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**PG – DESD**

**Module – Embedded C Programming**

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# DESD Modules

1. Embedded C Programming
2. Microcontroller Programming and Interfacing
3. Embedded Operating System
4. Data Structures and Algorithms
5. Embedded Linux Device Driver
6. Real Time Operating System
7. Internet of Things (IoT)
8. Aptitude and Effective Communication
9. Project

## Exam Pattern

Internal	+	Lab		+	Theory	
20		+	40		+	40 = 100 Marks



# History

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- C language was developed by Dennis Ritchie in 1972 at AT & T Bell Labs on PDP-11 machine.
- It was developed while porting UNIX from PDP-7 to PDP-11.
- Many features of C are inspired from B (Ken Thompson) and BCPL (Martin Richards).
- Initial release of C is referred as K & R C.



# Standardization

- C was standardized by ANSI in 1989. This is referred as C89.
- Standardization ensures C code to remain portable.
- C standard is revised multiple times to add new features in the language.
  - C89 – First ANSI standard
  - C90 – ANSI standard adopted by ISO
  - C99 – Added few C++ features like bool, inline, etc.
  - C11 – Added multi-threading feature.
  - C17 – Few technical corrections.



# Introduction

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- High-level
- Compiled
- Procedural
- Block-Structured (control structures).
- Typed
- Library Functions



# Features

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- Data types
- Operators
- Control structures
- Functions
- Storage classes
- Pointers
- Arrays
- Strings
- Dynamic memory allocation
- Structures
- Unions
- Enums
- File IO
- Preprocessor directives



# Strengths

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- Low level memory access (pointers, data structures)
- Effective memory access (bitwise operators, bit-fields, unions)
- Can access OS features (functions/commands)
- Extensive library functions (math, strings, file IO, ...)
- Compilers for different platforms & architectures
- Highly Readable (macros, enum, functions, ...)



# Applications

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- System programming
  - OS development
  - Device drivers
  - System utilities
- Embedded programming
  - ARM, AVR, PIC, etc.
  - IoT development
- Language development
  - Compiler development
- Achievements (tiobe.com)
  - In top-2 languages in last 40 years.
  - Language of year: 2019, 2017, 2008.





# Toolchain & IDE

- Toolchain is set of tools to convert high level language program to machine level code.
  - Preprocessor
  - Compiler
  - Assembler
  - Linker
  - Debugger
  - Utilities
- Popular compiler (toolchains)
  - GCC
  - Visual Studio
- IDE – Integrated development environment
  - Visual Studio
  - Eclipse
  - VS Code (+ gcc)
  - Turbo C
  - Anjuta, KDevelop, Codeblocks, Dev C++, etc.



# Software installation

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- Installations

- GCC (MinGW)
- VS Code

VS Code Download Link:

<https://code.visualstudio.com/Download>

TDM-GCC Download Link:

<https://jmeubank.github.io/tdm-gcc/download>



# Hello World

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- Source Code

```
// Hello World program
#include <stdio.h>
int main() {
    printf("Hello World\n");
    return 0;
}
```

- Commands

- cmd> gcc hello.c
- cmd> ./a.exe



# Hello World

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- `printf()` – library function
- `stdio.h` – header file
- `main()` – entry point function
  - `void main() { ... }`
  - `int main() { ... }`
  - `int main(void) { ... }`
  - `int main(int argc, char *argv[]) { ... }`
  - `int main(int argc, char *argv[], char *envp[]) { ... }`
- `return 0` – exit status





Thank you!

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