STRUCTURE FOR B.E. (PRODUCTION ENGINEERING) COURSE
TO BE REVISED FROM JULY 2008
S.E. (Prod. Engg.) Part – I Semester 3
(July 2008 Onwards)

Sr. No.	SUBJECT	Teaching Hours/Week				Paper Duration Hrs.	Examination Scheme				
		L	Pr	Tut	Total		PT	TW	Oral	Pract	Total
1	Engineering Mathematics-III	3	-	1*	4	3	100	25	-	-	125
2	Machine Drawing	2	4	-	6	4	100	25	25	-	150
3	Thermal Engineering	3	2	-	5	3	100	25	-	-	125
4	Electrical Technology & Industrial Electronics	4	2	-	6	3	100	25	-	-	125
5	Machine Tools & Processes	3	1	-	4	3	100	25	-	-	125
6	Advanced Programming Laboratory	1	4	-	5	-	-	25	-	50	75
7	Work Shop Practice-III	-	2	-	2	-	-	25	-	-	25
	TOTAL	16	15	1	32	-	500	175	25	50	750

L: Lecture, Pr: Practical, Tut: Tutorial, PT: Paper (Theory), TW: Term Work, Pract: Practical

* Tutorials shall be conducted batch-wise.

S.E. (Prod. Engg.) Part –II Semester 4

Sr. No.	SUBJECT	Teaching Hours/Week				Paper Duration Hrs.	Examination Scheme				
		L	Pr	Tut	Total		PT	TW	Oral	Pract	Total
1	Advanced Machine Tools & Processes	3	2	-	5	3	100	25	25	-	150
2	Foundry Technology	3	2	-	5	3	100	25	25	-	150
3	Analysis of Machine Elements	3	2	-	5	3	100	25	-	-	125
4	Welding Technology	3	2	-	5	3	100	25	-	-	125
5	Theory of Machines - I	3	2	-	5	4	100	25	-	-	125
6	Computer Aided Solid Modeling	2	2	-	4	-	-	25	-	50	75
7	Work Shop Practice-IV	-	2	-	2	-	-	25	-	50	75
8	Mini Project *	-	1	-	1	-	-	25	-	-	25
	TOTAL	17	15	-	32	--	500	200	50	100	850

* Note: For Mini Project, a group of nine students shall be considered.

T.E. (Prod. Engg.) - Part I - Semester 5

JULY 2009 ONWARDS

Sr. No.	SUBJECT	Teaching Hours/Week				Paper Duration Hrs.	Examination Scheme				
		L	Pr	Tut	Total		PT	TW	Oral	Pract	Total
1	Metallurgy - I	3	2	-	5	3	100	25	-	-	125
2	Theory of Machines – II	3	2	-	5	3	100	25	-	-	125
3	Design of Machine Elements	3	1	-	4	3	100	25	-	-	125
4	Tool Engineering – I	3	1	-	4	3	100	25	-	-	125
5	Metal Forming & Plastics Technology	3	2	-	5	3	100	25	-	-	125
6	Metrology	3	2	-	5	3	100	25	-	25	150
7	Basic CNC Laboratory	-	2	-	2	-	-	25	-	-	25
8	Work Shop Practice-V	-	2	-	2	-	-	-	-	-	-
	TOTAL	18	14	-	32	-	600	175	-	25	800

T.E.(Prod. Engg.) -Part II - Semester 6

Sr. No.	SUBJECT	Teaching Hours/Week				Paper Duration Hrs.	Examination Scheme				
		L	Pr	Tut	Total		PT	TW	Oral	Pract	Total
1	Metallurgy – II	3	2	-	5	3	100	25	-	-	125
2	Industrial Management	3	-	-	3	3	100	-	-	-	100
3	Industrial Hydraulics & Pneumatics	3	2	-	5	3	100	25	-	25	150
4	Tool Engineering – II	3	2	-	5	4	100	25	25	-	150
5	Total Quality Management	3	2	-	5	3	100	25	-	-	125
6	Machine Tools & Product Design	3	2	-	5	3	100	25	-	-	125
7	Work Shop Practice-VI	-	2	-	2	-	-	25	-	25	50
8	Seminar*	-	1	-	1	-	-	25	-	-	25
	TOTAL	18	13	-	31	-	600	175	25	50	850

* Note: For Seminar, a group of nine students shall be considered.

B. E. (Prod. Engg.) – Part I - Semester 7

JULY 2010 ONWARDS

Sr. No.	SUBJECT	Teaching Hours/Week				Paper Duration Hrs. Pr	Examination Scheme				
		L	Pr	Tut	Total		PT	TW	Oral	Pract	Total
1	Operations Research	3	2	-	5	3	100	25	-	-	125
2	Mechatronic Systems	3	2	-	5	3	100	25	-	25	150
3	Process Engineering	3	2	-	5	3	100	25	25	-	150
4	Production & Operations Management	3	-	2	5	3	100	25	-	-	125
5	Computer Aided Design and Analysis	3	2	-	5	3	100	25	25	-	150
6	Vacational In-plant Training Report*	-	1	-	1	-	-	25	-	-	25
7	Advanced CNC Laboratory	-	2	-	2	-	-	50	-	25	75
8	Project Work – Phase I*	-	2	-	2	-	-	25	25	-	50
	Total	15	13	2	30	-	500	225	75	50	850

*Note: For VIT Report and Project Work-Phase I, groups of nine students each shall be considered.

B. E. (Prod. Engg.) – Part II - Semester 8

Sr. No.	SUBJECT	Teaching Hours/Week				Paper Duration Hrs. Pr	Examination Scheme				
		L	Pr	Tut	Total		PT	TW	Oral	Pract	Total
1	Costing and Cost Control	3	2	-	5	3	100	25	-	-	125
2	Computer Integrated Manufacturing Systems	3	2	-	5	3	100	25	-	-	125
3	Advanced Industrial Engineering	3	2	-	5	3	100	25	-	-	125
4	Elective - I	3	1	-	4	3	100	25	-	-	125
5	Elective - II	3	2	-	5	3	100	25	25	-	150
6	Project Work – Phase II*	-	6	-	6	-	-	75	75	-	150
	TOTAL	15	15	-	30	-	500	200	100	-	800

*Note: For Project Work-Phase II, a group of nine students shall be considered.

LIST OF ELECTIVE SUBJECTS

ELECTIVE – I

1. Marketing Management
2. Materials Management
3. Data Base Management
4. Entrepreneurship Development
5. Financial Management
6. Environment & Pollution Control
7. Organizational Behaviour

ELECTIVE – II

1. Flexible Manufacturing Systems
2. Artificial Intelligence
3. Industrial Robotics
4. Rolling and Roll Pass Design
5. Material Handling Systems
6. Advanced Foundry Technology
7. Advanced Tool & Die Design

S.E. (Prod. Engg.)-Part I, Sem. III

ENGINEERING MATHEMATICS – III

Teaching Scheme		**Examination Scheme**	
Lectures	: 3 hours/week	Theory	: 100 marks
Tutorial	: 1 hours/week	Term work	: 25 marks

Course Objective

To study various mathematical tools available for analysis and design of engineering systems.

SECTION – I

Unit 1 Linear Differential Equations: Linear Differential Equations with constant coefficients, Homogenous Linear differential equations. [6 hours]

Unit 2 Applications of Linear Differential Equations: Applications of Linear Differential Equations with constant coefficients to Damped forced vibrations and Whirling of Shafts. [6 hours]

Unit 3 Partial differential equations: Four standard forms of partial differential equations of first order. [4 hours]

Unit 4: Applications of Partial differential equations:
Transformation of partial differential equation into Difference equation and solution of Laplace equation by using Jacobi and Gauss-Seidal method. [4 hours]

SECTION – II

Unit 1 Curve Fitting: Fitting of Curves by method of Least-squares, Coefficient of correlation, Spearman's rank correlation coefficient and lines of regression of bivariate data. [4 hours]

Unit 2 Probability: Random variable, Probability mass function and probability density function, Binomial, Poisson and Normal distributions. [5 hours]

Unit 3 Vector Calculus: Differentiation of vectors, Gradient of scalar point function, Directional derivative, Divergence of vector point function, Curl of a vector point function. [6 hours]

Unit 4 Fourier series: Definition, Euler's formulae, Dirichlet's Conditions, Functions having points of discontinuity, change of interval, expansions of odd and even periodic functions, Half range series [5 hours]

Term – Work

Minimum eight assignments based on the above syllabus covering all the topics.

General Instructions:

1. For the term work of 25 marks, tutorials shall be conducted batch-wise. The number of students per batch shall be 20 as per university norm for practical batches.

Nature of Question paper:

1. There will be two sections carrying 50 marks each.
2. There will be four questions in each section and any three questions should be answered from each section.

Reference Books:

1. A Text book of Applied Mathematics: Vol. I, II and III by J. N. Wartikar & P. N. Wartikar , (Vidyarthi Griha Prakashan, Pune.)
2. Higher Engineering Mathematics by Dr. B. S. Grewal. (Khanna Publications, New Delhi.)
3. Advanced Engineering Mathematics by Erwin Kreyszig. (John Wiley & Sons)
4. A Textbook of Engineering Mathematics by N. P. Bali, Ashok Saxena and N. Ch. S. N. Iyengar (Laxmi Publication, Delhi.)
5. Fundamental of Statistics by S. C. Gupta. (S. Chand & Co.)

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S.E. (Prod. Engg.)-Part I, Sem. III

2. Machine Drawing

Teaching Scheme:
Lectures: 2 Hrs/ Week
Practical: 4 Hrs/ Week/ Batch

Examination Scheme:
Theory Paper (4 Hours): 100 marks
Term Work: 25 marks
Oral Exam: 25 marks

Course Objective

Understanding, preparation and reading of 2D drawings of various machine parts and assemblies used in industry.

Section I

1. Study of I.S. conventions**:** Designation of drawing sheet sizes according to ISO A-series. Title block details and sizes. Screw thread terminology. Various parts of screw threads. Forms of screw threads. Conventional representation of V-threads and square threads. [internal & external].Different types of nuts and bolts, studs, set screws, cap screws, lock nuts, washers and split pins. To draw views of hexagonal and square nuts and bolts according to scale. IS conventions for- chamfer, tapped and drilled holes, slope and taper & welded joints. Conventions for showing different metals and materials on drawing. IS conventions of different types of gears like spur gears, helical gears, worm & worm wheel, bevel gears and rack & pinion. Conventions of different types of springs like helical spring, disc spring, spiral spring and leaf springs. Conventions for splined and serrated shafts. Conventions for straight & diamond Knurling, broken ends of shafts and rods. I.S. conventional representation of ball and roller bearings. Identification of bearings with reference to manufacturing catalogues.
(4 hours)

2. Dimensioning with tolerances**:** Study of Limits, Fits and Tolerances. Hole base and shaft base system for selection of fits. Selection of class and grade of hole & shaft by using hole base system and shaft base system. Selection of fits between various parts.
(3 hours)

3. Assembly and details of general units: Meaning and use of machine drawing. Purpose of making assembly and detail drawings. Classification of machine drawing- production drawings, working drawings. Practice in making assembly and detail drawings of units consisting of not more than 8 to10 parts [excluding fasteners], giving dimensions with limits fits and tolerances. (5 hours)

Section II

4. Free hand sketching: To draw free-hand proportionate sketches of the machine parts like-

4.1 All types of taper and parallel keys. Flanged coupling, protected type flanged coupling, muff coupling, solid coupling, pin type flexible coupling and universal coupling.

4.2 Flat belt pulleys, V-belt pulleys, rope pulleys and fast and loose pulleys.

4.3 Simple solid bearing, bushed bearing, pedestal bearing, foot step bearing.
(3 hours)

5. Preparation of working drawings: Preparation of working drawings of units and assemblies showing machining symbols, welding symbols, and other geometrical requirements like surface finish, flatness, straightness, parallelism, perpendicularity, concentricity, etc.
(3 hours)

6. Interpenetration of solids-Introduction, interpenetration of prism with prism, prism with cylinder, prism with cone, prism with pyramid, (prism and pyramid limited up to rectangular), cylinder with cylinder , cone with cylinder (4 hours)

7. Auxiliary projections: Types of auxiliary views. Principles of drawing auxiliary projections of simple machine parts having inclined surfaces. (2 hours)

Components mentioned above to be shown to the students before they draw it for understanding practical applications.

Term work

Each candidate has to draw following submission sheets on A-2 size drawing sheets-

1. Drawing details and assembly by taking actual measurements.
2. One sheet showing assembly from given details showing limits, fits. (Given problem of details to be attached and need not be drawn.)
3. One sheet showing details from given assembly showing tolerances. (Given problem of assembly to be attached and need not be drawn.)
4. Tracing and taking out ammonia print based on any of the above 5 sheets.
5. One sheet based on preparation of working drawings of simple machine parts, showing machining symbols, geometrical requirements, surface finish, welding symbols etc.
6. One sheet based on free hand sketching of machine parts mentioned in topic 4.
7. One sheet based on interpenetration of solids.
8. One sheet based on preparation of auxiliary views of simple machine parts, having inclined surfaces.

Oral Examination

External oral will be conducted based on term work and above syllabus.

