FACULTY OF ENGINEERING & TECHNOLOGY

SYLLABUS

FOR

B. TECH.
(MECHANICAL ENGINEERING)

(Under Credit Based Continuous Evaluation Grading System)
(SEMESTER: I – VIII)
Session: 2017–18

GURU NANAK DEV UNIVERSITY
AMRITSAR

B.Tech. (Mechanical Engineering) 1st Semester
(Under Credit Based Continuous Evaluation Grading System)

SEMESTER – I

Sr. No.	Course Code	Course Title	L	T	P	Credits
1.	CYL196	Engineering Chemistry	2	1	1	4
2.	MTL101	Mathematics-I	3	1	0	4
3.	ECL115	Electrical Engineering	3	1	0	4
4.	PHL182	Material Science	3	1	0	4
5.	ENL101	Communicative English	2	0	0	2
6.		Elective-I	2	0	0	2
7.	MEP101	Workshop Practices	0	0	2	2

List of Electives–I

1.	PBL121	Punjabi (Compulsory) **OR**	2	0	0	2
2.	PBL122	ਮੁੱਢਲੀ ਪੰਜਾਬੀ (In lieu of Punjabi Compulsory)	2	0	0	2
3. *	SOA 101	Drug Abuse: Problem, Management and Prevention (Compulsory)	3	0	0	
		TOTAL CREDITS:	**15**	**4**	**3**	**22**

*** Credits will not be included in SGPA**

B.Tech. (Mechanical Engineering) 2nd Semester
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SEMESTER – II

Sr.No.	Course Code	Course Title	L	T	P	Credits
1.	PHL183	Physics	3	1	1	5
2.	ARL196	Engineering Graphics & Drafting	3	1	0	4
3.	MTL102	Mathematics–II	3	1	0	4
4.	CSL125	Fundamentals of IT & Computer Programming	2	1	1	4
5.	CEL 120	Engineering Mechanics	3	1	0	4
6.		Elective–II	2	0	0	2

List of Electives–II

1.	PBL131	Punjabi (Compulsory) **OR**	2	0	0	2
2.	PBL132	ਮੁੱਢਲੀ ਪੰਜਾਬੀ (In lieu of Punjabi Compulsory)	2	0	0	2
3. *	SOA 102	Drug Abuse: Problem, Management and Prevention (Compulsory)	3	0	0	
		TOTAL CREDITS:	**16**	**5**	**2**	**23**

*** Credits will not be included in SGPA**

B.Tech. (Mechanical Engineering) 3rd Semester
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S. No.	University Course Code	Subject Group	Course Title	L	T	P	Contact hrs/wk	Credits
1.	MTL201	BS	Mathematics-III	3	1	0	4	4
2.	MEL 211	ES	Solid Mechanics	3	1	0	4	4
3.	MEL 212	ME	Primary Manufacturing	4	0	0	4	4
4.	MEL 213	ES	Thermodynamics	2	1	0	3	3
5.	MEL 214	ES	Engineering Materials	3	0	0	3	3
6.	MEL 215	ES	Machine Drawing	2	0	2	4	3
7.	ESL 220	MC-5	*****Environmental Studies	3*****	0	0	3	3
Practicals								
	ENP 291	HS	Written and Oral Technical Communication skills	0	0	2	2	1
	MEP 211	ES	Solid Mechanics	0	0	2	2	1
	MEP 212	ME	Primary Manufacturing	0	0	2	2	1
	MEP 214	ES	Engineering Materials	0	0	2	2	1
	MEP 215	ES	Basic Simulation Lab	0	0	2	2	1
	MEP 216	ME	Summer Training******	-	-	-	-	**S/US**
			TOTAL	**17**	**3**	**12**	**32**	**26**

*** Credits of ESL-220 will not be included in SGPA.**

****The student should undergo summer training at the end of 2nd Semester. The result will be satisfactory (S) or unsatisfactory (US).**

B.Tech. (Mechanical Engineering) 4*th* Semester
(Under Credit Based Continuous Evaluation Grading System)

S. No.	University Course Code	Subject Group	Course Title	L	T	P	Contact hrs/wk	Credits
1.	MEL 221	ME	Mechanisms & Machines	3	1	0	4	4
2.	MEL 222	ME	CAD & Computer Graphics	3	0	0	3	3
3.	MEL 223	ME	Engineering Workshop II	1	0	0	1	1
4.	MEL 224	ME	Design of Machine Elements	3	0	0	3	3
5.	MEL 225	ME	Fluid Mechanics	3	1	0	4	4
6.	MEL 226	ME	Mechanical Measurement and Metrology	3	0	0	3	3
Practicals								
	MEP 221	ME	Mechanisms & Machines	0	0	2	2	1
	MEP 222	ME	CAD & Computer Graphics	0	0	2	2	1
	MEP 223	ME	Engineering Workshop II	0	0	4	4	2
	MEP 224	ME	Design of Machine Elements	0	0	4	4	2
	MEP 225	ME	Fluid Mechanics	0	0	2	2	1
	MEP 226	ME	Mechanical Measurement and Metrology	0	0	2	2	1
			TOTAL	**16**	**2**	**16**	**34**	**26**

NOTE:
The students of B. Tech. (Mech. Engg.) 4th Semester are required to undergo Industrial Training four to six weeks after their major examination of 4th Semester in any Industry / Institute of repute. The viva voce will be held along with the viva voce of 5th Semester.

B.Tech. (Mechanical Engineering) 5th Semester
(Under Credit Based Continuous Evaluation Grading System)

S. No.	University Course Code	Subject Group	Course Title	L	T	P	Credits
1	MEL 311	ME	Control Engineering	3	0	0	3
2	MEL 312	ME	Vibration & Noise Control	3	1	0	4
3	MEL 313	ME	Heat Transfer	3	1	0	4
4		DE	Elective Course – I	3	0	0	3
5		DE	Elective Course – II	3	0	0	3
6		ID-I	Inter disciplinary Course – I	4	0	0	4
PRACTICALS:							
	MEP 311	ME	Control Engineering Lab	0	0	1	1
	MEP 312	ME	Vibration & Noise Control Lab	0	0	1	1
	MEP 313	ME	Heat Transfer Lab	0	0	1	1
	MEP 314	ME	Industrial Training **	-	-	-	S/US
			Lab Elective – II	0	0	1	1
			TOTAL:	**19**	**2**	**4**	**25**

** The result will be satisfactory (S) or unsatisfactory (US).

List of Elective-I

	MEL351	DE	Advanced Mechanics of Solids	3	0	0	3
	MEL352	DE	Advanced Fluid Mechanics	3	0	0	3

List of Elective-II

	MEL353	DE	Welding Technology	3	0	0	3
	MEL354	DE	Automobile Engineering	3	0	0	3

Lab of Elective-II

	MEP353	DE	Welding Technology Lab	0	0	1	1
	MEP354	DE	Automobile Engineering Lab	0	0	1	1

B.Tech. (Mechanical Engineering) 6thSemester
(Under Credit Based Continuous Evaluation Grading System)

S. No.	University Course Code	Subject Group	Course Title	L	T	P	Credits
1	MEL 321	ME	Non-Traditional & Computer Aided Manufacturing	3	0	0	3
2	MEL 322	ME	I.C. Engines	3	0	0	3
3	MEL 323	ME	Refrigeration and Air Conditioning	3	0	0	3
4	MEL 324	ME	Mechatronics	3	0	0	3
5		DE	Elective Course –III	3	1	0	4
6		DE	Elective Course –IV	3	1	0	4
Practicals							
	MEP 321	ME	Non Traditional & Computer Aided Manufacturing Lab	0	0	1	1
	MEP 322	ME	I.C. Engines Lab	0	0	1	1
	MEP 323	ME	Refrigeration and Air Conditioning Lab	0	0	1	1
		DE	Elective Course –IV	0	0	1	1
			TOTAL:	**18**	**2**	**4**	**24**

List of Elective-III

	MEL361	DE	Finite Element Methods in Engineering	3	1	0	4
	MEL362	DE	Applied Elasticity and Plasticity	3	1	0	4
	MEL363	DE	Introduction to Human Body Mechanics	3	1	0	4
	MEL364	DE	Robotics: Mechanics and Control	3	1	0	4

List of Elective-IV

	MEL365	DE	Advanced Computer Graphics and Solid Modelling	3	1	0	4
	MEL366	DE	Machinery Fault Diagnostics and Signal Processing	3	1	0	4

Lab of Elective-IV

	MEP365	DE	Advanced Computer Graphics and Solid Modelling Lab	0	0	1	1
	MEP366	DE	Machinery Fault Diagnostics and Signal Processing Lab	0	0	1	1

B.Tech. (Mechanical Engineering) 7thSemester
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S. No.	University Course Code	Subject Group	Course Title	L	T	P	Contact hrs/wk	Credits
1	MEL 415	ME	Power Plant Engineering	3	0	0	3	3
3		ID-II	Inter disciplinary Course – II	4	0	0	4	4
4		ID-III	Inter disciplinary Course – III	4	0	0	4	4
5		DE	Elective - V	4	0	0	4	4
6		DE	Elective - VI	3	0	0	3	3
Practicals								
	MEP 415	ME	Power Plant Engineering	0	0	2	2	1
	MEP 416	ME P1	Project Work I	0	0	12	12	6
			Lab Elective - VI	0	0	1	1	1
			TOTAL	**18**	**0**	**15**	**33**	**26**

List of Departmental Elective - V

	MEL451	DE	Non-destructive evaluation and testing	4	0	0	4
	MEL452	DE	Technology of Surface Coating	4	0	0	4

List of Departmental Elective - VI

	MEL453	DE	Tribology	3	0	1	4
	MEL454	DE	Machine tools and machining	3	0	1	4

Lab of Elective-VI

	MEP453	DE	Tribology	0	0	1	1
	MEP454	DE	Machine tools and machining	0	0	1	1

B.Tech. (Mechanical Engineering) 8thSemester
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S. No.	University Course Code	Subject Group	Course Title	L	T	P	Contact hrs/wk	Credits
1		DE	Elective - VII	4	0	0	4	4
2		DE	Elective - VIII	4	0	0	4	4
3		ID	Inter disciplinary Course – IV	4	0	0	4	4
4	MEP421	ME P2	Project Work II & Dissertation	0	0	24	24	12
			TOTAL	**12**	**0**	**24**	**36**	**24**

List of Departmental Elective - VII

	MEL461	DE	Quality Assurance and Reliability	4	0	0	4	4
	MEL462	DE	Optimization Techniques	4	0	0	4	4

List of Departmental Elective - VIII

	MEL463	DE	Mechanical Handling Systems & Equipment	4	0	0	4	4
	MEL464	DE	Simulation of Mechanical Systems	4	0	0	4	4

B.Tech. (Mechanical Engineering) 1st Semester
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CYL–196: ENGINEERING CHEMISTRY

L-T-P
2-1-1

(30 hrs.)

1 Concept of entropy; thermodynamic scale of temperature; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible reactions. Introduction to enthalpy, enthalpy change of reactions, effect of temperature and pressure on enthalpy of reaction. **(6 hrs.)**
Free Energy Functions: Gibbs and Helmholtz energy; Variation of S,G,A with T,V and P. Free energy Change and spontaneity. **(4 hrs.)**

2 Phase Equilibria: Concept of phases, components and degrees of freedom, Derivation of Gibb's phase rule for reactive and non reactive systems; Clausius Clapeyron equation and its application to solid-liquid, liquid vapour and solid vapour equilibria. **(5 hrs.)**

3 Physical basis of atomic and molecular structure: Valence band and molecular orbital approaches, LCAO-NO treatment of H_2^+, bonding and antibonding orbrtals, Qualitative extension to H_2 . Comparison of MO & VB approaches. **(4 hrs.)**

4 Organomettallic compounds
Introduction, Metal carbonyl complexes: binding mode and the structures of representative mono-, di-, tri- and tetra-nuclear complexes. Applications of organometallic compounds in catalysis (Hydroformylation, Monsanto acetic acid process, Ziegler-Natta catalyst in polymerisation reaction of alkenes, Alkene hydrogenation) **(3 hrs.)**

5 Coordination compounds
Bonding in coordination compounds (valence bond theory, crystal field theory and molecular orbital theory with representative examples). Discussion on the colors of Hexaaquo complexes of Cr^{2+}, $Cr^{3+}Co^{2+}$ and Ni^{2+}, considering their electronic transitions.
Magnetic properties: Paramagnetism, diamagnetism, ferro- and antiferromagnetism with examples. Spin only magnetic moments of 1st row transition elements and reasons for deviations observed in some cases.
Tetragonal distortions in the regular octahedral complexes (Jahn-Teller distortions) **(4 hrs.)**

6 Metal ions in biological systems
Introduction, energy sources for life, non-photosynthetic processes Essential and trace elements on biological processes, Biological role of alkali and alkaline earth metal ions with special reference of Na^+-K^+ Pump. **(2 hrs.)**

7 Silicone based compounds
Introduction, Preparation of silicones, cross linked silicones, Silicon fluids or oils, Silicon elastomers, Silicon resins and their applications. **(2 hrs.)**

Reference Books:

1. Casetllan, G.W. Physical Chemistry 4th edition Narosa 2004.
2. Peter A. and Paula, J.de Physical Chemistry 10th edition Oxford University Press (2014).
3. Mcquarrie, D.A. and Simon, J.D. Molecular Thermodynamics, Viva Books Pvt. Ltd. New Delhi.
4. Chanda A.K. Introductory Quantum Chemistry Tata McGraw Hill.
5. Anautharaman R. Fundamentals of Quantum Chemistry Mcmilan India Ltd.
6. Concise Inorganic Chemistry by J. D. Lee, fifth edition
7. Inorganic Chemistry by J. E. Huhey, fourth edition.
8. James E. Mark, Harry R. Allcock, Robert West, Inorganic Polymers, Second Edition, Oxford University Press (**2005)**

List of Practicals

1. Preparation of benzimidazole.
2. Synthesis of p-nitroacetanilide from acetanilide.
3. Quantitative estimation of given glucose solution.
4. Find the strength of $KMnO_4$ solution.
5. Determine number of water molecules in Mohr salt by titration method.
6. Determine percentage of sodium carbonate in given sample of washing soda.
7. Determination of total Hardness of Water.
8. Determine the percentage of Ca^{2+} and Mg^{2+} in the given sample of water.
9. To determine the strength of strong and weak acid conductometrically.
10. Determination of coefficient of viscosity of a given liquid by viscometer.
11. Determination of hydrogen ion concentration and pH of a given solution using potentiometric titration.
12. To find the mol. wt. of high polymer by using viscosity measurements.
13. Determination of surface tension of a given liquid by drop number method by stalagmometer.
14. To determine the critical micelle concentration of a soap (sodium laurate) by surface tension measurements.
15. Chemical Kinetics- Acid hydrolysis of ethylacetate.

Books Recommended:

1. Findlay's Practical Physical Chemistry.
2. Advanced Practical Physical Chemistry by J.B. Jadav.
3. Quantitative Organic Analysis by Vogel.

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MTL- 101: MATHEMATICS – I

L T P
3 1 0

PART – I

Calculus: Partial Derivatives, Euler's theorem on homogeneous functions, Maclaurin's and Taylor's expansions of single and two variables, Maxima and minima of functions of several variables, Lagrangian method of multipliers, Multiple integrals and their use in obtaining surface areas and volumes of solids.

PART – II

Infinite Series: Sequences and sub sequences and their convergence, Cauchy sequence, Infinite series and their convergence, Standard tests for convergence including p-test, Ratio test, Comparison test, Raabe's test, Cauchy Integral test, Cauchy root test, Gauss's test, Absolute Convergence, Alternating series and its convergence, Power Series.

PART – III

Vector Calculus: Scalar and Vector point functions, Differentiation of vectors, Gradient of a scalar field, Divergence and Curl of a vector field and their physical interpretations, Line integral of a vector field, Surface integral of vector field, Volume integral of a scalar field, Green's theorem, stokes theorem, Gauss divergence theorem (without proofs) and their applications.

Books Recommended:

1. Louis A. Pipes: Applied Mathematics for Engineers and Physicists, McGraw Hill Book Company.
2. Kreyszig: Engineering Mathematics, Wiley Eastern Ltd.
3. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, New Delhi.
4. Murray & Spiegel, Vector Analysis, Schaum Publication Co.

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ECL115: ELECTRICAL ENGINEERING

L T P
3 1 0

PART – I

1. **Electricity:** A brief review of various applications of electricity, difference between AC and DC, PARTs of voltage, current and resistance, concept of electromagnetic induction and production of alternating e.m.f. – single phase and poly phase, concept of 3 phase system star and delta connections, voltage and current relations (formula only).
2. **Power Supply:** A brief review of special features of the power supply system, power-station, transmission, distribution lines, service main, domestic and industrial wiring installation.
3. **Circuit Analysis:** A brief review of DC and single phase AC circuits. Three phase AC circuits, phasor representation, star–delta transformation, concept of balanced and unbalanced three phase circuits, measurement of power and power factor in three phase balanced circuits, AC circuits (L.R.C.) solution.
4. **Electrical Machinery:** Transformers, its working principle, types of transformers and their applications, performance losses, efficiency and voltage regulation open circuit and short circuit tests on a transformer, auto transformer.

PART – II

5. **DC Motors:** Force and EMF production, methods of excitation in DC machines, various types, characteristic and application of DC shunt and series motors.
6. **Phase Induction Motor:** Construction and type of three phase induction motors, equivalent circuits, application of different types of induction motors, starters and protective devices used for motors.
7. **Phase Synchronous Machines:** Principle of working and construction of alternators and synchronous motors.
8. **Single Phase Induction Motors:** Types and construction, their working principle, starting of single phase motor, application of single phase motors.

PART – III

9. **Control and Protection:** Control mechanism, principle and application of servo motors, protection devices for wiring installation and motors – fuses MCB, LCB, relays.
10. **Cables:** Types of cables, construction of LT and HT cables, laying of cables, selection of cables.
11. **Earthing and Grounding:** Need, types, Indian Electricity Rules, use of meggar and earth tester for measurement of earth resistance.

Books Recommended:

1. Principles of Electrical Engineering by Gupta BR; S. Chand and Company, New Delhi.

2. Electrical Technology by Hughes Edward; The English Language Book Society and Longmans Group Limited, London.

3. Electrical Machines by Bhattacharya SK; Tata McGraw Hill, Delhi.

4. Experiments in Basic Electrical Engineering by Bhattacharya SK and Rastogi KM; New Age International, New Delhi.

5. Experiments in Electrical Engineering by Bhatnagar US; Asia Publishing House, Bombay.

6. Advanced Electrical Technology by Cotton H; Isaac Pitmans and Sons Limited, London.

7. Electrical Engineering – Basic Technology by Hubschar; Deutsche Gesllschaft Fur Technische Zusammenabelt (GTZ) GMBH.

8. Basic Electrical Engineering by T.K. Naggarkar & Ms. Sakhija Seventh Edition 2008, Oxford University Press.

B.Tech. (Mechanical Engineering) 1st Semester
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PHL182: MATERIAL SCIENCE

L	T	P
3	1	0

PART-I

Structure-property relationship; crystal system, close packing, crystal planes and directions; Miller indices; Determination of crystal structure using X-Ray diffraction.

PART-II

Phase diagram; Unary and binary; Lever rule; solid solutions; steel types; non-ferrous materials and alloys.

PART-III

Elastic and Plastic deformation; Effect of temperature, impurity and grain size on strength of materials; Ferroelectric, dielectric, piezoelectric and pyroelectric materials.

Recommended Books:

1. Materials Science and Engineering by WD Callister Jr. (John Wiley & Sons Inc., Eighth Edition)
2. Materials Science and Engineering: A First Course by V Raghvan (Prentice-Hall of India Pvt. Ltd.).

B.Tech. (Mechanical Engineering) 1st Semester
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ENL–101: Communicative English–I

Time: 3 Hrs. **L T P**
2 0 0

Objective: To introduce students to the skills and strategies of reading and writing by identifying organizational patterns, spotting classification systems and understanding associations between ideas. This course will prepare students to read a variety of texts and also to communicate more effectively through writing. The course will also pay special attention to vocabulary building.

Prescribed Text books:

1. *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition.
2. *The Written Word* by Vandana R. Singh, Oxford University Press, New Delhi.

Course Contents:

1. Reading and Comprehension Skills:

Students will be required to read and comprehend the essays in Unit 1 and 2 of the book *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition. They will be required to answer the questions given after each essay.

2. Developing Vocabulary and using it in the Right Context:

The students will be required to master "Word List" and "Correct Usage of Commonly Used Words and Phrases" from the Chapter "Vocabulary" in the book *The Written Word.*

3. Writing Skills

Students will be required to learn "Report Writing" and "Letter Writing" as in the book *The Written Word.*

Students will be required to write long essays based on the prescribed text book *Making Connections: A Strategic Approach to Academic Reading.*

Minor 1:
Syllabus to be covered:
1. Unit 1 from *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition.
2. Report Writing from *TheWritten Word.*

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Suggested Paper Pattern:

1. Report Writing (8 marks)
2. Short answer type questions from Unit 1 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks)
3. Essay type question from Unit 1 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks)

Minor 2:

Syllabus to be covered:

1. "Word List" from the Chapter "Vocabulary" in the book *The Written Word.*
2. Unit-2 from the book *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition.

Suggested Paper Pattern:

1. Word List from the Chapter "Vocabulary" in the book *The Written Word* (8 marks)
2. Short answer type questions from Unit 2 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks)
3. Essay type question from Unit 2 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks)

Suggested Paper Pattern for Major Exam:

1. Letter Writing as prescribed in *The Written Word* /1 out of 2 (10 marks)
2. Short answer type questions from Unit 1,2 of *Making Connections: A Strategic Approach to Academic Reading* (14 marks)
3. "Word List" and "Correct Usage of Commonly Used Words and Phrases" from the Chapter "Vocabulary" present in the book *The Written Word.* (10 marks)
4. Essay type question from Unit 1,2 of *Making Connections: A Strategic Approach to Academic Reading* 1 out of 2 (8 marks)
5. Report Writing from *The Written Word* (8 marks)

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MEP101: Workshop Practices

L T P
0 0 2

1. Carpentry Shop:
a) Study of tools & operations and carpentry joints.
b) Simple exercise using jack plane.
c) To prepare half-lap corner joint, mortise & tennon joints.
d) Simple exercise on wood working lathe.

