MODERN EDUCATION SOCIETY'S

NOWROSJEE WADIA COLLEGE, PUNE -01

(An Autonomous college affiliated to Savitribai Phule Pune University)

M.Sc. II Electronic Science

SYLLABUS

UNDER NATIONAL EDUCATION POLICY 2020

TO BE IMPLEMENTED FROM

ACADEMIC YEAR 2024-25

(Faculty of Science and Technology)

Structure of Course

Basic structure/pattern (Framework) of the proposed postgraduate syllabus for the two-year integrated course leading to M.Sc. (Electronic Science).

Course Structure includes 2 compulsory theory courses of 4 credits each, Elective Theory courses of 4 credits and 2 compulsory practical courses of 2 credits as well for each semester.

In addition to this, one Elective theory course of 4 credits is to be chosen from the given list for optional course.

One Research Methodology course and OJT for semester I and II respectively.

Preamble:

Electronics technology has revolutionized various fields including communication, consumer appliances, medical, defense and so on. The advances in technology are making systems smaller, smarter and powerful. Electronics is an important branch of Science devoted to design implementation and analysis of circuits and systems. Knowledge of Electronics is based on fundamental laws of Physics and though new chips/SOC's are fabricated every day, basic principles remain the same.

The goal of the two-year course is to instill in students a confidence that they can get a grip of the subject and apply it for designing, testing and analyzing systems. The course will also make use of problem-solving approach wherein the students will be trained to apply the acquired knowledge to design and analyze circuits for specific applications. The students will be familiarized with programming languages, various development tools, modeling and simulation tools through lab sessions.

The syllabus has been designed such that basic fundamental concepts, knowledge and specific practical skills of the students are developed. The students will learn mathematical methods in electronics, they will develop circuits by using analogue and digital circuit design they will also acquire knowledge of PIC, AVR, Arduino, Raspberry Pi.

Course Outcome:

The course aims to generate trained manpower with adequate theoretical and practical knowledge of the various facets of electronic circuits and systems. In this course, the students will get a comprehensive understanding of electronic devices and circuits. To acquaint the students with the fundamental principles of various devices is one of the principle objectives of this course. The student will get profound knowledge to design electronic circuits and conduct investigations, as well as to analyse and interpret data.

They will develop the ability to use current techniques, skills, and modern tools necessary for practice.

Following are the objectives -

i. To design the syllabus with specific focus on key Learning Areas.

ii. To equip student with necessary fundamental concepts and knowledge base.

iii. To develop specific practical skills.

iv. To impart training on circuit design, analysis, building and testing.

v. To prepare students for demonstrating the acquired knowledge.

vi. To encourage student to develop skills for accepting challenges of upcoming technological advancements.

Program Specific Objectives:

i. To nurture academicians with focus and commitment to their subject
ii. To shape good and informed citizens from the students entering into the program.
iii. To credit a skilled workforce to match the requirements of society.
iv. To impart knowledge of science is the basic objective of this Programme.
v. To develop a scientific attitude is the major objective to make the students open-minded, critical and curious.
vi. To develop skills in practical work, experiments, and laboratory materials and equipment along with the collection and interpretation of scientific data to contribute to science.

Program outcomes:

i. The students will Postgraduate with proficiency in the subject of their choice.
ii. The students will be eligible to continue higher studies in their subject.
iii. The students will be eligible to pursue higher studies abroad.
iv. The students will be eligible to appear for the examinations for their jobs in government organizations.
v. The students will be eligible to apply for jobs with a minimum requirement of a M. Sc. Programme.
vi. The students will become entrepreneur.

Eligibility: As per Savitribai Phule Pune University.

Course Structure M.Sc. I

Course Type	Course	Course / Paper Title	Hours / Week	Credit
Semester I				
Major Mandatory	Major Paper 1 (Theory)	Advanced Analog Circuit Design	4	4
	Major Paper 2 (Theory)	Advanced Digital Circuit Design	4	4
	Major Paper (Theory)	Instrumentation and Measurement Techniques	2	2
	Major Paper (Practical)	Practical Course I	4	2
	Major Paper (Practical)	Practical Course II	4	2
Major Elective	Elective – I	Mathematical methods for Electronics using C	2	2
	Elective – II	Advanced Microcontrollers	2	2
	Elective Paper - I(Practical)	Mathematical methods for Electronics using C - Lab	4	2
	Elective Paper - II (Practical)	Advanced Microcontrollers - Lab	4	2
RM		Research Methodology	4	4
Semester II				
Major Mandatory	Major Paper 1 (Theory)	Applied Electromagnetics, Microwaves and Antennas	4	4
	Major Paper 2 (Theory)	Foundation of Semiconductor Devices	4	4
	Major Paper 3 (Theory)	VLSI System Design	2	2
	Major Paper (Practical)	Practical Course III	4	2
	Major Paper (Practical)	Practical Course IV	4	2
Major Elective	Elective - I	Device Fabrication Techniques	2	2
	Elective - II	32-bit Microcontroller based System Design	2	2
	Elective - I	Device Fabrication Techniques - Lab	4	2
	Elective - II	32-bit Microcontroller based System Design - Lab	4	2
OJT			4	4

COURSE STRUCTURE M. Sc. II

Course Type	Course	Course / Paper Title	Hours / Week	Credit
Semester III				
Major Mandatory (2*4 +2*2)	Major Paper 1 (Theory)	Control Systems	4	4
	Major Paper 2 (Theory)	Advanced communication systems	4	4
	Major Paper 3(Theory)	Digital Signal Processing and Applications	2	2
	Major Paper (Practical)	Major Practical V	4	2
	Major Paper (Practical)	Major Practical VI	4	2
Major Elective	Elective - I	Biomedical Instrumentation	2	2
	Elective - II	PLC Programming and Applications	2	2
	Elective – I-Practical	Biomedical Instrumentation – Lab	4	2
	Elective – II-Practical	PLC Programming and Applications – Lab	4	2
RP		Research Project / Internship	2	2
Semester IV				
Major Mandatory (2*4 +2*2)	Major Paper 1 (Theory)	Advanced Power Electronics	4	4
	Major Paper 2 (Theory)	Mechatronics and robotics	4	4
	Major Paper (Practical)	Practical Course VII	4	2
	Major Paper (Practical)	Practical Course VIII	4	2
Major Elective	Elective - I	Digital Image Processing	2	2
	Elective - II	Industrial Automation and Control	2	2
	Elective – I(Practical)	Digital Image Processing (Practical)	4	2
	Elective – II (Practical)	Industrial Automation and Control (Practical)	4	2
RP		Research Project / Internship	6	6

