

SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES
SCHOOL OF ENGINEERING
Outcome based Curriculum for
Undergraduate Degree Courses in Engineering & Technology
Department of Mechanical Engineering

BE-SEMESTER-VI SYLLABUS

MEA-601	NC and CNC Machine tools	2L:1T:0P	03 credits	3Hrs/Week
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Course Preamble:

This course covers Fundamentals and concepts of CNC machining centers, NC part programming, Programming through CAD/CAM (Master CAM), and Maintenance and Troubleshooting the CNC machine tools. This course offers more hands on experience through which the participants will be developing CNC programs and machining complicated shapes by using the CNC machine tools.

Course Outcomes:

The participants will be able to:

1. Understand fundamentals of NC/CNC
2. Learn and Write NC Part Programming
3. Learn NC Programming through CAD/CAM
4. Hands –on experience on Master CAM
5. Learn Tooling for NC/CNC
6. Understand machines like Chucking and Turning Centres, Machining Centres
7. Learn Maintenance and Trouble Shooting of CNC Machine Tools

UNIT - I:

Introduction: Fundamentals of numerical control, advantages limitations of N.C systems - classification of N.C systems. **Computer Numerical Control:** Nomenclature, types and features of CNC machine tools, machine control unit, position control and its significance, engineering analysis of NC positioning systems, open loop and closed loop systems, precision in NC positioning systems- control resolution, accuracy and repeatability. Actuators: servomotors, stepper motors, transducers and feedback elements.

(9 hours)

UNIT - II

Features of N.C. Machine tools: Design consideration of N.C machine tools - increasing productivity with N.C machines, tooling for CNC machine. **System Device:** Feed back system-counting devices digital analog converters. **Interpolations:** DDA integrators, simple and symmetrical DD reference word CNC interpolators.

(8 hours)

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UNIT - III

Part Programming: Process planning and flow chart for part programming, systems nomenclature and tool geometries, Tool presetting & modular tooling. Selection of tools based on machining capacity, accuracy and surface finish, elements of programming for turning and milling, part programming. Preparatory codes G, miscellaneous functions M, Interpolation, tool compensations, cycles for simplifying programming, typical part programming **Control Loops for N C Systems:** Introduction-control loops for point and counting systems.

(10 hours)

UNIT - IV

Computerized Numerical Control: CNC concepts-advantage of CNC reference planes, sampled data techniques, microcomputers in CNC. **Adaptive Control Systems:** Adaptive control with optimization and constraints-variable gains AC systems.

(8 hours)

UNIT - V

Modern CNC machines: CNC lathes, turning centers, machining centres, automatic pallet changers, automatic tool changers, direct numerical control and applications, CNC machine design features.

(8 hours)

REFERENCE :

1. Numerical control of machine tool – Koren & Ben Uri – Khanna Publisher, Delhi
2. Automation, Production Systems and Computer Integrated Manufacturing - Groover – PHI.
3. CNC Programming - S.K. Sinha - Galgotia
4. Mechatronics - HMT –TMH, Delhi
5. Numerical Control and Computer Aided Manufacturing -Tewari, Rao, Kundra- TMH, Delhi
6. Machine Tool Design and Numerical Control – N.K.Mehta – TMH Delhi
7. Fundamentals of Computer Numerical Control – NIIT – Prentice Hall, Delhi

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MEA-601	NC and CNC Machine tools	0L:0T:2P	1 credits	2Hrs/Week
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List of Experiment:

1. To make a Program on cnc lathe machine with all operations like turning, step turning, drilling, taper turning, thread cutting and knurling .
2. To make a job on cnc lathe machine with all operations like turning, step turning, drilling, taper turning, thread cutting and knurling.
3. To Study of different control systems and NC codes.
4. To Study of different control systems and CNC codes.
5. To make a Program for circular interpolation,
6. To make a program on cnc milling machine gear teeth
7. To make a job on cnc milling machine gear teeth

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MEA – 602	Heat and Mass Transfer	2L:1T:0P	03 credits	3Hrs/Week
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Course Preamble:

The main learning objective of this course is to prepare the students for:

1. Applying the principle mechanism of heat transfer under steady state and transient conditions.
2. Applying the fundamental concept and principles in convective heat transfer.
3. Applying the theory of phase change heat transfer and design of heat exchangers.
4. Applying the fundamental concept and principles in radiation heat transfer.
5. Analyzing the relation between heat and mass transfer and to solve simple mass transfer problems.