2. Fitting (Bench Working) Shop:
a) Study of tools & operations
b) Simple exercises involving fitting work.
c) Make perfect male-female joint.
d) Simple exercises involving drilling / tapping / dieing.

3. Black Smithy Shop:
a) Study of tools & operations
b) Simple exercises based on black smithy operations such as upsetting, drawing down, punching, bending, fullering & swaging.

4. Welding Shop:
a) Study of tools & operations of Gas welding & Arc welding.
b) Simple butt and Lap welded joints.
c) Oxy-acetylene flame cutting.

5. Sheet-metal Shop:
a) Study of tools & operations.
b) Making Funnel complete with soldering.
c) Fabrication of tool-box, tray, electric panel box etc.

6. Machine Shop:
a) Study of Single point cutting tool, machine tools and operations.
b) Plane turning.
c) Step turning.
d) Taper turning.
e) Threading.

7. Foundry Shop:
a) Study of tools & operations
b) Pattern making.
c) Mould making with the use of a core.
d) Casting

8. **Electrical and Electronics Shop:**
a) Study of tools & operations

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(Elective – I)

Punjabi (Compulsory)
PBL–121: pj`bl l`zml

Credits: 2–0–0

ਪਾਠ–ਕ੍ਰਮ ਅਤੇ ਪਾਠ ਪੁਸਤਕਾਂ

(I) 1. E`qm En`qm (sp. virE`m isG sD Eq f`. sihdrblr isG, gr n`nk dv wnlvristl, Eimqsr) ivcl hT ilK kh`xlk`r :

(a) grmK isG ms`iPr : gt`r
(E) sj`n isG : pT`x dl Dl
(e) krq`r isG dgl : acl Efl v`ll grg`bl
(kh`xl-s`r, ivS`-vsq, kh`xl-kl`, kh`xlk`r)

2. grmKl ErQgr`Pl dl jgq, (plql; mh`rnl; ibdl, itpl q EDk); ivr`m icn, Sbd jV (SD-ESD)

(II) 1. E`qm En`qm (sp. virE`m isG sD Eq f`. sihdrblr isG, gr n`nk dv wnlvristl, Eimqsr) ivcl hT ilK kh`xlk`r :

(a) sqK isG Dlr : s~Jl kD
(E) klvq isG ivrk : aj`V
(e) mihdr isG srn` : jQd`r mkd isG
(kh`xl-s`r, ivS`-vsq, kh`xl-kl`, kh`xlk`r)

2. lK rcn` (jlvnl-prk, sm`jk Eq clq iviSE~ aq):
10 lK ilKv`ax (kl`s ivc Eq Gr lel EiBE`s)

(III) 1. E`qm En`qm (sp. virE`m isG sD Eq f`. sihdrblr isG, gr n`nk dv wnlvristl, Eimqsr) ivcl hT ilK kh`xlk`r :

(a) pm pk`S : m`V` bd`
(E) glz`r isG sD : klCx
(e) mhn Bf`rl : Gtx`
(s) virE`m isG sD : dldl
(kh`xl-s`r, ivS`-vsq, kh`xl-kl`, kh`xlk`r)

2. pr` pV k pSn~ d aqr dx`
(E`qm En`qm psqk d kh`xl B`g ivcl 15 pirE~ d EiBE`s krv`ax)

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(Elective – I)

Mudhli Punjabi
PBL–122: ਮੁੱਢਲੀ ਪੰਜਾਬੀ
(In lieu of Punjabi Compulsory)

2-0-0

ਪਾਠ–ਕ੍ਰਮ

1. ਪੰਜਾਬੀ ਭਾਸ਼ਾ,
   ਗੁਰਮੁਖੀ ਲਿਪੀ
   ਗੁਰਮੁਖੀ ਲਿਪੀ : ਬਣਤਰ ਅਤੇ ਤਰਤੀਬ

2. ਗੁਰਮੁਖੀ ਆਰਥੋਗ੍ਰਾਫੀ
   ਸੁਰ ਬਣਤਰ ਅਤੇ ਉਚਾਰਨ
   ਵਿਅੰਜਨ ਬਣਤਰ ਅਤੇ ਉਚਾਰਨ

3. ਪੰਜਾਬੀ ਸ਼ਬਦ ਬਣਤਰ
   ਸਾਧਾਰਨ ਸ਼ਬਦ
   ਇਕ ਉਚਾਰਖੰਡੀ ਸ਼ਬਦ

ਯੂਨਿਟ ਅਤੇ ਥੀਮ

1. ਪੰਜਾਬੀ ਭਾਸ਼ਾ : ਨਾਮਕਰਣ ਅਤੇ ਸੰਖੇਪ ਜਾਣ ਪਛਾਣ, ਗੁਰਮੁਖੀ ਲਿਪੀ : ਨਾਮਕਰਣ, ਗੁਰਮੁਖੀ ਵਰਣਮਾਲਾ; ਪੈਂਤੀ ਅੱਖਰੀ, ਅੱਖਰ ਕ੍ਰਮ, ਸੁਰ ਵਾਹਕ (ਓ ਅ ੲ), ਲਗਾਂ ਮਾਤਰਾਂ, ਪੈਰ ਵਿਚ ਬਿੰਦੀ ਵਾਲੇ ਵਰਣ, ਪੈਰ ਵਿਚ ਪੈਣ ਵਾਲੇ ਵਰਣ, ਬਿੰਦੀ, ਟਿੱਪੀ, ਅੱਧਕ।

2. ਗੁਰਮੁਖੀ ਆਰਥੋਗ੍ਰਾਫੀ ਅਤੇ ਉਚਾਰਨ; ਸੁਰਾਂ ਦੀ ਬਣਤਰ ਅਤੇ ਉਚਾਰਨ (ਲਘੂ–ਦੀਰਘ ਸੁਰ); ਸੁਰ ਅਤੇ ਲਗਾਂ ਮਾਤਰਾਂ; ਵਿਅੰਜਨਾਂ ਦੀ ਬਣਤਰ ਅਤੇ ਉਚਾਰਨ; ਪੈਰ ਵਿਚ ਪੈਣ ਵਾਲੇ ਵਰਣਾਂ (ਹ, ਰ, ਵ) ਦਾ ਉਚਾਰਨ ; ਲ ਅਤੇ ਲ਼ ਦਾ ਉਚਾਰਨ; ਭ, ਧ, ਢ, ਝ, ਘ ਦਾ ਉਚਾਰਨ; ਪੈਰ ਵਿਚ ਬਿੰਦੀ ਵਾਲੇ ਵਰਣਾਂ ਦਾ ਉਚਾਰਨ।

3. ਪੰਜਾਬੀ ਸ਼ਬਦ–ਬਣਤਰ : ਸਾਧਾਰਨ ਸ਼ਬਦ; ਇਕੱਲਾ ਸੁਰ (ਜਿਵੇਂ ਆ); ਸੁਰ ਅਤੇ ਵਿਅੰਜਨ (ਜਿਵੇਂ ਆਰ); ਵਿਅੰਜਨ ਅਤੇ ਸੁਰ (ਜਿਵੇਂ ਪਾ); ਵਿਅੰਜਨ ਸੁਰ ਵਿਅੰਜਨ (ਜਿਵੇਂ ਪਾਰ); ਕੌਸ਼ਗਤ ਸ਼ਬਦ (ਜਿਵੇਂ ਘਰ, ਪੀ); ਵਿਆਕਰਣਕ ਸ਼ਬਦ (ਜਿਵੇਂ ਨੂੰ, ਨੇ); ਪੰਜਾਬੀ ਸ਼ਬਦ ਰਚਨਾ–1; ਲਿੰਗ–ਪੁਲਿੰਗ, ਇਕ ਵਚਨ–ਬਹੁ ਵਚਨ; ਨਿੱਤ ਵਰਤੋਂ ਦੀ ਪੰਜਾਬੀ ਸ਼ਬਦਾਵਲੀ–1: ਖਾਣ–ਪੀਣ, ਸਾਕਾਦਾਰੀ, ਰੁੱਤਾਂ, ਮਹੀਨਿਆਂ, ਗਿਣਤੀ, ਮੌਸਮ ਆਦਿ ਨਾਲ ਸੰਬੰਧਿਤ।

B.Tech. (Mechanical Engineering) 1st Semester
(Under Credit Based Continuous Evaluation Grading System)
(Elective – I)

SOA 101: Drug Abuse: Problem, Management and Prevention
(Compulsory Paper)

PROBLEM OF DRUG ABUSE

Time: 3 Hours **Credit 3-0-0**

1) **Meaning of Drug Abuse:** Concept and Overview, Historical Perspective of Drug Abuse, Drug Dependence, Drug Addiction, Physical and Psychological Dependence: Drug Tolerance and withdrawal symptoms.

2) **Types of Abused Drugs and their Effects.**
   1) Stimulants: Amphetamines – Benzedrine, Dexedrine, Cocaine.
   2) Depressants: Alcohol Barbiturates: Nembutal, Seconal, Phenobarbital and Rohypnol.
   3) Narcotics: Heroin, Morphine, Oxycodone.
   4) Hallucinogens: Cannabis, Marijuana, Hashish, Hash Oil, MDMA, LSD.
   5) Steroids.

3) **Nature and Extent of the Problem:** Magnitude or prevalence of the menace of Drug Abuse in India and Punjab, Vulnerable groups by age, gender and economic status, Signs and Symptoms of Drug Abuse: Physical, Academic, Behavioural and Psychological Indicators.

References:

1. Ahuja, Ram (2003), *Social Problems in India*, Rawat Publication, Jaipur.
2. Extent, Pattern and Trend of Drug Use in India, Ministry of Social Justice and Empowerment, Government of India, 2004.
3. Inciardi, J.A. 1981. *The Drug Crime Connection.* Beverly Hills: Sage Publications.
4. Kapoor. T. (1985) *Drug epidemic among Indian Youth*, New Delhi: Mittal Pub.
5. Modi, Ishwar and Modi, Shalini (1997) *Drugs: Addiction and Prevention*, Jaipur: Rawat Publication.
6. National Household Survey of Alcohol and Drug abuse. (2003) New Delhi, Clinical Epidemiological Unit, All India Institute of Medical Sciences, 2004.
7. Sain, Bhim 1991, *Drug Addiction Alcoholism*, Smoking obscenity New Delhi: Mittal Publications.
8. Sandhu, Ranvinder Singh, 2009, *Drug Addiction in Punjab*: A Sociological Study. Amritsar: Guru Nanak Dev University.
9. Singh, Chandra Paul 2000. *Alcohol and Dependence among Industrial Workers*: Delhi: Shipra.
10. Sussman, S and Ames, S.L. (2008). *Drug Abuse: Concepts, Prevention and Cessation,* Cambridge University Press.
11. World Drug Report 2010, United Nations office of Drug and Crime.
12. World Drug Report 2011, United Nations office of Drug and Crime.

B.Tech. (Mechanical Engineering) 2nd Semester
(Under Credit Based Continuous Evaluation Grading System)

PHL–183: PHYSICS

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3	1	1

UNIT-I

Electric and magnetic fields in a medium, Susceptibility and Conductivity, Maxwell's equations, Boundary conditions; EM wave equation, Plane wave solutions, Polarization of the EM waves, Pointing vector and intensity of the EM wave; Wave packet, Phase and Group velocities; Reflection and refraction of EM waves at a dielectric interface; Brewster angle; Total internal reflection at a dielectric interface; EM waves in a conducting medium and plasma.

UNIT-II

Wave-particle duality, de-Broglie waves; Quantum mechanical operators; Schroedinger equation, Wave function, Statistical interpretation, Superposition Principle, Continuity equation for probability density; Stationary states, Bound states.

UNIT-III

Free-particle solution, 1-D infinite potential well, Expectation values and uncertainty relations; 1-D finite potential well, Quantum mechanical tunnelling and alpha-decay, Kronig-Penny model and emergence of bands

Books Recommended:-

1. Concepts of Modern Physics. Arthur Beiser, (Tata McGraw-Hill, Sixth Edition 2003).
2. Lasers & Nonlinear optics. B.B. Laud (New Delhi, India: Wiley Eastern 1991).

List of Experiments (Lab-A)

1. STUDY OF POWER SOURCE

A. To Study the output voltage, output resistance, power dissipation in the load and source for same R_2/R_1 ratio.

I. Draw a graph between V_L and I_L for all the three sets of R_1 and R_2.

II. Find V_S and R_S from the graph and formula given in the book. Verify $R'_S = x R_5$ if R and R_2 are changed by a factor of x.

III. Calculate the power dissipated in the load resistance R_L form $P_L = V_L I_L$ and P_S from $V_S^2/2R_S$. Find P_L/P_S and show that the maximum value of this ratio is 0.5. Plot P vs R_L.

B. To Study the reflected load resistance in a network.

I. Calculate R'_L, from the relation
$R'_L = Vo/(Io-I)$
And compare it with the measured value.

II. Plot a graph between R_L' and R_L.

2. STUDY OF CAPACITOR

A. To study the voltage (V_C) across a capacitor during charging in an RC circuit.

I. Plot a graph between V_C and time. Find time constant of the circuit.

II. Verify the exponential nature of the charging process by a plot of log (Vo-V)/Vo and time. Determine the time constant from it.

B. To study the energy dissipation in charging of a capacitor and to study its dependence in C and V.

I. Plot a graph between I_2 and time. Calculate area under the curve. Calculate the energy dissipated in the circuit which is equal to R times this area.

II. Show the dependence of energy dissipation on V and C using the following combinations (V_1, R_1, C_1; V_1, R_1,C_2 V_2, R_1,C_1)

C. *To study the energy dissipation during adiabatic charging of a capacitor*.

I. Plot a graph between I_2 and time for three sets (0-5 and 5-10). Calculate the energy dissipated in each case. Show that the energy dissipated in two steps charging up to 1 volts is one third that of direct charging 0-10 V.

3. STUDY OF ELECTROMAGNETIC INDUCTION

A. To study the emf induced as a function of the velocity of the magnet.

I. Plot a graph between induced emf and velocity of the magnet.

B. To study electromagnetic induction.

I. Plota graph between induced emf, e(t) and number of pulses.

II. Plot a graph between induced emf, e(t) and 1/R where R is the resistance in the circuit.

III. Calculate maximum magnetic induction, B_{max}

C. To Study the electromagnetic damping.

I. Study the electromagnetic damping for closed circuit, open circuit, circuit containing the resistance and circuit containing the capacitor.

4. STUDY OF RC CIRCUIT WITH AC MAINS

A. To study simple RC circuit

I. Compare the measured value of current I with the calculated one from the formula $V_R=I_R$ and $V_C=I/WC$ in each case.

II. Plot a graph between V_C and I/C. determine the value of frequency of the source.

III. Determine the impedance of the circuit by formula Z=Vo/I and verify theoretically.

IV. From the vector diagram between V_R, V_C and V_O, show that $V_O^2= V_R^2+V_C^2$ in all cases.

V. Show that the sum of resistive voltage and the sum of capacitive voltage are in quadrature in circuit.

B. To study the deviation in the behavior of an actual capacitor by adding a series resistance.
   I. With source voltage V_O as base construct triangles for the resistance and the capacitor.
   II. Show that phase angle reduces as more and more resistances are added to C.

C. To study the deviation in the behavior of an actual capacitor by adding a shunt resistance.
   I. Draw voltage vector diagrams to evaluate the effect of increasing R on the performance of capacitor.
   II. Draw current vector diagrams also.

5. STUDY OF LCR CIRCUIT

A. To determine equivalent power loss resistance (r) of an inductor.
   I. Calculate r for all the observations from vector diagrams.
   II. Draw graphs between (i) r & V_O and (ii) r & R

B. To analyse LR and RC circuits.
Make parallel circuits containing (i) L_1R_1 and L_2R_2 (ii) C_1R_1 and C_2R_2 & (iii) L_1R_1 and C_2R_2
   I. Draw vector diagrams and find V_{ab} for all the observations. Show that calculated and measured V_{ab} are in agreement. Determine the condition for which V_{ab} becomes minimum.
   II. To find the value of an inductor in the LCR resonance circuit.

6. PHASE MEASUREMENTS BY SUPERPOSITION
(**Note**: Verify all phase angles of voltages across each element by vector diagrams also.)

A. To study the relative of voltages across the resistors and capacitors in series.

List of Experiments (LAB-B)

1. To determine the elastic constants of a solid using
   a. Koenig's method b. Maxwell's needle method
2. Measurement of wavelength of sodium light using a Fresnel Biprism.
3. a .To determine the thermal conductivity of an insulator by Lee's method.
   b. To study the behavior of coupled identical pendula and to establish a relationship between the coupling length and characteristic frequencies of the symmetric & antisymmetric modes of oscillations.
4. To study single-slit diffraction using He-Ne laser.
5. To determine the surface tension of a liquid using
   a. Jaeger's method b. Capillary-rise method
6. To obtained the Cauchy's dispersion formulae for refractive index of a prism.
7. *To determine the wavelengths of mercury vapour lamp using a diffraction grating.
8. To determine the viscosity of a liquid by the oscillating disc method (Mayer's method).
9. To determine the wavelength of sodium light by Newton's rings.

Exp 7 can be done only after doing Exp No. 6

B.Tech. (Mechanical Engineering) 2nd Semester
(Under Credit Based Continuous Evaluation Grading System)

ARL196: ENGINEERING GRAPHICS & DRAFTING

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Course Objectives:

A. Increase ability to communicate with people
B. Learn to sketch and take field dimensions.
C. Learn to take data and transform it into graphic drawings.
D. Learn basic engineering drawing formats
E. Prepare the student for future Engineering positions

Course Outcomes:

1. Student's ability to hand letter will improve.
2. Student's ability to perform basic sketching techniques will improve.
3. Students will be able to draw orthographic projections and sections.
4. Student's ability to use architectural and engineering scales will increase.
5. Students ability to produce engineered drawings will improve
6. Student's ability to convert sketches to engineered drawings will increase.
7. Students will become familiar with office practice and standards.
8. Students will develop good communication skills and team work.

PART – I

Drawing Techniques: Various types of lines, principles of dimensioning, size and location of dimensions, symbols, conventions scales (plane and diagonal) and lettering as per IS Code SP–46 of practice for general engineering drawings. Practice of drawing various types of lines and dimensioning exercises. Drawing exercises pertaining to symbols, conventions. Exercise on lettering techniques: Free hand printing and numerals in 3, 5, 8 and 12 mm sizes vertical and inclined at 75 ; instrumental lettering in single stroke.

Projection of Points, Lines and Planes: First angle and third angle projections, concept of horizontal and vertical planes, Projection of points and lines, True length, Horizontal and vertical traces, Projection of Planes, Traces of Planes, Auxiliary planes. Practice exercises on projection of points, lines and planes.

Projection and Selection of Solids: Projection of solids such as Prisms, Pyramids, Cylinders, Cones, Spheres, Auxiliary View. Principles of sectioning, types of sectioning, section lines, cutting plane lines. Practice on projection of solids.

PART – II

Isometric Projection: Exercises on isometric views.

Orthographic Projections: Orthographic views, Missing views. Exercises on identification of missing views. Practice on orthographic projections.

Practice of free hand sketching of different types of objects.

B.Tech. (Mechanical Engineering) 2nd Semester
(Under Credit Based Continuous Evaluation Grading System)

PART – III

Intersection and Development of Surfaces: Intersection of cylinders, cones and Prisms, Axis of solids being vertical or horizontal. Development of surfaces of truncated cylinders, cones and prisms. Exercises on intersection of solids – cylinder and cylinder, cylinder and cone, prism and prism, prism and cone, sphere with cylinder. Exercises involving development of surfaces (Y–Piece, Hopper, Tray and truncated pieces).

Fasteners: Introduction to temporary and permanent fasteners riveted and welded joints, types screw threads, conventional symbols for internal and external threads. Exercises involving drawing of bolts, nuts, studs and locking devices.

Symbols and Conventions: Symbol and conventions pertaining to relevant engineering disciplines.

Books Recommended:

1. Engineering Drawing by PS Gill, SK Kataria and Sons, Ludhiana.
2. Engineering Drawing by NK Bhatt.
3. Text Book of Engineering Drawing by R.K. Dhawan, S. Chand & Company Ltd.
4. Engineering and Teaching Drawing by Earl D. Black.

B.Tech. (Mechanical Engineering) 2nd Semester
(Under Credit Based Continuous Evaluation Grading System)

MTL102: MATHEMATICS – II

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PART – I

Differential Equations: Exact differential Equation, Higher order linear Differential equations, ODE's with constant coefficients.
Laplace Transforms: Laplace transforms, Properties of Laplace transforms, Laplace transform of derivatives and differentiation theorem, Integration theorem, Laplace transform of Integrals, Inverse Laplace transform, Formulas for obtaining inverse Laplace transforms, Convolution theorem, The second shifting property.

PART – II

Fourier Series and Fourier Transform: Fourier Series expansion, Fourier series for even and odd functions, half range series, harmonic functions, Modulation theorem, Shifting properties, convolution theorems, sine and cosine transforms, Fourier transform of derivatives and integrals, inverse Fourier transform, Applications to PDE's and ODE's.

PART – III

Complex Analysis: De Moivre's theorem with applications, Analytic functions, Cauchy-Riemann equations, Laplace equation, Cauchy's integral theorem, Cauchy's integral formula (without proofs), Taylor series and Laurent series (without proofs), Residues and their application in evaluating real improper integrals.

Books Recommended:

1. Louis A. Pipes: Applied Mathematics for Engineers and Physicists, McGraw Hill Book Company.
2. Kreyszig: Engineering Mathematics, Wiley Eastern Ltd.
3. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, New Delhi.

B.Tech. (Mechanical Engineering) 2nd Semester
(Under Credit Based Continuous Evaluation Grading System)

CSL125: FUNDAMENTALS OF IT AND COMPUTER PROGRAMMING

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PART – I

Block diagram of Computer, Associated peripherals, Memories – RAM, ROM, Secondary Storage Devices, Classification of Computers and Languages, Introduction to Compilers, Interpreter and Assemblers, Introduction of various operating system with their file system, Features of DOS, Internal and External commands of DOS, Introduction to Windows and Linux.

