



*References:*

1. *HARRY NYSTROM, " Creativity and innovation", John Wiley & Sons, 1979.*
2. *BRAIN TWISS, " Managing technological innovation", Pitman Publishing Ltd., 1992.*
3. *HARRY B.WATTON, " New Product Planning ", Prentice Hall Inc., 1992.*
4. *P.N.KHANDWALLA - " Fourth Eye (Excellence through Creativity) - Wheeler Publishing ", Allahabad, 1992.*
5. *I.P.R. Bulletins, TIFAC, New Delhi, 1997.*

**GE037 Intellectual Property Rights (IPR)**

**3 0 0 100**

**1 . UNIT I 5**

Introduction - Invention and Creativity - Intellectual Property (IP) - Importance - Protection of IPR - Basic types of property (i. Movable Property ii. Immovable Property and iii. Intellectual Property).

**2 . UNIT II 10**

IP - Patents - Copyrights and related rights - Trade Marks and rights arising from Trademark registration - Definitions - Industrial Designs and Integrated circuits - Protection of Geographical Indications at national and International levels - Application Procedures.

**3 . UNIT III 10**

International convention relating to Intellectual Property - Establishment of WIPO - Mission and Activities - History - General Agreement on Trade and Tariff (GATT).

**4 . UNIT IV 10**

Indian Position Vs WTO and Strategies - Indian IPR legislations - commitments to WTO-Patent Ordinance and the Bill - Draft of a national Intellectual Property Policy - Present against unfair competition.

**5 . UNIT V 10**

Case Studies on - Patents (Basumati rice, turmeric, Neem, etc.) - Copyright and related rights - Trade Marks - Industrial design and Integrated circuits - Geographic indications - Protection against unfair competition.

**Total No of periods: 45**

*TEXT BOOK*

*1. Subbaram N.R. " Handbook of Indian Patent Law and Practice ", S. Viswanathan (Printers and Publishers) Pvt. Ltd., 1998.*

*REFERENCES*

- 1. Eli Whitney, United States Patent Number : 72X, Cotton Gin, March 14, 1794.*
- 2. Intellectual Property Today : Volume 8, No. 5, May 2001, [www.iptoday.com].*
- 3. Using the Internet for non-patent prior art searches, Derwent IP Matters, July 2000. [www.ipmatters.net/features/000707\_gibbs.html.*

**1 . UNIT I 9**

Historical Background - Constituent Assembly of India - Philosophical foundations of the Indian Constitution - Preamble - Fundamental Rights - Directive Principles of State Policy - Fundamental Duties - Citizenship - Constitutional Remedies for citizens.

**2 . UNIT II 9**

Union Government - Structures of the Union Government and Functions - President - Vice President - Prime Minister - Cabinet - Parliament - Supreme Court of India - Judicial Review.

**3 . UNIT III 9**

State Government - Structure and Functions - Governor - Chief Minister - Cabinet - State Legislature - Judicial System in States - High Courts and other Subordinate Courts

**4 . UNIT IV 9**

Indian Federal System - Center - State Relations - President's Rule - Constitutional Amendments - Constitutional Functionaries - Assessment of working of the Parliamentary System in India.

**5 . UNIT V 9**

Society : Nature, Meaning and definition; Indian Social Structure; Caste, Religion, Language in India; Constitutional Remedies for citizens - Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.

**Total No of periods: 45**

**TEXT BOOKS**

1. *Durga Das Basu, " Introduction to the Constitution of India ", Prentice Hall of India, New Delhi.*
2. *R.C.Agarwal, " (1997) Indian Political System ", S.Chand and Company, New Delhi.*
3. *Maciver and Page, " Society: An Introduction Analysis ", Mac Milan India Ltd., New Delhi.*
4. *K.L.Sharma, " (1997) Social Stratification in India: Issues and Themes ", Jawaharlal Nehru University, New Delhi.*

**REFERENCES**

1. *Sharma, Brij Kishore, " Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.*
2. *U.R.Gahai, " (1998) Indian Political System ", New Academic Publishing House, Jalaendhar.*
3. *R.N. Sharma, " Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd.*
4. *Yogendra Singh, " (1997) Social Stratification and Charge in India ", Manohar, New Delhi.*

**1 . INTRODUCTION 5**

Special and comparative features of German with English, Hindi and Tamil - German Alphabets, pronunciation.