Course Outcomes:

Upon completion of this course, the students will be able to:

1. Apply the principle mechanism of heat transfer under steady state and transient conditions.
2. Apply the fundamental concept and principles in convective heat transfer.
3. Apply the theory of phase change heat transfer and design of heat exchangers.
4. Apply the fundamental concept and principles in radiation heat transfer.
5. Analyze the relation between heat and mass transfer and to solve simple mass transfer problems.

Unit-1

Basic Concepts: Modes of heat transfer, Fourier's law, Newton's law, Stefan Boltzman law; thermal resistance and conductance, analogy between flow of heat and electricity, combined heat transfer process; **Conduction:** Fourier heat conduction equation, its form in rectangular, cylindrical and spherical coordinates, thermal diffusivity, linear one dimensional steady state conduction through a slab, tubes, spherical shells and composite structures, electrical analogies, critical-insulation-thickness for pipes, effect of variable thermal conductivity.

(10 hours)

Unit 2

Extended surfaces (fins): Heat transfer from a straight and annular fin (plate) for a uniform cross section; error in measurement of temperature in a thermometer well, fin efficiency, fin effectiveness,

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applications; **Unsteady heat conduction:** Transient and periodic conduction, heating and cooling of bodies with known temperatures distribution, systems with infinite thermal conductivity, response of thermocouples.

(10 hours)

Unit 3

Convection: Introduction, free and forced convection; principle of dimensional analysis ,Buckingham „pie“ theorem, application of dimensional analysis of free and forced convection ,empirical correlations for laminar and turbulent flow over flat plate and tubular geometry; calculation of convective heat transfer coefficient using data book.

(8 hours)

Unit 4

Heat exchangers: Types- parallel flow, counter flow; evaporator and condensers, overall heat transfers coefficient, fouling factors, log-mean temperature difference (LMTD), method of heat exchanger analysis, effectiveness of heat exchanger, NTU method;

Mass transfer: Fick’s law, equi-molar diffusion, diffusion coefficient, analogy with heat transfer, diffusion of vapor in a stationary medium.

(8 hours)

Unit 5

Thermal radiation: Nature of radiation, emissive power, absorption, transmission, reflection and emission of radiation, Planck’s distribution law, radiation from real surfaces; radiation heat exchange between black and gray surfaces, shape factor, analogical electrical network, radiation shields.

Boiling and condensation: Film wise and drop wise condensation; Nusselt theory for film wise condensation on a vertical plate and its modification for horizontal tubes; boiling heat transfer phenomenon, regimes of boiling, boiling correlations.

(10 hours)

References:

1. Sukhatme SP; Heat and mass transfer; University Press Hyderabad
2. Holman JP; Heat transfer; TMH
3. Nag PK; heat and Mass Transfer; TMH
4. Dutta BK; Heat Transfer Principles And App; PHI Learning
5. Mills AF and Ganesan V; Heat transfer; Pearson
6. Cengel Yunus A; Heat and Mass transfer;TMH
7. Yadav R; Heat and Mass Transfer; Central India pub-Allahabad
8. Baehr HD;Stephan K; Heat and Mass Transfer; MacMillan

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MEA- 602	Heat and Mass Transfer	0L:0T:2P	1 credits	2Hrs/Week
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List of Experiments:

1. To determine Conduction through a rod to determine thermal conductivity of material
2. To understand the Forced and free convection over circular cylinder
3. To determine Free convection from extended surfaces
4. To determine Parallel flow and counter flow heat exchanger effectiveness and heat transfer rate
5. To determine Calibration of thermocouple
6. To determine Experimental determination of Stefan- Boltzman constant

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MEA-603 (A)	IC Engines	3L:1T:0P	04 credits	4 Hrs/Week
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Course Preamble:

1. To make students familiar with the design and operating characteristics of modern internal combustion engines
2. To apply analytical techniques to the engineering problems and performance analysis of internal combustion engines
3. To study the thermodynamics, combustion, heat transfer, friction and other factors affecting engine power, efficiency and emissions
4. To introduce students to the environmental and fuel economy challenges facing the internal combustion engine
5. To introduce students to future internal combustion engine technology and market trends

Course Outcomes:

1. Differentiate among different internal combustion engine designs
2. Recognize and understand reasons for differences among operating characteristics of different engine types and designs
3. Given an engine design specification, predict performance and fuel economy trends with good accuracy
4. Based on an in-depth analysis of the combustion process, predict concentrations of primary exhaust pollutants

UNIT I

Internal Combustion Engine: S.I. and C.I. engines of two and four stroke cycles, real cycle analysis of SI and CI engines, determination of engine dimensions, speed, fuel consumption, output, mean effective pressure, efficiency, factors effecting volumetric efficiency, heat balance, performance characteristics of SI and CI engines, cylinder arrangement, firing order, power balance for multi-cylinder engines, valve timing.