Note: Stress should be given on reading of "Industrial Drawings" by the students; and the same should be considered during external orals.

Reference Books

1 IS: SP 46- Engineering drawing practice for schools and colleges, BIS Publication.
2. Machine Drawing by N.D.Bhatt, (Charotar Publication, Anand)
3. Machine Drawing by N. Sidheswar, Shastri, Kanaiah, (TMH.)
4. Machine Drawing by K.L.Narayanan., (New Edge International Publishers)
5. Machine Drawing by R.K.Dhavan, G.R. Nagpal, (S. Chand & Co.)
6. Machine Drawing by P.S. Gill, (S. K. Kataria, Delhi)
7. Engineering drawing by N. D. Bhatt, (Charotar Publication, Anand)
8. Graphic Science & Design by French, Vierck & Foster (McGraw Hill)

S.E. (Prod. Engg.)-Part I, Sem. III

3. Thermal Engineering

Teaching Scheme:		**Examination Scheme:**	
Lectures:	3 Hrs/Week	Theory Paper (3 Hrs):	100 Marks
Practical:	2 Hr/Week/Batch	Term Work:	25 Marks

Course Objective

Students should study the fundamentals of various thermodynamic devices; be able to analyze the performance and understand the applications of thermodynamic systems.

Section –I

1. Second law of thermodynamics:

Limitations of first law, Statements of second law, Equivalence of Kelvin-Planck and Clausius statements, Corollaries of Second law, Refrigerators and Heat pumps, Reversibility and irreversibility, Causes of irreversibilities,Carnot theorem & Phase Property diagram. (6 hours)

2. Steam Engineering Rankine cycle, steam boilers, flow of steam through nozzles, critical pressure ratio, maximum discharge, effect of friction calculation of throat and exit areas, nozzle efficiency, use of Mollier chart. Introduction to steam turbines and condensers. (9 hours)

3. Heat transfer:

Modes and laws of heat transfer, steady state heat conduction, concept of thermal resistance, Heat Exchangers- Classification and types. (5 hours)

Section –II

4. I.C. Engines.

Analysis for cycles-Otto, Diesel and Dual combustion cycles, Classification of I..C. Engines, construction and working of two stroke, four stroke, S.I. and C.I. Engines, Cooling and lubrication systems of I.C. engines. Governing of I.C.Engines, Alternative fuels, applications of I.C. Engines. (8 hours)

5. Air Compressors:

Classifications, thermodynamic analysis of single stage and multi stage reciprocating air compressors without clearance volume. Construction and working of centrifugal and axial Flow air compressors. Applications of Compressed air. (5 hours)

6. Refrigeration and Air conditioning:

Reversed Carnot cycle, Bell Coleman Cycle, Analysis of Simple Vapour Compression Cycle, introduction to Vapour absorption cycle , types and properties of refrigerants, Eco-friendly refrigerants, concepts of Psychometry, Psychometric terms and processes, Summer, Winter and Industrial Air conditioning Systems. (7 hours)

Term Work:

1. Study of constructional details of Boilers.
2. Industrial visit to Steam power Plant and submission of the relevant report.
3. Determination of Thermal conductivity of metal rod
4. Determination of Experimental heat transfer coefficient of Natural Convection.
5. Trial on I.C.Engine to determine BSFC and Thermal Efficiency.
6. Trial on Reciprocating Air compressor to determine isothermal efficiency
7. Industrial visit to study refrigeration / Air Conditioning plant and submission of the relevant report.
8. Determination of COP of Vapour Compression Refrigeration System.

Recommended Books

1. Thermal Engineering by P.L. Ballaney (Khanna Publishers)
2. Basic & applied thermodynamics by P.K.Nag (TMH)
3. Thermal Engineering by R.K.Rajput (Laxmi Publications)
4. Thermal Engineering by B.K.Sarkar (TMH)
5. Thermal Engineering by Kothanderman (New Age International Publication)
6. Basic Engineering Thermodynamics by Rayner Joel (ELBS)
7. IC engines by Mathur and Sharma (Dhanpat Rai and Co.)
8. Basic Refrigeration & Air Conditioning by Ananthnarayanan (TMH)
9. Heat Transfer By R.K.Rajput (S.Chand and Co.)

S.E. (Prod. Engg.)-Part I, Sem. III
4. Electrical Technology & Industrial Electronics

Teaching Scheme:
Lectures: 4 Hrs/Week
Practical: 2 Hr/Week/Batch

Examination Scheme:
Theory Paper (3 Hrs): 100 Marks
Term Work: 25 Marks

Course Objective

To help the students to acquire skills in electrical and electronics engineering and make them compatible of operating and communicating with related engineering disciplines.

Section I

1. Three phase induction motor: Operating principle, construction, types, characteristics, applications.
Introduction to a.c. and d.c. servo motors and stepper motor, linear motor(induction and stepper). Selection of electric motors. (5 hours)

2. Starters, speed control and braking: Speed control of d.c. motors (Numerical treatment), Armature voltage control, flux control, speed control of 3 phase induction motor, frequency control, pole changing, rotor resistance control. 3 point starter and 4 point starter for d.c. motor, ster delta starter and auto transformer starter for induction motor.
Reversal of direction of rotation of electric motors.
Types of electric braking, comparison of mechanical and electrical braking. Electrical braking methods for d.c. motors and 3 phase induction motors. (7 hours)

3. Electric heating and melting : Direct and indirect resistance heating, resistance oven (Discriptive treatment) and salt bath furnace. Coreless and core type induction furnace, applications of induction heating. Direct and indirect arc furnace (Numerical treatment to energy conversions), Dielectric heating and its applications. (5 hours)

4. Power factor improvement : Methods of pf improvement (Numerical treatment) (2 hours)

5. Study of relays, contactors and switches (1 hour)

Section II

6. Silicon controlled rectifier : Structure, operation, VI characteristics, Gate triggering, Commutation, SCR as a switch SCR applications – D.C. motor speed control using 1 phase full converter and dual converter (Numerical treatment), 1 phase voltage source inverter.
TRIAC : Structure, operation, V-I characteristics. TRIAC applications- A.C. power control (Numerical treatment) (6 hours)

7. Enhancement type MOSFET: Structure , operation, V-I characteristics, MOSFET as a switch, Elementary voltage amplifier using MOSFET(Common source configuration), concepts of voltage gain, frequency response, bandwidth. (5 hours)

8. Digital circuits: Universal gates, Building digital circuits with universal gates using K map technique(with sum of products base , 3 variables only, numerical treatment)
Flip flops : Clocked SR and clocked JK flip flops – Circuit, operation , truth table. Flip flop applications – 4 bit synchronous counter. (5 hours)

9. Sensors : Concept of measurement using sensors., Active and passive sensors, contact type and non-contact type sensors, Sensor parameters . Study of phototransistors, thermocouple, bonded resistance strain gauge, limit switch. (4 hours)

Termwork

Minimum 8 experiments- 4 based on section I and 4 based on section II.

Section I

1. Speed control of d.c. motor
2. Study of starters for d.c. motors
3. Energy calculation for resistance furnace
4. P.F. improvement
5. Reversal of rotation of d.c. motor and 3 phase induction motor
6. Industrial Visit for studying working of arc furnace or induction furnace.

Section II

1. 1 phase full converter using SCR Or 1 phase inverter using SCR
2. 1 phase a.c. power control using Triac
3. Universal gate configurations as AND, OR, NOT Or Practical exercise on building digital circuit
4. Verification of flip-flop performance
5. Obtaining sensor characteristics (phototransistor or strain gauge or thermocouple)

Recommended books

1. Electrical Technology –B.L.Theraja(S.Chand)
2. Electrical Power –S.L.Uppal (Khanna Publ)
3. Industrial Electronics –S.K.Khedkar (Technova)
4. Electrical and Electronic Measurements and Instrumentation –A.K.Sawhney (Dhanpat Rai)

(Prod. Engg.)-Part I, Sem. III

5. Machine Tools and Processes

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs. / Week	Theory Paper (3 Hrs): 100 Marks
Practical: 1 Hr. / Week/Batch	Term work: 25 Marks

Course Objective

To study the various conventional and basic Machine Tools and manufacturing processes carried out on these machines for different applications.

Section I

1. Metal cutting machines – hacksaw, circular saw, band saw, abrasive cut off machines(general working) (2 hours)

2. Study of center lathe – Construction and working, Types of lathe, Operations performed – Turning, Facing, Step turning, Grooving, Undercutting, Taper turning, Eccentric turning, Boring, Thread cutting, Gear train calculations, Use of grinding attachment, Milling attachment (8 Hours)

3. Turret and Capstan lathe – Construction, working, Types. Types of tool holders, Bar feeding mechanism. (3 hours)

4. Study of Drilling machine – Types- Bench, Radial, Pillar machines Construction and working, Operations – Drilling, Reaming, Spot facing, Counter boring, Counter sinking, Tapping, Multi-spindle and Gang drilling machines (Classification only) (5 Hours)

Section II

5. Plain surface Generation – Shaper, Planer, Slotter – construction, working and applications, Types of these machines (Classification only) (2 hours)

6. Milling Machine – construction and working of Column and Knee Milling machine, Types of milling operations – up milling, down milling, face milling, end milling, plain end milling, straddle milling, gang milling. Types of milling machines – horizontal, vertical, universal, duplex, triplex, Plano-milling (Classification only). Milling cutters – types and use. Construction and working of Dividing head, methods of indexing and applications of dividing head (9 hours)

7. Grinding machines – Grinding machines and operations - External. Internal, Centreless, Surface grinding, Grinding wheel – elements, nomenclature, types, wheel mounting, wheel dressing, wheel tracing, wheel balancing, grinding wheel balancing. (7 hours)

Term work

1. At least two industrial visits to study applications related to the subject and submission of the relevant reports.

AND

2. Center lathes (Calculation and creation of setup for a taper turning exercise. Each group of about five students should create a setup for a different exercise along with submission of schematic sketch and description.)

3. Milling machines - Setting up of indexing mechanism on Universal Dividing Head for one exercise (Each group of about five students should create a setup for a different exercise along with submission of schematic sketch and description.)

Study of construction, mechanism and applications of any two of the following

4. Grinding Machines
5. Drilling Machines
6. Shaping Machines
7. Planing Machines

Recommended Books

1. Workshop Technology Vol. I & II by Hajra Chaudhary, (Media Promoters & Publishers Pvt. Ltd. Mumbai)
2. Workshop Technology Vol. I , II and III by W.A.J. Chapman, (ELBS)
3. Manufacturing Processes & Systems by Phillip F. Ostwald & Jairo Minoz (John Willey & Sons.)
4. Production Technology – HMT Handbook (HMT)
5. Production Technology by Jain Gupta, (Khanna Publishers, New Delhi)
6. Manufacturing Processes by Begeman Amstead, (Wiley.)
7. Manufacturing Processes by Rusinoff, (Tata McGraw Hill Publishing Co. Ltd.)
8. Advanced Manufacturing Technology by Kalpakjian (Addison Wesley)
9. Manufacturing Technology – Metal Cutting & Machine Tools by P. N. Rao (TMH)
10. Workshop Technology Vol. II by Bawa H. S. (TMH)

S.E. (Prod. Engg.)-Part I, Sem. III

6. Advanced Programming Laboratory

Teaching Scheme:	**Examination Scheme:**
Lecture: 1 Hr.	Term work: 50 Marks
Practical: 4 Hrs. / Week/Batch	Practical: 25 Marks

Course Objective

To develop programming skills using object oriented programming features, and other basic skills of office automation and database management.

1. Minimum 10 Programs on following topics in C++ and Visual Basic

A) C++ Language

i. **Arrays :** One dimensional and multi dimensional arrays.
ii. **Functions :** Types of functions, Recursive function, Function & Arrays, Function with default argument
iii. **Pointers :** Declaration, pointer arithmetic, Pointers & functions, Pointers to a function, Pointer & arrays.
iv. **Inheritance :** Forms of Inheritance, Direct & Indirect base class, Types of derivations (public, private, protected)
v. **Polymorphism :** Function Overloading, Operator Overloading
vi. Virtual Function and Pure virtual function
vii. **File Handling :** Opening file, writing data, reading data, closing file, file copy, file opening modes.

B) Visual Basic basics:
VB Environment, Menu Bar, Toolbars, Toolbox, Project Explorer, Property Window, Form designer, Form Layout

2. Minimum one Program on following topic.

Graphics in C++ : Shapes (circle, rectangle etc), Colors

3. Minimum 3 Exercises on following topics.

Excel Worksheet:
Use of formulas, functions, graphs (2-D, 3-D)
Types of charts, using filters.

4. Preparing at least one Presentation on a topic related to Manufacturing Engg.
(Minimum. 10 slides using **MS- Power-point or equivalent**, A separate presentation by each student.)

5. Minimum two Exercises on Database Management (Using MS-Access or equivalent)

i) Basics:
Concept of database, DBMS
Terminologies used: Table, Field, Record, Query, Form, Report
ii)Table :
Creating structure of table, adding various fields, decide field types and field properties, Concept of primary key;

Modification of Table Structure: adding/deleting fields, changing field name, data types and properties
Adding data to table.
Sorting the table in data sheet view.
Finding records.
Filtering records : Filter by selection
Printing table.

iii)Queries:

Creating queries in design view, adding table, selecting fields, running the query, specifying a sort order, Specifying criteria, adding calculated fields.

iv)**Introduction to forms**

Practical Examination: (One candidate on one PC terminal)

Duration : 3 Hrs.