PART – II

Algorithm and Flowchart, Introduction to C language, Various Data Types- Basic, Derived, user defined and void, Operators, Expressions, Variable, Constant, Header files, Formatted and unformatted input and output statements, Control and conditional statements. Arrays.

PART – III

String Handling, Functions- call be value and call by references, Structures and Unions, Array of structure, Pointers, Dynamic memory allocation using mallooc and calloc functions, File Handling, Modes of file handling, File handling Input and Output statements.

PRACTICAL

- Looking for directories and files under DOS.
- Changing drives, searching for files, looking at files extensions and size of files.
- Deleting and saving files, protecting and unprotecting file.
- Familiarizing with windows, closing, maximizing, shifting icons, ordering icons, changing the size of windows, moving windows.
- File manager to view the files, transfer files from directories/devices.
- Exercises (at least fifteen) involving assignment, looping, functions, arrays, structure, string, pointers and files in C.

Recommended Books:

1. Computers Today by Sanders.
2. Fundamentals of Computers TTTI Publication.
3. DOS Instant Reference by Harvey and Nelson.
4. Programming with ANSI and Turbo C 2nd Edition – Kamthane, Pearson Publication
5. Let US C 8th Edition – Yashwant Kanetkar- Infiniti Science Press
6. Mastering Turbo C by Brottle Stan Kelly.

B.Tech. (Mechanical Engineering) 2nd Semester
(Under Credit Based Continuous Evaluation Grading System)

CEL 120: ENGINEERING MECHANICS

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PART – I

Introduction: Force system, dimensions and PARTs in mechanics, laws of mechanics, vector algebra, addition and subtraction of forces, cross and dot products of vectors, moment of a force about a point and axis, couple and couple moment, transfer of a force to a parallel position, resultant of a force system using vector method, Problems involving vector application Equilibrium: Static and dynamic equilibrium, static in determinacy, general equations of equilibrium, Varingnon's theorem, Lami's theorem, equilibrium of bodies under a force system, Problems.

PART – II

Truss and Frames: Truss, classification of truss, assumptions in truss analysis, perfect truss, analysis of perfect plane truss using method of joints and method of sections, Problems. Centroid , Centre of mass and Centre of gravity, Determination of centroid, centre of mass and centre of gravity by integration method of regular and composite figures and solid objects, Problems.

Moment of Inertia: Area moment of inertia, mass moment of inertia, parallel axis and perpendicular axis theorems, radius of gyration, polar moment of inertia, product of inertia, principle axis, problem based on composite figures and solid objects. Kinematics: Concept of rigid body, velocity and acceleration, relative velocity, translation and rotation of rigid bodies, equations of motion for translation and rotation, problems.

PART – III

Particle Dynamics: Energy methods and momentum methods, Newton's laws, work energy equation for a system of particles, linear and angular momentum equations, projectile motion, problem. Shear Force and Bending Moment Diagram for statically determinant beams Classification of beams, types of loads, shear force and bending moment calculation and their graphical presentation, point of inflection, problem.

Books Recommended:

1. Engineering Mechanics – Irving H. Shames, PHI Publication

2. Engineering Mechanics – U.C.Jindal, Galgotia Publication

B.Tech. (Mechanical Engineering) 2nd Semester
(Under Credit Based Continuous Evaluation Grading System)
(Elective – II)

Punjabi (Compulsory)
PBL–131: ਪੰਜਾਬੀ ਲਾਜ਼ਮੀ

PBL 131 ਪੰਜਾਬੀ – II (ਲਾਜ਼ਮੀ)
p`T-km Eq p`T psqk-

Credits:

2-0-0

(I) 1. E`qm En`qm (sp. virE`m isG sD Eq f`. sihdrblr isG, gr n`nk dv wnlvristl,Eimqsr) ivcl hT- ilK kvl :

(a) B`el vlr isG
(E) p: prn isG
(e) p: mhn isG
(kivq`-s`r, ivS`–vsq, k`iv-kl`, kvl)

2. pj`bl Sbd bxqr: D`q/ml, vDqr (Egqr, ipCqr, ivalqpq Eq rp-qrl), sm`s |

(II) 1. E`qm En`qm (sp. virE`m isG sD Eq f`. sihdrblr isG, gr n`nk dv wnlvristl, Eimqsr) ivcl hT ilK kvl :

(a) Eimq` plqm
(E) f`. hrBjn isG
(e) iSv km`r bt`lvl
(kivq`-s`r, ivS`-vsq, k`iv-kl`, kvl)

2. pr` rcn` : kl`s ivc 10 iviSE- (siBE`c`rk, D`rimk Eq r`jnlqk) q pr` rcn` d EiBE`s krv`ax |

(III) 1. E`qm En`qm (sp. virE`m isG sD Eq f`. sihdrblr isG, gr n`nk dv wnlvristl, Eimqsr) ivcl hT ilK kvl :

(a) f`. jsvq isG nkl
(E) f`. jgq`r
(e) f`. srjlq p`qr
(s) p`S
(kivq`-s`r, ivS`-vsq, k`iv-kl`, kvl)

2. mh`vr q EK`x (EK`x q mh`vr` kS ivc) 200 mh`virE- Eq 100 EK`x- n v`k- ivc vrqx d EiBE`s krv`ax (kl`s ivc q Gr lel)|

B.Tech. (Mechanical Engineering) 2nd Semester
(Under Credit Based Continuous Evaluation Grading System)
(Elective – II)

Mudhli Punjabi
PBL–132: ਮੁੱਢਲੀ ਪੰਜਾਬੀ
(In lieu of Punjabi Compulsory)

2–0–0

ਪਾਠ–ਕ੍ਰਮ

1. ਪੰਜਾਬੀ ਸ਼ਬਦ–ਬਣਤਰ
   ਸੰਯੁਕਤ ਅਤੇ ਮਿਸ਼ਰਤ ਸ਼ਬਦ
   ਬਹੁ–ਉਚਾਰਖੰਡੀ ਸ਼ਬਦ

2. ਪੰਜਾਬੀ ਵਾਕ–ਬਣਤਰ
   ਸਾਧਾਰਨ–ਵਾਕ : ਕਿਸਮਾਂ
   ਸੰਯੁਕਤ–ਵਾਕ : ਕਿਸਮਾਂ
   ਮਿਸ਼ਰਤ–ਵਾਕ : ਕਿਸਮਾਂ

3. ਪ੍ਰਕਾਰਜੀ ਪੰਜਾਬੀ
   ਚਿੱਠੀ ਪੱਤਰ
   ਪੈਰ੍ਹਾ ਰਚਨਾ
   ਸੰਖੇਪ ਰਚਨਾ
   ਅਖਾਣ ਅਤੇ ਮੁਹਾਵਰੇ

ਯੂਨਿਟ ਅਤੇ ਥੀਮ

1. ਪੰਜਾਬੀ ਸ਼ਬਦ-ਬਣਤਰ : ਸੰਯੁਕਤ ਸ਼ਬਦ; ਸਮਾਸੀ ਸ਼ਬਦ (ਜਿਵੇਂ ਲੋਕ ਸਭਾ); ਦੋਜਾਤੀ ਸ਼ਬਦ (ਜਿਵੇਂ ਕਾਲਾ ਸਿਆਹ); ਦੋਹਰੇ ਸ਼ਬਦ/ਦੁਹਰਰੁਕਤੀ (ਜਿਵੇਂ ਧੂੜ੍ਹ ਧਾੜ੍ਹ/ਭਰ ਭਰ), ਮਿਸ਼ਰਤ ਸ਼ਬਦਾਂ ਦੀ ਬਣਤਰ/ਸਿਰਜਨਾ; ਅਗੇਤਰਾਂ ਰਾਹੀਂ (ਜਿਵੇਂ ਉਪ ਭਾਸ਼ਾ), ਪਿਛੇਤਰਾਂ ਰਾਹੀਂ (ਜਿਵੇਂ ਰੰਗਲਾ), ਪੰਜਾਬੀ ਸ਼ਬਦ ਰਚਨਾ–2: ਪੜਨਾਵੀਂ ਰੂਪ, ਕਿਰਿਆ/ਸਹਾਇਕ ਕਿਰਿਆ ਦੇ ਰੂਪ; ਨਿੱਤ ਵਰਤੋਂ ਦੀ ਪੰਜਾਬੀ ਸ਼ਬਦਾਵਲੀ–2: ਮਾਰਕੀਟ/ਬਾਜ਼ਾਰ, ਵਪਾਰ, ਧੰਦਿਆਂ ਨਾਲ ਸੰਬੰਧਿਤ।

2. ਪੰਜਾਬੀ ਵਾਕ-ਬਣਤਰ : ਕਰਤਾ ਕਰਮ ਕਿਰਿਆ; ਸਾਧਾਰਨ ਵਾਕ, ਬਿਆਨੀਆ, ਪ੍ਰਸ਼ਨਵਾਚਕ, ਆਗਿਆਵਾਚਕ, ਸੰਯੁਕਤ ਅਤੇ ਮਿਸ਼ਰਤ ਵਾਕਾਂ ਦੀਆਂ ਕਿਸਮਾਂ; ਸੁਤੰਤਰ ਅਤੇ ਅਧੀਨ ਉਪਵਾਕ; ਸਮਾਨ (ਤੇ/ਅਤੇ) ਅਤੇ ਅਧੀਨ (ਜੋ/ਕਿ) ਯੋਜਕਾਂ ਦੀ ਵਰਤੋਂ; ਪੰਜਾਬੀ ਵਾਕਾਂ ਦੀ ਵਰਤੋਂ : ਵਿਭਿੰਨ ਸਮਾਜਕ/ਸਭਿਆਚਾਰਕ ਪ੍ਰਸਥਿਤੀਆਂ ਦੇ ਅੰਤਰਗਤ; ਘਰ ਵਿਚ, ਬਾਜ਼ਾਰ ਵਿਚ, ਮੇਲੇ ਵਿਚ, ਸ਼ੋਪਿੰਗ ਮਾਲ/ਸਿਨਮੇ ਵਿਚ, ਵਿਆਹ ਵਿਚ, ਧਾਰਮਿਕ ਸਥਾਨਾਂ ਵਿਚ, ਦੋਸਤਾਂ ਨਾਲ ਆਦਿ।

3. ਇਸ ਯੂਨਿਟ ਵਿਚ ਚਿੱਠੀ ਪੱਤਰ (ਨਿੱਜੀ/ਦਫ਼ਤਰੀ/ਵਪਾਰਕ), ਪੈਰਾ ਰਚਨਾਂ, ਸੰਖੇਪ ਰਚਨਾ ਅਤੇ ਅਖਾਣ ਮੁਹਾਵਰਿਆਂ ਦੀ ਵਰਤੋਂ ਰਾਹੀਂ ਵਿਦਿਆਰਥੀ ਦੀ ਭਾਸ਼ਾਈ ਯੋਗਤਾ ਨੂੰ ਪਰਖਿਆ ਜਾਵੇਗਾ।

B.Tech. (Mechanical Engineering) 2nd Semester
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(Elective – II)

SOA 102: Drug Abuse: Problem, Management and Prevention
(Compulsory Paper)

DRUG ABUSE: MANAGEMENT AND PREVENTION

Time: 3 Hours **Credit 3-0-0**

Consequences of Drug Abuse for:

1) Individual – Education, employment and income issues.
2) Family – Violence
3) Society – Crime.
4) Nation – Law and order problem.

2) Management of Drug abuse:

1) Medical Management: Medication for treatment and to reduce withdrawal effects, Drug De-addiction clinics, Relapse management.
2) Psycho-Social Management: Counselling, family and group therapy, behavioural and cognitive therapy, Environmental Intervention.

3) Prevention of Drug Abuse:

1) Role of family: Parent child relationship, Family support, Supervision, Shaping values, Active Scrutiny.
2) School
   Counselling, Teacher as role-model. Parent-Teacher-Health Professional Coordination, Random testing on students.
3) Media:
   Restraint on advertisements of drugs, advertisements on bad effects of drugs, Publicity and media, Campaigns against drug abuse,
   Educational and awareness program
4) Legisltaion: NDPs act, Statutory warnings, Policing of Borders, Checking Supply/Smuggling of Drugs, Strict enforcement of laws, Time bound trials.

References:

1. Extent, Pattern and Trend of Drug Use in India, Ministry of Social Justice and Empowerment, Government of India, 2004.
2. Inciardi, J.A. 1981. *The Drug Crime Connection*. Beverly Hills: Sage Publications.
3. Modi, Ishwar and Modi, Shalini (1997) *Drugs: Addiction and Prevention*, Jaipur: Rawat Publication.
4. Sain, Bhim 1991, *Drug Addiction Alcoholism*, Smoking obscenity New Delhi: Mittal Publications.
5. Sandhu, Ranvinder Singh, 2009, *Drug Addiction in Punjab*: *A Sociological Study. Amritsar*: Guru Nanak Dev University.
6. Singh, Chandra Paul 2000. *Alcohol and Dependence among Industrial Workers*: Delhi: Shipra.
7. World Drug Report 2011, United Nations office of Drug and Crime.
8. World Drug Report 2010, United Nations office of Drug and Crime.

B.Tech. (Mechanical Engineering) 3rd Semester
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MTL201: MATHEMATICS-III

L T P
3 1 0

UNIT – I

Probability: Classical and axiomatic approach to the theory of probability, additive and multiplicative law of probability, conditional probability and bayes theorem.

Random Variables: Random Variables, probability mass function, probability density function, cumulative distribution function, function of random variable. Two and higher dimensional random variables, joint distribution, marginal and conditional distributions, Stochastic independence.

UNIT – II

Expectation: Mathematical expectations and moments, moment generating function and its properties.
Probability Distributions: Binomial, Poisson, Uniform, Exponential, Gamma, Normal distribution, t–distribution, chi–square distribution, F–distribution.

UNIT – III

Uniform Pseudo random number generation and random variable generation, Generating random variate from standard statistical distribution (discrete and continuous distribution), Monte– Carlo integration.

Books Recommended:

1. Hogg, RV, Mckean, JW and Craig, AT: Introduction to Mathematical Statistics.

2. Gupta, SC and Kapoor, K: Fundamentals of Mathematical Statistics, Sultan Chand & Co.

3. Rubinstein, R.Y.: Simulation and the Monte Carlo Method, John Wiley.

4. Probability and Statistics with Reliability by KS Trivedi, Prentice Hall.

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MEL211: Solid Mechanics

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3 1 0

Course Objectives and Course Outcomes: To familiarize the students with the fundamentals of deformation, stresses, strains in structural elements. Know the concepts of stress and strain, Analyze the beam of different cross sections for shear force, bending moment, slope and deflection, Understand the concepts necessary to design the structural elements and pressure vessels, Understand the concept of torsion

UNIT-I

1: Simple Stresses and Strains- Concept of stress and strain, St. Venant's principle, stress and strain diagram, Hooke's law, Young's modulus, Poisson's ratio, stress at a point, stresses and strains in bars subjected to axial loading, Modulus of elasticity, stress produced in compound bars subjected to axial loading. Temperature stress and strain calculations due to applications of axial loads and variation of temperature in single and compound walls.

2: Compound Stresses and Strains- Two dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr's circle of stress, ellipse of stress and their applications. Two dimensional stress-strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain. Relationship between elastic constants.

Unit-II

3: Bending moment and Shear Force Diagrams- Bending moment (BM) and shear force (SF) diagrams. BM and SF diagrams for cantilevers simply supported and fixed beams with or without overhangs. Calculation of maximum BM and SF and the point of contra flexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.

4: Theory of bending stresses-Assumptions in the simple bending theory, derivation of formula: its application to beams of rectangular, circular and channel sections, Composite beams, bending and shear stresses in composite beams.

5: Slope and deflection- Relationship between moment, slope and deflection, Moment area method, Macaulay's method. Use of these methods to calculate slope and deflection for determinant beams.

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UNIT-III

6: Torsion - Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity., Combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion. Analysis of close-coiled-helical springs.

7: Thin Cylinders and Spheres- Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder, and sphere subjected to internal pressures.

8: Columns and Struts- Columns under uni-axial load, Buckling of Columns, Slenderness ratio and conditions. Derivations of Euler's formula for elastic buckling load, equivalent length. Rankine Gordon's empirical formula.

Suggested Books:

1. Pytel A H and Singer F L, *"Strength of Materials"*, Harper Collins, New Delhi.
2. Beer P F and Johston (Jr) E R, *"Mechanics of Materials"*, SI Version, McGraw Hill, NY.
3. Popov E P, *"Engineering Mechanics of Solids"*, SI Version, Prentice Hall, New Delhi.
4. Timoshenko SP and Young DH, *"Elements of Strength of Materials"*, East West Press, New Delhi.
5. Shames, I. H., Pitarresi, J. M., "*Introduction to Solid Mechanics*," Prentice-Hall, NJ.
6. NPTEL courses, http://nptel.iitm.ac.in/courses.php, web and video courses on Strength of Materials by Prof. Sharma, S. C., and Prof. Harsha, S. P.

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MEL212: Primary Manufacturing

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Course Objectives and Course Outcomes: This course is designed to provide students with an overview of a wide variety of manufacturing processes for processing of engineering materials. The students will learn principles, operations and capabilities of various metal casting and metal joining processes. They will also learn about the defects, their causes and remedies in these processes. Upon completion of the course, the students should have the ability to understand the importance of the manufacturing processes and to select a suitable metal casting and metal joining processes to fabricate an engineering product.

UNIT-I

1: General Introduction-Manufacturing; definition and broad classification with typical examples of applications.

2: Casting-Introduction; History of the technology; Definition and major classification; Casting materials, Sand mould casting: Basic principles with simple examples of a solid casting and a hollow casting. Patterns; types, material and design including pattern allowances; Moulding sands; composition, preparation, properties and testing; Core; Purpose, definition, materials, preparation and applications; Design of gating system; pouring basin, sprue, runner and risers; Advantages, limitations and applications of top gate, bottom gate, parting gate and step gate; Estimation of pouring time for top gate and bottom gate type moulds. Foundry equipment and furnaces. Melting, pouring and solidification. Principles, method, relative advantages and applications of floor mould casting, shell mould casting, pit mould and loam mould casting CO2 mould casting; centrifugal casting (pure, semi and centrifuging types) investment casting including mercasting ; Permanent mould casting. Die casting; types, methods, relative advantages and applications Slush casting; principle and use, Casting defects; types, causes and remedy

UNIT-II

3: Forming Processes - Introduction; General principles; major classification with typical examples; Hot working and cold working; principle, purpose, relative advantages and applications. Forging:-Definition and classification giving few example of application; work materials different forging operations, tools and equipment; Smithy, drop forging and press forging (pressing) methods and use; Forging dies ;types, materials and design. Rolling: Introduction; basic principles and general applications; Characteristics and applications of hot rolling and cold rolling; various rolling processes and applications and rolled products; Roll pass design for different products Wire drawing and Extrusion: Basic principles and requirements; Classification, methods and applications; Work materials and products; Press tool works; Basic principles, system, operations and applications.

Shearing; Parting, notching, blanking and piercing. Cupping (drawing) and deep drawing. Design of blanks for any shearing and cupping operation. Estimation of forces and power required for shearing and cupping operations. Coining and embossing; basic principle and methods. Other forming processes: Principles, methods, essential requirements and applications of Spinning and flow turning; Bulging; Hydro forming; Magneto forming; Explosive forming.

UNIT-III

4: Welding- Introduction: Major classes of joining; Mechanical joining; temporary, semi- permanent and permanent Giving examples; Welding; Brazing and soldering; Adhesive bonding; Welding in Liquid state. Fusion welding: - Introduction; basic principle, definition and major classification; characteristics and applications of different fusion welding processes using different heat-sources. Heat source:-chemical; gas welding; thermit welding; Heat source:- electrical; Arc welding; Manual arc welding; Submerged arc welding; TIG and MIG; Induction welding; Plasma arc welding; Resistance welding; Spot welding; Butt welding; Seam welding; Projection welding. Laser beam welding and electron beam welding. Solid state welding: - Principles. Methods, requirements and application of the different types; Solid state welding in hot condition; Forge welding; Friction welding; Diffusion welding; Solid state welding in cold condition; Ultrasonic welding. Pressure welding. Explosive welding. Welding defects; Types, causes, effects and remedy.

Suggested Books:

1. Rao.P.N. 2001. Manufacturing technology: foundry, forming and welding: McGraw-Hill.

2. Ghosh, A., & Mallik, A. K. 1986. Manufacturing science: Ellis Horwood.

3. Kalpakjian, S., & Schmid, S. R. 2008. Manufacturing processes for engineering materials: Pearson Education.

4. Campbell, J. S. Principles of manufacturing materials and processes: Tata McGraw-Hill

5. Date. P.P. *Introduction to manufacturing processes;* Jaico Publishing House

6. NPTEL courses, *http://www.nptel.iitm.ac.in/courses.php?disciplineId=112* web and video resources on Manufacturing Processes - I.

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MEL213: Thermodynamics

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Course Objectives and Course Outcomes: This course is designed for comprehensive study of combustion and thermal aspects in internal combustion engines, steam power plants and its allied components. This will enable the students to understand combustion phenomenon and thermal analysis of steam power plant components. The students will be able to identify, track and solve various combustion problems and evaluate theoretically the performance of various components involved in steam power plants and internal combustion engines.

Unit-I

1: Basic Concepts- Basic concepts-concept of continuum, macroscopic approach, Thermodynamic systems - closed, open and isolated. Property, state, path and process, quasi- static process, work, modes of work. Zeroth law of thermodynamics, concept of temperature and heat. Concept of ideal and real gases.

