

COLLEGE OF ENGINEERING ROORKEE
SYLLABUS FOR
VALUE ADDED PROGRAM (VAP)



DEPARTMENT OF MECHANICAL
ENGINEERING

Approved by:

HOD

Dean Academics

S No	Semester	Course Code	Name of the Course	Page Number
1.	I	VAP/ME/ODD SEM/I	AutoCAD	3
2.	II	VAP/ME/EVEN SEM/II	Computer H/W, S/W & Network Troubleshooting	
3.	III	VAP/ME/ODD SEM/III	Solid Works	
4.	IV	VAP/ME/EVEN SEM/IV	Industrial Automation - PLC	
5.	V	VAP/ME/ODD SEM/V	Industrial Automation - Hydraulics	
6.	VI	VAP/ME/EVEN SEM/VI	Industrial Automation - Pneumatics	
7.	VII	VAP/ME/ODD SEM/VII	Advanced Refrigeration and Air conditioning- I	
8.	VIII	VAP/ME/ EVEN SEM/VIII	Advanced course in Measurement and control	

ODD SEMESTER	1st SEM
AutoCAD	

S.NO.	Heading	Subheading	Hours
1	Theory	Introduction of Engineering Drawing Classification according to the basis of co-ordinates Introduction to the Drawing and Modifying	3
2	Theory and software training	Function Keys in AutoCAD TRIM / EXTEND / OFFSET / OSNAPS MOVE / COPY / STRETCH / MIRROR RECTANGLE command. STRETCH command MIRROR command	4
3	Software training	ROTATE / FILLET / CHAMFER / ARRAY ROTATE command FILLET command. CHAMFER command ARRAY command	4
4	Software training	LAYERS / DIMENSIONING / TEXT / SCALE TEXT command Linear Dimensions command SCALE command	4
5	Software training	ORTHOGRAPHIC PROJECTION DDE AND OBJECT TRACKING Direct Distance Entry Object Snap Tracking Dynamic Input	4
6	Software training	INTRODUCTION TO BLOCKS - CREATING AND INSERTING HATCHING - FILLING AREAS Gradients Boundary POLYLINES	4
7	Software training	ISOMETRIC DRAWING 3-D CO-ORDINATE SYSTEM 3D Rotation Viewports Perspective Views	4
8	Software training	Extrude Extrude with Taper Extrude with Path Revolve Command Sweep Command Loft Command	4
		Total Hours	31

List of projects

Project No.	Projects
1	Drafting Apple logo in 2D drawing
2	Drafting Gittar in 2D drawing
3	Drafting knuckle joint in 2D drawing
4	Drafting connecting rod in 2D drawing
5	Drafting assemble drawing of IC engine parts
6	Drafting assemble drawing of screw jack

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EVEN SEMESTER	2nd SEM
Computer H/W, S/W & Network Troubleshooting	

S No	Heading	Sub Heading	Hours
1.	Experimental and hands on training	Identifying Computer Hardware Devices	
2.		Identifying Computer Assembly	
3.		Identifying external ports and interfacing	
4.		PC Identifying Problems & Troubleshooting	
5.		Operating System Installation	
6.		Printer - Installation / Troubleshooting	
7.		Introduction to LAN	
8.		Introduction to LAPTOPS	
9.		Hands on Training on PC Trainer KIT	
10.		Hands on Training on LAN Trainer KIT	
11.		Hands on Training on UPS Trainer KIT	
12.		Hands on Training on Monitor Trainer KIT	
13.		Preventive maintenance of a PC	
14.		Understanding CMOS	
15.		Working with Backups and Archival utilities	
	Total Contact Hours		30 Hours

