

5.1 CNC MACHINES AND AUTOMATION

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RATIONALE

Diploma holders are required to supervise and handle specialized machines and equipment like CNC machines. For this purpose, knowledge and skills about NC machines, part programming in NC machines and tooling for CNC machines are required to be imparted for enabling them to perform above functions. This subject aims at development of knowledge and skills about CNC machines, tools, equipment and use of high tech machines for increased productivity and quality.

DETAILED CONTENTS

1. Introduction (06 hrs)
Introduction to NC, CNC and DNC, their advantages, disadvantages and applications. Basic components of CNC machines, Machine Control Unit, input devices, selection of components to be machined on CNC machines, Axis identification
2. Construction and Tooling (06 Hrs)
Design features, specification of CNC machines, use of slideways, balls, rollers and coatings, motor and leadscrew, swarf removal, safety and guarding devices, various cutting tools for CNC machines, Concept of CNC tool holder, different pallet systems and automatic tool changer system, management of a tool room.
3. System Devices (12 Hrs)
Control System; Open Loop and Closed Loop System, Concept of Actuators, Transducers and Sensors, Tachometer, LVDT, opto-interrupters, potentiometers for linear and angular position, encoder and decoder and axis drives
4. Part Programming (08 Hrs)
Introduction to Part programming, Basic concepts of part programming, NC words, part programming formats, simple programming for rational components, part programming using coned cycles, subroutines and do loops, tool off sets, cutter radius compensation and tool wear compensation.
5. Problems in CNC Machines (04 Hrs)
Common problems in CNC machines related to mechanical, electrical and pneumatic, electronic components. Study of common problems and remedies, use of on-time fault finding diagnosis tools in CNC machines.

6. Automation and NC system (06 Hrs)

Concept of automation, emerging trends in automation, automatic assembly. Overview of FMS, Group technology, CAD/CAM and CIM.

7. Robot Technology (06 hrs)

Introduction to robot technology, basic robot motion and its applications

LIST OF PRACTICALS

1. Study of constructional detail of CNC lathe.
2. Study of constructional detail of CNC milling machine.
3. Study the constructional details and working of Automatic tool changer and Multiple pallets
4. Develop a part programme for following lathe operations and make the job on CNC lathe.
 - Plain turning and facing operation
 - Taper turning operation
 - Circular interpolation.
5. Develop a part programme for the following milling operation and make the job on CNC milling
 - Plain milling
 - Slot milling
 - Contouring
 - Pocket milling
6. Preparation of work instructions for machine operator
7. Preparation of preventive maintenance schedule for CNC machine.
8. Demonstration through industrial visit for awareness of actual working of FMS in production.

INSTRUCTIONAL STRATEGY

This is highly practice-based course. Efforts should be made to develop programming skills amongst the students. During practice work, it should be ensured that students get opportunity to individually perform practical tasks.

RECOMMENDED BOOKS

1. CNC Machines – Programming and Applications by M Adithan and BS Pabla; New Age International (P) Ltd., Delhi.
2. CNC Machines by M.S. Sehwat and J.S. Narang; Dhanpat Rai and Co., New Delhi.
3. Computer Aided Manufacturing by Rao, Kundra and Tiwari; Tata Mc Graw Hill, New Delhi.
4. CNC Machine by Bharaj; Satya Publications, New Delhi.
- 5.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	06	12
2	06	12
3	12	26
4	08	18
5	04	08
6	06	12
7	06	12
Total	48	100

5.2 POWER ELECTRONICS

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RATIONALE

Diploma holders play a vital role in the field of Electronics especially in industry and research organizations are required to handle a wide variety of power electronic equipment used in process control Industry. This subject will provide the student basic understanding of the principles of their working. The practical training will further re-inforce the knowledge and skill of the students.