1)	At least one program in C++ to be compiled and executed	**10 marks**
2)	At least one simple exercise from the following	**08 marks**
	a) EXCEL OR	
	b) Database OR	
	c) VB Basics	
Followed by Oral Examination.		**07 marks**
	Total	**25 marks**

Reference Books :

1) Object Oriented Programming –E.Balgurusamy (TMH)
2) Programming with C++ --Hubbard (Schaum Series) Tata McGraw Hill
3) Let Us C++ ----Yashwant Kanetkar (BPB Publications)
4) Mastering VB 6 –, Petroutson (BPB)
5) Help Manuals of MS-EXCEL, ACCESS , Power-point.

S.E. (Prod. Engg.)-Part I, Sem. III

7. Workshop Practice-III

Teaching Scheme: Practical: 2 Hrs/Week/Batch

Examination Scheme: Term work: 25 Marks

Course Objective

To practice basic metal cutting processes and acquire elementary skills.

Term Work

1 Machine shop – Two jobs (Mating parts).

Job 1-
Facing, Plain turning, Step turning, External taper turning, External threading, knurling, Parting-off, — 12 Marks.

Job 2- — 8 Marks.
Facing, Plain turning, Drilling, boring, Internal threading.

2 Hand forging and grinding of dummy tools — 5 Marks.

Note:-

1. Students should prepare setup wise working drawing showing all the details in work diary.
2. Dimensional accuracy is of prime importance.
3. Student must maintain work diary showing regular progress in the semester.
4. Assessment of the term work should be carried out considering the above points.

S.E. (Prod. Engg.)-Part II, Sem. IV

1. Advanced Machine Tools & Processes

Teaching Scheme:	**Examination Scheme:**	
Lectures: 3 Hrs. / Week	Theory Paper (3 Hrs):	100 Marks
Practical: 2 Hr. / Week/Batch	Term work:	25 Marks
	Oral:	25 Marks

Course Objective

To study the various advanced Machine Tools, as well as Non-Conventional Machine Tools and manufacturing processes carried out on these machines for different applications.

Section I

1. Broaching machine – Construction and working of horizontal, vertical pull type and push type. Use of broach head and fixtures. (2 hours)

2. Boring machines – Construction and working of boring machines, work setup and tool mountings, use of boring bar, types of boring – plain, step, recessing. (3 hours)

3. Thread manufacturing processes –Thread Cutting on Lathe, Thread milling, Thread Grinding, Thread Whirling, Thread Rolling, Use of Chasers & Dies for thread manufacturing. (3 hours)

4. Gear Manufacturing – Different methods of gear manufacturing (for Spur, Helical, Bevel Gears), Casting, Rolling, Extrusion, Stamping, Powder Metallurgy of Gears, Machining of Gears (Forming, Template generating). Gear finishing by Shaving, Lapping, Grinding, Burnishing. (6 hours)

5. Super Finishing processes – Working, Scope & Importance – Lapping, Honing, Burnishing, Buffing, Polishing & allied processes. (3 hours)

6. Automats – Construction, Working & Applications of single spindle automats. (2 hours)

Section II

7. Non-Conventional Machining – Importance & scope of various non-conventional machining processes like Electro-Chemical machining (ECM), Electro-Discharge machining (EDM), Abrasive Jet Machining (AJM), Laser Beam Machining (LBM), Ultrasonic Machining (USM). (4 hours)

8. Computer Numerical Control: Principle of Operation of Numerically controlled (NC) machine tools, control of axis motion, Advantages and limitations, Computer Numerical Control (CNC)– advantages over NC machine tools, Types of controls in CNC:- Point-To-Point (PTP), Para-axial, 2 axis and 3 axis Continuous Path, Closed and Open Loop; CNC elements:- structure, spindle, Drives- DC & AC Servomotors, Stepper Motors, Linear Motors, Lead screws and ball screws, Feedback Devices, Coordinate system and Axis nomenclature
(4 hours)
9. CNC Machining Centers: Types and construction:- Vertical-Traveling Column, Gantry type, Multiple spindle; Horizontal, Use of rotary table, Types of Operations on VMC and HMC, Pallets and pallet changers, Tools for machining centers- Tool Holder (Adaptor), Retention knob, Collets, Various cutting tools and materials- HSS,

Solid carbide, indexable insert type, Cemented carbide, coated carbide, ceramics, Concept of Tool Presetting, Tool Magazines, Automatic Tool Changer (5 hours)

10. CNC Turning Centers: CNC Lathes, Types and construction, Slant bed, Vertical, Twin turret, Multiple Spindle; Tool Turret, Feed and indexing, Turn-mill centers, Live spindle tool adaptors, Types of operations on Turn-mill centers, Coordinate system for CNC lathes, Work Holding, Tools for CNC Lathes, ISO coding system for turning tools and inserts (4 hours)

11. CNC Support Systems: Automatic Chip removal, Machine control unit (MCU), MCU operation control panel, Benefits, Control program, External inputs, External outputs, Additional programming facility, Communication, Tool Management, Graphic Proving, Concept of a CNC Part Program (2 hours)

Term Work

(To be assessed on the basis of Submission of Report of the following assignments)

1. Thread manufacturing: Calculation of Gear Trains for three different pitch values-Single and Double Start
2. Industrial visit to study Broaching, Thread Cutting and Super finishing Processes
3. Industrial Visit to study Gear manufacturing Processes, (Gear cutting on Milling/ Shaping / Hobbing, Gear Grinding)
4. Industrial visit to study Construction, Operation and accessories of VMC, HMC and Turning Centres

Recommended Books

1. Workshop Technology Vol. I & II by Hajra Chaudhary, (Media Promoters & Publishers Pvt. Ltd. Mumbai)
2. Workshop Technology Vol. I , II and III by W.A.J. Chapman, (ELBS)
3. Production Technology – HMT Handbook (TMH)
4. Production Technology by Jain, Gupta, (Khanna Publishers, New Delhi)
5. Manufacturing Processes by Begeman Amstead, (Wiley.)
6. Manufacturing Processes by Rusinoff, (Tata McGraw Hill Publishing Co. Ltd.)
7. Fundamentals of Modern Manufacturing – Materials, Processes & Systems (2/e) by Grover, Mikell P. (John Wiley & Sons)
8. Advanced Manufacturing Technology by Kalpakjian (Addison Wesley)
9. Manufacturing Technology – Metal Cutting & Machine Tools by P. N. Rao (TMH)
10. Workshop Technology Vol. II by Bawa H. S. (TMH)
11. CAD / CAM- Principles & Application (2/e) by P. N. Rao (TMH)
12. Computer Numerical Control - Machining & Turning Centers by Quesada & Jayapoovan (Pearson)
13. CNC Machines – M.Adithan, B.S.Pabala (New Age International Publication)
14. Non Conventional Machining Processes – Prof. P.K.Mishra (IIT, Kharagpur)

S.E. (Prod. Engg.)-Part II, Sem. IV

2. Foundry Technology

Teaching Scheme:	**Examination Scheme:**	
Lectures: 3 Hrs/Week	Theory Paper (3 Hrs):	100 Marks
Practical: 2 Hrs/Week/Batch	Term work:	25 Marks
	Oral:	25 Marks

Course Objective

- To make the students understand the basic foundry processes and related operations used for manufacture of castings
- To introduce to the students the recent trends in foundry technology with respect to manufacture, inspection and testing

Section I

1. **Introduction**

   Importance of casting process as a manufacturing process, Advantages and disadvantages of casting process, Classification of foundries based on different criteria, Flow chart describing basic steps & major foundry activities, Layout of different types of foundries, Introduction to different ferrous and non-ferrous cast alloys and their applications (2 hours)

2. **Patterns, core boxes and dies.** Types of patterns, Material used for pattern making, Criteria for selection of pattern material, functions of patterns, core boxes and dies. Design and layout of patterns, core boxes and dies, allowances and selection of parting line. Use CAD- CAM in Designing and manufacturing of patterns. (3 hours)

3. **Gating and Risering**

   Components of gating system, functions and importance, design parameters of gating. Gating ratio, pressurized and un-pressurized gating systems. Risers, functions and modulus. Directional solidification, use importance of chills and ceramic bricks. Yield of castings. Numerical treatment to be given to design of and gating system and riser design. Use of simulation software for designing, optimization of gating, risering and improving casting yield. (4 hours)

4. **Sand preparation. Molding , core making sands and processes:**
   a) Sand mullers and mixers, continuous and intensive mixers.
   b) Green sand mixes. Ingredients of green sand and their effect on properties of green sand like – Strength, Permeability, Compatibility, Permeability, Wet-tensile, Friability, and Collapsibility.
   c) Introduction to resin sands – Alkyd resins, Phenolic resins, Furan sands
   d) Hand, machine, high pressure line, disamatic (flask less) and shell molding,
   e) Simple sand mixes for core making, Oil sand, CO_2 process, cold box processes, Shell core making. Core shooters for shell core making and cold box
   f) Core assembly, Use of core prints and chaplets, Core and mould venting

   (6 hours)

5. **Introduction to special casting techniques**

   Investment, full mold, ceramic castings and their applications.
   Squeeze casting, Centrifugal casting and Die casting – Types and applications

   (3 hours)

Section II

6. Melting practices

a) Types of melting furnaces
Cupola: working of cupola, lining material, Raw material for melting, Charge calculations (numerical treatment), Latest designs and modifications in cupola melting. Rotary furnaces, Oil fired furnaces. Electric furnaces– Induction and arc furnaces (Construction, working, applications and selection parameters for furnaces)

b) Composition, physical properties and applications of ferrous and non-ferrous castings – Grey cast iron, S. G. iron, White cast iron, malleable cast iron, Aluminum copper and magnesium based alloys.

c) Importance and methods of inoculation in cast irons and De-oxidation practices in steel castings.

d) Degassing and modification treatments in aluminum, copper and magnesium alloy castings.

e) Ladles – Types, Use, Lining materials

f) Instruments for process control of melting and measurement of molten metal

Composition tests – CE meter, Wedge test, Wet chemical analyses, and Spectrometers. Temperature tests – Pyrometers. (8 hours)

7. Fettling and cleaning of castings

Knock out, Cutting of in-gates, Risers, Shot blasting, Finishing by using pneumatic chippers and grinders, and Salvaging of castings (2 hours)

8. Defects, inspection and testing of castings

Casting defects –Analyses and remedies. Visual and dimensional inspections. Leak test. Testing of strength and hardness, Non-destructive testing of castings

(3 hours)

9. Heat treatment and painting of castings:

Purposes, methods and process of heat treatment of cast irons (grey, white, and SG Irons) and Aluminum castings. Painting of castings: Purpose types and methods of painting of castings. (3 hours)

10. Pollution and safety in foundries

Possible hazards in foundries, Safety measures, Safety devices

Types and sources of pollution in foundries, Measures for pollution control

(2 hours)

Term Work:

1. Two industrial visits one each to a ferrous and a non-ferrous foundry to study foundry practices and submission of the relevant report.
2. Drawing sheet based on Design of pattern, Pattern layout, Pattern allowances, Selection of parting line, gating and risering system design. (two turns)
3. Pattern making based on the exercise no. 2 above. (Four practical turns for pattern making job in pattern shop)
4. Study of types and different tests on raw and prepared sand.
5. Sand tests of minimum three types (Sieve analyses, Sand preparation, Strength, clay content, moisture content, testing of Mould and core hardness)
6. Study of types of molds and cores.
7. At least one simple exercise for pattern making and metal pouring for the same separately for a group of about five students.

Recommended Books

1. Principles of Metal Casting by Heine, Loper, Rosenthal
2. Foundry Engineering by Taylor, Flemings, Wulff (Wiley Eastern Ltd.)
3. Foundry Practice by N. D. Titov (MIR)
4. Principles of Foundry Technology by P. L. Jain (Tata McGraw Hill)
5. Fundamentals of Metal Casting by P. C. Mukharjee (Oxford & IBH Publishing Co).
6. A Course on Workshop Technology – Vol. 1 by B. S. Raghuvanshi; (Dhanpat Rai & Co.)
7. A Text Book on Foundry Technology by M. Lal, O. P. Khanna(Dhanpat Rai & Co.)
8. Metal Casting – Principles & Practice by T. V. Rama Rao (New Age International Pvt. Ltd.)
9. Manufacturing Technology: Foundry, Forming & Welding by P. N. Rao (TMH)

S.E. (Prod. Engg.)-Part II, Sem. IV

3. Analysis of Machine Elements

Teaching Scheme:		**Examination Scheme:**	
Lectures:	3 Hrs/Week	Theory Paper (3 Hrs):	100 Marks
Practical:	2 Hrs/Week/Batch	Term work:	25 Marks

Course Objective

To study the effect of forces and bending moments on various machine elements with stress and strain analysis.