	MODERN EDUCATION SOCIETIES **NOWROSJEE WADIA COLLEGE, PUNE**	**Academic Year** **2024-2025**
Master of Electronic Science		
Major (Theory) – I		
YEAR-II	**Name of Paper- Control Systems** **Subject Code: PELMJ-231**	**CREDITS-4**
SEMESTER-III		**HOURS-60**

Course specific outcomes-

1. To analyse the control systems using different mathematical techniques such as transfer function and different stability criterion
2. To analyze and Distinguish different types of analog and digital controllers and control modes
3. To identify components of control systems
4. To design, develop and implement control systems for given applications

Sr no	**COURSE CONTENT / SYLLABUS**	**Lectures**
UNIT I	**Control system basics:** Closed loop control and functional elements in it open-loop control, continuous and discrete state control, control strategies such as feedback, feed forward and adaptive control, steady state optional control	**10**
UNIT II	**Control system analysis** Mathematical models of systems, concept of transfer function and its use, method of obtaining transfer function, block diagram of control system, rules of block diagram reductions and examples thereof. Concept of stability, Routh stability criterion, Roth- Hurwitz criterion, Root locus steps in drawing root locus, Use of root locus and examples thereof. Frequency response methods of control system analysis, Bode plots method to plot and examples thereof, Nyquist plots, method to plot and examples thereof, process loop tuning and control system evaluation, Open loop transient response method, Zeigler- Nichols method.	**20**
UNIT III	**Analog and Digital Controllers** Classification of controllers, Controller terms Discontinuous controllers: On-OFFController, three position controllers Continuous controllers: Proportional, Integral and Derivative control Composite control modes: PI, PD and PID controllers. Derivative overrun and integralwindup in PID control mode Design of analog controller circuits for above modes characteristics and applications Ladder Programming: Basic components such as relays, Design systems using ladder diagram such as conveyer belt monitoring, temperature control systems etc.	**15**

	DCS hardware and software, distributed process control station (DPCS), SCADA hardware and software, applications	
Unit IV	**Control system components and system examples** Principle and characteristics of control values, synchro-servo motors, Solenoids, actuators, annunciators, alarms, recorders, Standard Graphics Symbols for Process Control and Instrumentation Control system examples: Speed control system, position control systems, temperature and level control systems, reel drives, tension control system for paper	**15**
References	1. Process control: Principles and applications, Surekha Bhanot, Oxford UniversityPress 2nd Edition. 2. Control Engineering Noel. M. Morris, 3rd Edition Mac Graw Hill. 3. Process control instrumentation technology, C. D Johanson, PHI. 4. Control system engineering, Nagrath and Gopal, New age international limited. 5. Control Systems, U.A. Bakshi and V.U. Bakshi, Technical Publications Pune. 6. Modern Control engineering, Ogata, Prentice Hall, EEE. 7. Control engineering theory and practice, N.M. Bandhopadhyay, PHI. 8. Instrument Engineers' Handbook, Vol. 1: Process Measurement and Analysis, Bela G. Liptak, CRC Press	

	MODERN EDUCATION SOCIETIES **NOWROSJEE WADIA COLLEGE, PUNE**	**Academic Year** **2024-2025**
Master of Electronic Science		
Major (Theory) Subject-II		
YEAR-II	**Name of Paper-** Advanced communication systems	**CREDITS-4**
SEMESTER-III	**Subject Code: PELMJ-232**	**HOURS-60**

Course specific outcomes-

1. *Analyze continuous wave/analog method of communication (AM, FM and PM) considering noise, its generation and demodulation techniques*
2. *Compare different pulse modulation techniques (analog as well as digital)*
3. *Analyze digital modulation techniques and related correction methods*
4. *Distinguish different radio wave propagation techniques*
5. *Understand basic theory of antenna and their types as per applications*
6. *Understand basics of modern communication techniques like satellite communication and mobile communication*

Sr no	**COURSE CONTENT / SYLLABUS**	**Lectures**
UNIT I	**CW communication system** Communication systems, Modulation, Bandwidth requirements, External and Internal noise, Noise figure Theory of Amplitude modulation, Modulation index, side bands and frequency domain, Power distribution, Generation of AM, Suppression of carrier, suppression of unwanted side bands, Extensions of SSB, AM receivers Theory of frequency and Phase modulation, sidebands and modulation index, frequency modulation, Generation of FM, FM receivers	**15**
UNIT II	**Pulse Communication systems** Revision of PAM, PPM. PWM. Pulse code modulation, Delta modulation, Adaptive delta modulation, Time division multiplexing, Frequency division multiplexing, Characteristics of Data Transmission Circuits: Bandwidth Requirement, Speed, Baud Rate, Noise, Crosstalk, Distortion. DIGITAL CODES: ASCII Code – EBCDIC Code - Error Detection Codes – Parity Check Codes – Redundant Codes - Error Correction Codes – Retransmission- Forward Error Correcting Code – Hamming Code Digital Modulation Techniques – ASK, FSK, PSK, QPSK Modulation/Demodulation Techniques (Only Block Diagram	**15**

	and Operation). Data link protocols: SDLC, HDLC, XMODM protocols, ASK, FSK, PSK, QAM, telephone modems, cable modems and DSL	
UNIT III	**Radio wave propagation and Antennas** Propagation in free space, tropospheric, ionospheric propagation, Surface wave, Low and very low, extremely low frequency propagation Basic considerations, Wire radiations in space, Terms and definitions, Effects of ground on antennas, Antenna coupling at medium frequencies, Directional high frequency antennas, UHF and Microwave antennas, Wideband and special purpose antennas. Smart antenna analogy, Cellular radio systems evolution, signal propagation, Smart antenna benefitsand drawbacks	**15**
UNIT IV	**Communication Technologies** SATELLITE COMMUNICATION: Satellite system: Kepler's I, II, III laws – orbits – launching orbits – types - Geostationary synchronous satellites - Advantages – Apogee – Perigee - Active and passive satellite - Earth eclipse of satellite. Antenna: Parabolic reflector antenna – cassegrain antenna. Space segment: Power supply- Attitude control-station keeping – Transponders – TT and C subsystem – Antenna subsystem. Earth segment: Block diagram of Transmit receive earth station - Satellite mobile services - Basics of GPS. MICROWAVE COMMUNICATION: Microwave frequency ranges - microwave devices – Parametric amplifiers – travelling wave tubes – simple block diagram of microwave transmitter,receiver and microwave link repeater **MOBILE COMMUNICATION**: (Qualitative Treatment only) Cellular telephone– fundamentalconcepts – Simplified Cellular telephone system - frequency reuse – Interference – Co-channel Interference – Adjacent Channel Interference – Improving coverage and capacity in cellular systems - cell splitting – sectoring – Roaming and Handoff – Basics of blue tooth technology. SATELLITE MULTIPLE ACCESS TECHNIQUES: TDMA, FDMA, CDMA. Digital Cellular system – Global system for mobile communications (GSM) –GSM services GSM SystemArchitecture – Basics of GPRS.	**15**