DETAILED CONTENTS

1. Introduction to thyristors and other Power Electronics Devices (13 hrs)
 - a) Construction, Working principle of SCR, two transistor analogy of SCR, V-I characteristics of SCR.
 - b) SCR specifications and ratings.
 - c) Different methods of SCR triggering.
 - d) Different commutation circuits for SCR.
 - e) Series and parallel operation of SCR.
 - f) Construction and working principle of DIAC, TRIAC and their V-I characteristics.
 - g) Construction, working principle of UJT, V-I characteristics of UJT. UJT as relaxation oscillator.
 - h) Brief introduction to Gate Turn off thyristor (GTO), Programmable Uni-junction Transistor (PUT), MOSFET.
 - i) Basic idea about the selection of Heat sink for thyristors.
 - j) Applications such as light intensity control, speed control of universal motors, fan regulator, battery charger.
2. Controlled Rectifiers (07 hrs)
 - a) Single phase half wave controlled rectifier with load (R, R-L)
 - b) Single phase half controlled full wave rectifier with load (R, R-L)
 - c) Fully controlled full wave bridge rectifier.
 - d) Single phase full wave centre tap rectifier.
3. Inverters, Choppers, Dual Converters and Cyclo converters. (12 hrs)
 - a) Principle of operation of basic inverter circuits, concepts of duty cycle, series and parallel Inverters and their applications.

- b) Choppers: Introduction, types of choppers (Class A, Class B, Class C and Class D). Step up and step down choppers.
 - c) Dual Converters and cyclo converters: Introduction, types and basic working principle of dual converters and cyclo converters and their applications.
4. Thyristorised Control of Electric drives (10 hrs)
- a) DC drive control
 - i) Half wave drives
 - ii) Full wave drives
 - iii) Chopper drives (Speed control of DC motor using choppers)
 - b) AC drive control
 - i) Phase control
 - ii) Constant V/F operation
 - iii) Cycloconverter/Inverter drives.
5. Un interrupted Power Supply (UPS) (06 hrs)
- a) UPS: Block Diagram & specifications of on-line, off line and Smart UPS
 - b) Concept of high voltage DC transmission

LIST OF PRACTICALS

- 1) To plot V-I characteristic of an SCR.
- 2) To plot V-I characteristics of TRIAC.
- 3) To plot V-I characteristics of UJT.
- 4) To plot V-I characteristics of DIAC.
- 5) Study of UJT relaxation oscillator. And observe I/P and O/P wave forms
- 6) Observation of wave shape of voltage at relevant point of single-phase half wave controlled rectifier and effect of change of firing angle.
- 7) Observation of wave shapes of voltage at relevant point of single phase full wave controlled rectifier and effect of change of firing angle.
- 8) Observation of wave shapes and measurement of voltage at relevant points in TRIAC based AC phase control circuit for Varying lamp intensity and AC fan speed control.
- 9) Installation of UPS system and routine maintenance of batteries.

INSTRUCTIONAL STRATEGY

Power Electronics being very important for industrial controls requires a thorough know how about industrial devices. Teacher should take to the class various SCRs and other semiconductor devices to demonstrate these to the students. The teacher may encourage students to perform practical simultaneously for better understanding of the subject and verification of theoretical concepts. So industrial visit in between the course is a must.

RECOMMENDED BOOKS

- 1) Power Electronics by P.C. Sen, Tata Mc Graw Hill Education Pvt Ltd. New Delhi
- 2) Power Electronics by P.S. Bhimbhra, Khanna Publishers, New Delhi
- 3) Power Electronics – Principles and Applications by Vithayathi, Tata Mc Graw Hill Education Pvt Ltd. New Delhi
- 4) Power Electronics by Sanjay Puri & Chopra North Publication, Ambala
- 5) Power Electronics by M.S. Berde, Khanna Publishers, New Delhi.
- 6) Power Electronics by MH Rashid
- 7) Industrial Electronics and Control by SK Bhattacharya and S. Chatterji, New Age Publications. New Delhi

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING PAPER SETTER

Sr No	Topic	Time Allotted (Hrs)	Marks Allotted%
1	Introduction to thyristors and other power electronics devices	13	30
2	Controlled Rectifiers	07	15
3	Inverters, Choppers, Dual Converters and Cyclo converters.	12	25
4	Thyristorised Control of Electric drives	10	20
5	UPS	06	10
	Total	48	100

5.3 EMPLOYABILITY SKILLS – I

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RATIONALE

The present day world requires professionals who are not only well qualified and competent but also possess good communication skills. Our diploma students not only need to possess subject related knowledge but also soft skills to get good jobs or to rise steadily at their work place. The objective of this subject is to prepare students for employability in job market and survive in cut throat competition among professionals.