2: First Law of Thermodynamics-Concepts of Internal Energy, Specific Heat Capacities, Enthalpy. Energy Balance for Closed and Open Systems, Energy Balance for Steady-Flow Systems. Steady-Flow Engineering Devices. Energy Balance for Unsteady-Flow

3: Second Law of Thermodynamics-Thermal energy reservoirs, heat engines energy conversion, Kelvin's and Clausius statements of second law, the Carnot cycle, the Carnot Theorem, the thermodynamic temperature scale, the Carnot heat engine, efficiency, the Carnot refrigeration and heat pump, COP. Clausius inequality, concept of entropy, principle of increase of entropy – availability, the increase of entropy principle, perpetual-motion machines, reversible and irreversible processes, Entropy change of pure substances, isentropic processes, property diagrams involving entropy, entropy change of liquids and solids, the entropy change of ideal gases, reversible steady-flow work, minimizing the compressor work, isentropic efficiencies of steady- flow devices, and entropy balance.
Energy - a measure of work potential, including work potential of energy, reversible work and irreversibility, second-law efficiency, energy change of a system, energy transfer by heat, work, and mass, the decrease of energy principle and energy destruction, energy balance: closed systems and control volumes energy balance.

Unit-II

4: Properties of Pure Substance- Properties of pure substances. Thermodynamic properties of pure substances in solid, liquid and vapour phases. Phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces. Thermodynamic properties of steam. Calculations of work done and heat transfer in non- flow and flow processes.

5: Power Cycles- Vapour and combined power cycles, including the Carnot vapor cycle, Rankine cycle: the ideal cycle for vapor power, the ideal reheat and regenerative and the second- law analysis of vapour power cycles. Gas power cycles, including basic considerations in the analysis of power cycles, the Carnot cycle and its value in engineering, , an overview of reciprocating engines, air standard assumptions ,gasoline engine Otto cycle, diesel engine cycle, gas-turbine Brayton cycle, and the second-law analysis of gas power cycles.

Unit-III

6: Ideal and Real Gases and Thermodynamic Relations- Gas mixtures – properties ideal and real gases. Equation of state, Avogadro's Law, Vander Waal's equation of state, Compressibility factor, compressibility chart. Dalton's law of partial pressure. Exact differentials, T-D relations, Maxwell's relations. Clausius Clapeyron equations, Joule – Thomson coefficient.

7: Psychrometry and psychrometric charts, property calculations of air vapour mixtures. Psychrometric process – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling. Use of standard thermodynamic tables, Mollier diagram, Psychometric chart and Refrigerant property tables. Refrigeration cycles, including refrigerators and heat pumps, the ideal reversed Carnot vapour- compression refrigeration cycle, actual vapor- compression refrigeration cycles, heat pump systems, gas refrigeration cycles, and absorption refrigeration systems.

Text/ Reference Books:

1. Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi.

2. Cengel, „Thermodynamics – An Engineering Approach' Tata McGraw Hill, New Delhi.

3. Sonntag, R. E., Borgnakke, C., & Wylen, G. J. V. *Fundamentals of thermodynamics*: Wiley.

4. Moran, M. J., Shapiro, H. N., Boettner, D. D., & Bailey, M. *Fundamentals of Engineering Thermodynamics*: John Wiley & Sons.

5. Jones, J. B., & Dugan, R. E. *Engineering thermodynamics*: Prentice Hall.

6. Potter, M. C., & Somerton, C. W. *Schaum's Outline of Thermodynamics for Engineers*, McGraw- Hill.

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MEL214: ENGINEERING MATERIALS

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Course Objectives and Course Outcomes:

This course is designed to develop fundamental concepts of crystallography, phase transformation and heat treatment processes. The students will learn the atomic structure of metals, imperfections, diffusion mechanisms and theories of plastic deformation. They will also understand equilibrium diagrams, time-temperature transformation curves and heat treatment processes. Upon completion of the course, the students will be able to understand the concepts of crystal structure, microstructure and deformation. They will also be able to understand the phase diagrams which are useful for design and control of heat treating processes.

UNIT-I

1: Basic Crystallography- Crystal structure – BCC, FCC and HCP structure – unit cell – crystallographic planes and directions, miller indices. Crystal imperfections, point, line, planar and volume defects – Grain size, ASTM grain size number. Frank Reed source of dislocation Elastic & plastic modes of deformation, slip & twinning, strain hardening, seasons cracking, Bauschinger's effect, yield point phenomenon, cold/hot working, recovery, re-crystallization, and grain growth, strengthening of metals.

2: Constitution of Alloys and Phase Diagrams- Constitution of alloys – Solid solutions - substitutional and interstitial. Phase diagrams, Isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions. Iron – Iron carbide equilibrium diagram. Classification of steel and cast Iron microstructure, properties and application.

3: Heat Treatment-Definition – Full annealing, stress relief, recrystallisation and spheroidizing – normalising, hardening and tempering of steel. Isothermal transformation diagrams–cooling curves superimposed on I.T. diagram CCR Hardenability, Jominy end quench test–Austempering, martempering. Case hardening, carburising, nitriding, cyaniding, carbonitriding – Flame and Induction hardening.

UNIT-II

4: Ferrous and Non Ferrous Metals- Effect of alloying additions on steel (Mn, Si, Cr, Mo, V Ti & W) - stainless and tool steels – HSLA. Gray, White malleable, spheroidal -Graphite - alloy cast-iron. Copper and Copper alloys – Brass, Bronze and Cupronickel. Aluminium and Al-Cu – precipitation strengthening treatment – Bearing alloys.

5: Non-Metallic Materials- Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE Polymers. Urea and Phenol formaldehydes. Engineering Ceramics – Properties and applications of Al2O3, SiC, SiC, Si3, N4, PSZ etc. Fibre and particulate reinforced composites and resin plastics. Powder metallurgy, Manufacturing Process, Compacting, Sintering, Vacuum processing. Properties of Powder processed materials, high energy compaction. Metal matrix composites, preparation properties and uses.

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UNIT-III

6: Mechanical Properties and Testing- Mechanism of plastic deformation, slip and twinning. Types of fracture – Testing of materials under tension, compression and shear loads – dness tests (Brinell, Vickers and Rockwell) Impact test, Izod and charpy, fatigue and creep test.

7: Introduction to Science and Technology of Nano materials- Nano structured materials, Low- dimensional structures: Quantum wells, Quantum wires, and Quantum dots, Nano clusters & Nano crystals. Electronic and optical properties of nano crystallites, Metallic and semiconducting super lattices. Synthesis of nanostructured materials, Fabrication and characterization of nano electronic devices and MEMS. Basics of synthesis and characterization of nano-multi-component systems for sensors (magnetic, electronic and optical) and electrodes. Synthesis and fabrication of carbon nano structures for fuel cell and energy storage applications.

Suggested Books:

1. Kenneth G. Budinski and Michael K.Budinski, *Engineering Materials* Prentice-Hall of
   India
2. William D Callister, Material *Science and Engineering*, John Wiley and Sons.
3. Raghavan.V. *Materials Science and Engineering*, Prentice Hall of India.
4. Lakhtin, Y., & Weinstein, N. *Engineering Physical Metallurgy*: University Press of the
   Pacific.
5. Avner, S. H. *Introduction to physical metallurgy*: McGraw-Hill.
6. Jacobs, J. A., & Kilduff, T. F. *Engineering Materials Technology: Structures, Processing, Properties, and Selection:* Pearson/Prentice Hall.
7. Bolton, W., Engineering *materials technology*: Butterworth-Heinemann.
8. Flinn, R. A., & Trojan, P. K., Engineering *Materials and Their Applications*: Wiley
9. Koch, C. C. *Nanostructured materials: processing, properties, and applications*: William
   Andrew Pub.
10. NPTEL courses, *http://www.nptel.iitm.ac.in/courses.php?disciplineId=112:* related web and video resources under *Mechanical Engineering* & *Metallurgy and Material Science*

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MEL215: Machine Drawing

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Course Objectives and Course Outcomes:
The objective of this course is to make students understand the principles and requirements of production drawings and learning how to assemble and disassemble important parts used in major mechanical engineering applications. After going through this course, the student shall be able to understand the drawings of mechanical components and their assemblies along with their utility for design of components

Introduction: Principles of Drawing, Requirements of production drawing, Sectioning and conventional representation, Dimensioning, symbols of standard tolerances, Machining Symbols, introduction and Familiarization of Code IS: 296

Classification of Machine Drawings (with examples): Assembly Drawing, Part Drawing, Detailed Drawing, Catalogues Drawing.

Conventional Representation of Machine Components: screw threads, spring, gears, bearings, splined shaft,

Assembly and Part Drawings: couplings, clutches, bearings, gear assemblies, I.C. Engine components, valves, machine tools, etc.

Symbols: Symbols for surface roughness, Weldments, process flow, electrical and instrumentation units.

Solid Modeling: Introduction to solid modelers, solid modeling of various machine parts.

Project: A drawing project.

Suggested Books:

1. Ajeet Singh, Machine drawing Includes AutoCAD, Tata Mc GrawHill, 2008.
2. ND Junnarkar, Machine Drawing, Pearson Education, 2007.
3. N. D. Bhatt, Machine Drawing, Charotar Book Stall, Anand, 1996.
4. N. Sidheswar, P. Kanniah and V. V. S. Sastry, Machine Drawing, Tata McGraw Hill, 1983.
5. National Drawing Code, http://bis.org.in/other/WC_SP_46_03122014.pdf

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ESL 220: ENVIRONMENTAL STUDIES

Credit 3-0-0

1. **The Multidisciplinary Nature of Environmental Studies:** Definition, scope & its importance, Need for public awareness.

2. **Natural Resources**: Natural resources and associated problems.
   - **a)** **Forest Resources**: Use of over exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
   - **b)** **Water Resources**: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
   - **c)** **Mineral Resources**: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
   - **d)** **Food Resources**: World food problems, change caused by agriculture and overgrazing, effects or modern agriculture, fertilizer-pesticide problem, salinity, case studies.
   - **e)** **Energy Resources**: Growing of energy needs, renewable and non-renewable energy resources, use of alternate energy sources, case studies.
   - **f)** **Land Recourses**: Land as a resource, land degradation, soil erosion and desertification.
   - **g)** Role of an individual in conservation of natural resources, Equitable use of resources for sustainable lifestyles.

3. **Ecosystem:**
   Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids.
   Introduction, types, characteristic features, structure and function of the following ecosystems:
   a. Forest ecosystem
   b. Grassland ecosystem
   c. Desert ecosystem
   d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

4. **Biodiversity and its Conservation:**
   Definition: Genetic, species and ecosystem diversity, Biogeographical classification of India.
   Value of Biodiversity: Consumptive use; productive use, social, ethical, aesthetic and option values.
   Biodiversity of global, National and local levels, India as mega-diversity nation "Hot-spots of biodiversity.
   Threats to Biodiversity: Habitat loss, poaching of wild life, man wildlife conflicts Endangered and endemic species of India.
   Conservation of Biodiversity: In situ and Ex-situ conservation of biodiversity.

5. Environmental Pollution:

Definition, Causes, effects and control measures of:

a) Air Pollution
b) Water Pollution
c) Soil Pollution
d) Marine Pollution
e) Noise Pollution
f) Thermal Pollution
g) Nuclear Hazards

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes.

Role of an individual in prevention of pollution.

Pollution case studies Disaster Management: Floods, Earthquake, Cyclone and Landslides

6. Social Issues and Environment:

* From unsustainable to sustainable development
* Urban problems related to energy
* Water conservation, rain water harvesting, watershed management
* Resettlement and rehabilitation of people; its problems and concerns. Case studies
* Environmental ethics: Issues and possible solutions.
* Climate change, global warning, acid rain, ozone layer depletion, nuclear accidents and holocause. Case studies.
* Wasteland reclamation
* Consumerism and waste products
* Environmental Protection Act
* Air (prevention and Control of Pollution) Act
* Water (prevention and Control of Pollution) Act
* Wildlife Protection Act
* Forest Conservation Act
* Issues involved in enforcement of environmental legislation
* Public awareness

7. Human Population and the Environment

* Population growth, variation among nations
* Population explosion-Family welfare programme
* Environment and human health
* Human rights
* Value education
* HIV / AIDS
* Women and child welfare
* Role of information technology in environment: and human health
* Case studies

* **Road Safety Rules & Regulations:** Use of Safety Devices while Driving, Do's and Don'ts while Driving, Role of Citizens or Public Participation, Responsibilities of Public under Motor Vehicle Act, 1988, General Traffic Signs
* **Accident & First Aid:** First Aid to Road Accident Victims, Calling Patrolling Police & Ambulance

8. National Service Scheme

- **Introduction and Basic Concepts of NSS:** History, philosophy, aims & objectives of NSS: Emblem, flag, motto, song, badge etc.; Organization structure, roles and responsibilities of various NSS functionaries.
- **Health, Hygiene & Sanitation:** Definition, needs and scope of health education; Food and Nutrition; Safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan); National Health Programme; Reproductive health.
- **Civil/Self Defense:** Civil defense services, aims and objectives of civil defense; Needs for self defense training.

9. Field Work: Visit to a local area to document environmental assets–river / forest / grassland / hill / mountain. Visit to a local polluted site–Urban / Rural / Industrial / Agricultural. Study of common plants, insects, birds. Study of simple ecosystems–pond, river, hill slopes, etc. (Field work equal to 5 lecture hours)

References:

1. Agarwal, K. C. 2001. Environmental Biology, Nidhi Publications Ltd. Bikaner.
2. Bharucha, E. 2005. Textbook of Environmental Studies, Universities Press, Hyderabad.
3. Bharucha, E. 2004. The Biodiversity of India, Mapin Publishing Pvt. Ltd. Ahmedabad.
4. Brunner, R. C. 1989. Hazardous Waste Incineration, McGraw Hill Inc. New York.
5. Clark, R. S. 2000. Marine Pollution, Clanderson Press Oxford.
6. Cunningham, W. P., Cooper, T. H., Gorhani, E. & Hepworth, M. T. 2001. Environmental Encyclopedia, Jaico Publications House, Mumbai.
7. De, A. K. 1989. Environmental Chemistry, Wiley Eastern Ltd.
8. Down to Earth, Centre for Science and Environment, New Delhi.
9. Hawkins, R. E. 2000. Encyclopedia of Indian Natural History, Bombay Natural History Society.

10. Heywood, V. H & Waston, R. T. 1995. Global Biodiversity Assessment, Cambridge House, Delhi.
11. Jadhav, H. & Bhosale, V. M. 1995. Environmental Protection and Laws. Himalaya Pub.
12. Joseph, K. and Nagendran, R. 2004. Essentials of Environmental Studies, Pearson Education (Singapore) Pte. Ltd., Delhi.
13. Kaushik, A. & Kaushik, C. P. 2004. Perspective in Environmental Studies, New Age International (P) Ltd, New Delhi.
14. Miller, T. G. Jr. 2000. Environmental Science, Wadsworth Publishing Co.
15. Odum, E. P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA.
16. Rajagopalan, R. 2005. Environmental Studies from Crisis to Cure. Oxford University Press, New Delhi.
17. Sharma, B. K. 2001. Environmental Chemistry. Geol Publishing House, Meerut.
18. Sharma, J. P. 2004. Comprehensive Environmental Studies, Laxmi Publications (P) Ltd, New Delhi.
19. Sharma, P. D. 2005. Ecology and Environment, Rastogi Publications, Meerut.
20. Subramanian, V. 2002. A Text Book in Environmental Sciences, Narosa Publishing House, New Delhi.
21. Survey of the Environment. 2005. The Hindu.
22. Tiwari, S. C. 2003. Concepts of Modern Ecology, Bishen Singh Mahendra Pal Singh, Dehra Dun.
23. Townsend, C., Harper, J. and Michael, B. 2001. Essentials of Ecology, Blackwell Science.
24. Booklet on Safe Driving. Sukhmani Society (Suvidha Centre), District Court Complex, Amritsar

B.Tech. (Mechanical Engineering) 3rd Semester
(Under Credit Based Continuous Evaluation Grading System)

ENP291: Written & Oral Technical Communication Skills Lab

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Students should be asked to prepare Technical Presentation on the emerging areas of Information Technology and present the same to the group of Students.

B.Tech. (Mechanical Engineering) 3rd Semester
(Under Credit Based Continuous Evaluation Grading System)

MEP211: Solid Mechanics Lab

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1. To perform tensile test in ductile and brittle materials and to draw stress-strain curve and to determine various mechanical properties.

2. To perform compression test on Cast Iron.

3. To perform any one hardness tests (Rockwell, Brinell & Vicker's test).

4. To perform impact test to determine impact strength.

5. To perform torsion test and to determine various mechanical properties.

6. To perform Fatigue test on circular test piece.

7. To perform bending test on beam and to determine the Young's modulus and modulus of rupture.

8. Determination of Bucking loads of long columns with different end conditions.

B.Tech. (Mechanical Engineering) 3rd Semester
(Under Credit Based Continuous Evaluation Grading System)

MEP 212: Primary Manufacturing Lab

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Casting:

1. To determine clay content, moisture content, hardness of a moulding sand sample.
2. To determine shatter index of a moulding sand sample.
3. To test tensile, compressive, transverse strength of moulding sand in green condition.
4. To determine permeability and grain fineness number of a moulding sand sample.

Welding:

1. To make lap joint, butt joint and T- joints with oxy- acetylene gas welding and manual arc welding processes
2. To study MIG, TIG and Spot welding equipment and make weld joints by these processes.

Machining and Forming:

1. To study constructional features of following machines through drawings/ sketches:
   a. Grinding machines (Surface, Cylindrical)
   b. Hydraulic
   Press c. Draw
   Bench
   d. Drawing and Extrusion
   Dies e. Rolling Mills
2. To grind single point and multipoint cutting tools
3. To prepare job on Lathe involving specified tolerances; cutting of V- threads and square threads.
4. To prepare job on shaper involving plane surface,
5. Use of milling machines for generation of plane surfaces, spur gears and helical gears; use of end mill cutters.
6. To determine cutting forces with dynamometer for turning, drilling and milling operations.

B.Tech. (Mechanical Engineering) 3rd Semester
(Under Credit Based Continuous Evaluation Grading System)

MEP 214: Engineering Material Lab

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1. Preparation of models/charts related to atomic/crystal structure of metals.
2. Annealing the steel specimen and study the effect of annealing time and temperature on hardness of steel.
3. Hardening the steel specimen and study the effect of quenching medium on hardness of steel.
4. Practice of specimen preparation (cutting, mounting, polishing, etching) of mild steel, aluminium and hardened steel specimens.
5. Study of the microstructure of prepared specimens of mild steel, Aluminium and hardened steel.
6. Identification of ferrite and pearlite constituents in given specimen of mild steel.
7. Determination of hardenabilty of steel by Jominy End Quench Test.

B.Tech. (Mechanical Engineering) 3rd Semester
(Under Credit Based Continuous Evaluation Grading System)

MEP 215: Basic Simulation Laboratory

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(Simulation Lab. Experiments may be carried out using MATLAB)

1: Creating a One-Dimensional Array (Row / Column Vector) Exercise – Creating a vector of even whole numbers between 31 and 75; Creating a Two-Dimensional Array (Matrix of given size) and (A). Performing Arithmetic Operations - Addition, Subtraction, Multiplication and Exponentiation. (B). Obtaining Modified Matrix - Inverse, Transpose, with Appended and Deleted Elements.

2: Performing Matrix Manipulations - Concatenating, Indexing, Sorting, Shifting, Reshaping, Resizing and Flipping about a Vertical Axis / Horizontal Axis; Creating Arrays X & Y of given size (1 x N) and Performing (A). Relational Operations - >, <, ==, <=, >=, ~= (B). Logical Operations - ~, &, |, XOR

3: Generating a set of Commands on a given Vector (Example: X = [1 8 3 9 0 1]) to (A).
Add up the values of the elements (Check with **sum**)
(B). Compute the Running Sum (Check with **sum**), where Running Sum for element j = the sum of the elements from 1 to j, inclusive.
(C). Compute the Sine of the given X-values (should be a vector).
Also, Generating a Random Sequence using **rand() / randn()** functions and plotting them.

4: Evaluating a given expression and rounding it to the nearest integer value using Round, Floor, Ceil and Fix functions; Also, generating and Plots of (A) Trigonometric Functions - *sin(t), cos(t), tan(t), sec(t), cosec(t) and cot(t)* for a given duration *„t'*. (B). Logarithmic and other Functions – log(A), $\log_{10}$(A), Square root of A, Real n^{th} root of A.

5: Creating a vector X with elements, $X_n = (-1)^{(n+1)} / (2n-1)$ and adding up 100 elements of the vector X; and plotting the function, x, x^3, e^x, and $\exp^{(x.x)}$ the interval $0 < x < 4$ (by choosing appropriate mesh values for x to obtain smooth curves), on (A). A Rectangular Plot (B).
A Semi log Plot (C). A log-log Plot.

6: Generating a Sinusoidal Signal of a given frequency (say, 100Hz) and Plotting with Graphical Enhancements - Titling, Labelling, Adding Text, Adding Legends, Adding New Plots to Existing Plot, Printing Text in Greek Letters, Plotting as Multiple and
Sub-Plots; *Also,* Making Non-Choppy and Smooth Plot of the functions, $f(x) = \sin(1/x)$ for $0.01 < x < 0.1$ and $g(x) = (\sin x)/x$.

7: Creating A Structure, An Array of Structures and Writing Commands to Access Elements of the created Structure and Array of Structures; *Also,* Solving First Order Ordinary Differential Equation using Built-in Functions; *And,* Creating an M x N Array of Random Numbers using **rand** and setting any value that is < 0.2 to „0' and any value that is ≥ 0.2 to „1' by moving through the Array, Element by Element;

8: Generating normal and integer random numbers (1-D & 2-D) and plotting them;*Also,* Writing a Script (which keeps running until no number is provided to convert) that asks for Temperature in degrees Fahrenheit and Computes the Equivalent Temperature in degrees Celsius. [Hint: Function **is empty** is useful]

9: Writing brief Scripts starting each Script with a request for input (using **input**) to Evaluate the function h(T) using if-else statement, where h(T)=(T – 10) for $0 < T < 100$
=(0.45T+900) for T>100
Exercise: Testing the Scripts written using
A). T = 5, h = -5 and B). T = 110, h = 949.5 Also, Creating a Graphical User Interface (GUI); And, Curve Fitting using
(A) Straight line Fit
(B). Least Squares Fit

10: Interpolation based on following Schemes (A). Linear (B). Cubic (C). Spline *Also,* Generating the first Ten Fibonacci numbers according to the relation $F_n = F_{n-1} + F_{n-2}$ with $F_0 = F_1 = 1$, and Computing the ratio F_n / F_{n-1} for the first 50 Fibonacci numbers. [Exercise: Verifying that the computed ratio approaches the value of the golden mean (1 + sqrt(5)) / 2]; *Also* Generating Equivalent Square Wave from a Sine Wave of given Amplitude and Frequency; And,. Obtaining the Covariance & Correlation Coefficient Matrices for a given Data Matrix.