Section- I

1. Types of loads, Stress, Strain, Stress – Strain diagrams, factor of safety, failure stress, working stress, Modulus of Elasticity, Rigidity, Bulk Volume, relations, Hook's law, Poisson's ratio. (6 hours)

2. Shear force & Bending moments, Shear force and Bending moment computation and diagrams and diagram for statically determinate beams. Application for transverse point loads, UDL, UVL, Intermediate couples on simply supported and cantilever beams. Locating the place of contraflecture and maximum bending moments. (7 hours)

3. Theory of Bending, Flexural formula for straight prismatic beams, Role of Moment of Inertia, for economic use of materials, Neural Axis, Section modulus, moment of resistance, stresses due to bending, beams of uniform strength.5 hours Shear stresses in beams due to bending loads, Distribution of shear stresses across plane sections used for common structural purposes. (4 hours)

Section-II

4 Direct and Bending stresses: Axial loading combined with bending, eccentric loading on plane sections, core of section, middle third rule, applications to the problems of crane hooks, machine columns, brackets etc. (4 hours)

5 Deflection of statically determinate beams due to bending loads, Macaulay's method. Application for simply supported and cantilever beams. (4 hours)

6 Struts subjected to axial loading, end connections, Empirical design formulae, Euler's and Rankine's methods. (2 hours)

7 Principal stresses and planes, general equations for direct stresses in mutually perpendicular directions along with shear stress, Mohr's circle, determination of maximum shear stress and their planes. (5 hours)

8 Strain energy: strain energy due to axial forces, strain energy in bending. (3 hours)

Term Work:

The term work will consists of following assignments:

1. Compression test of mild steel, brass and aluminum.
2. Tensile test on mild steel, wire rope, cast iron .
3. Shear strength test on mild steel and cast iron.

4. Izod Impact test.
5. Computation of Shear force & Bending moment**.**
6 Computation of bending stresses.
7 Computation of shear stresses
8 Problems on deflection and slope
9 Problems on principal stresses
10 Problems on Struts.

Recommended Books

1. Mechanics of Structures Vol -I by S. B. Junnarkar & H. V. Adavi, , (Charotar Publishing House, Anand)
2. Strength of Materials by S. Ramamrutham, (Dhanapat Rai and Sons, Delhi)
3. Analysis of Structures Vol.- I by Vazirani & Ratwani, (Khanna Publishers, Delhi)
4. Strength of Materials by I. B. Prasad (Khanna Publishers, Delhi)
5. Strength of Materials : Vol. – I & II by Timoshenko., (Mc Graw Hill Publication)
6. Mechanics of Structures by Popov, (Prentice – Hall of India (P) Ltd. Delhi.)
7 Strength of Materials by R.S. Khurmi (S Chand & Co.Ltd.)
8 Strength of Materials by Dr.R.K. Bansal (Laxmi Publications Pvt. Ltd.)

S.E. (Prod. Engg.)-Part II, Sem. IV

5. Welding Technology

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs/ Week	Theory Paper (3 Hours): 100 marks
Tutorial: 2 Hr/ Week/ Batch	Term Work: 25 marks

Course Objective

To familiarize with various welding processes and their applications

Section-I

1. Fundamentals and Classification of Welding Processes.

Introduction, classification of Welding processes. Comparison with other joining processes, advantages, disadvantages, practical applications. Welding Symbols. Basic & supplementary weld symbols, types of weld Joints, Selection of Weld Joint, edge preparation. (3 hours)

2. Gas Welding

Principle of operation, types of flames, Gas welding Techniques, filler material and fluxes, Gas welding equipments, advantages and applications (3 hours)

3. Arc Welding Processes And Equipments

Definition, types of processes, Carbon Arc Welding, Flux Shielded Metal Arc Welding, Submerged Arc Welding, Tungsten Inert Gas Welding, Metal Inert Gas Welding, Electroslag Welding, Electro Gas Welding, Plasma Arc Welding , Arc Welding equipments, Electrodes Types, classification and coding of electrodes.

(6 hours)

4. Resistances Welding: Definition, Fundamentals, variables advantages and application, Spot Welding, Heat Shrinkage, Heat Balance Methods, Equipment, Electrodes, Seam, Projection Butt (up sets and flash), Percussion Welding – Definition, Principle of Operation, equipment, Metal Welded, advantages and application. (4 hours)

5. Soldering and Brazing: Definition, Comparison of Soldering, Brazing and Welding, principle, joint design, filler alloy, fluxes, processes and application (3 hours)

Section-II

6. Solid State Welding Processes

Cold Welding, Diffusion Welding, Ultrasonic Welding, Explosive Welding, Friction Welding, Inertia and Forge Welding – Definition, principle of operation advantages, limitation and application. (3 hours)

7. Thermal Cutting of Metal

Oxy-Fuel, Oxygen-Lance, Metal Powder, Chemicals Flux Cutting, Arc Cutting-Metallic, Air-Carbon, Tungsten Arc, Plasma Arc Cutting (3 hours)

8. (I) Weldability:- Definition, effect of alloying elements, Purpose and types of tests, Hot Cracking, Root Cracking and Cold Cracking Tests. (2 hours)

(II) Welding Distortion:- Concept of distortion, Types of distortion, Control of welding distortion (1 hour)

(III) Weld Defects: -Common Weld defects, Causes and remedies of defects. (1 hour)

9. Inspection and Testing of Welds

Stages of weld inspection & testing, Destructive testing of weld – Tensile, Bend, Impact, Nick Break, Hardness, Etch Tests, Non Destructive Testing of Welds – Visual, Leak, X- ray and Gamma ray Radiography, Magnetic Particle Inspection, Dye, Fluorescent Penetrant Tests, Ultrasonic Inspection & Eddy Current Testing (4 hours)

10. Welding of Ferrous and Non Ferrous Alloys:- Ferrous alloys- Carbon Steels , Alloy Steels, Stainless Steels, Welding Of Cast Iron, Non Ferrous Alloys, Aluminum and its alloys, Magnesium and its alloys. (3 hours)

11.Welding of Plastics:- Principle, Common weldable plastics, Processes such as heated tool, Hot gas, High Frequency- Ultrasonic, Friction Welding with the principle of operation advantages and applications. (3 hours)

Term Work

1. One Job- Butt Joint or Lap Joint by Manual Metal Arc Welding
2. One Job- Edge or corner or T Joint by Manual Metal Arc Welding
3. One Job – by using TIG or MIG welding
4. One Job – by using Gas Welding
5. One Job- by using Gas Cutting
6. One Job by using Resistance Welding
7. One Job by using soldering Method
8. Study of selection of Welding Processes
9. Minimum one Industrial Visit to study advanced welding processes

- Submission based on above assignments and reports

Recommended Books

1. Welding Processes and Technology by Dr. R.S.Parmar (Khanna Publisher)
2. Welding Science & Technology by Md. Ibrahim Khan (New Age International)
3. Welding Engineering and Technology by Dr. R.S. Parmar (Khanna Publisher)
4. Welding Technology –O.P. Khanna (Khanna Publisher)
5. Welding & Welding Technology-by Richard Little (TMH)
6. Welding Guide and Handbook by- James E Brambaugh (Taraporwala Mumbai)
7. Welding by A.L. Davies – (Cambridge University Press.)
8. Principles of Welding Technology- by L.M.Gourd (ELBS)
9. Advanced Welding systems- Vol..I ,II and III by Jeam Cornu (Jaico Publishing)
10. Arc and Gas welding- V. Rybakav (Mir Publication)
11. Manufacturing Technology: Foundry, Forming & Welding by P. N. Rao (TMH)

S.E. (Prod. Engg.)-Part II, Sem. IV

5. Theory of Machines –I

Teaching Scheme:		**Examination Scheme:**	
Lectures:	3 Hrs/Week	Theory Paper (4 Hrs):	100 Marks
Practical:	2 Hrs/Week/Batch	Term work:	25 Marks

Course Objective

To develop the ability to understand the concepts of mechanisms and the kinematic analysis of mechanisms.

Section – I

1. Introduction:

Theory of machines – scope, definitions-machine, mechanism, link, kinematic pair, degrees of freedom, mobility criteria, classification of kinematic pairs, conversion, inversion and expansion of mechanism, study of four bar chain, single slider and double slider crank chain and is inversions. (4 hours)

2. Kinematic Analysis of Mechanisms: (Velocity Analysis)

Concept of position, displacement and velocity of a point and link of a given mechanism, Kinematic analysis of mechanisms by -- Relative velocity method, graphical method, analytical method, Instantaneous Center method, (Numerical treatment expected)
(5 hours)

3. Kinematic Analysis of Mechanisms: (Acceleration Analysis)

Concept of acceleration of a point and link of a given mechanism, Kinematic analysis of mechanisms by -- Relative velocity method, graphical method, analytical method, Coriolis Component of Acceleration , Klein's construction (Numerical treatment expected)
(5 hours)

4. Simple Mechanisms :

Condition for steering, Ackermans steering mechanism, Devis steering mechanism, Hooke's Joint, Ratchet mechanism, Geneva mechanism. (Numerical treatment expected on Hooke's Joint) (4 hours)

Section – II

5. Cams and Followers:

Types of cams and followers, Follower displacement programming, Simple Harmonic Motion, Constant Velocity, Uniform Acceleration and Retardation, Cycloidal motion,. Graphical layout of cam, cam with specified counters. (4 hours)

6. Friction:

Types of friction, laws of friction, limiting angle of friction, inclined plane theory, efficiency of inclined plane, friction between screw and nut, square thread and v threads, friction in turning pairs- slider crank chain, four bar chain, friction at pivot bearings uniform pressure and uniform wear theory, Study of friction clutches. (Numerical treatment expected)
(5 hours)

7. Belt Drives:

Types of Belts, angular velocity ratio, effect of belt thickness, effect of slip, length of belt, angle of contact, angle of lap, law of belting, crowning of pulley, limiting tension ratio, power transmission, centrifugal tension in the belt and its effect on power transmission, initial

tension and its effect on power transmission. Creep of belt
(Numerical treatment expected) (4 hours)

8. Brakes and Dynamometers.
Introduction, External Shoe Brakes, Block Brakes, Double Shoe Block Brake, Internal Shoe Brake, Band Brakes, Band and Block Brake, Heat Generated in Braking.
Dynamometers, Absorption Dynamometers & Transmission Dynamometers,
(Numerical treatment expected on Brakes) (5 hours)

Term Work:

1. At least one industrial visit to study applications related to the subject and submission of the relevant report. (Compulsory)
2. One presentation (minimum 10 minutes duration) by each student related to the subject and submission of the write up on the presentation. (Optional)

and

Minimum 6 experiments from the following list.

1. Study of machine and mechanisms.
2. Velocity analysis.
3. Acceleration analysis.
4. Study of mechanisms with lower pairs.
5. Drawing graphical layout of cam profile.
6. Study of friction clutches
7. Study of dynamometers.
8. Study of belt drives.

Recommended Books

01. Theory of Machines, by Thomas Bevan, (CBS Publishers, Delhi)
02. Theory of Machines and Mechanisms, by Shigley, (Mc Graw Hill Publications)
03. Theory of Machines and Mechanisms, by P. L. Ballaney, (Khanna Publishers, Delhi)
04. Theory of Machines, by W. Green, ,
05. Theory of Machines, by S. S. Ratan, (TMH)
06. Theory of Mechanism and Machines by Ghosh and Mallik (EWP)

6. Computer Aided Solid Modeling

Teaching Scheme :
Lectures : 2 Hrs / week
Practical : 2 Hrs / week/Batch

Examination Scheme:
Term Work : 25 Marks
Practical Exam: 50 Marks

Course Objective

To acquire basic skills in computer aided solid modeling and drafting

1. Introduction to CAD : Need for implementing CAD, Application of CAD and its benefits Hardware Requirements, Different Software packages used for 3D Modeling (3 hours)
2. Use of Solid modeling soft ware packges for –
   a] Creating 3D Models of simple machine parts. (10 hours)
   b] Preparation of Assembly by using assembly features. (Assembly of minimum 5 components) (2 hours)
   c] Generation of Exploded views and Scenes . (2 hours)
   d] Generation of 2D Drawings – (4 hours)
      1. Orthographic views of individual components required for shop floor [working drawings] which will include all types of views, all types of sectional views, dimensioning, dimensional and geometrical tolerances etc.
      2. Orthographic views of assembly drawings, generation of part list

   e] Import and Export of drawings between two different software packages. (2 hours)
   f.] Plotting of drawings (1 hour)

Term Work:

1. Creation of minimum 5 different sketches
2. Creation of at list 5 solid models using solid modeling features.
3. Creation of 2 assembly drawings of at list 5 parts of different geometry.
4. Generation of 2D drawings for shop floor [working drawings] using above solids.
5. Generation of 2D drawings of above assembly
6. Generation of exploded views of above assembly
7. calculating mass properties by applying different types of materials
8. Plotting of above drawings on A2 size sheet.

Guideline for Practical : Maximum 2 students per computer terminal.

Note: Multimedia projection facility shall be used during lecture sessions along with computer facility e.g. laptop computer.

Practical Examination: Creation of solid model and generation of 2D views from the given part drawing followed by oral examination based on above term work.
(One candidate on one computer terminal.)