DETAILED CONTENTS\

1. Writing skills (08 hrs)
 - i) Official and business correspondence
 - ii) Job application - covering letter and resume
 - iii) Report writing - key features and kinds

2. Oral Communication Skills (20 hrs)
 - i) Giving advice
 - ii) Making comparisons
 - iii) Agreeing and disagreeing
 - iv) Taking turns in conversation
 - v) Fixing and cancelling appointments

3. Generic Skills (04 hrs)
 - i) Stress management
 - ii) Time management
 - iii) Negotiations and conflict resolution
 - iv) Team work and leadership qualities

5.4 ENVIRONMENTAL EDUCATION

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RATIONALE

A diploma holder must have knowledge of different types of pollution caused due to industries and constructional activities so that he may help in balancing the eco system and controlling pollution by pollution control measures. He should also be aware of environmental laws related to the control of pollution.

DETAILED CONTENTS

1. Definition, Scope and Importance of Environmental Education (02 hrs)
2. Basics of ecology, biodiversity, eco system and sustainable development (03 hrs)
3. Sources of pollution - natural and manmade, causes, effects and control measures of pollution (air, water, noise, soil, radioactive and nuclear) and their units of measurement (12 hrs)
4. Solid waste management – Causes, effects and control measures of urban and industrial waste (06 hrs)
5. Mining and deforestation – Causes, effects and control measures (04 hrs)
6. Environmental Legislation - Water (prevention and control of pollution) Act 1974, Air (Prevention and Control of Pollution) Act 1981 and Environmental Protection Act 1986, Role and Function of State Pollution Control Board, Environmental Impact Assessment (EIA) (10 hrs)
7. Role of Non-conventional Energy Resources (Solar Energy, Wind Energy, Bio Energy, Hydro Energy) (04 hrs)
8. Current Issues in Environmental Pollution – Global Warming, Green House Effect, Depletion of Ozone Layer, Recycling of Material, Environmental Ethics, Rain Water Harvesting, Maintenance of Groundwater, Acid Rain, Carbon Credits. (07 hrs)

INSTRUCTIONAL STRATEGY

In addition, different activities pertaining to Environmental Education like expert lectures, seminar and awareness camps etc. may also be organized.

RECOMMENDED BOOKS

1. Environmental and Pollution Awareness by Sharma BR; Satya Prakashan, New Delhi.
2. Environmental Protection Law and Policy in India by Thakur Kailash; Deep and Deep Publications, New Delhi.
3. Environmental Engineering and Management by Suresh K Dhamija; SK Kataria and Sons, New Delhi.
4. Environmental Science by Deswal and Deswal; Dhanpat Rai and Co. (P) Ltd. Delhi.
5. Engineering Chemistry by Jain and Jain; Dhanpat Rai and Co. (P) Ltd. Delhi.

6. Environmental Studies by Erach Bharucha; UGC University Press
7. Basic Environmental Engineering by R.C. Gaur; New Age International Publishers, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted for Lectures (Periods)	Marks Allotted (%)
1	02	04
2	03	06
3	12	24
4	06	12
5	04	10
6	10	20
7	04	10
8	07	14
Total	48	100

5.5 EMBEDDED SYSTEMS

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RATIONALE

The study of microprocessors in terms of architecture, software and interfacing techniques leads to the understanding of working of CPU in a microcomputer. The development in advance microprocessors brings diploma students face-to-face with sophisticated systems in industry. Knowledge of microprocessors and microcontrollers will help them find employment in RandD, assembly, repair and maintenance of hardware of embedded systems. Microprocessors find application in process control industry. They also form a part of the electronic switching system between source and destination in long distance telecommunications. Automation industries often use microcontrollers to introduce programmable control in their operations.