(10 hours)

UNIT 2

Combustion in SI engines: Flame development and propagation, ignition lag, effect of air density, temperature, engine speed, turbulence and ignition timings, physical and chemical aspects of detonation, effect of engine and fuel variables on knocking tendency, knock rating of volatile fuels, octane number, H.U.C.R., action of dopes, pre-ignition, its causes and remedy, salient features of

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various type combustion chambers, valve timing and firing order.

(9 hours)

UNIT 3

Combustion in C.I. Engines: Times base indicator diagrams and their study, various stages of combustion, delay period, diesel knock, octane number, knock inhibitors, salient features of various types of combustion chambers, fuel, ignition, cooling, exhaust and lubrication systems; Simple problems on fuel injection, various types of engines, their classification and salient features. Rotary I. C. engines, their principles of working.

(9 hours)

UNIT 4

I.C. Engine System: Fuels, ignition systems, cooling, exhaust/scavenging and lubrication system. Fuel metering in SI engine: Fuel injection in SI engine (MPFI & TBI), Theory of carburetion, simple problems on carburetion. Fuel metering in CI engines: Fuel injection in CI engine and simple problems, various types of engines, their classification and salient features. Fuels: Conventional fuels and alternate fuels, engine exhaust emission, carbon monoxide, unburnt hydro carbon, oxides of nitrogen, smoke, density, measurement and control, hydrogen as alternate fuel.

(10 hours)

UNIT 5

Supercharging: Effect of attitude on mixture strength and output of S.I. engines, low and high pressure super charging, exhaust, gas turbo-charging, supercharging of two stroke engines.

(8 hours)

References:

1. Ganeshan V; Internal Combustion engines; TMH
2. Mathur ML & Sharma RP; A. Course in IC engines; DhanpatRai
3. Gupta HN; Fundamentals of IC Engines; PHI
4. Srinivasan S; Automotive Engines; TMH
5. Halderman JD and Mitchell CD; Automotive Engines theory and servicing; Pearson
6. DomKundwar; Internal Combustion Engines ; Dhanpat Rai Publications
7. Taylor GF; Internal Combustion Engines Theory & Practice; MIT Press
8. Richard Stone; Introduction to IC Engines; Society of Automotive Engr (Palgrave Mc Millan)

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MEA-603 (B)	MECHANICAL MEASUREMENT AND CONTROL	3L:1T:0P	04 credits	4 Hrs/Week
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Course Preamble:

1. To understand the basic principles, construction and working of engineering mechanical measurement science.
2. To acquire proficiency in using, calibrating various measurement systems
3. To understand the problems in measurement system and develop the competency to resolve the problems.
4. To know all the measuring instruments and to measure different parameters in day-today work.

Course Outcomes:

After going through basic study of generalized measurement system, students will be able

1. To understand the stepwise working of all instruments and will be able to find out the output factors.
2. They will be able to know the importance of all factors affecting on output of instruments
3. They can suggest some points in the design & working of instruments after studying the basics of metrology.
4. Students will be able to differentiate between all types of measurements i.e. Direct & indirect type, contact & non-contact type as well as they can design the components with provisions of tolerance in manufacturing through the concepts of metrology.

UNIT 1

Measurement: Significance of Mechanical Measurements, Classification of measuring instruments, generalized measurement system, types of inputs: Desired, interfering and modifying inputs. Static characteristics: Static calibration, Linearity, Static Sensitivity, Accuracy, Static error, Precision, Reproducibility, Threshold, Resolution, Hysteresis, Drift, Span & Range etc. Errors in measurement: Types of errors, Effect of component errors, Probable errors. **(10 hours)**

UNIT 2

Displacement Measurement : Transducers for displacement, displacement measurement, potentiometer, LVDT, Capacitance Types, Digital Transducers (optical encoder) **Strain Measurement :** Theory of Strain Gauges, gauge factor, temperature Compensation, Bridge circuit, orientation of strain gauges for force and torque, Strain gauge based load cells and torque sensors **Measurement of Angular Velocity:** Tachometers, Tachogenerators, Digital tachometers and Stroboscopic Methods, Acceleration Measurement.