Recommended Books

1. Various Software Manuals
2. CAD / CAM, Theory and Practice by Zeid, (TMH)
3. CAD / CAM, Principles & Applications by P. N. Rao (TMH)

S.E. (Prod. Engg.)-Part II, Sem. IV

7. Workshop Practice - IV

Teaching Scheme:	**Examination Scheme:**
Practical: 2 Hrs/Week/Batch	Term work: - 25 Marks
	Practical Examination- 50 Marks.

Course Objective

To practice basic metal cutting processes and enhance the skills.

Term Work

1	One composite job consisting of three to four parts employing operations on lathe in addition to profile turning and eccentric turning and operations on Milling, Drilling Demonstration of Grinding operation on Grinding Machine.	50 Marks.

Note:-

1. Students should prepare setup wise working drawing showing all the details in work diary.
2. Dimensional accuracy is of prime importance.
3. Student must maintain work diary showing regular progress in the semester.
4. Assessment of the term work should be carried out considering the above points.

Practical examination of 6 hours duration will be held and shall consist of preparation of job involving operations based on Workshop Practice-III and workshop practice-IV syllabus.

S.E. (Prod. Engg.)-Part II, Sem. IV

8. Mini Project

Teaching Scheme:
Practical: 1 Hrs/Week/Batch

Examination Scheme:
Term work: 25 Marks

Course Objective

To encourage hands-on working skills by fabricating simple working mechanisms illustrating technical principles.

Term Work:
Any one of the following two:

1. A group of maximum four students will design and fabricate one simple working mechanism involving mechanical or electromechanical components / sensors. (Mechanisms already proven may also be taken up.)
For example : Gear trains, shaft bearing assembly, mechanisms with lower and higher pairs, water level indicator, Screw jack etc.

Assessment scheme:

Fabrication of model and presentation	: **20 marks**
Report (5 – 10 pages, typed on A4 sheets)	: **5 marks**
Total	**: 25 marks**

Ref. Books –

1. Machines and Mechanisms (Mir Publications, Moscow)
2. School Projects

OR

2. A group of maximum four students will carry out disassembly of a product comprising of 5 to 10 components; prepare the drawings of the components and reassemble the components to the final product so that it is again in working condition. The report of this work should consist of part drawings and engineering aspects of each part and the assembly.

Assessment scheme:

Disassembly or assembly and understanding with presentation	: **20 marks**
Report (5 – 10 pages, typed on A4 sheets)	: **5 marks**
Total	**: 25 marks**

Shivaji University, Kolhapur

Board of Studies in Production Engg.

Equivalence of subjects after revision of syllabus from July 2008 for S.E. (Prod. Engg.)

Sr. No.	Examination	Subject in Old Syllabus	Equivalent Subject at SE (Prod.) Part I,Sem 3 (Revised)
1	S.E. (Prod. Engg.) Part I Sem. 3	Applied Mathematics	Engineering Mathematics-III
2	S.E. (Prod. Engg.) Part I Sem.3	Machine Drawing-I	Machine Drawing
3	S.E. (Prod. Engg.) Part I Sem.3	Applied Thermodynamics	Applied Thermodynamics at S.E. (Mech.) Part I Sem.3 (Revised)
4	S.E. (Prod. Engg.) Part I Sem.3	Electrical Technology & Industrial Electronics	Electrical Technology & Industrial Electronics
5	S.E. (Prod. Engg.) Part I Sem.3	Machine Tools & Processes	Machine Tools & Processes
6	S.E. (Prod. Engg.) Part I Sem.3	Computer Programming in C++	*
7	S.E. (Prod. Engg.) Part II Sem.4	Machine Drawing – II	Computer Aided Solid Modelling

Sr. No.	Examination	Subject in Old Syllabus	Equivalent Subject at SE (Prod.) Part II, Sem 4 (Revised)
8	S.E. (Prod. Engg.) Part II Sem.4	Heat Power Engineering	Thermal Engineering at SE (Prod.) Part I Sem. 3 (Revised)
9	S.E. (Prod. Engg.) Part II Sem.4	Foundry Technology	Foundry Technology
10	S.E. (Prod. Engg.) Part II Sem.4	Analysis of Machine Elements	Analysis of Machine Elements
11	S.E. (Prod. Engg.) Part II Sem.4	Welding & Plastic Technology	Welding Technology
12	S.E. (Prod. Engg.) Part II Sem.4	Theory of Machines-I	Theory of Machines-I
13	S.E. (Prod. Engg.) Part II Sem.4	Work Shop Practice-IV	Work Shop Practice-IV

***Equivalence for the subject Computer Programming in C++ at S.E. Part I, Sem.3:-**

A new subject "Basic Electronics & Computer Programming in C/C++" has been introduced at F.E. Part I has been introduced w.e.f. July 2007. As a result the theory examination of Computer Programming in C++ at S.E. Part I, Sem. 3 has been removed in the revised syllabus for all branches. Hence it is requested to provide two additional extra chances for this subject after the regular chances are over.

S.E. (Prod. Engg.)-Part I, Sem. III

ENGINEERING MATHEMATICS – III

Teaching Scheme		**Examination Scheme**	
Lectures	: 3 hours/week	Theory	: 100 marks
Tutorial	: 1 hours/week	Term work	: 25 marks

Course Objective

To study various mathematical tools available for analysis and design of engineering systems.

SECTION – I

Unit 1 Linear Differential Equations: Linear Differential Equations with constant coefficients, Homogenous Linear differential equations. [6 hours]

Unit 2 Applications of Linear Differential Equations: Applications of Linear Differential Equations with constant coefficients to Damped forced vibrations and Whirling of Shafts. [6 hours]

Unit 3 Partial differential equations: Four standard forms of partial differential equations of first order. [4 hours]

Unit 4: Applications of Partial differential equations:
Transformation of partial differential equation into Difference equation and solution of Laplace equation by using Jacobi and Gauss-Seidal method. [4 hours]

SECTION – II

Unit 1 Curve Fitting: Fitting of Curves by method of Least-squares, Coefficient of correlation, Spearman's rank correlation coefficient and lines of regression of bivariate data. [4 hours]

Unit 2 Probability: Random variable, Probability mass function and probability density function, Binomial, Poisson and Normal distributions. [5 hours]

Unit 3 Vector Calculus: Differentiation of vectors, Gradient of scalar point function, Directional derivative, Divergence of vector point function, Curl of a vector point function. [6 hours]

Unit 4 Fourier series: Definition, Euler's formulae, Dirichlet's Conditions, Functions having points of discontinuity, change of interval, expansions of odd and even periodic functions, Half range series [5 hours]

Term – Work

Minimum eight assignments based on the above syllabus covering all the topics.

General Instructions:

2. For the term work of 25 marks, tutorials shall be conducted batch-wise. The number of students per batch shall be 20 as per university norm for practical batches.

Nature of Question paper:

3. There will be two sections carrying 50 marks each.

4. There will be four questions in each section and any three questions should be answered from each section.

Reference Books:

6. A Text book of Applied Mathematics: Vol. I, II and III by J. N. Wartikar & P. N. Wartikar , (Vidyarthi Griha Prakashan, Pune.)
7. Higher Engineering Mathematics by Dr. B. S. Grewal. (Khanna Publications, New Delhi.)
8. Advanced Engineering Mathematics by Erwin Kreyszig. (John Wiley & Sons)
9. A Textbook of Engineering Mathematics by N. P. Bali, Ashok Saxena and N. Ch. S. N. Iyengar (Laxmi Publication, Delhi.)
10. Fundamental of Statistics by S. C. Gupta. (S. Chand & Co.)

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S.E. (Prod. Engg.)-Part I, Sem. III

2. Machine Drawing

Teaching Scheme:
Lectures: 2 Hrs/ Week
Practical: 4 Hrs/ Week/ Batch

Examination Scheme:
Theory Paper (4 Hours): 100 marks
Term Work: 25 marks
Oral Exam: 25 marks

Course Objective

Understanding, preparation and reading of 2D drawings of various machine parts and assemblies used in industry.

Section I

1. Study of I.S. conventions**:** Designation of drawing sheet sizes according to ISO A-series. Title block details and sizes. Screw thread terminology. Various parts of screw threads. Forms of screw threads. Conventional representation of V-threads and square threads. [internal & external].Different types of nuts and bolts, studs, set screws, cap screws, lock nuts, washers and split pins. To draw views of hexagonal and square nuts and bolts according to scale. IS conventions for- chamfer, tapped and drilled holes, slope and taper & welded joints. Conventions for showing different metals and materials on drawing. IS conventions of different types of gears like spur gears, helical gears, worm & worm wheel, bevel gears and rack & pinion. Conventions of different types of springs like helical spring, disc spring, spiral spring and leaf springs. Conventions for splined and serrated shafts. Conventions for straight & diamond Knurling, broken ends of shafts and rods. I.S. conventional representation of ball and roller bearings. Identification of bearings with reference to manufacturing catalogues.
(4 hours)

2. Dimensioning with tolerances**:** Study of Limits, Fits and Tolerances. Hole base and shaft base system for selection of fits. Selection of class and grade of hole & shaft by using hole base system and shaft base system. Selection of fits between various parts.
(3 hours)

3. Assembly and details of general units: Meaning and use of machine drawing. Purpose of making assembly and detail drawings. Classification of machine drawing- production drawings, working drawings. Practice in making assembly and detail drawings of units consisting of not more than 8 to10 parts [excluding fasteners], giving dimensions with limits fits and tolerances. (5 hours)

Section II

4. Free hand sketching: To draw free-hand proportionate sketches of the machine parts like-

4.1 All types of taper and parallel keys. Flanged coupling, protected type flanged coupling, muff coupling, solid coupling, pin type flexible coupling and universal coupling.

4.2 Flat belt pulleys, V-belt pulleys, rope pulleys and fast and loose pulleys.

4.3 Simple solid bearing, bushed bearing, pedestal bearing, foot step bearing.
(3 hours)

5. Preparation of working drawings: Preparation of working drawings of units and assemblies showing machining symbols, welding symbols, and other geometrical requirements like surface finish, flatness, straightness, parallelism, perpendicularity, concentricity, etc.
(3 hours)

6. Interpenetration of solids-Introduction, interpenetration of prism with prism, prism with cylinder, prism with cone, prism with pyramid, (prism and pyramid limited up to rectangular), cylinder with cylinder , cone with cylinder (4 hours)

7. Auxiliary projections: Types of auxiliary views. Principles of drawing auxiliary projections of simple machine parts having inclined surfaces. (2 hours)

Components mentioned above to be shown to the students before they draw it for understanding practical applications.

Term work

Each candidate has to draw following submission sheets on A-2 size drawing sheets-

9. Drawing details and assembly by taking actual measurements.
10. One sheet showing assembly from given details showing limits, fits. (Given problem of details to be attached and need not be drawn.)
11. One sheet showing details from given assembly showing tolerances. (Given problem of assembly to be attached and need not be drawn.)
12. Tracing and taking out ammonia print based on any of the above 5 sheets.
13. One sheet based on preparation of working drawings of simple machine parts, showing machining symbols, geometrical requirements, surface finish, welding symbols etc.
14. One sheet based on free hand sketching of machine parts mentioned in topic 4.
15. One sheet based on interpenetration of solids.
16. One sheet based on preparation of auxiliary views of simple machine parts, having inclined surfaces.

Oral Examination

External oral will be conducted based on term work and above syllabus.

Note: Stress should be given on reading of "Industrial Drawings" by the students; and the same should be considered during external orals.

Reference Books

1 IS: SP 46- Engineering drawing practice for schools and colleges, BIS Publication.
2. Machine Drawing by N.D.Bhatt, (Charotar Publication, Anand)
3. Machine Drawing by N. Sidheswar, Shastri, Kanaiah, (TMH.)
4. Machine Drawing by K.L.Narayanan., (New Edge International Publishers)
5. Machine Drawing by R.K.Dhavan, G.R. Nagpal, (S. Chand & Co.)
6. Machine Drawing by P.S. Gill, (S. K. Kataria, Delhi)
7. Engineering drawing by N. D. Bhatt, (Charotar Publication, Anand)
8. Graphic Science & Design by French, Vierck & Foster (McGraw Hill)

S.E. (Prod. Engg.)-Part I, Sem. III

3. Thermal Engineering

Teaching Scheme:		**Examination Scheme:**	
Lectures:	3 Hrs/Week	Theory Paper (3 Hrs):	100 Marks
Practical:	2 Hr/Week/Batch	Term Work:	25 Marks

Course Objective

Students should study the fundamentals of various thermodynamic devices; be able to analyze the performance and understand the applications of thermodynamic systems.