DETAILED CONTENTS

1. Evolution of Microprocessor (04 hrs)

Typical organization of a microcomputer system and functions of its various blocks. Microprocessor, its evolution, function and impact on modern society
2. Architecture of a Microprocessor (with reference to 8085 microprocessor) (08 hrs)

Concept of Bus, bus organization of 8085, Functional block diagram of 8085 and function of each block, Pin details of 8085 and related signals, Demultiplexing of address/data bus generation of read/write control signals, Steps to execute a stored programme
3. Programming (with respect to 8085 microprocessor) (08 hrs)

Brief idea of machine and assembly languages, Machines and Mnemonic codes. Instruction format and Addressing mode. Identification of instructions as to which addressing mode they belong. Concept of Instruction set. Explanation of the instructions of the following groups of instruction set. Data transfer group, Arithmetic Group, Logic Group, Stack, I/O and Machine Control Group. Programming exercises in assembly language. (Examples can be taken from the list of experiments).
4. Memories and I/O interfacing (08 hrs)

Memory organization, Concept of memory mapping, partitioning of total memory space. Address decoding, concept of I/O mapped I/O and memory mapped I/O. Interfacing of memory mapped I/O devices. Concept of stack and its function. Basic RAM Cell, N X M bit RAM, Expansion of word length and capacity, static and dynamic RAM, basic idea of ROM, PROM, EPROM and EEPROM.

5. Interrupts (04 hrs)
 Concept of interrupt, Maskable and non-maskable, Edge triggered and level triggered interrupts, Software interrupt, Restart interrupts and its use, Various hardware interrupts of 8085, Servicing interrupts, extending interrupt system
6. Data Transfer Techniques (04 hrs)
 Concept of programmed I/O operations, sync data transfer, async data transfer (hand shaking), Interrupt driven data transfer, DMA, Serial output data, Serial input data
7. Peripheral Devices (06 hrs)
 8255 PPI and 8253 PIT, 8257 DMA controller, 8279 Programmable KB/Display Interface, 8251 Communication Interface Adapter, 8155/8156
8. Architecture of a Microcontroller (8051) (08 hrs)
9. 8051 Instruction set and Programming (08hrs)
 Addressing modes, Timer operation, serial communication and interrupts
10. Interfacing of 8051 with other devices like keypad, LCD, A/D, D/A, RTC, stepper motor (06 hrs)

LIST OF PRACTICALS

1. Familiarization of different keys of 8085 microprocessor kit and its memory map
2. Steps to enter, modify data/program and to execute a programme on 8085 kit
3. Writing and execution of ALP for addition and subtraction of two 8 bit numbers
4. Writing and execution of ALP for multiplication and division of two 8 bit numbers
5. Writing and execution of ALP for arranging 10 numbers in ascending/descending order
6. Writing and execution of ALP for 0 to 9 BCD counters (up/down counter according to choice stored in memory)
7. Interfacing exercise on 8255 like LED display control
8. Interfacing exercise on 8253 programmable interval timer
9. Interfacing exercise on 8279 programmable KB/display interface like to display the hex code of key pressed on display
10. Study and use of interfacing 8 bit A/D card and D/A card in sampling, wave generation, multiplexer, de-multiplexer and counter
11. Use of 8085 emulator for hardware testing
12. Programming practice with 8051 instruction set.

INSTRUCTIONAL STRATEGY

The digital systems in microprocessors have significant importance in the area of electronics. Adequate competency needs to be developed by giving sufficient practical knowledge in microprocessors (programming as well as interfacing). Help may be taken in the form of charts, simulation packages to develop clear concepts of the subject. Programming exercises other than the given in the list may be given to the students.