References:	1. Electronic Communication Systems, George Kennedy and Bernard Davis Publ. Tata McGraw Hill. 2. Antenna theory analysis and design, Constantine A. Balanis 3. Electronic communications, Dennis Roddy and John Coolen, Pearson Publ. 4. Communication Electronics Principles and applications, Louis E. Frenzel, Tata McGraw Hill. 5. Digital data communication, Miller 6. Modern Electronic Communication by Jeffrey Beasley and Gary Miller 7. Advanced Electronic Communication systems, Tomasi

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Master of Electronic Science		
Major (Theory) Subject-III		
YEAR-II	**Name of Paper- Digital Signal Processing and Applications** **Subject Code: PELMJ-233**	**CREDITS-2**
SEMESTER-III		**HOURS-30**

Course specific outcomes-

1. *To understand and working knowledge of design, implementation and analysis DSP systems.*
2. *To make students familiar with the essential methods in DSP, including digital filter design, transform-domain processing and the importance of Signal Processors.*
3. *To make students aware of the meaning and implications of the properties of systems and signals.*

Sr no	**COURSE CONTENT / SYLLABUS**	**Lectures**
UNIT I	**Basics of Digital Signal Processing:** Analog Vs. Digital Signal Processing, Block diagram of digital signal processor, Sampling Theorem, Sampling, Quantization, Aliasing.	**8**
UNIT II	**Signals and Systems:** Basic signals, representation of signals in various ways, types of signals, systems: classification of systems, properties of systems, LSI system, delta function, impulse response, linear and circular convolution, properties of convolution, correlation, its type and applications. Types of filters, Infinite impulse response filters, Finite impulse response filters.	**12**
UNIT III	**DSP Applications:** Audio compression and decompression, audio equalization, audio noise cancellation, audio echo cancellation, video compression, video stabilization, image compression, face finding, image resizing, data modulation and demodulation, speech synthesis, mobile telephone, set-top box and ECG monitoring.	**10**
References:	1. Digital Signal Processors- Kuo and Gan, Pearson Education. 2. Digital Signal Processing: D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, J Wile and sons, Singapore. 3. Digital Signal Processing: Principle, Algorithms and Applications, John G. Proakis and D.G. Manolakis, Prentice-Hall. 4. Theory and Application of Digital Signal Processing: L. R. Rabiner and B. Gold, Prentice-Hall.	

	MODERN EDUCATION SOCIETIES NOWROSJEE WADIA COLLEGE, PUNE	**Academic Year 2024-2025**
Master of Electronic Science		
Major Practical		
YEAR-II	**Name of Paper- Major Practical – V Subject Code: PELMJ-234**	**CREDITS-2**
SEMESTER-III		**HOURS-60**

List of Practicals (Any 12)

1. Design of AM transmitter and receiver
2. Design of FM transmitter and receiver
3. Design of Delta modulation
4. Design PCM encoder and decoder system
5. Design of FSK modulator and demodulator
6. Design of telemetry system
7. Time division Multiplexing
8. Telemetry Applications
9. Varactor diode characteristics and its application in FM
10. Simulation of controller modes P/PI.
11. Simulation of controller modes PD/PID.
12. Design and develop ON/OFF controller using microcontroller.
13. Ladder diagram programming for basic circuits
14. Study of process automation system using ladder diagram for Vending machine
15. Study of process automation system using ladder diagram for bottle filling plant)
16. Design and Development of ON/OFF temperature control system using Arduino/Raspberry
17. DC Position Control System
18. AC Position Control System.

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Master of Electronic Science		
Major Practical		
YEAR-II	**Name of Paper- Major Practical – VI Subject Code: PELMJ-235**	**CREDITS-2**
SEMESTER-III		**HOURS-60**

List of Practicals (Any 12)

1. Design of Pulse Amplitude Modulation
2. Study of PLL as frequency Multiplier
3. Study of PLL as FSK demodulator.
4. Design of lag and lead compensation for the given plant.
5. Step and frequency response of a plant.
6. Step response of second order system.
7. Temperature control System.
8. Write a MATLAB programs for the generation of Periodic square pulse and Aperiodic Triangular Pulse.
9. Write a MATLAB programs for the addition and multiplication of Signals.
10. Write a MATLAB program for Real signal decomposition into even and odd parts.
11. Study of Linear convolution techniques using MATLAB.
12. Study of Circular convolution techniques using MATLAB.
13. Study of Auto correlation techniques using MATLAB.
14. Study of Cross Correlation techniques using MATLAB.
15. Implementation of LP FIR filters for a given sequence.
16. Implementation of HP FIR filters for a given sequence.
17. Implementation of LP IIR filters for a given sequence.
18. Implementation of HP IIR filters for a given sequence.

	MODERN EDUCATION SOCIETIES **NOWROSJEE WADIA COLLEGE, PUNE**	**Academic Year** **2024-2025**
Master of Electronic Science		
Major (Elective) –I		
YEAR-II	**Name of Paper- Biomedical Instrumentation**	**CREDITS-2**
SEMESTER-III	**Subject Code: PELME-236**	**HOURS-30**

Course specific outcomes-

1. *To introduce the students to the application of biomedical instrumentation.*
2. *To learn the practical aspects of various medical transducers and their characteristics.*
3. *To impart knowledge in measurement of Resistance, Inductance and Capacitance using bridges.*
4. *To explore the application of sensors and transducers in the physiological parameter measuring system.*
5. *To understand the basic principles and phenomena in the area of medical diagnostic instrumentation.*