ODD SEMSTER		3 RD SEM	
SOLIDWORKS			
S.No	Heading	Subheading	Hours
1	Software training	Solid work documentation tip, Default template unit selection, Navigating the solid works interface, Customizing the command manager, The Menu Bar toolbar and menu	2
2	Software training	Changing interface colors Customizing strategies <ul style="list-style-type: none"> • Toolbars, Menus, Background colors or images Saving custom interface setting Working with multiple document windows Copying the existing settings	2
3	Software training	Working with sketches <ul style="list-style-type: none"> • Simple sketch,3D-sketch,Dimensioning,Dimension Properties,Dimension (Angles), Structure of splines, Offset, Mirror, Point sketch, Trim Interface, Polygon creation, Ellipse, Partial ellipse, Parabola, Linear pattern, Circular Pattern, Modifying sketch, Slot sketch entities 	3
4	Software training	Dimension relation toolbar <ul style="list-style-type: none"> • Smart dimension, Horizontal Dimensions, Chamfer dimension 	2
5	Software training	Working with Reference Geometries <ul style="list-style-type: none"> • Creating Planes, Working with axis, Using Coordinate system, Using point as reference , geometry 	2
6	Software training	Creating simple parts <ul style="list-style-type: none"> • Bottle example, Extrude feature option, Cut extrude, Thin feature panel, Using instant 3D , Making first extrude feature, Cutting a slot, Hole using 2D versus 3D sketches, Fillets and chamfers 	3
7	Software training	Using visualization Techniques <ul style="list-style-type: none"> • Manipulating the view, Using arrow keys, Using mouse gestures, Using the view toolbar, Wireframe, Hidden lines visible, Shaded with edges, 3D Drawing view, Zebra strips, Annotation views, Applying appearances, Using Display Status 	3
8	Software training	Functions <ul style="list-style-type: none"> • Copying and moving sketch, entities, Move entities, Rotate entities, Copy entities, Scale entities, Modify sketch, Derived sketch, Using 	3

S.No	Heading	Subheading	Hours
		sketch text	
9	Software training	Working with revolving features, Getting more from your sketch, Copying and moving sketch entities, Using colors and line styles with sketches	3
10	Software training	Selecting features Working with revolving features Controlling sweep features Cut sweep with a solid profile	3
11	Software training	Creating curve features Working with helix features Creating projected curves Putting together a composite curve	3
12	Software training	Understanding fillet types Creating a constant radius fillet Creating variable radius fillet	2
		Total Hours	31

List of projects

Project No.	Projects
1	Modeling of CAD - CAM lab
2	Layout of Mechanical Workshop
3	Modeling of Milling Machine
4	Modeling of Grinding Machine
5	Modeling of cylinder Piston arrangement
6	Modeling of Shaper machine
7	Building design and assembly
8	Machine component design and assembly

ODD SEMESTER	4TH SEM
Industrial Automation - PLC	



S.No	Heading	Subheading	Hours
1	Module 1: Programmable Logic Controller (PLC)	Introduction to PLC hardware Architectural Evolution of PLC Role of PLC in automation Introduction to the field devices attached to PLC PLC Fundamentals - (Block diagram of PLC's) Detail information about PLC components <ul style="list-style-type: none"> • Power supply , CPU , I/O modules, Communication bus Various ranges available in PLCs Types of Inputs & outputs Source Sink Concept in PLC Concept of flags Scan cycle execution	6
2	Module 1: Programmable Logic Controller (PLC)	Practical Exposure on 6 PLC Allen Bradley / Siemens / Modicon / Mitsubishi / Omron/ GE Fanuc PLC Introduction to PLC programming software Addressing concepts Introduction to bit, byte & word concept Programming instructions arithmetic and logical Upload, download, Monitoring of programs Forcing I/P & O/P Monitoring / Modifying data table values Standard procedure to be followed in wiring / writing ladder etc Hands on experience on writing programs <ul style="list-style-type: none"> • Case studies for conveyer, motors control, timer & counter applications etc. Troubleshooting and fault diagnostics of PLC Documenting the project Program assignments for real time applications	8
3	Module 2 : Supervisory Control & Data Acquisition Software(SCADA)	Topics covered Applications of SCADA software Different packages available with I/O structure Features of SCADA software	4