Text Books:

1. *Getting Started with MATLAB - A Quick introduction for Scientists & Engineers* by Rudra Pratap, Oxford Univ. Press, 5th edition, 2010.
2. *MATLAB An Introduction with Applications* by Amos Gilat, Wiley Student Edition, 2009.
3. *MATLAB Programming for Engineers* by Stephen J. Chapman, Thomson Learning, 2008.

Reference Books:

1. www.mathworks.com/nn8/moler, e-book, 2009.
2. *Introduction to MATLAB 7 for Engineers* by William Palm III, McGraw-Hill, 2nd Edition, 2004.
3. *MATLAB and its Applications in Engineering* by Raj Kumar Bansal, Ashok Kumar
4. Goel, Manoj Sharma - Pearson Education,1st Edition, 2009.

B.Tech. (Mechanical Engineering) 4th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEL221: Mechanisms and Machines

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Course Objectives and Course Outcomes:
Planar kinematics of rigid bodies, systems of rigid bodies and particles, problem formulation and solution methods for the dynamic equations of motions for planar motion of rigid bodies, develop simplified, rigid body models for systems of mechanical components, introduce the concepts and uses of work and kinetic energy, understand fundamental concepts and solution strategies for cams, mechanical vibration problems, gears, concept of balancing. The students will understand the basic concepts of machines and able to understand constructional and working features of important machine elements. The students should be able to understand various parts involved in kinematics of machines for different applications. The students shall also be able to understand requirements of basic machine parts which would help them to understand the design aspects of the machine parts.

Unit-I

1. Introduction-General concepts, Introduction of Simple mechanism, Different types of Kinematics pair, Grublers rule for degree of freedom, Grashof's Criterion for mobility determination. Inversions of 3R-P, 2R-2P chains.

2. Kinematic Analysis – Concepts of vectorial analysis. Velocity and Acceleration, Analysis of planar mechanisms.

3. Cams-Classification, Cams with uniform acceleration and retardation, SHM, Cylcloidal motion, oscillating followers.

Unit-II

4. Vibrations- Vibration analysis of SDOF systems, Natural, damped forced vibrations, Based- excited vibrations, transmissibility ratio.

5. Gears- Geometry of tooth profiles, Law of gearing, Involute profile, interference, helical, spiral and worm gears, simple, compound gear trains. Epicyclic gear trains – Analysis by tabular and relative velocity method, fixing torque.

6. Dynamic Analysis- Slider-crank mechanisms, turning moment computations.

Unit-III

7. Balancing- Static and Dynamic balancing, Balancing of revolving & reciprocating masses in single and multi-cylinder engines.

8. Gyroscopes-Basic concepts Gyroscopic law, effect of gyroscopic couple on automobiles, ships, aircrafts.

Suggested Books:

1. Mallik, A. K., Ghosh, A., & Dittrich, G. *Kinematic analysis and synthesis of mechanisms*: CRC Press.
2. Uicker, J. J., Pennock, G. R., & Shigley, J. E. *Theory of machines and mechanisms*: OUP.
3. Norton, R.L. *Design of machinery: An Introduction to the Synthesis and Analysis of Mechanisms and Machines*: McGraw-Hill.
4. Rattan.S.S. *Theory of Machines*: McGraw-Hill Education (India) Pvt Ltd.
5. Rao, J. S. The Theory of Machines Through Solved Problems: New Age International.
6. Ballaney PL, *Theory of Machines and Mechanisms*, Khanna Publications.
7. Bevan, T. *The theory of machines: A Text-Book for Engineering Students*: Pearson Education
8. Vinogradov, O. G. *Fundamentals of Kinematics and Dynamics of Machines and Mechanisms:* CRC Press.
9. NPTEL courses: *http://nptel.iitm.ac.in/courses.php*, related web and video resources on Kinematics of Machines and Dynamics of Machines.

B.Tech. (Mechanical Engineering) 4th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEL222: CAD and Computer Graphics

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Course objectives and Course outcomes:

Overview of CAD, CAD Applications, Solid Modeling: Wireframe, B-Rep, CSG approaches, Transformations and Projections, Mathematical representation of curves and surfaces, Ferguson, Bezier and B-spline curves and properties, Ferguson, Bezier and Bspline surfaces and properties, Computations for Geometric Design, Introduction to Finite Element Analysis and Optimization.

Unit-I

1. Introduction-Need and Scope of Computer Aided Design, Fundamental of CAD and computer graphics-Application areas, Hardware and software-overview of graphics systems, video-display devices, and raster-scan systems, random scan systems, graphics monitors and workstations and input devices. Interactive hardware/software techniques, Drawing standards, dimensioning and text writing, concept of layers, advanced concepts of CAD software- blocks, UCS, 3D-line, 3D object, DXF & DXB file formats. Output primitives-Points and lines, line drawing algorithms, mid-point circle and ellipse algorithms. Filled area primitives Scan line polygon fill algorithm, boundary fill and flood-fill algorithms.

2. 2-D geometrical transforms-Translation, scaling, rotation, reflection and shear transformations. Matrix representations and homogeneous coordinates, composite transforms, transformations between coordinate systems. 2-D viewing-The viewing pipeline, viewing coordinate reference frame. Window to view port coordinate transformation, viewing functions. Cohen-Sutherland and Cyrus-beck line clipping algorithms, Sutherland–Hodgeman polygon clipping algorithm.

Unit-II

3. 3-D Object Representation-Polygon surfaces, quadric surfaces, spline representation. Hermite curve, Bezier curve and B-Spline curves, Bezier and B-Spline surfaces. Basic illumination models, polygon-rendering methods. 3-D viewing-Viewing pipeline, viewing coordinates, view volume and general projection transforms and clipping.

4. 3-D Geometric transformations-Translation, rotation, scaling, reflection and shear transformations, composite transformations. Visible surface detection methods-Classification, back-face detection, depth buffer, scan-line, depth sorting, BSP-tree methods, area sub- division and octree methods.

Unit-III

5. Finite Element Method- Numerical Methods-Introduction, Errors in numbers, Root finding- Bisection method, Newton Raphson method, Curve fitting-Least square method, Numerical differentiation-Newton's interpolation, Numerical Integration-Trapezoidal and Simpson method. Introduction to the principles of Finite elements modeling, Stiffness matrix/displacement matrix, Stiffness matrix for spring system, bar & beam elements, bar elements in 2D space (truss element), solution of finite element equation-higher order and iso- parametric elements, equilibrium problems in structural mechanics, Eigen value problems.

6. Introduction to CAD CAM- Overview, orientation and application commands of CAD and CAE modeling software platforms for feature based Parametric and Variation modelling and analysis. Boolean, and sweep operations on primitives with applications to CAD of machine elements.

Suggested Books:

1. McConnell, J. J. *Computer Graphics Theory into Practice* Jones and Bartlett Publishers.
2. Davis, M. J. *Computer Graphics* Nova Science Pub Inc.
3. Rogers, D.F., Earnshaw, R.A., Graphics, B.C.S.C., Group, D., & Society, C. G. *Computer Graphics Techniques Theory and Practice* Springer-Verlag.
4. Salomon, D. *Transformations and Projections in Computer Graphics* Springer.
5. Bethune, J. D. *Engineering Design and Graphics with Solid Works* Prentice Hall.
6. Zeid, I. *Mastering CAD/CAM (Engineering Series)* McGraw-Hill Higher Education.
7. NPTEL courses *http//nptel.iitm.ac.in/courses.php*- web and video resources on *Computer Aided Design and Manufacturing.*

B.Tech. (Mechanical Engineering) 4th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEL223: Engineering Workshop-II

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(Practical Hands-on Training with one hour lecture covering salient features of followings):

Unit-I

1. Turning-Taper turning using tailstock offset method and taper turning attachment Eccentric external turning using a four jaw huck.

2. Boring-Using a boring tool–both concentric and eccentric. Boring using a boring bar in a centre lathe. Square and hexagonal hole drilling using die-sinking EDM.

Unit-II

3. Grinding - Cylindrical grinding using grinding attachment in a centre lathe

4. Thread Cutting- Internal and external thread cutting using a single point cutting tool.

5. Gears- Cutting teeth of spur gears using form milling cutter in a universal milling machine, Gear hobbing, Gear shaping.

Unit-III

6. Welding-Introduction. Edge/Joint preparation in welding and joining using shielded metal arc welding. Hands-on practice on metal inert gas welding (MIG) or gas metal arc welding. Hands-on practice on tungsten inert gas welding (TIG) or gas tungsten arc welding. Hands-on practice on spot welding. Hands-on practice on submerged arc welding

Text / Reference Books:

1. Kalpakjian, S. & Schmid, S.R. *Manufacturing Processes for Engineering Materials*: Pearson Education.
2. DeGarmo, E.P., Black, J.T., & Kohser, R. A. *Materials and Processes in Manufacturing*: Wiley.
3. Lindberg, R. A. *Processes and Materials of Manufacture*: Allyn and Bacon.
4. Chapman, W. *Workshop Technology*: Edward Arnold.
5. NPTEL courses, *http://www.nptel.iitm.ac.in/courses.php?disciplineId=112* Web and Video Resources on Manufacturing Processes II by Prof. A.K. Chattopadhyay, Prof. A.B. Chattopadhyay, Prof. S. Paul.

B.Tech. (Mechanical Engineering) 4th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEL224: Design of Machine Elements

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Course objectives and Course outcomes:
Basics of mechanical design: visual thinking, engineering drawing, and machine anatomy.
Basics of manufacturing: processes, and materials aspects. Use of computers in various phases of design and manufacturing.

Course Contents:

Unit-I

1. Introduction to Mechanical Engineering Design- Review of models of Solid mechanics, uncertainties in design equations and factor of safety. Role of off the shelf available machine elements and standards. Standard numbering system including BIS designations of materials. Application of theories of failure to design

Unit-II

2. Design procedure and applications of Statically Loaded Machine Elements- Design of elements subjected to simple loading: Riveted joints, Screws including power screws Bolted joints including eccentrically loaded joints, Axles, and coupling, Clutches and brakes.

Unit-III

3. Fatigue-Introduction to design for fatigue strength. Endurance and modifying factors. Surface strength. Review of design procedure of fatigue failure with application to the design of bolts and springs subjected to fatigue loading.

4. Design procedure and applications of Dynamically Loaded Machine Elements. Shafts, Spur, helical, bevel and worm gears, Journal and rolling contact bearings, Belts and chains. Assemblies of various machine elements like those of a screw jack and a gear box.

Text/Reference Books:

1. Budynas, R. G., & Nisbett, J. K., *Shigley's Mechanical Engineering Design*: McGraw-Hill.
2. Norton, R. L. *Machine Design: an Integrated Approach*: Prentice Hall
3. Spotts, M. F., Shoup, T. E., & Hornberger, L. E. *Design of Machine Elements*: Pearson/Prentice Hall
4. Hamrock,B.J. et.al., Fundamentals of Machine Elements, McGraw Hill
5. Bhandari, V. B. *Design of Machine Elements*: McGraw-Hill Education (India) Pvt Ltd.
6. Juvinall, R. C., & Marshek, K. M. *Fundamentals of Machine Component Design*: John Wiley.
7. NPTEL courses: *http://nptel.iitm.ac.in/courses.php* - Web and Video Resources on *Dynamics of Mechanical System/ Design of Machine Elements /Machine Design.*

B.Tech. (Mechanical Engineering) 4th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEL225: Fluid Mechanics

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Course Objectives and Course Outcomes:
To provide the basic knowledge of fluid statics and dynamics.

Unit-I

1. Basic Concepts and Properties- Fluid – definition, distinction between solid and fluid - s and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary and surface tension. Fluid statics concept of fluid static pressure, absolute and gauge pressures–pressure measurements by manometers and pressure gauges. Hydrostatic forces on submerged surfaces, Stability of floating bodies.

2. Fluid Kinematics and Fluid Dynamics- Fluid Kinematics - Flow visualization - lines of flow- types of flow - velocity field and acceleration - continuity equation (one and three dimensional differential forms)- Equation of streamline - stream function - velocity potential function - circulation - flow net. Fluid dynamics - equations of motion - Euler's equation along a streamline - Bernoulli's equation, applications - Venturi meter, Orifice meter, Pitot tube. Dimensional analysis - Buckingham's Pei theorem- applications - similarity laws and models.

Unit-II

3. Incompressible Fluid Flow- Viscous flow - Navier - Stoke's equation (Statement only) - Shear stress, pressure gradient relationship - laminar flow between parallel plates - Laminar flow through circular tubes. (Hagen Poiseulle's equation). Hydraulic and energy gradient - flow through pipes - Darcy -Weisback's equation – pipe roughness -friction factor- Moody's diagram-minor losses - flow through pipes in series and in parallel - power transmission. Boundary layer flows, boundary layer thickness and boundary layer separation. Drag and lift coefficients.

4. Hydraulic Turbines- Fluid machines definition and classification - exchange of energy - Euler's equation for turbo machines - Construction of velocity vector diagram's - head and specific work - components of energy transfer - degree of reaction. Hydro turbines definition and classifications - Pelton turbine - Francis turbine - propeller turbine Kaplan turbine .Working principles - velocity triangles - work done - specific speed – efficiencies - performance curve for turbines.

Unit-III

5. Hydraulic Pumps-Pumps definition and classifications. Centrifugal pump classifications, working principles, velocity triangles, specific speed, efficiency and performance curves. Reciprocating pump classification, working principles, indicator diagram, work saved by air vessels and performance curves, cavitation in pumps Rotary pumps working principles of gear and vane pumps.

Text /Reference Books:

1. Som, S. K., & Biswas, G. *Introduction to Fluid Mechanics and Fluid Machines*: Tata McGraw- Hill.
2. Fox, R. W., McDonald, A. T., & Pritchard, P. J. *Introduction to fluid Mechanics*: Wiley.
3. Munson, B. R., Young, D. F., & Okiishi, T. H. *Fundamentals of Fluid Mechanics: Student Solutions Manual*: Wiley.
4. Bansal, R. K. *A Textbook of Fluid Mechanics and Hydraulic Machines: (in S.I. Units)*: Laxmi Publications.
5. Massey, B. S., & Ward-Smith, J. *Mechanics of Fluids*: Stanley Thornes.
6. NPTEL Courses: http://nptel.iitm.ac.in/courses.php - Web and Video Resources on *Fluid Mechanics.*

B.Tech. (Mechanical Engineering) 4th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEL226: Mechanical Measurement and Metrology

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Course Objectives:
To impart basic knowledge about the measurement systems and their components and various methods of engineering metrology.

Course Contents: Mechanical Measurement

Unit-I

1. Introduction to measurements, Errors in measurements, Statistical analysis of data, Regression analysis, correlation, estimation of uncertainty and presentation of data, design of experiments.
2. Measurement of field quantities like temperature, pressure, velocity by intrusive and non- intrusive techniques under various conditions met with in practice like steady and transient conditions.

Unit-II

3. Measurement of derived quantities like heat flux, volume/mass flow rate, temperature in flowing fluids.
4. Measurement of thermo-physical properties, radiation properties of surfaces, vibration and noise.

Unit-III

5. Computer assisted data acquisition, data manipulation, data presentation.

Metrology:

1. Measurement of length, measurement of angle
2. Limits and fits
3. Measurement of geometric forms, straightness, flatness, roundness etc. Mechanical and optical methods.
4. Measurement of screw threads and gears.
5. Measurement of surface roughness and texture
6. Introduction to CMM. In-process gages.
7. Inspection and quality monitoring.

B.Tech. (Mechanical Engineering) 4th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEP221: Mechanisms and Machines Lab

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1. To draw displacement, velocity & acceleration diagram of slider - crank and four bar mechanism.

2. To study the various inversions of kinematic chains.

3. Conduct experiments on various types of governors and draw graphs between height and equilibrium speed of a governor.

4. Determination of gyroscopic couple (graphical method).

5. Balancing of rotating masses (graphical method).

6. Cam profile analysis (graphical method)

7. Determination of gear- train value of compound gear trains and epicyclic gear trains.

8. To draw circumferential and axial pressure profile in a full journal bearing.

9. To determine coefficient of friction for a belt-pulley material combination.

10. Determination of moment of inertia of flywheel.

B.Tech. (Mechanical Engineering) 4th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEP222: CAD & Computer Graphics Lab

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COMPUTER AIDED DRAFTING OF MACHINE ELEMENTS:
Orthographic views - Isometric views - Sectional views. Dimensioning - Annotations - Symbols – Welding - Surface finish - Threads. Text - Bill of Materials- Title block. Exercise: Knuckle, Gib and Cotter Joint - Screw Jack - Foot step bearing.

GEOMETRIC MODELING OF MACHINE COMPONENTS:
Protrusion - cut - Sweep - Revolve - Draft and loft - Modify/edit - Pattern - Transformation - Boolean operation. Exercise: Individual parts of Universal Joint - Flange Coupling - Piston and Connecting rod.

CONVERSION OF 3D TO 2D:
Conversion of 3D to 2D and Mass property calculations for parts created in Units I and II.

ASSEMBLY OF MACHINE PARTS:
Exercise: Assemble from parts created in Unit II.

FINITE ELEMENT ANALYSIS:
FEA of simple structural members - Cantilever beam - Simply supported beam and a plate with a hole.

LIST OF EXPERIMENTS:

1. Orthographic projections – I (from part model)
2. Orthographic projections – II (from assembly model)
3. 3D part modeling with basic features.
4. 3D part modelling with advanced features.
5. 3D assembly modelling.
6. Data exchange standards.
7. 3D to 2D conversion.
8. Structural analysis

B.Tech. (Mechanical Engineering) 4th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEP223: Engineering Workshop-II

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1. Introduction- lathe machine, plain turning, Step turning & grooving (Including lathe mechanisms, simple problems).
2. Taper turning-compound rest/offset method & Drilling using lathe (Including Drilling feed mechanism, Twist drill nomenclature, and Different types of taper turning operations).
3. External threading-Single start (Including Thread cutting mechanism-simple problems).
4. Eccentric turning-Single axis.
5. Shaping-V-Block (Including Shaper quick return mechanism).
6. Grinding-Cylindrical /Surface/Tool & cutter.
7. Slotting-Keyways (Including Broaching tool nomenclature and Slotter mechanism).
8. Milling-Polygon /Spur gear (Including Milling mechanism, simple problems).
9. Gear hobbing-Helical gear.
10. Drilling, reaming, counter boring.
11. Planning/Capstan lathe/Burnishing process (Planner Mechanism, Description of capstan and turret lathe).
12. Mini Project work- Application oriented products using above experiments.

B.Tech. (Mechanical Engineering) 4th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEP224: Design of Machine Elements Lab

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1. Design of circumferential/longitudinal riveted joint of boiler.
2. Design of rigid flange coupling.
3. Design of flexible coupling (Bush pin type)
4. Design of eccentrically loaded bracket.
5. Design of pipe and pipe joints subjected to internal pressure.
6. Design of shaft carrying one pulley and supported in two bearing.

B.Tech. (Mechanical Engineering) 4th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEP225: Fluid Mechanics Lab

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1. To determine the metacentric height of a floating vessel under loaded and unloaded conditions.
2. To study the flow through a variable area duct and verify Bernoulli's energy equation.
3. To determine the coefficient of discharge for an obstruction flow meter (venturi meter/ orifice meter)
4. To determine the discharge coefficient for a V- notch or rectangular notch.
5. To study the transition from laminar to turbulent flow and to ascertain the lower critical
   Reynolds number.
6. To determine the hydraulic coefficients for flow through an orifice.
7. To determine the friction coefficients for pipes of different diameters.
8. To determine the head loss in a pipe line due to sudden expansion/ sudden contraction/ bend.
9. To determine the velocity distribution for pipeline flow with a pitot static probe.
10. Experimental evaluation of free and forced vortex flow.

B.Tech. (Mechanical Engineering) 4th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEP226: Mechanical Measurement and Metrology Lab

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1. Measurement of an angle with the help of sine bar
2. Measurement of surface roughness of a machined Plate, Rod and Pipe
3. Measurement of gear elements using profile projector
4. Measurement of effective diameter of external threads using Three wire method
5. Measurement of thread element by Tool maker's microscope
6. Calibration of a pressure gauge with the help of a dead weight gauge tester
7. Use of stroboscope for measurement of speed of shaft
8. Use of pitot tube to plot velocity profile of a fluid through a circular duct
9. Preparation of a thermocouple, its calibration and application for temperature measurement

B.Tech. (Mechanical Engineering) 5th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEL311: CONTROL ENGINEERING

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Course Objectives: To introduce the principles of control theory and its applications.
Course Contents:

Unit-I

1. **Introduction to Control**-Brief history and developments in Feedback control.
2. **Modeling of Physical Systems-** Mechanical, electrical, thermal and hydraulic systems. Concepts of state, state variable, state model. State models for linear continuous time functions, state space model formulation. Block diagram and signal flow graph analysis, transfer function. (Modern approaches such as Bond graphs may be used for modeling and control.)

Unit-II

3. **System Response-** Time response of first and second-order systems, Steady-state errors and error constants. Performance specifications in time-domain. Effect of pole locations. Concept of stability, relative stability, Routh's stability criterion. Root locus method of analysis and design. Lead and lag compensation.

Unit-III

4. **Frequency-Response Analysis-** Relationship between time & frequency response, Polar plots, Bode's plot, stability in frequency domain, Nyquist plots. Nyquist stability criterion. Performance specifications in frequency-domain. Frequency-domain methods of design. Compensation and their realization in time and frequency domains.
5. **State Variable Analysis-** Solution of state equations. Concepts of controllability and observability. Pole placement design. Proportional, Integral and derivative feedback. Simple case studies.(These may be supported using software such as MATLAB.)