Sr no	COURSE CONTENT / SYLLABUS	Lectures
UNIT I	**Bioelectric Signals and Electrodes**: Origin of Bioelectric Signals, Recording Electrodes, Silver-Silver Chloride Electrodes, Electrodes for ECG, EEG, EMG, Electrical Conductivity of Electrode Jellies and Creams, Microelectrodes, Limb electrodes, floating electrodes, pre-gelled disposable electrodes, Micro, needle and surface electrodes Physiological Systems of the Body, Sources of Biomedical Signals, Basic Medical Instrumentation System, Micro-Electro-Mechanical Systems (MEMS).	**07**
UNIT III	**Recording System:** Basic Recording System, General Considerations for Signal Conditioners Preamplifiers, Sources of Noise in Low Level Measurements, Biomedical Signal Analysis and Processing Techniques, The Main Amplifier and Driver Stage, Writing Systems, Potentiometric Recorder, Digital Recorders, Electrocardiograph, Vector cardiograph (VCG), Phonocardiograph (PCG), Digital Stethoscope Pulmonary Function Analysers, Clinical Laboratory Instruments, Blood Ph Measurement, Types of Blood Cells, Methods of Cell Counting, Audiometers and Hearing Aids: Mechanism of Hearing, Measurement of Sound, Basic Audiometer, Patient Safety: Electric Shock Hazards, Leakage Currents. X-Ray Machines And Digital Radiography: Basis of Diagnostic Radiology, Nature of X-Rays, Production of X-Rays, X-Ray Machine. Magnetic Resonance Imaging System:, Principle of NMR Imaging System, Image Reconstruction Techniques, Basic NMR Components, Biological Effect of NMR Imaging, Advantages of NMR Imaging System	**18**

UNIT IV	**Biomedical Recorders:** Electroencephalograph (EEG), Electromyograph, Other Biomedical Recorders, Biofeedback Instrumentation	**5**
References	1. R S Khandpur - HANDBOOK OF BIOMEDICAL INSTRUMENTATION-McGraw-Hill Education _ India (2014). 2. Webster, John G._ Eren, Halit - Measurement, instrumentation, and sensors handbook. Electromagnetic, optical, radiation, chemical, and biomedical measurement-CRC Press (2014) 3. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, 'Bio-Medical Instrumentation and Measurements', II edition, Pearson Education, 2002 / PHI. 4. J.Webster, 'Medical Instrumentation', John Wiley & Sons, 1995. 5. L.A. Geddes and L.E.Baker, 'Principles of Applied Bio-Medical Instrumentation', John Wiley & Sons, 1975.	

	MODERN EDUCATION SOCIETIES **NOWROSJEE WADIA COLLEGE, PUNE**	**Academic Year** **2024-2025**
Master of Electronic Science		
Major (Elective) – II		
YEAR-II	**Name of Paper- PLC Programming and Applications** **Subject Code: PELME-237**	**CREDITS-2**
SEMESTER-III		**HOURS-30**

Course specific outcomes-

1. *To understand basics of Programmable Logic Controllers, their working and their programming*
2. *To design, modify and troubleshoot such control circuits*
3. *To program PLCs to automate the systems for different applications*

Sr no	**COURSE CONTENT / SYLLABUS**	**Lectures**
UNIT I	**Introduction to PLC:** Concept of PLC, Building blocks of PLC, Functions of various blocks, limitations of relays. Advantages of PLCs over electromagnetic relays. Different programming languages, PLC manufacturer etc. Working of PLC - Basic operation and principles of PLC, Scan Cycle, Memory structures, I/O structure - Programming terminal, power supply. Basic instructions like latch, master control self-holding relays. Timer instruction like retentive timers, resetting of timers. - Counter instructions like up counter, down counter, resetting of counters. - Arithmetic Instructions (ADD, SUB, DIV, MUL etc.) - MOV instruction – RTC (Real Time Clock Function) - Watch Dug Timer - Comparison instructions like equal, not equal, greater, greater than equal, less than, less than equal	**20**
UNIT II	**PLC Programming and applications:** Ladder Diagram Programming: Programming based on basic instructions, timer, counter, and comparison instructions using ladder program. **Applications of PLCs:** Object counter - On-off control, Car parking, Sequential starting of motors, Traffic light control, Motor in forward and reverse direction - Filling of Bottles, Room Automation.	**10**
References	1. Programmable logic controller, Dunning 2. Programmable Logic Controller by Job Dan Otter; P.H. International, Inc, USA 3. Introduction to PLCs by Gary Dunning. McGraw Hill 4. Module on PLCs and their Applications by Rajesh Kumar, NITTTR Chandigarh	

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Master of Electronic Science		
Major Elective (Practical) – I		
YEAR-II	**Name of Paper- Elective Practical's based on Biomedical and Instruments**	**CREDITS-2**
SEMESTER-III	**Practical Course –I Subject Code: PELME-236A**	**HOURS-60**

List of Practicals (Any 12)

1. Analyze Instrumentation amplifier for biomedical signals
2. Learn pulse oximeter/Diathermy
3. Simulate the real time ECG monitoring and ECG wave analysis
4. Simulate the real time EEG monitoring and EEG wave analysis
5. Observe the real time patient monitoring system (Visit to Hospital)
6. Observe of pacemakers/ defibrillators / Ventilators/MRI/X-ray (Visit to Hospital)
7. Design and analysis of biological pre-amplifiers.
8. Experiment of Thermistors.
9. Recording of ECG signal and analysis.
10. Recording of EMG-Signal.
11. Recording of various physiological parameters using patient monitoring system
12. and telemetry units.
13. Measurement of respiration rate.
14. Measurement and recording of peripheral blood flow.
15. Study of characteristics of optical Isolation amplifier.
16. Measurement of PH and Conductivity.
17. Measurement of Blood Glucose.
18. Measurement of Blood Pressure.

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Master of Electronic Science		
Major Elective (Practical) - II		
YEAR-II	**Name of Paper- Programmable Logic Controller**	**CREDITS-2**
SEMESTER-III	**Practical Course –II** **Subject Code: PELME-237A**	**HOURS-60**

List of Practical's: (Any 12)

1. Different applications of Push buttons.
2. Sequential operation of ON/OFF of a set of lights.
3. Latching and Unlatching of a Motor.
4. Automatic indication of water tank level.
5. Write a simple ladder logic program for Traffic lights indication.
6. Implementation of Logic Gates.
7. Write a simple ladder logic program for Interlocking.
8. Forward and Reverse direction control of Motors.
9. Implementation of DOL Starter.
10. Implementation of On-Delay Timer.
11. Implementation of Off-Delay Timer.
12. Write and implementation of simple ladder logic program for Up-Down Counter.
13. Implementation of PLC Arithmetic Instructions.
14. Implementation of PID Controller.