Section –I

1. Second law of thermodynamics:

Limitations of first law, Statements of second law, Equivalence of Kelvin-Planck and Clausius statements, Corollaries of Second law, Refrigerators and Heat pumps, Reversibility and irreversibility, Causes of irreversibilities,Carnot theorem & Phase Property diagram. (6 hours)

2. Steam Engineering Rankine cycle, steam boilers, flow of steam through nozzles, critical pressure ratio, maximum discharge, effect of friction calculation of throat and exit areas, nozzle efficiency, use of Mollier chart. Introduction to steam turbines and condensers. (9 hours)

3. Heat transfer:

Modes and laws of heat transfer, steady state heat conduction, concept of thermal resistance, Heat Exchangers- Classification and types. (5 hours)

Section –II

4. I.C. Engines.

Analysis for cycles-Otto, Diesel and Dual combustion cycles, Classification of I..C. Engines, construction and working of two stroke, four stroke, S.I. and C.I. Engines, Cooling and lubrication systems of I.C. engines. Governing of I.C.Engines, Alternative fuels, applications of I.C. Engines. (8 hours)

5. Air Compressors:

Classifications, thermodynamic analysis of single stage and multi stage reciprocating air compressors without clearance volume. Construction and working of centrifugal and axial Flow air compressors. Applications of Compressed air. (5 hours)

6. Refrigeration and Air conditioning:

Reversed Carnot cycle, Bell Coleman Cycle, Analysis of Simple Vapour Compression Cycle, introduction to Vapour absorption cycle , types and properties of refrigerants, Eco-friendly refrigerants, concepts of Psychometry, Psychometric terms and processes, Summer, Winter and Industrial Air conditioning Systems. (7 hours)

Term Work:

9. Study of constructional details of Boilers.
10. Industrial visit to Steam power Plant and submission of the relevant report.
11. Determination of Thermal conductivity of metal rod

12. Determination of Experimental heat transfer coefficient of Natural Convection.
13. Trial on I.C.Engine to determine BSFC and Thermal Efficiency.
14. Trial on Reciprocating Air compressor to determine isothermal efficiency
15. Industrial visit to study refrigeration / Air Conditioning plant and submission of the relevant report.
16. Determination of COP of Vapour Compression Refrigeration System.

Recommended Books

1. Thermal Engineering by P.L. Ballaney (Khanna Publishers)
2. Basic & applied thermodynamics by P.K.Nag (TMH)
3. Thermal Engineering by R.K.Rajput (Laxmi Publications)
4. Thermal Engineering by B.K.Sarkar (TMH)
5. Thermal Engineering by Kothanderman (New Age International Publication)
6. Basic Engineering Thermodynamics by Rayner Joel (ELBS)
7. IC engines by Mathur and Sharma (Dhanpat Rai and Co.)
7. Basic Refrigeration & Air Conditioning by Ananthnarayanan (TMH)
8. Heat Transfer By R.K.Rajput (S.Chand and Co.)

S.E. (Prod. Engg.)-Part I, Sem. III

4. Electrical Technology & Industrial Electronics

Teaching Scheme:		**Examination Scheme:**	
Lectures:	4 Hrs/Week	Theory Paper (3 Hrs):	100 Marks
Practical:	2 Hr/Week/Batch	Term Work:	25 Marks

Course Objective

To help the students to acquire skills in electrical and electronics engineering and make them compatible of operating and communicating with related engineering disciplines.

Section I

2. Three phase induction motor: Operating principle, construction, types, characteristics, applications.

Introduction to a.c. and d.c. servo motors and stepper motor, linear motor(induction and stepper). Selection of electric motors. (5 hours)

2. Starters, speed control and braking: Speed control of d.c. motors (Numerical treatment), Armature voltage control, flux control, speed control of 3 phase induction motor, frequency control, pole changing, rotor resistance control. 3 point starter and 4 point starter for d.c. motor, ster delta starter and auto transformer starter for induction motor.

Reversal of direction of rotation of electric motors.

Types of electric braking, comparison of mechanical and electrical braking. Electrical braking methods for d.c. motors and 3 phase induction motors. (7 hours)

3. Electric heating and melting : Direct and indirect resistance heating, resistance oven (Discriptive treatment) and salt bath furnace. Coreless and core type induction furnace, applications of induction heating. Direct and indirect arc furnace (Numerical treatment to energy conversions), Dielectric heating and its applications. (5 hours)

4. Power factor improvement : Methods of pf improvement (Numerical treatment) (2 hours)

5. Study of relays, contactors and switches (1 hour)

Section II

6. Silicon controlled rectifier : Structure, operation, VI characteristics, Gate triggering, Commutation, SCR as a switch

SCR applications – D.C. motor speed control using 1 phase full converter and dual converter (Numerical treatment), 1 phase voltage source inverter.

TRIAC : Structure, operation, V-I characteristics. TRIAC applications- A.C. power control (Numerical treatment) (6 hours)

7. Enhancement type MOSFET: Structure , operation, V-I characteristics, MOSFET as a switch, Elementary voltage amplifier using MOSFET(Common source configuration), concepts of voltage gain, frequency response, bandwidth. (5 hours)

8. Digital circuits: Universal gates, Building digital circuits with universal gates using K map technique(with sum of products base , 3 variables only, numerical treatment)

Flip flops : Clocked SR and clocked JK flip flops – Circuit, operation , truth table. Flip flop applications – 4 bit synchronous counter. (5 hours)

9. Sensors : Concept of measurement using sensors., Active and passive sensors, contact type and non-contact type sensors, Sensor parameters . Study of phototransistors, thermocouple, bonded resistance strain gauge, limit switch. (4 hours)

Termwork

Minimum 8 experiments- 4 based on section I and 4 based on section II.

Section I

7. Speed control of d.c. motor
8. Study of starters for d.c. motors
9. Energy calculation for resistance furnace
10. P.F. improvement
11. Reversal of rotation of d.c. motor and 3 phase induction motor
12. Industrial Visit for studying working of arc furnace or induction furnace.

Section II

6. 1 phase full converter using SCR Or 1 phase inverter using SCR
7. 1 phase a.c. power control using Triac
8. Universal gate configurations as AND, OR, NOT Or Practical exercise on building digital circuit
9. Verification of flip-flop performance
10. Obtaining sensor characteristics (phototransistor or strain gauge or thermocouple)

Recommended books

5. Electrical Technology –B.L.Theraja(S.Chand)
6. Electrical Power –S.L.Uppal (Khanna Publ)
7. Industrial Electronics –S.K.Khedkar (Technova)
8. Electrical and Electronic Measurements and Instrumentation –A.K.Sawhney (Dhanpat Rai)

S.E. (Prod. Engg.)-Part I, Sem. III

5. Machine Tools and Processes

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs. / Week	Theory Paper (3 Hrs): 100 Marks
Practical: 1 Hr. / Week/Batch	Term work: 25 Marks

Course Objective

To study the various conventional and basic Machine Tools and manufacturing processes carried out on these machines for different applications.

Section I

1. Metal cutting machines – hacksaw, circular saw, band saw, abrasive cut off machines(general working) (2 hours)

2. Study of center lathe – Construction and working, Types of lathe, Operations performed – Turning, Facing, Step turning, Grooving, Undercutting, Taper turning, Eccentric turning, Boring, Thread cutting, Gear train calculations, Use of grinding attachment, Milling attachment (8 Hours)

3. Turret and Capstan lathe – Construction, working, Types. Types of tool holders, Bar feeding mechanism. (3 hours)

4. Study of Drilling machine – Types- Bench, Radial, Pillar machines Construction and working, Operations – Drilling, Reaming, Spot facing, Counter boring, Counter sinking, Tapping, Multi-spindle and Gang drilling machines (Classification only) (5 Hours)

Section II

5. Plain surface Generation – Shaper, Planer, Slotter – construction, working and applications, Types of these machines (Classification only) (2 hours)

6. Milling Machine – construction and working of Column and Knee Milling machine, Types of milling operations – up milling, down milling, face milling, end milling, plain end milling, straddle milling, gang milling. Types of milling machines – horizontal, vertical, universal, duplex, triplex, Plano-milling (Classification only). Milling cutters – types and use. Construction and working of Dividing head, methods of indexing and applications of dividing head (9 hours)

7. Grinding machines – Grinding machines and operations - External. Internal, Centreless, Surface grinding, Grinding wheel – elements, nomenclature, types, wheel mounting, wheel dressing, wheel tracing, wheel balancing, grinding wheel balancing. (7 hours)

Term work

8. At least two industrial visits to study applications related to the subject and submission of the relevant reports.

AND

9. Center lathes (Calculation and creation of setup for a taper turning exercise. Each group of about five students should create a setup for a different exercise along with submission of schematic sketch and description.)
10. Milling machines - Setting up of indexing mechanism on Universal Dividing Head for one exercise (Each group of about five students should create a setup for a different exercise along with submission of schematic sketch and description.)

Study of construction, mechanism and applications of any two of the following

11. Grinding Machines
12. Drilling Machines
13. Shaping Machines
14. Planing Machines

Recommended Books

11. Workshop Technology Vol. I & II by Hajra Chaudhary, (Media Promoters & Publishers Pvt. Ltd. Mumbai)
12. Workshop Technology Vol. I , II and III by W.A.J. Chapman, (ELBS)
13. Manufacturing Processes & Systems by Phillip F. Ostwald & Jairo Minoz (John Willey & Sons.)
14. Production Technology – HMT Handbook (HMT)
15. Production Technology by Jain Gupta, (Khanna Publishers, New Delhi)
16. Manufacturing Processes by Begeman Amstead, (Wiley.)
17. Manufacturing Processes by Rusinoff, (Tata McGraw Hill Publishing Co. Ltd.)
18. Advanced Manufacturing Technology by Kalpakjian (Addison Wesley)
19. Manufacturing Technology – Metal Cutting & Machine Tools by P. N. Rao (TMH)
20. Workshop Technology Vol. II by Bawa H. S. (TMH)

S.E. (Prod. Engg.)-Part I, Sem. III

6. Advanced Programming Laboratory

Teaching Scheme:	**Examination Scheme:**
Lecture: 1 Hr.	Term work: 50 Marks
Practical: 4 Hrs. / Week/Batch	Practical: 25 Marks

Course Objective

To develop programming skills using object oriented programming features, and other basic skills of office automation and database management.

2. Minimum 10 Programs on following topics in C++ and Visual Basic

A) C++ Language

i. **Arrays :** One dimensional and multi dimensional arrays.
ii. **Functions :** Types of functions, Recursive function, Function & Arrays, Function with default argument
iii. **Pointers :** Declaration, pointer arithmetic, Pointers & functions, Pointers to a function, Pointer & arrays.
iv. **Inheritance :** Forms of Inheritance, Direct & Indirect base class, Types of derivations (public, private, protected)
v. **Polymorphism :** Function Overloading, Operator Overloading
vi. Virtual Function and Pure virtual function
vii. **File Handling :** Opening file, writing data, reading data, closing file, file copy, file opening modes.

B) Visual Basic basics:
VB Environment, Menu Bar, Toolbars, Toolbox, Project Explorer, Property Window, Form designer, Form Layout

2. Minimum one Program on following topic.

Graphics in C++ : Shapes (circle, rectangle etc), Colors

3. Minimum 3 Exercises on following topics.

Excel Worksheet:
Use of formulas, functions, graphs (2-D, 3-D)
Types of charts, using filters.

4. Preparing at least one Presentation on a topic related to Manufacturing Engg.
(Minimum. 10 slides using **MS- Power-point or equivalent**, A separate presentation by each student.)

5. Minimum two Exercises on Database Management (Using MS-Access or equivalent)

i) Basics:
Concept of database, DBMS
Terminologies used: Table, Field, Record, Query, Form, Report
ii)Table :
Creating structure of table, adding various fields, decide field types and field properties, Concept of primary key;

Modification of Table Structure: adding/deleting fields, changing field name, data types and properties
Adding data to table.
Sorting the table in data sheet view.
Finding records.
Filtering records : Filter by selection
Printing table.

iii)Queries:

Creating queries in design view, adding table, selecting fields, running the query, specifying a sort order, Specifying criteria, adding calculated fields.

iv)**Introduction to forms**

Practical Examination: (One candidate on one PC terminal)

Duration : 3 Hrs.

3) At least one program in C++ to be compiled and executed **10 marks**

4) At least one simple exercise from the following **08 marks**

a) EXCEL OR
b) Database OR
c) VB Basics

Followed by Oral Examination. **07 marks**

Total **25 marks**

Reference Books :

6) Object Oriented Programming –E.Balgurusamy (TMH)
7) Programming with C++ --Hubbard (Schaum Series) Tata McGraw Hill
8) Let Us C++ ----Yashwant Kanetkar (BPB Publications)
9) Mastering VB 6 –, Petroutson (BPB)
10) Help Manuals of MS-EXCEL, ACCESS , Power-point.

S.E. (Prod. Engg.)-Part I, Sem. III

7. Workshop Practice-III

Teaching Scheme: Practical: 2 Hrs/Week/Batch

Examination Scheme: Term work: 25 Marks

Course Objective

To practice basic metal cutting processes and acquire elementary skills.

Term Work

1 Machine shop – Two jobs (Mating parts).

Job 1-
Facing, Plain turning, Step turning, External taper turning, External threading, knurling, Parting-off, — 12 Marks.

Job 2- — 8 Marks.
Facing, Plain turning, Drilling, boring, Internal threading.

2 Hand forging and grinding of dummy tools — 5 Marks.

Note:-

1. Students should prepare setup wise working drawing showing all the details in work diary.
2. Dimensional accuracy is of prime importance.
3. Student must maintain work diary showing regular progress in the semester.
4. Assessment of the term work should be carried out considering the above points.