4	Module 2 : Supervisory Control & Data Acquisition Software(SC ADA)	<u>Application development in WonderwareInTouch: Creating a new SCADA application</u> Creating Database of Tags Creating & Editing graphic display with animation <ul style="list-style-type: none"> • Data Entry / Start Stop command, Analog entry, Sizing, Movement, Blinking, Visibility, Filling Trending <ul style="list-style-type: none"> • Creating & Accessing Real-time Trends, Creating & Accessing Historical Trends Creating Alarms & Events Writing logic through script <ul style="list-style-type: none"> • Application script, Condition, Data Change, Window script, Special functions 	6
	Module 2 : Supervisory Control & Data Acquisition Software(SC ADA)	Connectivity with the different hardware <ul style="list-style-type: none"> • Communication protocols, Communication with PLC, Communication with Data Acquisition System Connectivity between software <ul style="list-style-type: none"> • Communication with Excel, Communication with Visual Basic Commissioning the network nodes Troubleshooting the application Control Valves <ul style="list-style-type: none"> • Terms, types & Selection parameters, Sliding Stem Control valves, Rotary shaft control valves, Actuator basics : Spring, Diaphragm, Actuator Sizing, Valve positioners., Control Valve Sizing, Control Valve noise & Cavitations, Control Valve maintenance, Valve response Closed Loop Controls <ul style="list-style-type: none"> • Process Control Basics, Understanding Control Loops, Loop Tuning & Valve Considerations, PID & Cascade basics, Feed forward control, Ratio Control, Process Terminology & behaviors 	8

	Module 3 : Electrical and Electronic Basics	Module 3 :Electrical and Electronic Basics Basic Electricity Electrical Terms and Definition , Capacitors, Conductors and Inductors , Ohm’s Law, Series and Parallel connection , AC and DC Principles , Reading Electrical diagrams , Cables and Wiring Types of Cables and wiring, Termination and jointing of cables , Working with Site Plans and Symbols L. V. Switchgear Push Buttons, Limit switches, Contactors, Bi metal Relays, Fuses, MCB, ELCB Basic Electronics	6
	Module 4 : Automation and Industrial Robotics	Module 4 :Automation and Industrial Robotics Introduction to the world of Robotics Electrical and Electronics Theory Components of Robots Basics of Embedded System Introduction to Programmable Logic Controllers Interfacing Sensors with Microcontroller and with Programmable Logic Controllers Embedded and PLC Programming for Robotics Motors interface and control with control system <ul style="list-style-type: none"> • Controlling Direction of Rotation of a Motor, Rotation in Forward and Backward direction, Controlling speed of motor Detecting objects using photo-electrical sensors Control of Robot through SCADA terminal Robotic Project implementation <ul style="list-style-type: none"> • Conveyor Belt with AC Drive, Selection and Rejection mechanism using PLC Controlled Pick and Place Robotic Arm, Hardware Soldering, Assembling, PLC programming , SCADA Application Development Troubleshooting	8
Total Hours			46

List of projects

Experiment no.	Experiments
1	Automatic door control using PLC.
2	Car parking systems using PLC
3	Bottle filling plant using PLC
4	Tank level control
5	Traffic light systems

6	Industrial control using PLC, Scada and gsm
7	Robotic arm using pneumatic with PLC
8	Lift Control system
9	Home Automation system
10	Shifting of divider on road according to traffic
11	Automatic railway crossing gate
12	Electrical Station variables reader/controller with true graph and SCADA
13	Microcontroller based SCADA for substation
14	Multi Channel voltage scanner using SCADA
15	Plc based bottle filling station with conveyors
16	Automatic anaesthesia controller using infusion pump with heart beat
17	Automatic anaesthesia controller using infusion pump with respiratory