	MODERN EDUCATION SOCIETIES **NOWROSJEE WADIA COLLEGE, PUNE**	**Academic Year** **2024-2025**
Master of Electronic Science		
Research Project/Internship		
YEAR-II	**Name of Paper- Research Project/Internship**	**CREDITS-2**
SEMESTER-III	**Subject Code: PELRP-238**	**HOURS-30**

Research Project/Internship

	MODERN EDUCATION SOCIETIES **NOWROSJEE WADIA COLLEGE, PUNE**	**Academic Year** **2024-2025**
Master of Electronic Science		
Major (Theory) –I		
YEAR-II	**Name of Paper-Advanced Power Electronics**	**CREDITS-4**
SEMESTER-IV	**Subject Code: PELMJ-241**	**HOURS-60**

Course specific outcomes-

1. *To study the basic principles and applications of power electronics*
2. *To understand the solid-state devices required for power electronic circuits*
3. *To study and understand the power conversion and power transmission principles*
4. *To study the industrial and domestic applications*

Sr no	**COURSE CONTENT / SYLLABUS**	**Lectures**
UNIT I	**Introduction** Applications of Power Electronics, Concept of single phase and three phase using phasors, Single phase, 3 phase transformers, power transformer, Concept of Power circuits using block diagram. Review of Power Semiconductor Devices 6 11% Power Diodes, Power BJT, Power MOSFETs, Thyristor, GTOs, IGBT, MCT – Basic characteristics and controlling, Emerging devices and circuits, Power Integrated Circuits	**5**
UNIT II	**Power Circuits:** Rectifiers: single phase half-wave, center tapped full wave and bridge rectifiers performance parameters, three phase bridge rectifiers Controlled rectifiers: Single phase and three phase – half-wave, semi-full wave and dual converters, Single phase series converters, 12-pulse converters, Power factor improvement techniques AC voltage controllers: ON-OFF control, phase control, single phase Bidirectional controller, 3-phase Bi-directional controller and their types, PWM control, Single phase and 3- phase cyclo converter and their types **DC-DC converters:** step-up and step-down converters, performance parameters, switch mode regulators: Buck, Boost, Buck-Boost and Cuk regulators Inverters: Performance parameters, single-phase bridge inverter, 3 Phase inverters-120° and 180°conduction, voltage control methods for inverters, harmonic reduction, current source inverters, Introduction to resonant pulse inverters Static Switches: Single phase and three phase AC switches, AC switches for Bus transfer, DC switches. Solid state and Microelectronic Relays	**25**

UNIT III	**Applications of Power Electronics** DC power supplies: switch mode DC power supplies, flyback, forward, push pull, half bridge, full bridge-converters, resonant DC power supplies, resonant power supplies, bidirectional power supplies AC Power supplies (UPS): switch mode AC Power supplies, resonant and bidirectional AC Power supplies DC drives: Basic characteristics of DC motors, Operating modes, single phase and 3 phase drives, DC –DC converter Drives, Closed loop control of DC drives AC drives: Induction motors drives-squirrel cage and wound rotor motor, Performance characteristics, control methods Synchronous motor drives-cylindrical rotor, sailent pole, control methods Brushless DC and AC Motors and Stepper Motor: types and Control Electric Utility Applications: High voltage DC transmission, shunt and series Var compensators, Flexible AC Transmission systems (FACTs), Integral half cycle /cycle control, space heating and air conditioning, HF fluorescent lightning, Induction and capacitive heating, modern electric welding	**20**
UNIT IV	**Practical Design Considerations** Snubber circuits for diodes, SCRs and transistors, Turn-on and turn-off and over voltage snubbers, isolation methods Cooling and heat sinks, reverse recovery transients, supply and load side transients, Selenium diodes and MOVs for voltage protections, Current protection methods, EMI standards, sources and shielding methods Practical Design Considerations: Gate and Base drive circuits – Design Consideration for different Devices, DC-Coupled Circuits, Isolated Drive Circuits, and Protection in Drive Circuits. Snubber circuits Designing, Temperature control and Heat sink design consideration, Design of Magnetic Components	**10**
References	1. Power Electronics: Circuits, Devices and Applications, Muhammad H. Rashid, 3rd Edition, Pearson. 2. 2. Power Electronics: Converters, Applications, and Design, Ned Mohan, Tore M. Undeland, William P. Robbins, 3rd Edition, Wiley. 3. Power Electronics, P. C. Sen, Tata McGraw-Hill Education. 4. Power Electronics: A First Course, Ned Mohan, 2012. 5. Power Electronics Handbook, edited by Muhammad Rashid, Elsevier 6. Fundamentals of Power Electronics, Robert W. Erickson, Dragan Maksimovic, Springer *7.* Power Electronics, Daniel Hart, Tata McGraw-Hill Education, 2011	

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Master of Electronic Science		
Major (Theory) Subject-I		
YEAR-II	**Name of Paper-** Mechatronics and Robotics **Subject Code: PELMJ-242**	**CREDITS-4**
SEMESTER-IV		**HOURS-60**

Course specific outcomes-

1. *Identify different components or blocks in any mechatronic system*
2. *Analyze mechatronic systems using system models and dynamic responses using transformation methods*
3. *Distinguish different sensing and actuating mechanisms used in mechatronics and robotic systems*
4. *Compare different control mechanisms used in robotic systems*

Sr no	COURSE CONTENT / SYLLABUS	Lectures
UNIT I	**Introduction** Basics of mechatronic systems: sensors and transducers: digital sensors for motion measurement, torque and tactile sensors, vibration sensors, control systems Brief history of robots, types of robots– components and structure, kinematic arrangements (configurations), classification of robots based on various methods of classification such as control method, power source, applications and coordinate systems, Application areas of robots Solid state switches- diodes, thyristors, BJTs and MOSFETs and their applications asswitches and driver circuits, solenoids DC Motor-: types, basic construction and working, brushed and brushless DC motor drivercircuits, and speed control AC motors- basic idea of single phase and three phase motors and their speed control Stepper motors- types, construction, features, specifications, control of drives.	**15**
	Systems, responses and transformations **Basic system models:** Mechanical (translational and rotational) system building blocks, electrical system building blocks, electrical and mechanical analogies and their use in analysis. **Dynamic responses of systems:** modeling dynamic systems,	**15**