S.E. (Prod. Engg.)-Part II, Sem. IV

1. Advanced Machine Tools & Processes

Teaching Scheme:	**Examination Scheme:**	
Lectures: 3 Hrs. / Week	Theory Paper (3 Hrs):	100 Marks
Practical: 2 Hr. / Week/Batch	Term work:	25 Marks
	Oral:	25 Marks

Course Objective

To study the various advanced Machine Tools, as well as Non-Conventional Machine Tools and manufacturing processes carried out on these machines for different applications.

Section I

1. Broaching machine – Construction and working of horizontal, vertical pull type and push type. Use of broach head and fixtures. (2 hours)

2. Boring machines – Construction and working of boring machines, work setup and tool mountings, use of boring bar, types of boring – plain, step, recessing. (3 hours)

3. Thread manufacturing processes –Thread Cutting on Lathe, Thread milling, Thread Grinding, Thread Whirling, Thread Rolling, Use of Chasers & Dies for thread manufacturing. (3 hours)

4. Gear Manufacturing – Different methods of gear manufacturing (for Spur, Helical, Bevel Gears), Casting, Rolling, Extrusion, Stamping, Powder Metallurgy of Gears, Machining of Gears (Forming, Template generating). Gear finishing by Shaving, Lapping, Grinding, Burnishing. (6 hours)

5. Super Finishing processes – Working, Scope & Importance – Lapping, Honing, Burnishing, Buffing, Polishing & allied processes. (3 hours)

6. Automats – Construction, Working & Applications of single spindle automats. (2 hours)

Section II

7. Non-Conventional Machining – Importance & scope of various non-conventional machining processes like Electro-Chemical machining (ECM), Electro-Discharge machining (EDM), Abrasive Jet Machining (AJM), Laser Beam Machining (LBM), Ultrasonic Machining (USM). (4 hours)

8. Computer Numerical Control: Principle of Operation of Numerically controlled (NC) machine tools, control of axis motion, Advantages and limitations, Computer Numerical Control (CNC)– advantages over NC machine tools, Types of controls in CNC:- Point-To-Point (PTP), Para-axial, 2 axis and 3 axis Continuous Path, Closed and Open Loop; CNC elements:- structure, spindle, Drives- DC & AC Servomotors, Stepper Motors, Linear Motors, Lead screws and ball screws, Feedback Devices, Coordinate system and Axis nomenclature (4 hours)
9. CNC Machining Centers: Types and construction:- Vertical-Traveling Column, Gantry type, Multiple spindle; Horizontal, Use of rotary table, Types of Operations on VMC and HMC, Pallets and pallet changers, Tools for machining centers- Tool Holder (Adaptor), Retention knob, Collets, Various cutting tools and materials- HSS, Solid carbide, indexable insert type, Cemented carbide, coated carbide, ceramics,

Concept of Tool Presetting, Tool Magazines, Automatic Tool Changer (5 hours)

10. CNC Turning Centers: CNC Lathes, Types and construction, Slant bed, Vertical, Twin turret, Multiple Spindle; Tool Turret, Feed and indexing, Turn-mill centers, Live spindle tool adaptors, Types of operations on Turn-mill centers, Coordinate system for CNC lathes, Work Holding, Tools for CNC Lathes, ISO coding system for turning tools and inserts (4 hours)

11. CNC Support Systems: Automatic Chip removal, Machine control unit (MCU), MCU operation control panel, Benefits, Control program, External inputs, External outputs, Additional programming facility, Communication, Tool Management, Graphic Proving, Concept of a CNC Part Program (2 hours)

Term Work

(To be assessed on the basis of Submission of Report of the following assignments)

1. Thread manufacturing: Calculation of Gear Trains for three different pitch values-Single and Double Start
2. Industrial visit to study Broaching, Thread Cutting and Super finishing Processes
3. Industrial Visit to study Gear manufacturing Processes, (Gear cutting on Milling/ Shaping / Hobbing, Gear Grinding)
4. Industrial visit to study Construction, Operation and accessories of VMC, HMC and Turning Centres

Recommended Books

1. Workshop Technology Vol. I & II by Hajra Chaudhary, (Media Promoters & Publishers Pvt. Ltd. Mumbai)
2. Workshop Technology Vol. I , II and III by W.A.J. Chapman, (ELBS)
3. Production Technology – HMT Handbook (TMH)
4. Production Technology by Jain, Gupta, (Khanna Publishers, New Delhi)
5. Manufacturing Processes by Begeman Amstead, (Wiley.)
6. Manufacturing Processes by Rusinoff, (Tata McGraw Hill Publishing Co. Ltd.)
7. Fundamentals of Modern Manufacturing – Materials, Processes & Systems (2/e) by Grover, Mikell P. (John Wiley & Sons)
8. Advanced Manufacturing Technology by Kalpakjian (Addison Wesley)
9. Manufacturing Technology – Metal Cutting & Machine Tools by P. N. Rao (TMH)
10. Workshop Technology Vol. II by Bawa H. S. (TMH)
11. CAD / CAM- Principles & Application (2/e) by P. N. Rao (TMH)
12. Computer Numerical Control - Machining & Turning Centers by Quesada & Jayapoovan (Pearson)
13. CNC Machines – M.Adithan, B.S.Pabala (New Age International Publication)
14. Non Conventional Machining Processes – Prof. P.K.Mishra (IIT, Kharagpur)

S.E. (Prod. Engg.)-Part II, Sem. IV

2. Foundry Technology

Teaching Scheme:	**Examination Scheme:**	
Lectures: 3 Hrs/Week	Theory Paper (3 Hrs):	100 Marks
Practical: 2 Hrs/Week/Batch	Term work:	25 Marks
	Oral:	25 Marks

Course Objective

- To make the students understand the basic foundry processes and related operations used for manufacture of castings
- To introduce to the students the recent trends in foundry technology with respect to manufacture, inspection and testing

Section I

1. Introduction

Importance of casting process as a manufacturing process, Advantages and disadvantages of casting process, Classification of foundries based on different criteria, Flow chart describing basic steps & major foundry activities, Layout of different types of foundries, Introduction to different ferrous and non-ferrous cast alloys and their applications (2 hours)

2. Patterns, core boxes and dies. Types of patterns, Material used for pattern making, Criteria for selection of pattern material, functions of patterns, core boxes and dies. Design and layout of patterns, core boxes and dies, allowances and selection of parting line. Use CAD- CAM in Designing and manufacturing of patterns. (3 hours)

3. Gating and Risering

Components of gating system, functions and importance, design parameters of gating. Gating ratio, pressurized and un-pressurized gating systems. Risers, functions and modulus. Directional solidification, use importance of chills and ceramic bricks. Yield of castings. Numerical treatment to be given to design of and gating system and riser design. Use of simulation software for designing, optimization of gating, risering and improving casting yield. (4 hours)

4. Sand preparation. Molding , core making sands and processes:

g) Sand mullers and mixers, continuous and intensive mixers.
h) Green sand mixes. Ingredients of green sand and their effect on properties of green sand like – Strength, Permeability, Compatibility, Permeability, Wet-tensile, Friability, and Collapsibility.
i) Introduction to resin sands – Alkyd resins, Phenolic resins, Furan sands
j) Hand, machine, high pressure line, disamatic (flask less) and shell molding,
k) Simple sand mixes for core making, Oil sand, CO_2 process, cold box processes, Shell core making. Core shooters for shell core making and cold box
l) Core assembly, Use of core prints and chaplets, Core and mould venting

(6 hours)

5. Introduction to special casting techniques

Investment, full mold, ceramic castings and their applications.
Squeeze casting, Centrifugal casting and Die casting – Types and applications

(3 hours)

Section II

6. Melting practices

g) Types of melting furnaces
Cupola: working of cupola, lining material, Raw material for melting, Charge calculations (numerical treatment), Latest designs and modifications in cupola melting. Rotary furnaces, Oil fired furnaces. Electric furnaces– Induction and arc furnaces (Construction, working, applications and selection parameters for furnaces)

h) Composition, physical properties and applications of ferrous and non-ferrous castings – Grey cast iron, S. G. iron, White cast iron, malleable cast iron, Aluminum copper and magnesium based alloys.

i) Importance and methods of inoculation in cast irons and De-oxidation practices in steel castings.

j) Degassing and modification treatments in aluminum, copper and magnesium alloy castings.

k) Ladles – Types, Use, Lining materials

l) Instruments for process control of melting and measurement of molten metal

Composition tests – CE meter, Wedge test, Wet chemical analyses, and Spectrometers. Temperature tests – Pyrometers. (8 hours)

7. Fettling and cleaning of castings

Knock out, Cutting of in-gates, Risers, Shot blasting, Finishing by using pneumatic chippers and grinders, and Salvaging of castings (2 hours)

8. Defects, inspection and testing of castings

Casting defects –Analyses and remedies. Visual and dimensional inspections. Leak test. Testing of strength and hardness, Non-destructive testing of castings

(3 hours)

9. Heat treatment and painting of castings:

Purposes, methods and process of heat treatment of cast irons (grey, white, and SG Irons) and Aluminum castings. Painting of castings: Purpose types and methods of painting of castings. (3 hours)

10. Pollution and safety in foundries

Possible hazards in foundries, Safety measures, Safety devices

Types and sources of pollution in foundries, Measures for pollution control

(2 hours)

Term Work:

1. Two industrial visits one each to a ferrous and a non-ferrous foundry to study foundry practices and submission of the relevant report.
2. Drawing sheet based on Design of pattern, Pattern layout, Pattern allowances, Selection of parting line, gating and risering system design. (two turns)
3. Pattern making based on the exercise no. 2 above. (Four practical turns for pattern making job in pattern shop)
4. Study of types and different tests on raw and prepared sand.
5. Sand tests of minimum three types (Sieve analyses, Sand preparation, Strength, clay content, moisture content, testing of Mould and core hardness)
6. Study of types of molds and cores.
7. At least one simple exercise for pattern making and metal pouring for the same separately for a group of about five students.

Recommended Books

10. Principles of Metal Casting by Heine, Loper, Rosenthal
11. Foundry Engineering by Taylor, Flemings, Wulff (Wiley Eastern Ltd.)
12. Foundry Practice by N. D. Titov (MIR)
13. Principles of Foundry Technology by P. L. Jain (Tata McGraw Hill)
14. Fundamentals of Metal Casting by P. C. Mukharjee (Oxford & IBH Publishing Co).
15. A Course on Workshop Technology – Vol. 1 by B. S. Raghuvanshi; (Dhanpat Rai & Co.)
16. A Text Book on Foundry Technology by M. Lal, O. P. Khanna(Dhanpat Rai & Co.)
17. Metal Casting – Principles & Practice by T. V. Rama Rao (New Age International Pvt. Ltd.)
18. Manufacturing Technology: Foundry, Forming & Welding by P. N. Rao (TMH)

S.E. (Prod. Engg.)-Part II, Sem. IV

3. Analysis of Machine Elements

Teaching Scheme:		**Examination Scheme:**	
Lectures:	3 Hrs/Week	Theory Paper (3 Hrs):	100 Marks
Practical:	2 Hrs/Week/Batch	Term work:	25 Marks

Course Objective

To study the effect of forces and bending moments on various machine elements with stress and strain analysis.

Section- I

1. Types of loads, Stress, Strain, Stress – Strain diagrams, factor of safety, failure stress, working stress, Modulus of Elasticity, Rigidity, Bulk Volume, relations, Hook's law, Poisson's ratio. (6 hours)

2. Shear force & Bending moments, Shear force and Bending moment computation and diagrams and diagram for statically determinate beams. Application for transverse point loads, UDL, UVL, Intermediate couples on simply supported and cantilever beams. Locating the place of contraflecture and maximum bending moments. (7 hours)

3. Theory of Bending, Flexural formula for straight prismatic beams, Role of Moment of Inertia, for economic use of materials, Neural Axis, Section modulus, moment of resistance, stresses due to bending, beams of uniform strength.5 hours Shear stresses in beams due to bending loads, Distribution of shear stresses across plane sections used for common structural purposes. (4 hours)

Section-II

4 Direct and Bending stresses: Axial loading combined with bending, eccentric loading on plane sections, core of section, middle third rule, applications to the problems of crane hooks, machine columns, brackets etc. (4 hours)

5 Deflection of statically determinate beams due to bending loads, Macaulay's method. Application for simply supported and cantilever beams. (4 hours)

6 Struts subjected to axial loading, end connections, Empirical design formulae, Euler's and Rankine's methods. (2 hours)

7 Principal stresses and planes, general equations for direct stresses in mutually perpendicular directions along with shear stress, Mohr's circle, determination of maximum shear stress and their planes. (5 hours)

8 Strain energy: strain energy due to axial forces, strain energy in bending. (3 hours)

Term Work:

The term work will consists of following assignments:

1. Compression test of mild steel, brass and aluminum.
2. Tensile test on mild steel, wire rope, cast iron .
3. Shear strength test on mild steel and cast iron.

4. Izod Impact test.
5. Computation of Shear force & Bending moment**.**
6 Computation of bending stresses.
7 Computation of shear stresses
8 Problems on deflection and slope
9 Problems on principal stresses
10 Problems on Struts.