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(9 hours)

UNIT 3

Pressure Measurement: Elastic pressure transducers viz. Bourdon tubes, diaphragm, bellows and piezoelectric pressure sensors, High Pressure Measurements. Vacuum measurement: Vacuum gauges viz. McLeod gauge, Ionization and Thermal Conductivity gauges. Flow Measurement: Bernoulli's flow meters, Ultrasonic Flowmeter, Magnetic flow meter, rotameter. Temperature Measurement: Electrical methods of temperature measurement Resistance thermometers, Thermistors and thermocouples, Pyrometers.

(10 hours)

UNIT 4

Introduction to control systems, Classification of control system, Open loop and closed loop systems, Mathematical modelling of control systems, concept of transfer function, Block diagram algebra.

(8 hours)

UNIT 5

Transient and steady state analysis of first and second order system . Time Domain specifications. Step response of second order system. Steady-state error ,error coefficients, steady state analysis of different type of systems using step, ramp and parabolic inputs.

(8 hours)

References:

1. Measurement Systems (Applications and Design) 5th ed.- E.O. Doebelin - McGraw Hill.
2. Mechanical Engineering Measurement - Thomas Beckwith, N.Lewis Buck, Roy Marangoni Narosa Publishing House, Bombay.
3. Mechanical Engineering Measurements - A. K. Sawhney - DhanpatRai& Sons, New Delhi.
4. Instrumentation Devices & Systems - C.S. Rangan&G.R.Sarna - Tata McGraw Hill.
5. Instrumentation & Mechanical Measurements - A.K. Thayal.
6. Control System Engineering: by Nagrath IJ. and Gopal .

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MEA-604 (A)	Power Plant Engineering	3L:0T:0P	03 credits	3Hrs/Week
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Course Preamble:

1. To develop an ability to apply knowledge of Mathematics and Thermal Sciences
2. To develop an ability to design a system component and processes to meet the desired needs of Power Plant.
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Course Outcomes:

1. Ability to have adequacy with design, erection and development of Power Plant
2. Optimization of Power Plants with respect to available resources.

Unit I

Introduction to methods of converting various energy sources to electric power, direct conversion methods renewable energy sources, solar, wind, tidal, geothermal, bio-thermal, biogas and hybrid energy systems, fuel cells, thermoelectric modules, MHD-Converter.

(9 hours)

Unit II

Fossil fuel steam stations: Basic principles of siting and station design, effect of climatic factors on station and equipment design, choice of steam cycle and main equipment, recent trends in turbine and boiler sizes and steam conditions, plant design and layout, outdoor and indoor plant, system components, fuel handling, burning systems, element of feed water treatment plant, condensing plant and circulating water systems, cooling towers, turbine room and auxiliary plant equipment., instrumentation, testing and plant heat balance.

(10 hours)

UNIT III

Nuclear Power Station: Importance of nuclear power development in the world and Indian context, Review of atomic structure and radio activity, binding energy concept, fission and fusion reaction, fissionable and fertile materials, thermal neutron fission, important nuclear fuels, moderators and coolants, their relative merits, thermal and fast breeder reactors, principles of reactor control, safety and reliability features.

(9 hours)

Unit IV

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Hydro-Power Station: Elements of Hydrological computations, rainfall run off, flow and power duration curves, mass curves, storage capacity, salient features of various types of hydro stations, component such as dams, spillways, intake systems, head works, pressure tunnels, penstocks, reservoir, balancing reservoirs, Micro and pico hydro machines, selection of hydraulic turbines for power stations, selection of site.

(9 hours)

Unit V

Power Station Economics: Estimation and prediction of load. Maximum demand, load factor, diversity factor, plant factor and their influence on plant design, operation and economics; comparison of hydro and nuclear power plants typical cost structures, simple problems on cost analysis, economic performance and tariffs, interconnected system and their advantages, elements of load dispatch in interconnected systems.

(9 hours)

References:

1. Nag PK; Power plant Engg; TMH
2. Al-Wakil MM; Power plant Technology; TMH
3. Sharma PC; Power plant Engg; Kataria and sons, Delhi
4. Domkundwar; Power Plant Engg; Dhanpatrai & sons.
5. Rajput RK; A text book of Power plant Engg.; Laxmi Publications.
6. Yadav R; Steam and gas turbine and power plant engg.