UNIT II	terminology of first order and second order system, performance measures for second order system, system identification **Transformations**: Rigid Motions: Rotations – coordinate transformations relating to representation of a point intwo different frames, composition law for rotational transformations, rotation about an arbitrary axis, representing an arbitrary rotation using only three independent quantities using axis/angle representation, Euler angle representation and roll-pitch-yaw representation Homogeneous transformation matrices, skew symmetric matrices, angular velocity and angular acceleration, addition of angular velocities	
UNIT III	**Mechanical and electrical actuation systems** Mechanical actuation systems: mechanisms and their role in mechatronic systems, translational and rotational motion – degrees of freedom, kinematic chains – examples of links, toggle linkage, slider-crank etc. cams, gears – types, gear trains, gear ratios, uses of rotation-to- translational motion – rack and pinion, ball screw and links, Ratchet and pawl, belt and chain drives, bearings– types and uses, consideration of moment of inertia and torque for motor selection Electrical actuation systems: Relays and applications with driver circuits,	**15**
UNIT IV	**Dynamics and Robot Control** Dynamics: deriving dynamical equations of a manipulator by deriving Euler–Lagrange equations by forming Lagrangian of a system Trajectory planning and generation, joint space schemes, Joint space schemes with via points. Cartesian straight-line motion and circular motion, trajectory planning for orientation, difficulties in trajectory planning Independent Joint Control: basic structure of feedback control system, dynamics of PMDC motor, DC motor control system, set-point tracking using PD and PID compensator, Drive- train dynamics, trajectory interpolation Force control– static force / torque relationships, natural and artificial constraints, stiffness and compliance.	**15**
References	1. Mechatronics by W. Bolton, 4th Edition, Pearson. 2. Mechatronics System Design, by Devdas Shetty and Richard Kolk, 2nd Edition, Cengage Learning. 3. Robotics Engineering – An integrated approach. By Richard W. Klafter, Thomas A. Chmielewski and Michael Negin, PHI Learning Pvt. Ltd. 4. Robot Dynamics and Control, Spong and M. Vidyasagar, Wiley Student Edition 5. Robotics: Fundamental Concepts and Analysis, Ashitava Ghoshal, Oxford Higher Education 6. Robotic Engineering: An integrated approach, Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, Prentice-Hall India	

	MODERN EDUCATION SOCIETIES NOWROSJEE WADIA COLLEGE, PUNE	**Academic Year 2024-2025**
Master of Electronic Science		
Major Practical		
YEAR-II	**Name of Paper- Major Practical – VII** **Subject Code: PELMJ-243**	**CREDITS-2**
SEMESTER-IV		**HOURS-60**

List of Practicals (Any 12)

1. To study, understand and design gate drive circuits for SCR.
2. To study, understand and design gate drive circuits for MOSFET.
3. To study, understand and design gate drive circuits for IGBT.
4. Emergency Light
5. To study Characteristics of power devices like BJT/MOSFET/IGBT/Triac
6. To design, build and test light dimmer circuit.
7. To design, build and test triggering circuit using PUT.
8. To study High frequency heating / induction heating
9. To demonstrate Class A/B/C/ D commutation circuit.
10. To design, build and test Single phase/Dual converter.
11. To design, build and test Half wave/Full Wave controlled rectifier.
12. To demonstrate SMPS/UPS
13. Comparative study of different types of EVs
14. To troubleshoot the dual power supply

	MODERN EDUCATION SOCIETIES NOWROSJEE WADIA COLLEGE, PUNE	**Academic Year 2024-2025**
Master of Electronic Science		
Major Practical		
YEAR-II	**Name of Paper- Major Practical – VIII Subject Code: PELMJ-244**	**CREDITS-2**
SEMESTER-IV		**HOURS-60**

List of Practical's (Any 12)

1. Study and Demonstration of Mechatronics System Components
2. Study and demonstration of Tinkercad Software.
3. Designing of robot arm using Tinkercad software.
4. Building a 3D robot using Tinkercad software.
5. Design simple mobile robot platform with wheel Using Tinkercad
6. Study of a DC servo motor.
7. Study of BLDC motor, its speed control/position control.
8. Study of PMDC motor toque speed characteristics.
9. Study of AC servo motor, its speed control/position control.
10. Set up a flow control system using suitable flow sensor and actuator.
11. Implementation of velocity profile of servo control.
12. Programming of Robotic gripper using microcontroller.
13. To design and simulate a 2DOF planar robot using MATLAB.
14. Mechatronics System Case Study.
15. Robotics system case study.

	MODERN EDUCATION SOCIETY'S **NOWROSJEE WADIA COLLEGE, PUNE**	**Academic Year 2024-2025**
Bachelor of Science in Electronic Science		
Major Elective (Theory) Subject-I		
YEAR-II	**Name of Paper- Digital Image Processing and Applications**	**CREDITS-2**
SEMESTER-IV	**Subject Code: PELME-245**	**HOURS-30**

Course specific outcomes-

1. *To make students understand image fundamentals and how digital images can be processed.*
2. *To know Image enhancement techniques and its application.*
3. *To know Image compression and its applicability for real-time image processing.*

Sr. no.	**COURSE CONTENT / SYLLABUS**	**Lectures**
UNIT I	**Introduction**: Components of an; Image Processing system and Applications, Human Eye and Image Formation Sampling and Quantization. **Image processing operations:** Image Enhancement: Spatial Domain-Gray Level transformations, Histogram, Arithmetic/Logical Operations, Spatial filtering, Smoothing and Sharpening Spatial Filters, Frequency domain filtering and smoothening operation.	**10**
UNIT II	**Image segmentation and Thresholding:** Introduction to morphological operations; binary morphology-erosion, dilation, opening and closing operations, applications; basic gray-scale morphology operations. **Image Restoration and compression:** Inverse filtering, Wiener filtering; Image Compression Standards JPEG, JPEG 2000, MPEG; Video compression.	**10**
UNIT III	**Color image processing**: Color fundamentals, color models, Pseudo-color image processing, basics of full color image processing, color transformation, Color image filtering: smoothening and sharpening, color segmentation: segmentation in HSI color space, segmentation in RGB color space, color edge detection.	**10**
References:	1. Digital Image Processing, R. C. Gonzalez and R. E. Woods, Pearson Education. 2. Digital Image Processing using MATLAB, R. C. Gonzalez, R. E. Woods and S. L. Eddins, Pearson Education. 3. Fundamentals of Digital Image processing, A. K. Jain, Pearson Education. 4. Digital Image Processing, Kenneth & Castleman (PHI). 5. Digital Image Processing & Analysis, Chanda & Mazumdar (PHI).	