Suggested Books:

1. Kuo, B. C., Automatic Control Systems, Prentice Hall.
2. Ogata, K., Modern Control Engineering, Prentice Hall
3. Franklin, G. F., Powell, J. D., Emami-Naeini, A., Feedback Control of Dynamic Systems, Pearson Education Inc.
4. Gopal. M., Control Systems Principles and Design, Tata McGraw-Hill.
5. Eronini Umez-Eronini, System Dynamics & Control, Brooks/ Cole Publishing Company.
6. Mukherjee .A, Karmakar. R and Samantaray .A.K, Bond Graph in Modeling, Simulation and FaultIdentification, I. K. International Publishing House Pvt. Ltd.
7. Karnopp, Margolis, Rosenberg, System Dynamics Modeling and Simulation of Mechatronic Systems, Wiley (Higher education).
8. Bernard Friedland, Control Systems Design, McGraw-Hill.
9. NPTEL courses, http//nptel.iitm.ac.in/courses.php, web and video courses on Control Engineering byProfessor Gopal, M., Prof. Agashe, S. D, and Sivakumar, M. S.

B.Tech. (Mechanical Engineering) 5th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEL312: Vibration and Noise Control

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Course Objectives: To introduce the fundamentals of vibration and noise control and application of these principles to real life problems.

Unit-I

1: **Vibration of single degree of freedom (SDF) system**-Modelling of stiffness and damping (both Viscous and Coulomb). Estimation of damping by decay plots and half power method. Impulse, transient and forced vibration response of SDF system. Theory and practice of vibration isolation. Vibration measuring instruments.

2: **Two degree freedom system** – Application to undamped and damped absorbers. Multi-degree freedom systems. Modal analysis. Rayleigh's and Dunkerley's method. Holzer's and transfer matrix methods.

Unit-II

3: **Continuous systems** –Governing wave equation and Euler-Bernoulli equation. Free and forced vibrations including modal analysis.

4: **Finite element analysis** – Dynamic analysis of simple systems. Introduction to modal testing and system identification problems.

Unit-III

5: **Acoustics and Noise Control**- Acoustic wave equation, Acoustic energy and sound intensity. Propagation of sound, Concept of Acoustic impedance. Sound power transmission, Transmission Loss. Human Response and ratings, Various Measures of Sound. Weighting filters, Loudness, Indices of Loudness. Acoustic radiation from spherical source and piston source. Acoustic sensors. Measuring Techniques and Instruments, Octave Filtering, Sound Intensity Measurement, Intensity Mapping. Different types of measurement environment and uses. Sound absorption coefficient. Noise control measures in building. Reverberation time and auditorium design. Industrial Noise control, Noise in Machinery, Traffic Noise, Vehicle Noise. Design of silencers and mufflers. Active noise control.

Suggested Books:

1. Meirovitch Leonard; Element of Vibration Analysis; TMH
2. Singiresu Rao, Mechanical Vibrations, Pearson Education
3. Dukikipati RV, Srinivas J, Textbook of Mechanical Vibrations; PHI
4. Thomson,W.T., Theory of Vibration with Applications, C.B.S Pub & Distributors
5. G.K.Grover, Mechanical Vibration, Nemchand and Bross, Roorkee.

B.Tech. (Mechanical Engineering) 5th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEL313: HEAT TRANSFER

L T P
3 1 0

Course objectives: To impart basic knowledge of heat and mass transfer mechanisms.
Course Contents:

Unit-I

1. **Introduction-**Modes and mechanisms of heat transfer: Basic laws of heat transfer, General discussion about applications of heat transfer. Conduction heat transfer: Fourier rate equation, General heat conduction equation in Cartesian, cylindrical and spherical coordinates. Simplification and forms of the field equation: steady, unsteady and periodic heat transfer, Initial and boundary conditions.
2. **One Dimensional Steady State Conduction-** Heat transfer in homogeneous slabs, hollow cylinders and spheres overall heat transfer coefficient electrical analogy critical radius of insulation. Variable thermal conductivity systems with heat sources of heat generation. Extended surface (fins) heat transfer along a fin, fin with insulated tip and short fin. Application to error measurement of temperature.

Unit-II

3. **One Dimensional Transient Conduction Heat Transfer**- Systems with negligible internal resistance; Significance of Biot and Fourier numbers. Chart solutions of transient conduction systems- concept of functional body.
4. **Convective Heat Transfer-** Classification of systems based on causation of flow, condition of flow, configuration of flow and medium of flow. Dimensional analysis as a tool for experimental investigation. Buckingham Pi-Theorem and method. Application for developing semi-empirical non- dimensional correlation for convection heat transfer, significance of non- dimensional numbers. Concepts of continuity. Momentum and energy equations. Forced convection: External flows: Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer. Flat plates and cylinders. Internal Flows: Concepts about hydrodynamic and thermal entry lengths division of internal flow based on this use of empirical relations for horizontal pipe flow and annulus flow.

Unit-III

5. **Free Convection-** Development of hydrodynamic and thermal boundary layer along a vertical plate. Use of empirical relations for vertical plates and pipes.
6. **Heat Transfer with Phase Change-** Boiling: Pool boiling regimes calculations on nucleate boiling, critical heat flux and film boiling. Condensation: Film wise and drop wise condensation, Nusselt Theory of condensation on a vertical plate-Film condensation on vertical and horizontal cylinders using empirical correlations. Heat Exchangers- Classification of heat exchangers overall heat transfer-Coefficient and fouling factor. Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.
7. **Radiation Heat Transfer-** Emission characteristics and laws of black-body radiation, Irradiation total and monochromatic quantities, laws of Planck, Wien, Kirchhoff, Lambert, Stefan and Boltzmann, heat exchange between two black bodies, concepts of shape factor. Emissivity heat exchange between grey bodies radiation shields electrical analogy for radiation networks.

Suggested Book:

1. Som, S. K Introduction To Heat Transfer. Prentice-Hall of India Pvt. Ltd.
2. Incropera, F. P., DeWitt, D. P., Bergman, T. L., & Lavine, A. S. Fundamentals of Heat and Mass Transfer: John Wiley & Sons.
3. Özısık, M. N. Heat transfer: a Basic Approach: McGraw-Hill.
4. Holman, J. P. Heat Transfer: McGraw Hill Higher Education.
5. Çengel, Y. A. Heat transfer: a Practical Approach: McGraw-Hill.
6. Lienhard, J. H., & Lienhard, J.H. A Heat Transfer Textbook: Fourth Edition: Dover Publications.

B.Tech. (Mechanical Engineering) 5th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEP311: CONTROL ENGINEERING LAB

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List of Experiments

1. Using MATLAB for control systems.
2. Mathematical modeling of physical systems.
3. Modeling of physical systems using SIMULINK.
4. Linear time-invariant systems and representation.
5. Block diagram reduction.
6. Performance of first order and second order systems.
7. DC motor characteristics.
8. Validation of DC motor characteristics.
9. Effect of feedback on disturbance & control system design.
10. Effect of feedback on disturbance & control system design of tank level system.
11. Introduction to PID controller.
12. Open loop and closed loop position control of DC motor.
13. Simple speed control of DC motor.
14. PID controller design for two tank system.

B.Tech. (Mechanical Engineering) 5th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEP312: VIBRATION & NOISE CONTROL LAB

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List of Experiments

1. Free vibration of cantilever beam
2. Free vibration of simply supported beam
3. Free vibration of fixed beam
4. Forced vibration of SDOF system
5. Base Excitation
6. Rotating Unbalance
7. 2DOF Forced vibration
8. Dynamic Vibration Absorber

B.Tech. (Mechanical Engineering) 5th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEP313: HEAT TRANSFER LAB

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List of Experiments

1. Determination of thermal conductivity of:
- a solid insulating material by slab method
- powder materials by concentric spheres method / or by some transient heat transfer technique
- a metal by comparison with another metal by employing two bars when kept in seriesand / or in parallel under different boundary conditions
- Liquids by employing thin layer
2. Determination of coefficient of heat transfer for free/forced convection from the surface of a cylinder / plate when kept:

a) along the direction of flow
b) perpendicular to the direction of flow
c) inclined at an angle to the direction of flow

3. To plot the pool boiling curves for water and to determine its critical point
4. Determination of heat transfer coefficient for

i) film condensation
ii) drop-wise condensation

5. Determination heat transfer coefficient by radiation and hence find the Stefan Boltzman's constant using two plates/two cylinders of same size by making one of the plates/cylinders as a black body.
6. Determination of shape factor of a complex body by an analog technique.
7. To plot the temperature profile and to determine fin effectiveness and fin efficiency for

i) A rod fin when its tip surface is superimposed by different boundary condition like: Insulated tip, Cooled tip, Temperature controlled tip
ii) Straight triangular fins of various sizes and optimization of fin proportions
iii)Circumferential fins of rectangular/triangular section

B.Tech. (Mechanical Engineering) 5th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEL351: ADVANCED MECHANICS OF SOLIDS

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UNIT-I

1. **Strain Energy & Impact Loading:** Definitions, expressions for strain energy stored in a body when load is applied (i) gradually, (ii) suddenly and (iii) with impact, strain energy of beams in bending, beam deflections, strain energy of shafts in twisting, energy methods in determining spring deflection, Castigliano's & Maxwell's theorems, Numericals.
2. **Theories of Elastic Failure:** Various theories of elastic failures with derivations and graphical representations, applications to problems of 2- dimensional stress system with (i) Combined direct loading and bending, and (ii) combined torsional and direct loading, Numericals.

UNIT-II

3. **Unsymmetrical Bending**: Properties of beam cross section, product of inertia, ellipse of inertia, slope of the neutral axis, stresses & deflections, shear center and the flexural axis Numericals.
4. **Thick Cylinders & Spheres:** Derivation of Lame's equations, radial & hoop stresses and strains in thick and compound cylinders and spherical shells subjected to internal fluid pressure only, wire wound cylinders, hub shrunk on solid shaft, Numericals.

UNIT-III

5. **Rotating Rims & Discs:** Stresses in uniform rotating rings & discs, rotating discs of uniform strength, stresses in (i) rotating rims, neglecting the effect of spokes, (ii) rotating cylinders, hollow cylinders & solids cylinders. Numericals.
6. **Bending of Curved Bars** : Stresses in bars of initial large radius of curvature, bars of initial small radius of curvature, stresses in crane hooks, rings of circular & trapezoidal sections, deflection of curved bars & rings, deflection of rings by Castigliano's theorem stresses in simple chain link, deflection of simple chain links, Problems.
7. **Springs:** Stresses in open coiled helical spring subjected to axial loads and twisting couples, leaf springs, flat spiral springs, concentric springs, Numericals.

Suggested Books:

1. Strength of Materials – G.H.Ryder, Third Edition in SI Units 1969 Macmillan, India.
2. Strength of Materials – Sadhu Singh, Khanna Publishers
3. Book of Solid Mechanics – Kazmi, Tata Mc Graw Hill
4. Strength of Materials – D.S. Bedi - S. Chand & Co. Ltd
5. Strength of Materials – U.C Jindal - Pearson India Ltd.

B.Tech. (Mechanical Engineering) 5th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEL352: ADVANCED FLUID MECHANICS

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1. **Review of Kinematics of Fluid Motion-** Method of describing fluid motion, translation, rate of deformation, the material derivatives, acceleration. Vorticity in Cartesian & polar coordinates. Reynolds transport theorem, stress at a point, velocity profile, wall shear stress.
2. **Non-viscous Incompressible Flow-** Equation of continuity, Euler's equation of motion, Bernoulli's equation, circulation and its theorem, stress function, velocity potential, irrotational flow, two dimensional source, sink, source-sink pair, doublet vortex, superposition of source-sink with rectilinear flow, Rankine body, Superposition of rectilinear flow and doublet, flow around a spinning circular cylinder, Magnus effect, lift & drag, skin friction. Lift of aero foils.
3. **Boundary Layer Concept-**Introduction to boundary layer formation, Navier-stokes equation, Boundary layer thickness, momentum thickness, energy thickness, Boundary layer equations, Momentum-Integral equation – Von Korman, Blasius solution of boundary layer on a flat plate without pressure gradient, flow with very small Reynolds number, Hagen Poisseuille flow, Plane Couette flow, Hydrodynamic theory of lubrication.
4. **Compressible Flow-** Propagation of pressure change, sound velocity, elastic waves, Mach number, Mach cone, isentropic flow relations in terms of sonic velocity and Mach number, Stagnation properties, regions of flow, energy equation, effect of Mach number on compressibility. Propagation of infinitesimal waves, Non-steep finite pressure wave and steep finite pressure waves, expansion waves, isentropic flow with variable area, Mach number variation and its effect on flow through nozzles and diffusers. Area ratio, impulse function, Use of Gas/Air tables.
5. **Flow with Normal Shock Waves-** Development of shock wave, rarefaction wave, governing equations, Prandtl-Meyer relation. Thermodynamic properties across shock. Wind tunnels. -Fanno curves, Fanno flow equations, Solution of Fanno flow equations. Variation of flow properties. Tables & charts for Fanno flow. Rayleigh line, fundamental equations, Rayleigh flow relation, Variation of flow properties. Tables & charts for Rayleigh flow.

Suggested Books:

1. Kundu, P. K., Cohen, I. M., & Dowling, D. R. Fluid Mechanics with Multimedia DVD: Elsevier Science & Technology.
2. Muralidhar, K., & Biswas, G. Advanced Engineering Fluid Mechanics: Alpha Science International.
3. Graebel, W. P. Advanced Fluid Mechanics: Academic Press.
4. Streeter, V. L. Fluid Mechanics: McGraw-Hill.
5. Fox, R. W., McDonald, A. T., & Pritchard, P. J. Introduction to Fluid Mechanics: John Wiley.
6. Anderson, J. D. Computational Fluid Dynamics: the Basics with Applications: McGraw-Hill.
7. Yahya, S. M Fundamentals of Compressible Flow: New Age International.

B.Tech. (Mechanical Engineering) 5th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEL353: WELDING TECHNOLOGY

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Unit-I

1. **Introduction-** Welding as a production process – its advantages and limitations. Gas welding process, Types of fuels, acetylene, Indene, Butane etc. Gas welding equipment, gas welding technique. Electric arc welding – manual metal arc welding – power supplies, cables and other accessories for arc welding, welding technique - atomic, hydrogen welding, thermit welding, soldering, brazing and braze welding.
2. **Special Welding Processes-** Power sources, equipments and accessories, application, limitation and other characteristics of: (a) Gas tungsten arc (TIG) welding (b) Gas metal arc (MIG) welding (c) Submerged arc welding (d) Electro slag welding processes. Resistance welding processes- principle- Types (spot, seam, projection and percussion flash), equipment required for each application.

Unit-II

3. **Modern Welding Processes-**Electron beam welding, Laser beam welding, Plasma arc welding, Friction welding, Explosive welding, Ultrasonic welding, Stud welding, Under water welding, Diffusion bonding, Cold welding, Welding of dissimilar metals.
4. **Weldment Testing-** Defects in welding in various processes-Causes and remedies; Destructive testing of weldments - Strength, hardness, ductility, fatigue, creep properties etc. Non- destructive testing of weldments; Ultrasonic dye penetrant, magnetic particle inspection. X ray testing procedures and identification of defects – case studies. Weld thermal cycle – Residual stressed distortion in welding stress relieving techniques.

Unit-III

5. **Weldability, Automation and Design in Welding-** Weldability –definition. Temperature distribution in welding –heat affected zone weldability of steel, cast iron. Aluminum, pre heating and post heating of weldments. Estimation of transition temperature. Automation in welding – Seam tracking vision and arc sensing welding robots. Design of weldments-welding symbols positions of welding joint and groove design. Weld stress –calculations – design of weld size.

Suggested Books:

1. Abbott, J., & Smith, K. M., Welding Technology: Texas State Technical College Publishing.
2. Radhakrishnan.V.M. Welding Technology and Design, New Age International Pub. Ltd.,
3. Little R.L.,Welding Technology Tata McGraw-Hill
4. Partner R.S.Welding Process and Technology, Khanna Publishers
5. Lancaster J.F.,Metallurgy of Welding,George Allen and Unwin.
6. “AWS Welding Hand Book”, Volume 1 to 4, AWS.

B.Tech. (Mechanical Engineering) 5th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEP353: WELDING TECHNOLOGY LAB

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List of Experiments

1. Welding- Introduction.
2. Edge/joint preparation in welding and joining using arc welding and gas welding.
3. Hands-on practice on shielded metal arc welding.
4. Hands-on practice on metal inert gas welding (MIG) or gas metal arc welding.
5. Hands-on practice on tungsten inert gas welding (TIG) or gas tungsten arc welding.
6. Hands-on practice on spot welding.
7. Hands-on practice on submerged arc welding.

B.Tech. (Mechanical Engineering) 5th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEL354: AUTOMOBILE ENGINEERING

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Unit-I

1. **Vehicle Structure and Engines-**Types of automobiles, vehicle construction – chassis, frame and body, aerodynamics, components of engine – their forms, functions and materials, review of cooling and lubrication systems in engine, turbo chargers, engine emission control by– way catalytic controller, electronic engine management system.
2. **Engine Auxiliary Systems-**Carburetor– working principle, electronic fuel injection system – mono-point and multi - point injection systems, electrical systems – battery generator - starting motor and drives – lighting and ignition (battery, magneto coil and electronic type)- regulators-cut outs.

Unit-II

3. **Transmission Systems-**Clutch – types and construction, gear boxes- manual and automatic, simple floor mounted shift mechanism, over drives, transfer box fluid flywheel- torque convertors, propeller shaft – slip Joint – universal joints, differential and rear axle, hotch kiss drive and torque tube drive.

Unit-III

4. **Steering, Brakes and Suspension-** Wheels and tires – wheel alignment parameters steering geometry and types of steering gear box, power steering, types of front axle – suspension systems. Braking systems – types and construction – diagonal braking system – antilock braking system.
5. **Alternative Energy Sources-**Use of natural gas, LPG, biodiesel, gasohol and hydrogen in automobiles, electric and hybrid vehicles, fuel cells.

Suggested Books:

1. Crolla, D. Automotive Engineering: Powertrain, Chassis System and Vehicle Body: Butterworth-Heinemann.
2. Heisler, H. Advanced Vehicle Technology: Butterworth-Heinemann.
3. Happian-Smith, J. An Introduction to Modern Vehicle Design: Butterworth-Heinemann.
4. Newton, Steeds and Garet, Motor Vehicles, Butterworth Publishers.
5. Crouse, W. H., &Anglin, D. L. Automotive Mechanics, Study Guide: McGraw-Hill.

B.Tech. (Mechanical Engineering) 5th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEP354: AUTOMOBILE ENGINEERING LAB

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List of Experiments

1. Study and demonstration of layout of an automobile.
2. Study and demonstration of differential.
3. Study and demonstration of clutches.
4. Study and demonstration of brakes.
5. Study and demonstration of gear box.
6. Study and demonstration of steering mechanism.
7. Study and demonstration of suspension system.
8. Study and demonstration of internal combustion engine.

B.Tech. (Mechanical Engineering) 6th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEL321: NON-TRADITIONAL AND COMPUTER AIDED MANUFACTURING

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Course objectives: To provide the students with a proper understanding of nontraditional machining processes.

Unit-I

Non-Traditional Manufacturing

1. **Introduction-** Classifications of material removal processes. Characteristics of conventional material removal (machining) processes. Need for non-conventional or non- traditional processes.
2. **Process Description, Modelling, Application and Product Quality Related Issues-** Abrasive Jet Machining. Ultrasonic Machining. Water Jet Machining. Abrasive Water Jet Machining. Electro-Discharge Machining. Chemical & Photo Chemical Machining. Electro- Chemical Machining. Electron Beam Machining. Laser Beam Machining.

Unit-II

3. **Advanced Topics-** Basic introduction to chemical, physical vapour deposition processes. Thermal spraying processes. Hybrid processes like electro-jet drilling, electro chemical grinding, electro-chemical discharge machining. Rapid prototyping.

Computer Aided Manufacturing

1. **Introduction-** Relation between production volume and flexibility. Various manufacturing systems – batch, mass, group, cellular and flexible manufacturing systems; Type of automation and benefits of soft or flexible automation.

Unit-III

2. Automation in material handling and assembly.
3. **CNC Machines-** Introduction, classification, design and control features including interpolations.
4. NC Part-Programming;
5. **Introduction to Robotics-**Definitions, motivation, historical development. Basic structure, classification, workspace, drives, controls, sensors, grippers, specifications.

Suggested Books:

1. Mishra, P. K., Non-Conventional Machining, Narosa Publishing House
2. Pandey and Shan, Modern Machining Processes, McGraw Hill
3. Bhattacharya, A., New Technology, Institution of Engineers (I)
4. Jain, S. K. and Schmid, S. R., Manufacturing Engg. & Technology, Addison Wesley Ltd.
5. NPTEL courses, http://www.nptel.iitm.ac.in/courses.php?disciplineId=112 web and video resources on Manufacturing Processes & Advanced manufacturing processes.

B.Tech. (Mechanical Engineering) 6th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEL322: I.C. ENGINES

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Course Objectives:
Analytical approach to the engineering problem and performance analysis of internal combustion engines. Study of thermodynamics, combustion, heat transfer, friction, and other factors affecting engine power, efficiency, and emissions. Design and operating characteristics of different types of engines.

Unit-1

1. **Basic Concepts-**Air standard cycles and fuel-air cycles, assumptions, Otto, Diesel & dual cycles, comparison of cycles, fuel air cycle, valve timing diagram, actual engine cycle.
2. **S.I. Engines-** Theory of carburetion, types of carburetors, electronic fuel injection system, GDI. Combustion in spark ignition engines, stages of combustion, flame propagation, rate of pressure rise, abnormal combustion. Phenomenon of detonation in SI engines, effect of engine variables on detonation. Combustion chambers. Rating of fuels in SI engines. Additives.
3. **C.I. Engines-** Fuel supply system, types of fuel pump, injector and distribution system, combustion in compression ignition engines, stages of combustion, factors affecting combustion, Phenomenon of knocking in CI engine. Effect of knocking. Types of combustion chambers rating of fuels in CI engines. Additives; Comparison of knocking in SI & CI engines, concepts of supercharging and turbo charging.