ODD SEMESTER	5TH SEM
Industrial Automation - Hydraulics	

Syllabus

S.No	Heading	Subheading	Hours
1	Introduction:	Hydraulics, Important basic terms, Industrial Hydraulics, Basic physical properties, Comparisons of Drives (Hydraulics Vs. Pneumatics, Electrical / Electronics & Mechanical), Applications of Hydraulics	2
2	Graphical Symbols and Hydraulic circuit Diagrams:	Basic elements, commonly used symbols, Circuit symbols,	6
3	Functionality and Design of a Hydraulic System:	Principle of Energy Conversion, Functional Groups in a Hydraulic System, Functionality of a Hydraulic System	8
4	Hydraulic Fluids:	Main functions of Hydraulic fluids, Requirements of Hydraulic fluids, Types of Hydraulic Fluids, Selection of Hydraulic fluid for an applications,	4
5	Hydraulic pumps:	Functions and Operating principle Different types of Hydraulic pumps and its selection	2
6	Hydraulic Cylinder:	Design and operation, Types of cylinder	2
7	Pressure control valves:	Design and function, pressure relief valve, pressure reducing valve,	2
8	Directional Control Valves:	Operation and Function, Types of directional control valves, Spool positions, Designation of Directional control valves	5
9	Flow Control Valves:	Design and Function, Throttle valves, throttle check valve, Meter-in flow control, Meter-out flow control	5
10	Accessories:	Accumulator, Filter	2
11	Introduction to Electro-Hydraulics:	Solenoids, Function and operating principle of a relay, Relay as a logical switch, Symbols of most important switching elements (NO and NC), Signal storage concept, Electrical interlocking concept, Electrical ladder diagram, Momentary-contact limit switches	5
Total			43

List of experiments

Experiment no.	Experiments
1	Hydraulic pump characteristic Curve
2	Single rod cylinder pressure intensification (Meter-in and meter out Circuits)
3	4/3 directional valve application
4	Hydraulic Accumulator
5	Extension of a cylinder upon operation of a push button
6	Signal Storage by means of electrical self-locking
7	Signal storage by means of electrical self-locking resetting by means of a proximity switch

EVEN - SESSION : 2019-20	6TH SEM
Industrial Automation - Pneumatics	

Theory

S.No	Heading	Subheading	Hours
1	Introduction to pneumatics:	Pneumatics, Important basic terms Characteristics of Industrial Pneumatics, advantages and limitations, Comparisons of Pneumatics over other technology like Hydraulics, Electrical/ Electronic and Mechanical drives (Systems Comparison), Applications	4
2	Graphical Symbols and Pneumatic circuits	Basic elements, commonly used symbols, Circuit symbols. Compressed Air Preparation. Compressor Unit, Drying of Compressed Air, Distribution of Compressed air, Filter, Pressure control valve, lubricator, air dryer etc...	8
3	Direction Control Valve:	Design Principle, Symbols, Operations, 3/2 Directional control valve, Manual operated, 5/2 Directional control valve, pneumatically operated, 5/3 Directional control valve, electrically operated	6
4	Pressure Valves:	Pressure regulating valve, Pressure relief valve, Pressure sequence valve	4
5	Flow Control Valves:	Throttle valve, Throttle check valve	2
6	Pneumatic cylinders:	Introduction, Cylinder types, Single acting cylinder, Double acting cylinder	2
7	Introduction to Electro-Pneumatics:	Electro - mechanical Relays, Symbols of electrical components like switch, contacts, solenoid, relay, LED etc, NO and NC contacts, magnetic proximity switch working principle, Electrical signal storage, Electrical ladder diagram, Logic flow diagram, Solenoid working principle, Solenoid operated valves, Advantages of solenoid operated valves over manual valves	8
Total			34

List of experiments

Experiment no.	Experiments
Basic Pneumatics Exercises	
Exercise 01:	Direct control of a single-acting cylinder, extending and retracting
Exercise 02:	Direct control of a double-acting cylinder with push-button
Exercise 03:	Indirect control of a double-acting cylinder

Exercise 04:	Speed regulation of a double-acting cylinder
Exercise 05:	Controlling a double-acting cylinder, impulse valve, 2 push-buttons
Exercise 06:	Position dependent control of a double-acting cylinder with mechanical limit switches
Exercise 07:	Pressure dependent control of one double-acting cylinder
Exercise 08:	Time-dependent control of one double-acting cylinder
Electro-Pneumatics Exercises	
Exercise 01:	Command-variable control of a double-acting cylinder with spring return valve
Exercise 02:	Basic circuit with electric latching circuits
Exercise 03:	Displacement-dependent control of a double-acting cylinder, impulse valve, cylinder Switch
Exercise 04:	Sequential control of two double-acting cylinders with impulse valve