	MODERN EDUCATION SOCIETY'S **NOWROSJEE WADIA COLLEGE, PUNE**	**Academic Year 2024-2025**
Bachelor of Science in Electronic Science		
Major Elective (Theory) Subject-II		
YEAR-II	**Name of Paper- Industrial Automation and Control**	**CREDITS-2**
SEMESTER-IV	**Subject Code: PELME-246**	**HOURS-30**

Course specific outcomes-

1. *To understand the fundamental process of automation in industry*
2. *To study Mechatronics systems and explore their applications in industry*
3. *To determine hardware and software requirements of CNC systems*
4. *To study different types of sensors and actuators and various drive systems and motors.*

Sr. no.	**COURSE CONTENT / SYLLABUS**	**Lectures**
UNIT II	**PLC, SCADA and CNC systems:** Introduction of PLC and SCADA, ladder programming,, Principle of numerical control, types and features of CNC System, Constituent parts of CNC machines and assembly techniques, configuration, Interfacing, Monitoring and diagnostics. Case studies.	**8**
UNIT II	**Actuators and Mechanism:** Actuator types and application areas- Electromechanical actuators, Fluid power actuators and active Material based actuators, Mechanism- Bearings, Belt, Chain, Pulleys, Gears, Rack and Pinion, Slider and Crank, Cams and Followers, Four-bar linkages.	**10**
UNIT III	**Industrial drives:** Overview of servo control, Servo Hydraulic and Pneumatic Drive: Overview of Servo Hydraulic and Pneumatic Drive, Fundamentals of Hydraulic and Pneumatic Drives, Components of Fluidic Drives Systems, Basic Hydraulic Circuits, Electric Drives: Overview of Electric Drives, Electric Motors, Power Electronics, Sensors. Industrial Visits/Interaction.	**12**
References:	1. Industrial Automation using PLC, SCADA & DCS, Rajesh G Jamkar, Global Education Ltd. 2. Mechatronics, W. Bolton, Addition –Wesley Longman Ltd. 3. Mechatronics, Denny K. Miu, Springer- Verlag 4. Drives and Control for Industrial Automation, Tan KokKiongAndiSudjana Putra, Springer.	

	MODERN EDUCATION SOCIETY'S **NOWROSJEE WADIA COLLEGE, PUNE**	**Academic Year 2024-2025**
Bachelor of Science in Electronic Science		
Major Elective (Practical) Subject-I		
YEAR-II	**Name of Paper- Digital Image Processing and Applications Practical Course –I** **Subject Code: PELME-245A**	**CREDITS-2**
SEMESTER-IV		**HOURS-30**
Course specific outcomes- *1. Perform various operations over digital image.* *2. Use MATLAB tools for Image processing operations.* *3. Use MATLAB tools to study the image segmentation and compression.*		
Sr. No.	**COURSE CONTENT / SYLLABUS**	**Lectures**
	List of Practicals (Any 12) 1. Read an image and perform edge modification operations using MATLAB. 2. Perform erosion, dilation, opening and closing operation over the image. 3. Perform skeletonization operation over fingerprint. 4. Perform histogram operation on images having different contrast levels. 5. Simulation and Display of an Image, Negative of an Image (Binary & Gray Scale) 6. Study the basic grey level transformations. 7. Color image filtering using MATLAB. 8. Perform image compression using MATLAB. 9. Write a program for Image Restoration. 10. Write a program for image segmentation. 11. Write a program for image enhancement. 12. To fill the region of interest for the image.	

	MODERN EDUCATION SOCIETY'S **NOWROSJEE WADIA COLLEGE, PUNE**	**Academic Year 2024-2025**
Bachelor of Science in Electronic Science		
Major Elective (Practical) Subject-II		
YEAR-II	**Name of Paper- Industrial Automation and Control Practical Course –II** **Subject Code: PELME-246A**	**CREDITS-2**
SEMESTER-IV		**HOURS-30**
Course specific outcomes- *1) To develop skill of PLC circuit connections for mechatronics* *2) To Study the actuator and sensors with PLC system* *3) To train them to design and analyze the circuits and drives for specific purpose* *4) To motivate them to work on different mini projects*		
Sr. No.	**COURSE CONTENT / SYLLABUS**	**Lectures**
	List of Practicals (Any 12) 1. Develop a bottle filling plant using PLC. 2. Develop Car washing automation plant using PLC. 3. PLC Based Door Open and Closing System. 4. Sequential control of DC motor using PLC. 5. Study of CNC and preparing a given job using CNC. 6. Develop an Object sorting system using PLC. 7. PLC Based Multi-channel Temperature Monitoring and Controlling System. 8. Study PLC Based Elevator System. 9. Study of Electromechanical actuators. 10. Study PLC Based Level Control System. 11. Study of servo hydraulic and pneumatic drives. 12. Study PLC Based Temperature Controller. 13. Implementation of PLC Based electric drives: AC Motor Controlling System. 14. Write a ladder program for PLC based Moving Message Display. 15. Implementation of PLC Based Water Level Indicator.	

	MODERN EDUCATION SOCIETIES **NOWROSJEE WADIA COLLEGE, PUNE**	**Academic Year** **2024-2025**
Master of Electronic Science		
Research Project/Internship		
YEAR-II	**Name of Paper- Research Project/Internship**	**CREDITS-6**
SEMESTER-IV	**Subject Code: PELRP-247**	**HOURS-90**

Research Project/Internship

EVALUATION PATTERN : For Two Credit Courses

(i) Each course shall be evaluated with Continuous Evaluation (CE) and End

SemesterExamination (EE).

(ii) Continuous Evaluation shall be of 15 marks and End Semester Examination (EE) shall be of 35 marks

(iii) To pass a course of 2credits, a student has to earn minimum 20 marks, provided that he/she should earn minimum 6 marks in Continuous Evaluation and minimum 14 marks in End-Semester Examination. That is passing criterion is minimum 40% marks in the examination.

(iv) For Internal evaluation (out of 15 marks), There has to be one written test of 10 marks (Mid-Semester Examination). For remaining 5 marks shall be based on the continuous evaluation consisting of tutorial, viva, seminars, home-assignments, mini project, survey, group discussion etc.(on approval of Head of the Department)

(v) There shall be revaluation of the answer scripts of End-Semester Examination (out of 35 marks) of theory papers only, but not of internal assessment papers as per Ordinance No. **134 A and B.**

ATKT RULES: As per SPPU.