Unit-II

4. **Engine Systems and Components-**Ignition system (battery, magneto & electronic); lubrication system; engine starting system; engine cooling system; governing system (quality and quantity hit & miss governing); intake and exhaust systems (two valves & four valves); drive train (cam shaft, valves etc.)
5. **Performance Characteristics & Testing of I.C. Engines-**Introduction to Indian Standards for testing of I.C. engine, mean effective pressure, indicated power, brake power, friction power, methods to determine power and efficiencies, variables affecting performance of engine, characteristic curves, heat balance sheet, methods of improving engine performance; super & turbocharged engines.

Unit-III

6. **Fuels and Emissions-** Chemical structure of the petroleum, refining process for petroleum, important qualities of the engine fuels - (SI & CI engines) and diesel and gasoline fuels- Indian specifications. Alternate fuels (SI & CI engines)- Liquid fuels, gaseous fuels, hydrogen engines (LPG, HC NG (15%, 20%, 25 % blends) Hydrogen and bio-fuels), Air pollution due to IC engine, engine emissions, hydrocarbon emissions, (HC) & PPM & carbon monoxide emissions (CO), oxides of Nitrogen (NOx) Euro norms , Bharat stage norms, Introduction to EDC and IDC , Introduction to carbon credit, emission control methods for SI and CI engines, electronic control , catalytic converters, EGR concept of hybrid vehicles.

Suggested Books:

1. Ganesan.V. Internal Combustion Engines: Tata Mcgraw-Hill Publishing Company Limited.
2. Heywood, J. B. Internal Combustion Engine Fundamentals: McGraw-Hill.
3. Lumley, J. L;Engines: An Introduction: Cambridge University Press.
4. Ferguson, C.R., & Kirkpatrick, A.T. Internal Combustion Engines: Applied Thermosciences: John Wiley.
5. Stone, R. Introduction to Internal Combustion Engines:

B.Tech. (Mechanical Engineering) 6th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEL323: REFRIGERATION AND AIR CONDITIONING

L T P
3 0 0

Course Objectives:
Analytical approach to the engineering problem and performance analysis of refrigeration and air conditioning system. Study of thermodynamics behind it. Design and operating characteristics of different types of refrigeration system. Refrigeration and air conditioning concepts.

Unit-I

Refrigeration

1. **Introduction**-Necessity and applications; of refrigeration and C.O.P. Mechanical refrigeration; Types of ideal cycles of refrigeration. Air refrigeration: Bell Coleman cycle and Brayton cycle, open and dense air systems; Actual air refrigeration system problems; Refrigeration needs of aircrafts.
2. **Vapour Compression Refrigeration-** Working principle and essential components of the plant; Simple vapour compression refrigeration cycle; COP; Representation of cycle on T-S and p-h charts; effect of sub cooling and super heating; cycle analysis; Actual cycle Influence of various parameters on system performance; Use of p-h charts; numerical problems.

Unit-II

3. **Refrigeration System Components-**Compressors; General classification; comparison; Advantages and disadvantages. Condensers: classification; Working principles. Evaporators: classification; Working principles. Expansion devices: Types; Working principles. Refrigerants: Desirable properties; classification refrigerants used; Nomenclature; Ozone depletion; Global warming.
4. **Vapor Absorption Refrigeration-** Calculation of max COP; description and working of NH3; water system and Li Br; water (Two shell & four shell) system. Principle of operation Three fluid absorption system, salient features.
5. **Other Refrigeration Systems-** Steam Jet refrigeration system; Working principle and basic components. Principle and operation of (i) Thermoelectric refrigerator (ii) Vortex tube tube.

Unit-III

Air Conditioning

6. **Introduction-** Psychometric properties & processes; Characterization of sensible and latent heat loads; Need for ventilation, consideration of infiltration; Load concepts of RSHF, GSHF- problems, concept of ESHF and ADP. Requirements of human comfort and concept of effective temperature; Comfort chart; Comfort Air conditioning; Requirements of industrial air conditioning ;
7. **Air Conditioning System Components-**Equipment for cooling, heating humidification and dehumidification, filters, grills and registers, fans and blowers. Heat pump; Heat sources, different heat pump circuits.

Suggested Books:

1. Arora, C. P. Refrigeration and Air Conditioning: McGraw-Hill.
2. Stoecker, W. F., & Jones, J. W. Refrigeration and Air Conditioning: McGraw-Hill.
3. Whitman, W. C., Johnson, W. M., &Tomczyk, J. Refrigeration & Air Conditioning Technology: Delmar
4. Dossat. Principles of Refrigeration: Pearson Education.

B.Tech. (Mechanical Engineering) 6th Semester
(Under Credit Based Continuous Evaluation Grading System)

MEL324: MECHATRONICS

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Course Objectives:
Gain a complete understanding of basic electrical circuits and electronic devices. Learn how to understand and apply semiconductor devices. Learn the basics of digital electronics. Learn how to program and interface microcontrollers. Learn the theoretical and practical aspects of measurement system design. Learn the basics of sensor and actuator theory, design, and application. Become proficient with using laboratory instrumentation and with building basic circuits.

Course Contents:

Unit-I

1. **Introduction-** Mechatronics: What and why?
2. **Essential Electronics and Boolean Algebra-** Digital representation: binary, decimal, hexadecimal, conversion from binary to decimal and vice-versa. Binary arithmetic: addition, subtraction: 2's complement, multiplication and division, boolean algebra: AND, OR, NOT, NAND, NOR, XOR logic, Truth table, realization of logic in physical systems: switches-LEDs, cylinders. Fundamental identities, De Morgan's theorems and relationship with sets, simplification, electronics fundamentals: Review of some semiconductor devices, Concepts of digital and analog systems, digital output (DO) and input (DI), using switches, transistors, pneumatic devices, etc. to realize DI & DO. Operational Amplifier: principles, configurations: inverting; summing; integrating and differentiating configurations, digital to analog conversion (DAC), the R-2R and summing op-amp circuit, analog to digital conversion (ADC), successive approximation method, flash method, etc. Programs for DI, DO, DA and AD for PC based plug in cards.

Unit-II

3. **Microprocessor, Computers and Embedded Systems-** Introduction to the 8085 (8-bit microprocessor) and microcontroller: Architecture, programming, I/O, Computer interfacing, Programmable logic controller basics.
4. **Sensors and Actuators-** Strain gauge, resistive potentiometers, tactile and force sensors, tachometers, LVDT, piezoelectric accelerometer, hall effect sensor, optical encoder, resolver, inductosyn, pneumatic and hydraulic actuators, stepper motor, DC motor, AC motor.

Unit-III

5. **Control Systems-**Mathematical modeling of physical systems, system equations, controllability and observability, Pole placement, PID controller, control of hydraulic, pneumatic, mechanical and electrical systems.
6. **Integration and Case Studies-** Integration of mechatronics component subsystems into a complete mechatronics system, applications to CNC machines and robotics.

Suggested Books:

1. David G. Alciatore, and Michael B. Histand, “Introduction to Mechatronics and Measurement Systems”, Tata
2. McGraw Hill, New Delhi.
3. W. Bolton, “Mechatronics”, Pearson Education Asia, New Delhi.
4. Dan Necsulescu, “Mechatronics”, Pearson Education Asia, New Delhi.
5. N. P. Mahalik, “Mechatronics”, Tata McGraw Hill, New Delhi.
6. Wolfram Stadler, “Analytical Robotics and Mechatronics”, McGraw-Hill Book Co.
7. EroniniUmez-Eronini, “System Dynamics & Control”, Thomson Asia.
8. ShettyDevdas and Richard A Kolk, “Mechatronics System Design”, Thomson Learning, Vikas Publishing House, New Delhi.

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MEP321: NON-TRADITIONAL & COMPUTER AIDED MANUFACTURING LAB

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List of Experiments

Non-Traditional Manufacturing lab

a. To perform an experiment on EDM.
b. To perform an experiment on ECM.
c. To perform an experiment on WJM.
d. To perform an experiment on AJM.
e. To perform an experiment on laser beam machining.
f. To perform an experiment on plasma arc machining.

CAM Lab

1) Manual part programming (using G and M codes) in CNC lathe.
   i. Part programming for linear and circular interpolation, chamfering and grooving.
   ii. Part programming is using standard canned cycles for turning, facing, taper turning and thread cutting.
2) Manual part programming (using G and M codes) in CNC milling.
   1. Part programming for linear and circular interpolation and contour motions.
   2. Part programming involving canned cycle for drilling, peck drilling and boring.

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MEP322: I.C. ENGINES LAB

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List of Experiments

1) To study four strokes spark ignition (S.I) engine and differences between S.I. ad C.I engines.
2) To study two strokes S.I. engine and differences between two strokes and four strokes engines.
3) To study battery ignition system for four cylinders S.I. engines and requirements of ignition system.
4) To study magneto ignition system for SI engine having four cylinders and differences between magneto and battery Ignition system
5) Study of carburetor with compensating and starting Jet devices
6) Determination of brake power (BP), friction power (FP) and indicated power (IP) of four stroke four cylinder diesel engine with rope break dynamometer.
7) To determine mechanical efficiency, brake thermal efficiency and indicated thermal efficiency of four strokes, four cylinder diesel engine.
8) To draw heat balance sheet for four stroke, four cylinder diesel engines.
9) To study open cycle constant pressure combustion gas turbine with inter cooler, regenerator and reheat.
10) To study centrifugal compressor and differences between centrifugal and axial compressors.

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MEP323: REFRIGERATION AND AIR CONDITIONING LAB

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List of Experiments

1) To study refrigeration cycle, determine of coefficient of performance of cycle & determine of tonnage capacity of refrigeration unit.
2) To determine the COP and tonnage capacity of the chilling plant.
3) To determine COP and tonnage capacity of an air conditioning system.
4) To determine the COP and tonnage capacity of a mechanical heat pump.
5) To determine the COP and tonnage capacity of an Ice plant.
6) To study the cut sectional model of reciprocating, rotary and centrifugal compressor.
7) To study various controls used in refrigeration and air-conditioning system.
8) To study different psychometric process & chart.
9) To study works principle of steam jet refrigeration system.
10) To study the analysis of simple vapour compression cycle and explain the types of vapour compression cycle with T-S and P-H diagram.
11) To study the chilling plant and its working cycle.
12) To determine sensible heat factor of Air on re-circulated air conditioning set up.
13) To Study the Mechanical heat pump and find it’s C.O.P.
14) To study the Air and Water heat pump and find it’s C.O.P.

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MEL361: FINITE ELEMENT METHODS IN ENGINEERING

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Course Contents:

Unit-I

1. **Basic Concepts-** The standard discrete system, finite elements of an elastic continuum-displacement approach, generalization of the finite element concepts- weighted residual and variational approaches.

Unit-II

2. **Element Types-** Triangular, rectangular, quadrilateral, sector, curved, iso-parametric elements and numerical integration. Automatic mesh generation schemes.
3. **Application to Structural Mechanics Problems-** Plane stress and plane strains, axi-symmetric stress analysis, three dimensional stress analyses, bending of plates.

Unit-III

4. **FEM in Steady State Field Problems-** Introduction, heat conduction, fluid flow and non- linear material problems, plasticity, creep etc. Computer procedures for Finite element analysis.

Suggested Books:

1. Chandrupatla T.R., and Belegundu A.D., Introduction to Finite Elements in Engineering, Pearson Education
2. David V Hutton, Fundamentals of Finite Element Analysis McGraw-Hill Int. Ed.
3. Rao S.S. The Finite Element Method in Engineering, Pergammon Press.
4. Logan D.L., A First course in the Finite Element Method, Third Edition, Thomson Learning,
5. Robert D.Cook., David.S, Malkucs Michael E Plesha , Concepts and Applications of Finite Element Analysis.
6. Reddy J.N, An Introduction to Finite Element Method, McGraw-Hill International Student Edition
7. O.C.Zienkiewicz and R.L.Taylor, The Finite Element Methods, Vol.1. The basic formulation and linear problems, Vol.1, Butterworth Heineman.

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MEL362: APPLIED ELASTICITY AND PLASTICITY

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Course Contents:

1. **Theory of Elasticity-** Analysis of stress and strain, equilibrium, compatibility and constitutive equations, plane stress and plane strain problems, general equation in polar co- ordinates, rotating discs and stresses in circular discs, stress function in terms of harmonic and complex functions, equation of equilibrium of a deformed body in curvilinear coordinates, principle of superposition and principle of virtual work, torsion of thin tubes, bending of cantilevers, uniformly and continuous loaded beams, bending of circular, elliptical and rectangular cross-section bars, Axi-symmetric formulation and deformation of solids of revolution.
2. **Theory of Plasticity-**Nature of engineering plasticity, differential equations of equilibrium, 3D stress analysis, infinitesimal deformation, finite deformation, Von Mises', Tresca's and anisotropic yield criteria, Halgh-Westergard stress space representation of yieldcriteria, experimental verification of yield criteria, subsequent yield surfaces. Elastic and plastic stress-strain relations and stress strain rate equations, Prandtle-Reuaa equations, generalized plastic stress strain relations, anisotropy and instability. Plane plastic flow, slip-line field theory, application of slip line field theory to plane strain metal forming processes plane plastic stress and pseudo plane stress analysis and its applications, extremum principle for rigid perfectly plastic material, surfaces of stress and velocity discontinuity. Upper bound and lower bound theorems and applications.

Suggested Books:

1. A I Lurie ; Theory of Elasticity (Foundations of Engineering Mechanics)
2. Gladwell G M Kluwer ; Contact Problems in the Classical Theory of Elasticity; Aca
3. Chakrabarty J.,Applied Plasticity; Springer-Verlag
4. R. Hill; The Mathematical Theory of Plasticity, Oxford University.

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MEL363: INTRODUCTION TO HUMAN BODY MECHANICS

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Course Contents:

Unit-I

1. I**ntroduction to Biomechanics-** Basic terminology and concept of human musculoskeletal system, anatomy and overall function.
2. **Biomechanics of Tissues-** Structures of musculoskeletal system – composition, structure and biomechanical behavior: bone, articular cartilage, muscle, tendon and ligament.

Unit-II

3. **Biomechanics of Joints-** Structure, range of motions, musculoskeletal model of forces: (i) hip; (ii) knee; (iii) shoulder; (iv) elbow; spine. Lubrication of joints.
4. **Motion and Gait Analysis-** Method, gait cycle, segmental kinetics, engineering approaches to posture analysis.

Unit-III

5. **Joint Replacement and Fracture-**Fixation **–** stress analysis and basic design approach, failure mechanisms, wear in joint arthroplasty and bone remodeling.
6. **Biomaterials-** Properties and application.

Suggested Books:

1. LeVeau, B. F. Biomechanics of Human Motion: Basics and Beyond for the Health Professions: Slack Incorporated.
2. Tözeren, A. Human Body Dynamics: Classical Mechanics and Human Movement: Springer.
3. Yamaguchi, G. T. Dynamic Modeling of Musculoskeletal Motion: A Vectorized Approach for Biomechanical Analysis in Three Dimensions: Springer.
4. Zatsiorsky, V. M. Kinematics of Human Motion: Human Kinetics.
5. Nordin, M., & Frankel, V. H. Basic Biomechanics of the Musculoskeletal System: Lippincott Williams & Wilkins.
6. Winter, D. A. Biomechanics and Motor Control of Human Movement: Wiley.
7. Perry, J. Gait Analysis: Normal and Pathological Function: Slack.

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MEL364: ROBOTICS: MECHANICS AND CONTROL

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Course Contents:

Unit-I

1. **Introduction to Robotics-** Robot, robotics, types of robot, robot classification, types of robot, degrees of freedom.
2. **Kinematics and Dynamics of Robotic Linkages (Open Ended Type Manipulators) -** Frames, transformations: Translation and rotation, Denavit-Hartenberg parameters, forward and inverse kinematics, Jacobian, dynamics: Equations of motion, Newton-Euler formulation.

Unit-II

3. **Sensors and Actuators-** Strain gauge, resistive potentiometers, tactile and force sensors, tachometers, LVDT, piezoelectric accelerometer, Hall effect sensors, optical encoders, pneumatic and hydraulic actuators, servo valves, DC motor, stepper motor, drives.

Unit-III

4. **Control of Manipulators-** Feedback control of II order linear systems, Joint control, trajectory control, controllers, PID control
5. **Robot Programming-**Language-overview, commands for elementary operations.

Suggested Books:

1. John J. Craig, Introduction to Robotics: Mechanics and Control, Addison-Wesley.
2. Tsuneo Yoshikawa, Foundations of Robotics, MIT Press.
3. Saeed B. Niku, Introduction to Robotics: Analysis, Systems, Applications, Pearson Education Inc.
4. Spong M. W., and Vidyasagar M., Robot Dynamics and Control, John Wiley & Sons.
5. Murray R. M., et al, A Mathematical Introduction to Robotic Manipulation, CRC Press,
6. Waldron K. J., and Kinzel G. L., Kinematics, Dynamics and Design of Machinery, John Wiley
7. EroniniUmez-Eronini, System Dynamics & Control, Brooks/ Cole Publishing Company,
8. Amalendu Mukherjee, Ranjit Karmakar and Arun Kumar Samantaray, Bond Graph in Modelling, Simulation and Fault Identification, I. K. International Publishing House Pvt. Ltd.

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MEL365: ADVANCED COMPUTER GRAPHICS AND SOLID MODELING

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Course Contents:

Unit-I

1. Introduction to application of computer graphics for visualizing concepts
2. **Introduction of Hardware Including Operating Systems-** Introduction to workstations, graphic terminals, input/output devices, file management and hardware limitations, data representation, languages, operating systems.

Unit-II

3. **Graphic Packages-** Exploration of various packages for illustration, drawing, desk top publishing page composition and animation. Introduction to the concepts of programming in media applications.

Unit-III

4. **Fundamentals of CAD-**Design process, database constructing the geometry, wire frame and solid modelling. Introduction to software packages and its applications for CAD, Use of auto lisp. CAD-CAM Integration.

Suggested Books:

1. Hoffmann, C.M., Geometric and Solid Modeling: an Introduction, Morgan Kaufman.
2. Farin, G., Curves and Surfaces for Computer Aided Geometric Design: A Practical Guide, Academic Press Inc.
3. Watt A. and M. Watt, Advanced Animation and Rendering Techniques Theory and Practice, Addison- Wesley.
4. Foley, J.D., A. van Dam, S. Feiner, and J. Hughes, Computer Graphics: Principles and Practice, Addison- Wesley
5. Neider, J., T. Davis, and M. Woo, OpenGL Programming Guide , Addison-
6. Wesley Blinn J., A Trip Down the Graphics Pipeline. Jim Blinn's Corner Morgan Kaufmann.

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MEP365: ADVANCED COMPUTER GRAPHICS AND SOLID MODELING LAB

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List of Experiments:

1. 3D part modeling with advanced features.
2. 3D assembly modeling.
3. Data exchange standards.
4. 3D to 2D conversion.
5. Structural analysis.

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MEL366: MACHINERY FAULT DIAGNOSTICS AND SIGNAL PROCESSING

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Course Contents:

1. **Failure and Failure Analysis-**Failures and failure analysis. Fault detection sensors. Data processing and signal analysis. Condition based maintenance principles. Fault analysis planning and system availability.
2. **Failure Concepts and Characteristics-**Reliability/failure concepts. Application of diagnostic maintenance to specific industrial machinery and plants.
3. **Failure Analysis-**FMECA, Basics of Machine Vibration. Computer aided data acquisition, time domain signal analysis, frequency domain signal analysis. Fault detection transducers and monitoring, vibration monitoring. Field Balancing of Rotors. Condition monitoring of rotating machines. Noise monitoring, wear & debris analysis. Thermography, electric motor current signature analysis ultrasonic in condition monitoring, NDT techniques in condition monitoring, case studies.

Suggested Books:

1. E. S. Tehrani and K. Khorasani,Fault Diagnostics of a Nonlinear System Using a Hybrid Approach , Springer.
2. PareshGirdhar, Cornelius Scheffer ,Practical Machinery Vibration Analysis and Predictive Maintenance, Elsevier
3. Rolf Isermann, B. Freyermuth, Fault Detection, Supervision and Safety for Technical Processes, Pergamon Press.

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MEP366: MACHINERY FAULT DIAGNOSTICS AND SIGNAL PROCESSING LAB

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List of Experiments

1) To find out the actual soft foot of rotating machinery by experimental method.
2) How to diagnosis of shaft misalignment and its effects based on vibration.
3) To study the static balancing of rotary systems.
4) To understand the effect of oil whirl on machinery vibration.
5) To understand the effect of looseness in rotating systems.
6) To study the vibration response of bearing defects of various types.
7) To study the effects of bent shafts on rotor performance.

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MEL415: POWER PLANT ENGINEERING

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Course Objectives: The course objective is to introduce students to the various components of thermal power plants and the related thermal and economical tools for effective engineering analysis of such plants.

Course Contents:

Unit-I

1. **Introduction -** Analysis of steam cycles, optimization of reheat pressure and degree of regeneration, coupled cycles and combined plants, process heat and power. Fuels and their properties, stoichiometric and actual air requirements, flue gas analysis.
2. **Boilers -** Different types of boilers, boiler mountings, feed water treatment, boiler loading and manner of operation. Boiler energy balance, draft system. Different types of furnaces for burning coal, fuel oil and gas. Circulation theory, down-comers and risers, economizers and super-heaters, air pre-heater, drum and its internals.

Unit-II

3. **Steam Turbines -** Convergent and convergent-divergent nozzles - theory and design. Impulse and reaction turbines, compounding of turbines, optimum velocity ratio, reheat factor and condition line, parallel exhaust, losses in steam turbines, steam turbine governing.
4. **Plant Components -** Theory and design of condensers, air ejector and cooling towers. Types and applications.

Unit-III

1. **Facility Location and Layout -** Power Plant Economics & Environmental Considerations- Plant energy studies: concepts and resources, procedures and implementation. Energy accounting. Various thermal systems and energy management. Electrical load management. Economic analysis. Waste heat recovery. Multi objective energy management- conservation, pollution control and evaluation of alternative energy sources. Cost of energy management and payback.

