taxonomy Mapping

CO	At the end of this course, the student should be able to:	No. of Contact Hours	Program Outcomes (PO's)	BL
CO1	Apply and use the various type of architectures and its classes, pipelines ,instruction sets	12	PO3	3
CO2	Analyze and design the various components of processors , pipeline stages, and developing applications on ARM	9	PO5	4
CO3	Evaluate and justify the processing section of control units	9	PO4	5

1.3 Assessment Plan



MANIPAL SCHOOL OF INFORMATION SCIENCES

MANIPAL

(A constituent unit of MAHE, Manipal)

Components	Mid Semester	Flexible Assessments (2 – 3 in number)	End semester/ Makeup examination
Duration	90 minutes	To be decided by the faculty.	180 minutes
Weightage	0.3	0.1	0.5
Typology of questions	Applying; Analyzing, Evaluating	Applying; Analyzing. Evaluating.	Applying; Analyzing; Evaluating.
Pattern	Answer all 5 questions of 10 marks each. Each question may have 2 to 3 parts of 3/4/5/6/7 marks.	Assignment: [To be decided by the faculty. May be Assignments, Problem solving, etc.]	Answer all 10 full questions of 10 marks each. Each question may have 2 to 3 parts of 3/4/5/6/7 marks.
Schedule	As per academic calendar.	Assignment submission: Decided by faculty may be November 2024	As per academic calendar.
Topics covered	Introduction - ECODING TECHNIUES,	DESIGNING THE HARDWARES, INSTRUCTION	Comprehensive examination covering the full syllabus.



MANIPAL SCHOOL OF INFORMATION SCIENCES

MANIPAL

(A constituent unit of MAHE, Manipal)

	INSTRUCTION SET, BUS STRUCTURES ADDERS MULTIPLIERS DIVISORS, REGISTERS DESIGN OF CONTROL UNITS APPLICATIONS OF ARM PROGRAMS	SET ARCHITECTURES, MEMORY CONCEPTS PARALLEL ARCHITECTURES HAZARDS	Students are expected to answer all questions.
--	--	--	---



MANIPAL SCHOOL OF INFORMATION SCIENCES

MANIPAL

(A constituent unit of MAHE, Manipal)

1.4 Lesson Plan

L. No.	TOPICS	Course Outcome Addressed
L0	Course delivery plan, Course assessment plan, Course outcomes, Program outcomes, CO-PO mapping, reference books	---
L1	Introduction of types of architectures, bus structures	CO1
L2	Bus structures, classification	CO1
L3	Introduction of ARM processors architectures	CO1
L4	Instruction level register ,general purpose register designs	CO3
L5	Instruction sets, types	CO2
L6	Adders, types of adders logical designs	CO3
L7	Multipliers, designs	CO3
L8	Barrel shifters	CO2



MANIPAL SCHOOL OF INFORMATION SCIENCES

MANIPAL

(A constituent unit of MAHE, Manipal)

L9	Barrel shift registers	CO2
L10	Sequential multipliers	CO2
L11	Sequential multipliers and design	CO3
L12	ROM based multipliers	CO3
L13	ALU design	CO2
L14	Addressing modes	CO2
L15	Addressing modes	CO3
L16	ARM and THUMB instructions, endianness assembly programming	CO2
L17	Booths algorithms	CO3
L18	Division algorithms	CO2
L19	Control unit	CO2
L20	Hardware approach	CO3
IT1	INTERNAL TEST 1	CO2, CO3
L21	Microprogrammed approach	CO2
L22	Firmware coprocessor float point numbers	CO1
L23	Memory , types	CO1
L24	Memory hierarchy	CO1
L25	Static and dynamic RAM, ROM, types	CO1
L26	Cache memory performances	CO2
L27	Virtual memories	CO2



MANIPAL SCHOOL OF INFORMATION SCIENCES

MANIPAL

(A constituent unit of MAHE, Manipal)

L28	Introduction to pipeling	CO1
L29	Hazards	CO3
L30	Datapath and control considerations	CO3
L31	Parallel processing	CO1
L32	Uni and multi processor	CO1
L33	Parallel computer structures, architectures	CO2
L34	Classification schemes of parallel computer structures	CO2
L35	Principle and vector processing	CO1
L36	Structures and algorithms for array processors	CO1



MANIPAL SCHOOL OF INFORMATION SCIENCES

MANIPAL

(A constituent unit of MAHE, Manipal)