Recommended Books

1. Mechanics of Structures Vol -I by S. B. Junnarkar & H. V. Adavi, , (Charotar Publishing House, Anand)
2. Strength of Materials by S. Ramamrutham, (Dhanapat Rai and Sons, Delhi)
3. Analysis of Structures Vol.- I by Vazirani & Ratwani, (Khanna Publishers, Delhi)
4. Strength of Materials by I. B. Prasad (Khanna Publishers, Delhi)
5. Strength of Materials : Vol. – I & II by Timoshenko., (Mc Graw Hill Publication)
6. Mechanics of Structures by Popov, (Prentice – Hall of India (P) Ltd. Delhi.)
9 Strength of Materials by R.S. Khurmi (S Chand & Co.Ltd.)
10 Strength of Materials by Dr.R.K. Bansal (Laxmi Publications Pvt. Ltd.)

S.E. (Prod. Engg.)-Part II, Sem. IV

5. Welding Technology

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs/ Week	Theory Paper (3 Hours): 100 marks
Tutorial: 2 Hr/ Week/ Batch	Term Work: 25 marks

Course Objective

To familiarize with various welding processes and their applications

Section-I

1. Fundamentals and Classification of Welding Processes.

Introduction, classification of Welding processes. Comparison with other joining processes, advantages, disadvantages, practical applications. Welding Symbols. Basic & supplementary weld symbols, types of weld Joints, Selection of Weld Joint, edge preparation. (3 hours)

2. Gas Welding

Principle of operation, types of flames, Gas welding Techniques, filler material and fluxes, Gas welding equipments, advantages and applications (3 hours)

3. Arc Welding Processes And Equipments

Definition, types of processes, Carbon Arc Welding, Flux Shielded Metal Arc Welding, Submerged Arc Welding, Tungsten Inert Gas Welding, Metal Inert Gas Welding, Electroslag Welding, Electro Gas Welding, Plasma Arc Welding , Arc Welding equipments, Electrodes Types, classification and coding of electrodes.

(6 hours)

4. Resistances Welding: Definition, Fundamentals, variables advantages and application, Spot Welding, Heat Shrinkage, Heat Balance Methods, Equipment, Electrodes, Seam, Projection Butt (up sets and flash), Percussion Welding – Definition, Principle of Operation, equipment, Metal Welded, advantages and application. (4 hours)

6. Soldering and Brazing: Definition, Comparison of Soldering, Brazing and Welding, principle, joint design, filler alloy, fluxes, processes and application (3 hours)

Section-II

6. Solid State Welding Processes

Cold Welding, Diffusion Welding, Ultrasonic Welding, Explosive Welding, Friction Welding, Inertia and Forge Welding – Definition, principle of operation advantages, limitation and application. (3 hours)

7. Thermal Cutting of Metal

Oxy-Fuel, Oxygen-Lance, Metal Powder, Chemicals Flux Cutting, Arc Cutting-Metallic, Air-Carbon, Tungsten Arc, Plasma Arc Cutting (3 hours)

8. (I) Weldability:- Definition, effect of alloying elements, Purpose and types of tests, Hot Cracking, Root Cracking and Cold Cracking Tests. (2 hours)

(II) Welding Distortion:- Concept of distortion, Types of distortion, Control of welding distortion (1 hour)

(III) Weld Defects: -Common Weld defects, Causes and remedies of defects.

(1 hour)

9. Inspection and Testing of Welds

Stages of weld inspection & testing, Destructive testing of weld – Tensile, Bend, Impact, Nick Break, Hardness, Etch Tests, Non Destructive Testing of Welds – Visual, Leak, X- ray and Gamma ray Radiography, Magnetic Particle Inspection, Dye, Fluorescent Penetrant Tests, Ultrasonic Inspection & Eddy Current Testing (4 hours)

10. Welding of Ferrous and Non Ferrous Alloys:- Ferrous alloys- Carbon Steels , Alloy Steels, Stainless Steels, Welding Of Cast Iron, Non Ferrous Alloys, Aluminum and its alloys, Magnesium and its alloys. (3 hours)

11.Welding of Plastics:- Principle, Common weldable plastics, Processes such as heated tool, Hot gas, High Frequency- Ultrasonic, Friction Welding with the principle of operation advantages and applications. (3 hours)

Term Work

1. One Job- Butt Joint or Lap Joint by Manual Metal Arc Welding
2. One Job- Edge or corner or T Joint by Manual Metal Arc Welding
3. One Job – by using TIG or MIG welding
4. One Job – by using Gas Welding
5. One Job- by using Gas Cutting
6. One Job by using Resistance Welding
7. One Job by using soldering Method
8. Study of selection of Welding Processes
9. Minimum one Industrial Visit to study advanced welding processes

- Submission based on above assignments and reports

Recommended Books

1. Welding Processes and Technology by Dr. R.S.Parmar (Khanna Publisher)
2. Welding Science & Technology by Md. Ibrahim Khan (New Age International)
3. Welding Engineering and Technology by Dr. R.S. Parmar (Khanna Publisher)
4. Welding Technology –O.P. Khanna (Khanna Publisher)
5. Welding & Welding Technology-by Richard Little (TMH)
6. Welding Guide and Handbook by- James E Brambaugh (Taraporwala Mumbai)
7. Welding by A.L. Davies – (Cambridge University Press.)
8. Principles of Welding Technology- by L.M.Gourd (ELBS)
9. Advanced Welding systems- Vol..I ,II and III by Jeam Cornu (Jaico Publishing)
10. Arc and Gas welding- V. Rybakav (Mir Publication)
11. Manufacturing Technology: Foundry, Forming & Welding by P. N. Rao (TMH)

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5. Theory of Machines –I

Teaching Scheme:		**Examination Scheme:**	
Lectures:	3 Hrs/Week	Theory Paper (4 Hrs):	100 Marks
Practical:	2 Hrs/Week/Batch	Term work:	25 Marks

Course Objective

To develop the ability to understand the concepts of mechanisms and the kinematic analysis of mechanisms.

Section – I

1. Introduction:

Theory of machines – scope, definitions-machine, mechanism, link, kinematic pair, degrees of freedom, mobility criteria, classification of kinematic pairs, conversion, inversion and expansion of mechanism, study of four bar chain, single slider and double slider crank chain and is inversions. (4 hours)

2. Kinematic Analysis of Mechanisms: (Velocity Analysis)

Concept of position, displacement and velocity of a point and link of a given mechanism, Kinematic analysis of mechanisms by -- Relative velocity method, graphical method, analytical method, Instantaneous Center method, (Numerical treatment expected)
(5 hours)

3. Kinematic Analysis of Mechanisms: (Acceleration Analysis)

Concept of acceleration of a point and link of a given mechanism, Kinematic analysis of mechanisms by -- Relative velocity method, graphical method, analytical method, Coriolis Component of Acceleration , Klein's construction (Numerical treatment expected)
(5 hours)

4. Simple Mechanisms :

Condition for steering, Ackermans steering mechanism, Devis steering mechanism, Hooke's Joint, Ratchet mechanism, Geneva mechanism. (Numerical treatment expected on Hooke's Joint) (4 hours)

Section – II

5. Cams and Followers:

Types of cams and followers, Follower displacement programming, Simple Harmonic Motion, Constant Velocity, Uniform Acceleration and Retardation, Cycloidal motion,. Graphical layout of cam, cam with specified counters. (4 hours)

6. Friction:

Types of friction, laws of friction, limiting angle of friction, inclined plane theory, efficiency of inclined plane, friction between screw and nut, square thread and v threads, friction in turning pairs- slider crank chain, four bar chain, friction at pivot bearings uniform pressure and uniform wear theory, Study of friction clutches. (Numerical treatment expected)
(5 hours)

7. Belt Drives:

Types of Belts, angular velocity ratio, effect of belt thickness, effect of slip, length of belt, angle of contact, angle of lap, law of belting, crowning of pulley, limiting tension ratio, power transmission, centrifugal tension in the belt and its effect on power transmission, initial

tension and its effect on power transmission. Creep of belt
(Numerical treatment expected) (4 hours)

8. Brakes and Dynamometers.
Introduction, External Shoe Brakes, Block Brakes, Double Shoe Block Brake, Internal Shoe Brake, Band Brakes, Band and Block Brake, Heat Generated in Braking.
Dynamometers, Absorption Dynamometers & Transmission Dynamometers,
(Numerical treatment expected on Brakes) (5 hours)

Term Work:

1. At least one industrial visit to study applications related to the subject and submission of the relevant report. (Compulsory)
2. One presentation (minimum 10 minutes duration) by each student related to the subject and submission of the write up on the presentation. (Optional)

and

Minimum 6 experiments from the following list.

1. Study of machine and mechanisms.
2. Velocity analysis.
3. Acceleration analysis.
4. Study of mechanisms with lower pairs.
5. Drawing graphical layout of cam profile.
6. Study of friction clutches
7. Study of dynamometers.
8. Study of belt drives.

Recommended Books

01. Theory of Machines, by Thomas Bevan, (CBS Publishers, Delhi)
02. Theory of Machines and Mechanisms, by Shigley, (Mc Graw Hill Publications)
03. Theory of Machines and Mechanisms, by P. L. Ballaney, (Khanna Publishers, Delhi)
04. Theory of Machines, by W. Green, ,
05. Theory of Machines, by S. S. Ratan, (TMH)
06. Theory of Mechanism and Machines by Ghosh and Mallik (EWP)

6. Computer Aided Solid Modeling

Teaching Scheme :	**Examination Scheme:**	
Lectures : 2 Hrs / week	Term Work :	25 Marks
Practical : 2 Hrs / week/Batch	Practical Exam:	50 Marks

Course Objective

To acquire basic skills in computer aided solid modeling and drafting

1. Introduction to CAD : Need for implementing CAD, Application of CAD and its benefits Hardware Requirements, Different Software packages used for 3D Modeling (3 hours)
2. Use of Solid modeling soft ware packges for –
   a] Creating 3D Models of simple machine parts. (10 hours)
   b] Preparation of Assembly by using assembly features. (Assembly of

minimum 5 components) (2 hours)

c] Generation of Exploded views and Scenes . (2 hours)

d] Generation of 2D Drawings – (4 hours)

3. Orthographic views of individual components required for shop floor [working drawings] which will include all types of views, all types of sectional views, dimensioning, dimensional and geometrical tolerances etc.
4. Orthographic views of assembly drawings, generation of part list

e] Import and Export of drawings between two different software packages. (2 hours)

f.] Plotting of drawings (1 hour)

Term Work:

1. Creation of minimum 5 different sketches
2. Creation of at list 5 solid models using solid modeling features.
3. Creation of 2 assembly drawings of at list 5 parts of different geometry.
4. Generation of 2D drawings for shop floor [working drawings] using above solids.
5. Generation of 2D drawings of above assembly
6. Generation of exploded views of above assembly
7. calculating mass properties by applying different types of materials
8. Plotting of above drawings on A2 size sheet.

Guideline for Practical : Maximum 2 students per computer terminal.

Note: Multimedia projection facility shall be used during lecture sessions along with computer facility e.g. laptop computer.

Practical Examination: Creation of solid model and generation of 2D views from the given part drawing followed by oral examination based on above term work.

(One candidate on one computer terminal.)

Recommended Books

1. Various Software Manuals
2. CAD / CAM, Theory and Practice by Zeid, (TMH)
3. CAD / CAM, Principles & Applications by P. N. Rao (TMH)

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7. Workshop Practice - IV

Teaching Scheme:
Practical: 2 Hrs/Week/Batch

Examination Scheme:
Term work: - 25 Marks
Practical Examination- 50 Marks.

Course Objective

To practice basic metal cutting processes and enhance the skills.

Term Work

1	One composite job consisting of three to four parts employing operations on lathe in addition to profile turning and eccentric turning and operations on Milling, Drilling Demonstration of Grinding operation on Grinding Machine.	50 Marks.

Note:-

1. Students should prepare setup wise working drawing showing all the details in work diary.
2. Dimensional accuracy is of prime importance.
3. Student must maintain work diary showing regular progress in the semester.
4. Assessment of the term work should be carried out considering the above points.

Practical examination of 6 hours duration will be held and shall consist of preparation of job involving operations based on Workshop Practice-III and workshop practice-IV syllabus.

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8. Mini Project

Teaching Scheme:
Practical: 1 Hrs/Week/Batch

Examination Scheme:
Term work: 25 Marks

Course Objective

To encourage hands-on working skills by fabricating simple working mechanisms illustrating technical principles.

Term Work:
Any one of the following two:

1. A group of maximum four students will design and fabricate one simple working mechanism involving mechanical or electromechanical components / sensors. (Mechanisms already proven may also be taken up.)
For example : Gear trains, shaft bearing assembly, mechanisms with lower and higher pairs, water level indicator, Screw jack etc.

Assessment scheme:

Fabrication of model and presentation	: **20 marks**
Report (5 – 10 pages, typed on A4 sheets)	: **5 marks**
Total	**: 25 marks**

Ref. Books –

3. Machines and Mechanisms (Mir Publications, Moscow)
4. School Projects

OR

2. A group of maximum four students will carry out disassembly of a product comprising of 5 to 10 components; prepare the drawings of the components and reassemble the components to the final product so that it is again in working condition. The report of this work should consist of part drawings and engineering aspects of each part and the assembly.

Assessment scheme:

Disassembly or assembly and understanding with presentation	: **20 marks**
Report (5 – 10 pages, typed on A4 sheets)	: **5 marks**
Total	**: 25 marks**