Suggested Books:

1. Nag.P.K. Power plant engineering: Tata McGraw-Hill.
2. Arora, S. C., & Domkundwar, S. A course in power plant engineering: Dhanpat Rai.
3. Elanchezhian, C. Power Plant Engineering: I.K. International Pub. House.
4. Sharma, P. C. Power Plant Engineering: S. K. Kataria & Sons.
5. Drbal, L. F., Boston, P. G., Westra, K. L., Black, & Veatch. Power plant engineering: Chapman & Hall.
6. Skrotzki, B. G. A., & Vopat, W. A. Power station engineering and economy: McGraw- Hill.

B.Tech. (Mechanical Engineering) 7th Semester
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MEL451: NON-DESTRUCTIVE EVALUATION AND TESTING

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Course Objectives: The course objective is to introduce students to the classification of NDT methods, defects of cast materials, Defects of welded materials, Visual testing methods.

Course Contents:

Unit-I

6. **Introduction and Visual Methods -** Optical aids, In-situ metallography, Optical holographic methods, Dynamic inspection; Penetrant Flaw Detection- Principles: Process: Penetrant systems: Liquid penetrant materials: Emulsifiers: cleaners, developers: sensitivity: Advantages: Limitations: Applications;
7. **Radiographic Methods-** Limitations: Principles of radiography: sources of radiation, Ionising radiation - X-rays sources, gama-rays sources Recording of radiation: Radiographic sensitivity: Fluoroscopic methods: special techniques: Radiation safety; Ultrasonic Testing of Materials- Advantages, disadvantages, Applications, Generation of. Ultrasonic waves, general characteristics of ultrasonic waves: methods and instruments for ultrasonic materials testing: special techniques;

Unit-II

8. **Magnetic Methods-** Advantages, Limitations, Methods of generating fields: magnetic particles and suspending liquids Magnetography, field sensitive probes: applications. Measurement of metal properties; Electrical Methods- Eddy current methods: potential-drop methods, applications.

Unit-III

9. **Electromagnetic Testing-** Magnetism: Magnetic domains: Magnetization curves: Magnetic Hysteresis: Hysteresis loop tests: comparator - bridge tests Absolute single-coil system: applications.
10. **Other Methods-** Acoustic Emission methods, Acoustic methods: Leak detection: Thermal inspection.

Suggested Books:

1. P. Halmshaw, Non-Destructive Testing
2. Metals Handbook Vol. II, Non-destructive inspection and quality control

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MEL452: TECHNOLOGY OF SURFACE CAOTING

L	T	P
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Course Objectives: The course objective is to introduce students the various types of surface coatings, their types and applications in engineering.

Course Contents:

Unit-I

1. **Introduction -** Influence of different manufacturing processes on various surface and sub-surface properties; need of augmentation of surface properties; need from the view point of friction, wear, thermal barrier, erosion, corrosion etc.
2. **Techniques of different surface engineering-** Heat treatments, dip-coatings, galvanizing, painting electro-depositions, physical vapour deposition processes, chemical vapour deposition processes, thick coating processes (like plasma spraying, high velocity oxy fuel spray, detonation gun spray, cold spray gun etc.)

Unit-II

3. **Corrosion-** Fundamentals of corrosion, types or corrosions and electrochemical protection, protective coating, corrosion measurement
4. **Experimental and Approach-** Evaluation of engineered properties – control properties, response properties; surface geometry – characterization techniques (conventional and recent trends); coating thickness measurements – laboratory techniques and special techniques for accurate routine thickness measurements; adhesion measurement – conventional methods and recent developments

Unit-III

5. **Tribology and Nano technology-** Measurement of mechanical properties of engineered surface in nano scale; Evaluation of tribological characteristics of engineered surface in macro, micro and nano scale, simulation of actual application environment in tribometer

Suggested Books:

1. Brian N. Chapman, Science and technology of surface coating, Academic Press.
2. Niir Board, Modern technology of surface coating with formulae & their applications, Asian Pacific Business Press.
3. Swaraj Paul, Surface coatings: science & technology, Edition 2, J. Wiley, ISBN 0471958182.
4. P. Ghosh, Adhesive and Coating Technology, Tata McGraw Hill.
5. Donatas Satas, Arthur A. Tracton, Coatings technology handbook, Marcel Dekker.

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MEL453: TRIBOLOGY

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Course Objectives: The course objective is to make students understand the surface phenomena related to relative motion, the nature of friction, and mechanisms of wear, Studying engineering problems related to friction, wear, and lubrication. Learning basic skills for tribological analyses, practicing tribological design of mechanical elements and systems.

Course Contents:

Unit-I

1. **Surfaces and Friction-** Topography of Engineering surfaces- Contact between surfaces -
   Sources of sliding Friction -Adhesion Ploughint- Energy dissipation mechanisms, Friction
   Characteristics of metals - Friction of non-metals. Friction of lamellar solids - friction of Ceramic materials and polymers - Rolling Friction. Source of Rolling Friction - Stick slip motion - Measurement of Friction.
2. **Wear-** Types of wear - Simple theory of Sliding Wear Mechanism of sliding wear of metals - Abrasive wear. Materials for Adhesive and Abrasive wear situations - Corrosive wear - Surface Fatigue wear situations - Brittle Fracture wear - Wear of Ceramics and Polymers – Wear Measurements.

Unit-II

3. **Lubricants and Lubrication Types-** Types and properties of Lubricants – Testing methods - Hydrodynamic Lubrication – Elasto hydrodynamic lubrication- Boundary Lubrication - Solid Lubrication Hydrostatic Lubrication.
4. **Film Lubrication Theory-** Fluid film in simple shear - Viscous flow between very close parallel plates - Shear stress variation, Reynolds Equation for film Lubrication - High speed unloaded journal bearings - Loaded journal bearings - Reaction torque on the bearings –Virtual Coefficient of friction - The Somerfield diagram.

Unit-III

5. **Surface Engineering and Materials for Bearings-** Surface modifications - Transformation Hardening, surface fusion - Thermo chemical processes - Surface coatings - Plating and anodizing Fusion Processes - Vapour Phase processes - Materials for rolling Element bearings - Materials for fluid film bearings - Materials for marginally lubricated and dry bearings.

Suggested Books:

1. I.M. Hutchings, Tribology, Friction and Wear of Engineering Material, Edward Arnold
2. T.A. Stolarski, Tribology in Machine Design , Industrial Press Inc
3. E. P.Bowden and Tabor.D., Friction and Lubrication , Heinemann Educational Books Ltd
4. A. Cameron, Basic Lubrication theory, Longman, U.K.., 1981.
5. M. J.Neale (Editor), Tribology Handbook, Newnes. Butter worth, Heinemann, U.K.

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MEL454: MACHINE TOOLS AND MACHINING

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Course Objectives: The course objective is to make students understand the various manufacturing processes, machine parts, chip formation, mechanisms of machining, tool wear, tool life, screw thread measurement and gear measurements.

Course Contents:

Unit-I

1. **Introduction-** Classifications of manufacturing processes, characteristics of material removal processes, need and purpose of conventional material removal processes. Basic description of conventional machining processes, identification of process parameters, concept of machinability. General Constructional Configuration of Basic Machine Tools- Constructional configuration and specifications of basic machine tools like lathe, drilling machine, shaping machine, milling machine, grinding machine. Concept of generatrix and directrix.
2. **Basic Kinematic Structure of Centre Lathe-** Kinematic analysis of: Speed Gear Box, Feed Gear Box, Apron Mechanism, Thread Cutting. Tool Geometry- Detailed discussions restricted to ASA, ORS and MRS and for single point cutting tool as well as WRS, Introduction to NRS. Introduction to tool geometry of milling cutters and drills.
3. **Mechanism of Chip Formation-** Detailing on chip formation mechanism of brittle and ductile work material. Chip reduction coefficient, shear angle. Kronenberg's relation. Build-up edge (BUE). Cutting strain, cutting strain rate, orthogonal machining, causes and modelling of chip deviation concept of effective rake, concept of oblique machining. Effect of process parameters and tool geometry on mechanism of chip formation. Introduction to characteristics of chip formation in milling.

Unit-II

4. **Mechanics of machining-** Identification of cutting forces on orthogonal plane. Merchant's circle diagram, interrelations between cutting forces, angle relationships. Merchant's 1st solution, 2nd solution and Lee and Shaffer's solution. Cutting forces in turning, milling, shaping and drilling. Effect of process parameters and tool geometry on mechanics of chip formation, Measurement of cutting forces, effect of tool geometry. Mechanism of chip formation of surface roughness. Effect of cutting forces on product quality. Cutting temperature - Identification of heat sources in machining. Effect of cutting temperature on product quality and cutting tool. Estimation, measurement and control of cutting temperature. Effect of process parameters and tool geometry on cutting temperature.

5. **Tool Wear, Tool Life and Tool Material-** Different mechanism of tool wear. Types of tool wear (crater, flank etc), Measurement and control of tool wear, Concept of tool life, Taylor's tool life equation (including modified version). Different tool materials and applications including effect of tool coating. Machining Time- Estimation of machining time in different machining operations, Introduction to economics of machining, Revisit to the concept of machinability.
6. **Introduction to Grinding -** Need and different methods of grinding, Wheel specifications, Mechanics of grinding, Similarities and differences between grinding and machining. Basic Kinematic systems and operations of Other Machine Tools- Kinematic system and operations of drilling machines. Kinematic system and operations of milling machines. Construction, working principle and applications of shaping, planing and slotting.

Unit-III

7. **Precision and Accuracy-** Methods of estimating accuracy and precision; Needs for accuracy and precision; Standards and their evolution; Types of errors in measurements. Limits, Fits and Tolerances, & Gauge Design- Basic concepts in limits, fits and tolerances Tolerance grades; ISO system of tolerance, Principles gauge design. Work Shop and Inspection gauges.
8. **Screw Thread Measurement-** Standard thread profiles, Different Thread Elements, Effective diameter, 2 wire and 3 wire methods as applied to standard and non-standard thread profiles, Best wire size, Virtual Effective Diameter. Surface Roughness-Sources of surface irregularities in manufacturing, Different elements of surface roughness, Definition of center line and related roughness parameters, Measurement Instruments, Profilometers, Analysis of roughness signal in frequency domain
9. **Gear Metrology-** Different types of gears, Basic elements of a gear, Involute function, Relations between different gear elements of spur and helical gears, Virtual number of teeth, Use of gear tooth Vernier for chordal and constant chordal measurements, Span measurement using Base Tangent Micrometers. Coordinate Measuring Machines- Introduction to Coordinate Measuring Machines.

Suggested Books:

1. Sen, G. C., & Bhattacharyya, A. Principles of Machine Tools: New Central Book Agency
2. Bhattacharyya A, Theory & Practice Of Metal Cutting, New Central Book Agency
3. Boothroyd, G., & Knight, W. A., Fundamentals of machining and machine tools: Taylor and Francis.

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MEP453: Tribology

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List of Experiments

1. Multipurpose Friction and Wear Test.
2. Lubricity Test.
3. Rolling Fatigue Testing.
4. Air Bearing Rig Test.
5. Friction and wear performance Test.
6. Bearing Friction Measurement.

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MEP454: MACHINE TOOLS AND MACHINING

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List of Experiments

1. Step Turning and Taper Turning on Lathe
2. Thread Cutting and Knurling on Lathe
3. Machining Flat Surface using Shaper Machine
4. Manufacturing of Spur Gear using Milling Machine
5. Making Internal Splines using Slotting Machine
6. Drilling, Tapping & Grinding
7. Grinding of Single Point Cutting Tool
8. Planing Machine

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MEP416: PROJECT WORK I

L	T	P
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The object of *Project Work I* is to enable the student to take up investigative study in the broad field of *Mechanical Engineering*, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

- Survey and study of published literature on the assigned topic;
- Working out a preliminary Approach to the Problem relating to the assigned topic;
- Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
- Preparing a Written Report on the Study conducted for presentation to the Department;
- Final Seminar, as oral Presentation before a Departmental Committee.

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MEL461: QUALITY ASSURANCE AND RELIABILITY

L	T	P
4	0	0

Course Objectives: The course objective is to make students understand the meaning of quality and its importance in mechanical engineering.

Course Contents:

Unit-I

1. **Introduction-**Definition of Quality, Quality function, Dimensions of Quality, Quality. Engineering terminology, Brief history of quality methodology, Statistical methods for quality improvement, Quality costs – four categories costs and hidden costs. Brief discussion on sporadic and chronic quality problems. Introduction to Quality function deployment.
2. **Quality Assurance-**Definition and concept of quality assurance, departmental assurance activities. Quality audit concept, audit approach etc. structuring the audit program, planning and performing audit activities, audit reporting, ingredients of a quality program.

Unit-II

3. **Statistical Process Control-**Introduction to statistical process control – chance and assignable causes variation. Basic principles of control charts, choice of control limits, sample size and sampling frequency, rational subgroups. Analysis of patterns of control charts. Case Studies on application of SPC. Process capability – Basic definition, standardized formula, relation to product tolerance and six sigma concept of process capability, Seven QC tools.
4. **Control Charts for Variables-** Controls charts for X bar and Range ®, statistical basis of the charts, development and use of X bat and R charts interpretation of charts. Control charts for X bar and standard deviation (S), development and use of X bat and S chart. Brief discussion on – Pre control X bar and S control charts with variable sample size, control charts for individual measurements, moving-range charts.

Unit-III

5. **Control Charts for Attributes-** Controls chart for fraction non- conforming (defectives) development and operation of control chart, brief discussion on variable sample size. Control chart for non-conformities (defects) – development and operation of control chart for constant sample size and variable sample size. Choice between variables and attributes control charts. Guidelines for implementing control charts. Sampling Inspection-Concept of accepting sampling, economics of inspection,
6. **Acceptance plans –** single, double and multiple sampling. Operating characteristic curves – construction and use. Determinations of average outgoing quality, average outgoing quality level, average total inspection, producer risk and consumer risk, published sampling plans, Gauge R and R and MSA. Statistical Theory of Tolerances-Application of statistical theory of tolerances to design of tolerances in random assemblies and application in other areas.

7. **Reliability and Life Testing-** Failure models of components, definition of reliability, MTBF, Failure rate, common failure rate curve, types of failure, reliability evaluation in simple cases of exponential failures in series, paralleled and series-parallel device configurations, Redundancy and improvement factors evaluations.

Suggested Books:

1. D C Montgomery, Introduction to statistical Quality Control, John Wiley and Sons.
2. J M Juran, Frank M Gryna, Quality Planning & Analysis; Tata McGraw Hill,
3. NVR Naidu, KM Babu and G. Rajendra, Total Quality Management; New Age International Pvt.
4. Grant and Leavenworth ; Statistical Quality Control, McGraw Hill,
5. Janet L Novak and Kathleen C Bosheers, The QS9000 Documentation Toolkit, Prentice Hall PTR
6. Suresh Dalela and Saurabh, ISO 9000 a Manual for Total Quality Management, S. Chand Co.
7. Kesavan R, Total Quality Management; I.K. International.

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MEL462: OPTIMIZATION TECHNIQUES

L	T	P
4	0	0

Course Objectives: The course objective is to make students understand the concept of optimum design, approach towards optimization approach, its techniques etc.
Course Contents:

Unit-I

1. **Introduction -** Origin of OR and its role in solving industrial problems, General approach for solving OR problems. Classification of mathematical models: various decision making
   environments.
2. **Linear Programming** - Formulation of linear mathematical models: Graphical and simplex techniques for solution of linear programming problems, Big M method and two phase method, Introduction to duality theory and sensitivity analysis.
3. **Transportation and Assignment Models** - Various initial basic feasible solutions methods, Optimization of transportation and assignment using different methods considering the concept of time and cost function.

Unit- II

4. **Dynamic Programming** - Introduction to deterministic and probabilistic dynamic programming.
5. **Queuing Theory** -Types of queuing situation, Queuing models with Poisson's input and exponential service, their application to simple situations.
6. **Replacement Models** - Replacement of items that deteriorate, Replacement of items whose maintenance and repair costs increase with time, replacement of items that fail suddenly; replacement of items whose maintenance costs increase with time and value of money also changes, individual replacement policy, group replacement policy.

Unit- III

7. **Network models** - Shortest route and travelling sales - man problems, PERT & CPM-introduction, analysis of time bound project situations, construction of net works, identification of critical path, slack and float, crashing of network for cost reduction.
8. **Non-linear Programming Models** - Introduction to non-linear programming models. Problems related to the topic.

Suggested Books:

1. H.M Wagner, Principles of Operations Research, Prentice Hall.
2. P.K. Gupta and D.S. Hira, Operations Research, S. Chand & Co.
3. F.S. Hiller and G.I. Libermann, Introduction to Operation Research, Holden Ray.
4. A Management Guide to PERT/CPM Wiest & Levy Prentice Hall

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MEL463: MECHANICAL HANDLING SYSTEMS AND EQUIPMENT

L	T	P
4	0	0

Course Objectives: The course objective is to make students understand the basics of material handling system, selection of equipment, design of handling equipment.

Course Contents:

Unit-I

1. **Elements of Material Handling System-** Importance, Terminology, Objectives and benefits of better Material Handling; Principles and features of Material Handling System; Interrelationships between material handling and plant layout, physical facilities and other
   organizational functions; Classification of Material Handling Equipment.
2. **Selection of Material Handling Equipment-**Factors affecting for selection; Material Handling Equation; Choices of Material Handling Equipment; General analysis Procedures; Basic Analytical techniques; The unit load concept; Selection of suitable types of systems for applications ; Activity cost data and economic analysis for design of components of Material Handling Systems; functions and parameters affecting service; packing and storage of materials.

Unit-II

3. **Design of Mechanical Handling Equipment-** Design of Hoists, Drives for hoisting, components, and hoisting mechanisms; rail travelling components and mechanisms; hoisting gear operation during transient motion; selecting the motor rating and determining breaking torque for hoisting mechanisms. Design of Cranes, Hand-propelled and electrically driven E.O.T. overheat Travelling cranes; Traveling mechanisms of cantilever and monorail cranes; design considerations for structures of rotary cranes with fixed radius ; fixed post and overhead travelling cranes; Stability of stationary rotary and travelling rotary cranes.
4. **Design of load lifting attachments-** Load chains and types of ropes used in Material Handling System; Forged, Standard and Ramshorn Hooks; Crane Grabs and Clamps; Grab
   Buckets; Electromagnet; Design consideration for conveyor belts; Application of attachments.

Unit-III

5. **Study of systems and Equipment used for Material Storage-** Objectives of storage; Bulk material handling; Gravity flow of solids through slides and chutes; Storage in bins and hoppers; Belt conveyors; Bucket-elevators; Screw conveyors; Vibratory Conveyors; Cabin conveyors; Mobile racks etc.
6. **Material Handling / Warehouse Automation and Safety considerations-**Storage and warehouse planning and design; computerized warehouse planning; Need, Factors and Indicators for consideration in warehouse automation; which function, when and How to automate; Levels and Means of Mechanizations. Safety and design; Safety regulations and discipline.

Suggested Books:

1. N. Rudenko, Material Handling Equipments, Peace Publishers, Moscow.
2. James M. Apple, Material Handling System Design, John-Willlwy and Sons Publication, New York.
3. John R. Immer, Material Handling, McGraw Hill Co. Ltd., New York.
4. Colin Hardi, Material Handling in Machine Shops, Machinery Publication Co. Ltd., London.
5. M .P. Nexandrn, Material Handling Equipment, MIR Publication, Moscow.
6. C. R. Cock and J. Mason, Bulk Solid Handling, Leonard Hill Publication Co. Ltd., U.S.A.
7. Spivakovsy, A.O. and Dyachkov, V.K., Conveying Machines, Volumes I and II, MIR Publishers.
8. Kulwiac R.A., Material Handling Hand Book, John Willy Publication, New York.

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MEL464: SIMULATION OF MECHANICAL SYSTEMS

L	T	P
4	0	0

Course Objectives: The course objective is to make students understand the importance of use of probability and statistics in engineering along with systematic simulation and approach.

Course Contents:

Unit-I

1. **Introduction -** A review of basic probability and statistics, random variables and their properties, Estimation of means variances and correlation.
2. **Physical Modeling -** Concept of System and environment, Continuous and discrete systems, Linear and nonlinear systems, Stochastic activities, Static and Dynamic models, Principles of modeling, Basic Simulation modeling, Role of simulation in model evaluation and studies, advantages of simulation

Unit-II

3. **System Simulation and Approach -** Techniques of simulation, Monte Carlo method, Experimental nature of simulation, Numerical computation techniques, Continuous system models, Analog and Hybrid simulation, Feedback systems, Computers in simulation studies, Simulation software packages. System Dynamics: Growth and Decay models, Logistic curves, System dynamics diagrams. Probability Concepts in Simulation: Stochastic variables, discrete and continuous probability functions, Random numbers, Generation of Random numbers, Variance reduction techniques, Determination of length of simulation runs.

Unit-III

4. **Simulation of Mechanical Systems -** Building of Simulation models, Simulation of translational and rotational mechanical systems, Simulation of hydraulic systems. Simulation of Manufacturing Systems: Simulation of waiting line systems, Job shop with material handling and Flexible manufacturing systems, Simulation software for manufacturing, Case studies.

Suggested Books:

1. Geoffrey Gordon, System Simulation, Prentice Hall.
2. Robert E. Shannon ; System Simulation, The Art and Science ;Prentice Hall
3. J. Schwarzenbach and K.F. Gill Edward Arnold, System Modelling and Control

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MEP421: PROJECT WORK II & DISSERTATION

L	T	P
0	0	12

The object of *Project Work II & Dissertation* is to enable the student to extend further the investigative study taken up under *Project Work*, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

- In depth study of the topic assigned in the light of the Report prepared under *Project work I;*
- Review and finalization of the Approach to the Problem relating to the assigned topic;
- Preparing an *Action Plan* for conducting the investigation, including team work;
- Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
- Final development of product/process, testing, results, conclusions and future directions;
- Preparing a paper for Conference presentation/Publication in Journals, if possible;
- Preparing a Dissertation in the standard format for being evaluated by the Department;
- Final Seminar Presentation before a Departmental Committee.