ODD SEMSTER	7TH SEM
Advanced Refrigeration and Air conditioning	
Syllabus	

S. No.	COURSE CONTENT	Hrs.
1.	Introduction of refrigeration and air conditioning, unit of refrigeration, coefficient of performance, types and application of refrigeration and air condensing systems.	1
2.	Vapour Compression system: Simple system on P-h and T-s diagrams, analysis of the simple cycle, factors affecting the performance of the cycle, actual cycle Compound Compression System: Compound compression with intercooler, flash gas removal and flash intercooler, multiple evaporators with back pressure valves and with multiple expansion valves without flash inter cooling, analysis of two evaporators with flash intercooler and individual expansion valve and multiple expansion valve, cascade refrigeration system	3
3.	Absorption refrigeration system: Desirable characteristics of refrigerant, selection of pair, practical H ₂ O -NH ₃ cycle, LiBr - H ₂ O system and its working, h-x diagram and simple calculation of various process like adiabatic mixing and mixing with heat transfer, throttling, Electrolux refrigeration system.	2
4.	Refrigerants: Classification, nomenclature, desirable properties, secondary refrigerants, future industrial refrigerants	1
5.	Refrigeration system components: Types; construction; working; comparison and selection of compressors; condensers; expansion devices; and evaporators, refrigeration piping accessories, evacuation and charging of refrigerant, properties and classification of thermal insulation	4
6.	Psychrometry: Dalton's law of partial pressure, Properties of moist air, temperature and humidity measuring instruments, psychrometric chart, psychrometric processes such as sensible heating and cooling, heating and humidification cooling and dehumidification, chemical dehumidification, adiabatic saturation	2
7.	Human comfort: Selection of inside design conditions, thermal comfort, heat balance equation for a human being, factors affecting thermal comfort, Effective temperature, comfort chart and factors governing effective temperature, selection of outside design conditions	3
8.	Load calculation and duct design	2
9.	Air-conditioning systems: Classification, system components, all air; all water; and air-water systems, room air conditioners, packaged air conditioning plant, central air conditioning systems, split air conditioning systems	2
10.	Practical (hands on experience)	10
Total duration		30

List of experiments

Experiment no.	Experiments
1	Study and performance analysis of transparent evaporator refrigeration

2	Study and performance analysis of Vapour absorption refrigeration system
3	Study and performance analysis of Heat pump
4	Study and performance analysis of Ice plant
5	Study and performance analysis of automotive air conditioning system
6	Study and performance analysis of Heat exchanger air as medium
7	Study and performance analysis of Heat exchanger water as medium
8	Study of compressors
9	Study of expansion devices, electronic expansion device
10	Study of condenser and evaporators
11	Study and performance analysis of water cooler
12	Study of fault diagnosis tutor in refrigeration systems

EVEN SEMSTER	8th SEM
Advanced course in Measurement and control	

CONTENT	HOURS
1. Sensors and Transducers	1
2. Signal Transmission	1
3. Signal Display & Recording Device	1
4. Time Related Measurement	1
5. Stroboscope	1
6. Frequency Measurement, Displacement	2
7. Pressure Measurement	2
8. Flow Measurement Nozzle, Orifice, Ventury (New)	2
9. Strain Measurement	2
10. Level Measurement(New)	2
11. Force & Torque Measurement	2
12. Temperature Measurement, Humidity Measurement(New)	2
13. Vibration Measurement	2
14. Noise Measurement(New)	2
15. Advances in Metrology & Inspection	2
16. Straightness, Flatness & roundness measurement	2
17. Interferometry	2
18. Screw threads and Gears	2
19. Surface Roughness	2
20. Automatic Control	2
21. Control components & Systems	2
22. Controllers Pneumatic, hydraulic and Electric controllers (in Detail)	2
TOTAL	39