AWARD OF GRADES AND GRADE POINTS

The mapping of percentage to letter grade and grade point is given in the following Table 1

CGPA will be calculated as follows:

Table No. 1

Sr. No.	Grade Letter	Grade Point	Marks
1.	O (Outstanding)	10	90 □ Marks □ 100
2.	A+ (Excellent	9	80□ Marks □ 89
3.	A (Very Good)	8	70 □ Marks □ 79
4.	B+ (Good)	7	55 □ Marks □ 69
5.	B (Above Average)	6	50 □ Marks □ 54
6.	C (Average)	5	45 □ Marks □ 49
7.	D (Pass)	4	40 □ Marks □ 44
8.	F (Fail)	0	Marks □ 40
9.	Ab (Absent)	0	

PERFORMANCE INDICES:

The performance of a student in a Semester is indicated by a number called the Semester Grade Point Average (SGPA). Similarly, the performance of a student in the Course is indicated by a number called the Course Grade Point Average (CGPA).

The End-Semester results and final result of the courses will contain SGPA and CGPA, respectively.

(1) **SGPA**: The SGPA is the weighted average of the grade points obtained by students in all the courses during the Semester. That is

$$SGPA = \frac{\sum_{i=1}^{p} C_i G_i}{\sum_{i=1}^{p} C_i}$$

(2) For example, suppose in a Semester, student has registered for five courses having credits C1, C2, C3, C4 and C5 and suppose his/her grade points are G1, G2, G3, G4 and G5, respectively. The SGPA is calculated as

$$SGPA = \frac{C_1 G_1 + C_2 G_2 + C_3 G_3 + C_4 G_4 + C_5 G_5}{C_1 + C_2 + C_3 + C_4 + C_5}$$

SGPA is calculated correct up to two decimal places by rounding off.

(3) **CGPA**: The CGPA is the weighted average of the grade points obtained in all courses (theory and Practicals) by students in all the courses in 6 semesters. It is calculated in the same manner as the SGPA.

RESULTS:

Based on the performance of the student in the Semester Examinations, Nowrosjee Wadia College will declare the results and issue the Semester Grade sheets. Also, the College will declare the results and issue the Grade sheets at the end of the course.

The class will be awarded to a student on the basis of CGPA. The award of the class shall be as per Table 2 and corresponding percentage calculation for the CGPA is given in Table No. 3

Table 2

Sr. No.	CGPA	Class of the degree awarded
1	9.50 or more than 9.50	OUTSTANDING (O)
2	8.50 or more but less than 9.50	EXCELLENT (A+)
3	7.50 or more but less than 8.50	VERY GOOD (A)
4	6.25 or more but less than 7.50	GOOD (B+)
5	5.25 or more but less than 6.25	ABOVE AVERAGE (B)
6	4.75 or more but less than 5.25	AVERAGE (C)
7	4.00 or more but less than 4.75	PASS (D)

Percentage of marks corresponding to CGPA is calculated by the formulae which are given in the following Table 3.

Table 3

GRADE	Formula for the percentage of marks
O	20 × CGPA - 100
A+	10 × CGPA -5
A	10 × CGPA - 5
B+	12× CGPA - 20
B	5× CGPA + 23.75
C	10 × CGPA -2.50
D	6.6× CGPA + 13.6

The above percentage calculations are illustrated in the following Table 4

Table 4

Some examples of CGPA to Percentage calculations

CGPA obtained	Formula	Percentage (%)	Grade
10	20 × 10 - 100 = 100	100	O
9.75	20 × 9.75 - 100 = 95	95	O
9.5	20 × 9.5 - 100 = 90	90	O
9.0	10 × 9 – 5 = 85	85	A+
8.0	10 × 8.0 – 5 = 75	75	A
7.0	12 × 7.0 – 20 = 64	64	B+
6.67	12 × 6.67 – 20 = 60.04	60.04	B+
6.25	12× 6.25 – 20 = 55	55	B+
5.25	5 × 5.25 + 23.75 = 50	50	B
4.75	10 × 4.75 – 2.50 = 45	45	C
4.0	6.6 × 4.0 + 13.6 = 40	40	D

While declaring the results, the existing ordinances are applicable. There is also a provision for verification and revaluation. In case of verification, the existing rules will be applicable. The

revaluation result will be adopted if there is a change of at least 10% marks and in the grade of the course.

PATTERN OF THE QUESTION PAPER: EVALUATION PATTERN: For Four Credit Courses

(i) Each course shall be evaluated with Continuous Evaluation (CE) and End Semester Examination (EE).

(ii) Continuous Evaluation shall be of 30 marks and End Semester Examination (EE) shall be of 70 marks.

(iii) To pass a course of 4 credits, a student has to earn minimum 40 marks, provided that he/she should earn minimum 12 marks in Continuous Evaluation and minimum 28 marks in End-Semester Examination. That is passing criterion is minimum 40% marks in the examination.

(iv) For Internal evaluation (out of 30 marks), There has to be one written test of 20 marks (Mid-Semester Examination). For remaining 10 marks shall be based on the continuous evaluation consisting of tutorial, viva, seminars, home-assignments, mini project, survey, group discussion etc. (on approval of Head of the Department)

(v) There shall be revaluation of the answer scripts of End-Semester Examination (out of 70 marks) of theory papers only, but not of internal assessment papers as per Ordinance No. **134 A and B.**

PATTERN OF THE QUESTION PAPER: Four Credits

(1) Internal Examination:

(Mid-Semester Examination of 20 marks, Duration: 30 Mins)

Question No.	Total Marks	No. Of questions	Remarks
Q. 1.	10	Attempt any 5 out of 7	Definitions/Counter examples/Short answer / objective type of questions/True or False. (Each question carries 2 mark.)
Q. 2.	10	Solve any 1 out of 2 questions	Descriptive type questions (Each question carries 10 marks)

(2) End Semester Examination (EE):

Shall be of 70 marks, 2 hours and 30 Minutes duration. The pattern of the question paper shall be as follows:

Question No.	Total Marks	No. Of questions	Remarks
Q. 1.	10	Solve any 5 out of 7	Definitions/Counter examples/Short answer / objective type of questions/True or False. (Each question carries 2 mark.)
Q. 2.	20	Solve any 5 out of 7 OR Solve any 2 out of 3	Descriptive type questions
Q. 3.	20	Solve any 2 out of 3	Descriptive type questions (Each question carries 5 marks)
Q. 4.	20	Solve any 2 out of 3 OR Solve any 1 out of 2	Descriptive type questions

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