1.5 References

1. CV Hamacher, Vranseic and Zaky , “Computer Organization”, Fifth Edition, Tata-MacgrawHill
2. Rafiquzzamann ,“Modern Computer Architecture”,Chandra,Galgotia Publications
3. John L Hennessy and David A Patterson ,“Computer Architecture: A Quantitative approach”, 2nd Edition
4. John L Hennessy and David A Patterson ,“Principles of Computer Architecture”, Prentice Hall
5. Shivarama Danadamudi, “Guide to RISC Processors for Programmers & Engineers”, Springer Publications.
6. “ARM Architecture Reference Manual”, David Seal ,Addison-Wesley,2nd Edition
7. “AMBA Specification”, ARM7TDMI Datasheet.
8. “Computer Organisation and Design”, David A Patterson, John L Hennessy
9. David Seal, "ARM Architecture Reference Manual", 2nd Edition, Addison-Wesley Professional.
10. Steve Furber,"ARM System-on-Chip Architecture",2nd Edition, Addison-Wesley Professional, ISBN-13: 078-5342675191,ISBN-10: 0201675196
11. William Hohl, Christopher Hinds,"ARM Assembly Language: Fundamentals and Techniques",2nd Edition, ISBN-13: 978-1482229851, ISBN-10: 1482229854
12. Andrew Sloss, Dominic Symes, Chris Wright,"ARM System Developer's Guide: Designing and Optimizing System Software",1st Edition,The Morgan Kaufmann Series in Computer Architecture and Design, ISBN13: 978-1558608740, ISBN-10: 1558608745
13. Websites & Transaction Papers 14.
14. MOOC: <https://www.mooc-list.com/course/computer-architecture-coursera>

1.6 Other Resources (Online, Text, Multimedia, etc.)

1. Web Resources: Blog, Online tools and cloud resources.
2. Journal Articles.



MANIPAL SCHOOL OF INFORMATION SCIENCES

MANIPAL

(A constituent unit of MAHE, Manipal)

1.7 Course Timetable

1 st Semester Embedded Systems				Room: LG1 LH				
	9-10	10-11	11-12	12-1	1-2	2-3	3-4	4-5
MON							ACA	
TUE								
WED							ACA	
THU						ACA LAB		
FRI							ACA	
SAT								



MANIPAL SCHOOL OF INFORMATION SCIENCES

MANIPAL

(A constituent unit of MAHE, Manipal)

1.8 Assessment Plan

COs					
CO No.	CO Name	IT-1 (Max. 50)	Assignment (Max. 10)	End Semester (Max. 100)	CO wise Weightage
CO1	Apply and use the various type of architectures and its classes, pipelines ,instruction sets		5	20	0.2
CO2	Analyze and design the various components of processors , pipeline stages, and developing applications on ARM	25	5-	40	0.4
CO3	Evaluate and justify the processing section of control units	25	10	40	0.4
	Marks (weightage)	0.3	0.2	0.5	1.0

Note:



MANIPAL SCHOOL OF INFORMATION SCIENCES

MANIPAL

(A constituent unit of MAHE, Manipal)

- In-semester Assessment is considered as the Internal Assessment (IA) in this course for 50 marks, which includes the performances in class participation, assignment work, class tests, mid-term tests, quizzes etc.
- End-semester examination (ESE) for this course is conducted for a maximum of 100 and the same will be scaled down to 50.
- End-semester marks for a maximum of 50 and IA marks for a maximum of 50 are added for a maximum of 100 marks to decide upon the grade in this course.

$$\begin{aligned}\text{Weightage for CO1} &= (\text{IT1 marks for CO1} / 2.5 + \text{IT2 marks for CO1} / 2.5 + \text{Assignment marks for CO1} + \text{ESE marks for CO1} / 2) / 100 \\ &= (25/2.5 + 0 + 0 + 20/2) / 100 = 0.2\end{aligned}$$

1.9 Assessment Details

The assessment tools to be used for the Current Academic Year (CAY) are as follows:



MANIPAL SCHOOL OF INFORMATION SCIENCES

MANIPAL

(A constituent unit of MAHE, Manipal)

Sl. No.	Tools	Weightage	Frequency	Details of Measurement (Weightage/Rubrics/Duration, etc.)
1	Internal Test	0.3	1	<ul style="list-style-type: none">• Performance is measured using internal test attainment level.• Reference: question paper and answer scheme.• Each internal test is assessed for a maximum of 50 marks and scaled down to 40 marks.
2	Assignments	0.2	2	<ul style="list-style-type: none">• Performance is measured using assignments/quiz attainment level.• Assignments/quiz are evaluated for a maximum of 10 marks.
3	ESE	0.5	1	<ul style="list-style-type: none">• Performance is measured using ESE attainment level.• Reference: question paper and answer scheme.• ESE is assessed for a maximum of 100 marks and scaled down to 50 marks.

1.10 Course Articulation Matrix



MANIPAL SCHOOL OF INFORMATION SCIENCES

MANIPAL

(A constituent unit of MAHE, Manipal)

CO	PO1	PO2	PO3	PO4	PO5
CO1			Y		
CO2				Y	
CO3					Y
Average Articulation Level			Y	Y	Y