RECOMMENDED BOOKS

1. Microprocessor Architecture, Programming and Applications with 8080/8085 by Ramesh S Gaonker, Willey Eastern Ltd. New Delhi
2. Microprocessor and Microcontrollers by Dr BP Singh, Galgotia Publications, New Delhi
3. Microprocessor and Applications by Badri Ram: Tata McGraw Hill Education Pvt Ltd , New Delhi
4. Microprocessor and Microcomputers by Refiquzzaman, Prentice Hall of India Ltd., New Delhi.
5. 8051 Microcontroller by Ayla K. J; Pearson, New Delhi
6. 8051 Microcontroller and Embedded Systems by Mazidi, M.A. ; Pearson, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Hrs)	Marks Allotted (%)
1.	04	5
2.	08	10
3	08	10
4	08	10
5.	04	5
6.	04	5
7.	06	15
8.	08	15
9.	08	15
10.	06	10
Total	64	100

5.6 PROCESS CONTROL AND DATA COMMUNICATION

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RATIONALE

For a diploma student, early emphasis on automatic control is vital since a process designed and constructed with proper consideration for its control is the need of modern industry. This course introduces various control mechanisms, modes and devices which are necessary to understand simple control systems in a process plant. The contents of the course have been selected and arranged so as to treat it in a logical manner, to understand the important laws of operation of industrial automatic control systems and to provide a practical background of theory. The course will enable the student to visualize and evaluate the effect of changes in process parameters on the control response.

This course also provides the basics of electronic communication systems including transmitters and receivers. In addition to components and systems of analog communication, the students will learn the basics of digital communication.

DETAILED CONTENTS

1. Introduction (08 hrs)
 - 1.1 Basics of control system
 - 1.2 Time varying and time invariant system
 - 1.3 Continuous and discrete time control system
 - 1.4 Open loop and close loop control system
 - 1.5 Comparison between open loop and closed loop control system
 - 1.6 Components/elements of closed loop system

2. Basics of Process Control (12 hrs)

Basics of process control, process variable. Concept of on-off, proportional, integral, derivative, PI, PD and PID, Examples. Relative merits and demerits, Response of different control modes to step and ramp test inputs.

3. Control Elements (06 hrs)

Principle of operation and constructional details of solenoid valves, diaphragm operated valve, piston operated valve, valve positioners, control valve characteristics and their sizing.

4. Basic Communication System (06 hrs)
 - 4.1 Need and types of modulation systems
 - 4.2 Analog and digital modulation
 - 4.3 Electromagnetic spectrum and its various ranges: VLF, LF, MF, HF, VHF, UHF, microwave.

5. Analog Modulation Systems (08 hrs)

Block diagram of AM transmitters, AM receivers, DSB, DSB-SC, SSB system, FM transmitters and receivers, Vestigial side band systems.

6. Data Communication (08 hrs)

- 6.1 Basic block diagram and principle of working of the following ASK, FSK, PSK, QPSK
6.2 Spread Spectrum Techniques, Frequency Hopping Technique

INSTRUCTIONAL STRATEGY

The subject requires both theory and practical emphasis simultaneously, so that the student can understand the practical significance of the various areas. Visits to instrumentation and communications industries must be carried out, so as to make the students can understand where and how the various instruments are used in the industry.

RECOMMENDED BOOKS

1. Control Systems Engineering by I.J. Nagrath and M. Gopal
2. Linear Control Systems by B.S. Manke; Khanna Publishers
3. Process Control by Harrist P; McGraw Hill
4. Process Control Instrumentation Technology by Johnson , Curtis D; John Willey and Sons
5. Communication Systems by George Kennedy, Tata McGraw Hill Education Pvt Ltd, New Delhi.
6. Introduction to Data Communication by Blanchard

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Hrs)	Marks Allotted%
1	08	16
2	12	24
3	06	14
4	06	14
5.	08	16
6.	08	16
Total	48	100

5.7 MANUFACTURING PROCESSES - II

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3 - 6

RATIONALE

Diploma holders are responsible for supervising production processes to achieve production targets and for optimal utilization of resources. For this purpose, knowledge about various machining processes and cutting tools is required to be imparted. Hence the subject of Manufacturing Processes-II.

DETAILED CONTENTS

1. Cutting Tools and Cutting Materials (04 hrs)

Cutting Tools - Various types of single point cutting tools and their uses, Single point cutting tool geometry, tool signature and its effect.
2. Lathe (14 hrs)
 - 2.1 Principle of turning
 - 2.2 Function of various parts of a lathe
 - 2.3 Classification and specification of various types of lathe
 - 2.4 Work holding devices
 - 2.5 Lathe operations :- Plain and step turning, facing, parting off, taper turning, eccentric turning, drilling, reaming, boring, threading and knurling, form turning, spinning.
 - 2.6 Cutting parameters – Speed, feed and depth of cut for various materials and for various operations, machining time.
 - 2.7 Speed ratio, preferred numbers of speed selection.
 - 2.8 Lathe accessories:- Centers, dogs, different types of chucks, collets, face plate, angle plate, mandrel, steady rest, follower rest, taper turning attachment.
- 3 Milling (9 hrs)
 - 3.1 Principle of Milling
 - 3.2 Classification of milling machine and application
 - 3.3 Main parts of column and knee type milling machines
 - 3.4 Milling method - Up milling and Down milling
 - 3.5 Milling Operations- face milling, angular milling, form milling, straddle milling and gang milling
 - 3.6 Introduction to indexing
 - 3.7 Universal dividing head
4. Drilling and Boring (09 hrs)
 - 4.1 Principle of drilling.
 - 4.2 Classification of drilling machines and their description.
 - 4.3 Various operation performed on drilling machine – drilling, spot facing, reaming, boring, counter boring, counter sinking, hole milling, tapping.
 - 4.4 Nomenclature of a twist drill
 - 4.5 Principle of boring
 - 4.6 Classification of boring machines

5. Shaping, Planing and Slotting (08 hrs)
- 5.1 Working principle of shaper, planer and slotter.
 - 5.2 Type of shaper
 - 5.3 Type of planer
 - 5.4 Types of tools used and their geometry.
 - 5.5 Speeds and feeds in above processes.
6. Cutting Fluids and Lubricants (04 hrs)
- 6.1 Function of cutting fluid
 - 6.2 Types of cutting fluids
 - 6.3 Difference between cutting fluid and lubricant
 - 6.4 Selection of cutting fluids for different materials and operations
 - 6.5 Common methods of lubrication of machine tools.

PRACTICAL EXERCISES

Turning Shop

- Job 1. Grinding of single point turning tool.
- Job 2. Exercise of simple turning and step turning.
- Job 3. A composite job involving, turning, taper turning, external thread cutting and knurling.

Advance Fitting Shop

- Job 1. Exercise on drilling, reaming, counter boring, counter sinking and tapping
- Job 2. Dove tail fitting in mild steel
- Job 3. Radius fitting in mild steel

Machine Shop

- Job 1. Prepare a V-Block up to ± 0.5 mm accuracy on shaper machine
- Job 2. Exercise on key way cutting and spline cutting on shaper machine.
- Job3. Exercise on milling machine to produce a rectangular block.
- Job4. Exercise on milling machine to produce a spur gear.

INSTRUCTIONAL STRATEGY

- 1. Teachers should lay emphasis in making students conversant with concepts and principles of manufacturing processes.
- 2. Focus should be on preparing jobs using various machines in the workshop

RECOMMENDED BOOKS

1. Workshop Technology by B.S. Raghuwanshi; Dhanpat Rai and Sons; Delhi
2. Elements of Workshop Technology by SK Choudhry and Hajra; Asia Publishing House
3. A Text Book of Production Engineering by PC Sharma; S Chand and Company Ltd. Delhi
4. Workshop Technology by R.C. Jindal; North Publication, Ishan Publishers

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	04	10
2	14	30
3	09	20
4	09	15
5	08	15
6	04	10
Tot1al	48	100