**2 . THEMA 10**

Name, Land Wohnort - Studium, Beruf - Familie, Geschwister, Alter - Tagesablauf , termine - Einladung - Stellensuche, Berufswahl - Einkauf.

**3 . GRAMMATIK 10**

Personalpronomen, Verb, Wortstellung, Ort - Possessivpronomen, Verb - 'Sein' - Verb - 'Haben', Unbestimmter Artikel, Negation - 'Nicht' - 'Kein' - Zeit, Bestimmter Artikel, Starke Verben - Trennbare Verben, Imperativ - Modal Verben - Akkusativ.

**4 . UEBUNGEN 10**

Partner uebungen - Schriftliche Uebungen - Aussprache Uebungen - Kontrollue bungen - Text generation.

**5 . DIALOGUE 5**

Oral - Written.

**6 . GLOSSARY 5**

Technical Words.

**7 . TUTORIAL 15**

**Total No of periods: 60**

*Text Book:*

*1. LERNZIEL DEUTSCH (Deutsch als Fremdsprache) - Grundstufe 1 from Max Hueber varlag.*



*Text Book:*

*1. LERNZIEL DEUTSCH (Deutsch als Fremdsprache) - Grundstufe 1 from MAX Hueber Verlag.*

**1 . 9**

Introduction to Japanese Alphabets - Hiragana, Katakana and Kanji - group 1,2,3 & 4 Syllabus - Writing Practice - Pronunciation - word Order - Greetings - Receiving a visitor and exchange of pleasantries - Kanji Practice.

**2 . 9**

Basic structure of sentences - classification of verbs - Polite form of verbs - irregular verbs - Particle-E - Time expressions - question sentences - Japanese numerals - Kanji practice.

**3 . 9**

Classification of particles - Ga, Ka, Wa, O, E, Ni etc - aural comprehension - reading comprehension - noun -1 Wa, noun -2 desu - Demonstrative pronouns - kore, sore , are and dore - kono, sono, ano and dono - kochira - sochira - achira and dochira - particle - No, kara, ni and de - question - itsu - conversational grammar - soo desu ka - Na, I adjectives perfect and imperfect - question words - Doo and ikaga - particle - To, ne and yo - Kanji practice.

**4 . 9**

Desu as a substitute for a verb - demonstrative pronouns sono and sore - Group 1 particles - de, O, Made and Ka - conjunction - soshite - Question words - dare, nani, doko, itsu, dore, dochira, doyatte, ikutsu, ikura - Words for degrees - gurai or kurai - Phrase - Saa - anoo - numerals - counters and numbers - humble form of desu and arimasu - Kanji practice.

**5 . 9**

Verbs ending in-te or de - classification of Te forms and Masu forms - verb modifiers - koo, soo, aa and doo - Set phrase - Onegaishimasu - Sumimasen - Adverbs - Mazu, sore kara and saigo ni - formation of the Te form of I adjective and desu - kanji practice.

**Total No of periods: 45**

*Text Books:*

1. *OOTSUBO et al - " A Course in Modern Japanese ", Vol.1, 1983, The University of Nagoya Press, Japan.*
2. *SHIYO SUZUKI and IKUO KAWASE - Nihongo Shoho text book with audio tapes, 1981.*
3. *YAN - SAN Serial - Video tapes, Japan.*

<b>1 .</b>	<b>9</b>
<p>Demonstrative Pronouns: Are - Interjection: Ee - Quoted Sentences - omoimsu - Non polite form of verbs - Group 1 ending in -ert or iru, group 2 verbs ending in - u - Non polite forms of - I - adjectives -non polite form of desu,deshoo,daroo - Suffic - Sugiru - expression of reason - tame (ni) - Counters: - Hon and - Do - Kanji practice.</p>	
<b>2 .</b>	<b>9</b>
<p>Negative - Te - form of verbs -I adjectives - Permission and prohibition - te mo desuka and - te wa ikemasen ka - Na - adjectives - suki and kirai - Verbs:Itadaku - Conjunction - Nagara - Phrase - No koto na n desu ga - usage of chotto - kanji practice.</p>	
<b>3 .</b>	<b>9</b>
<p>Noun modifiers - Quoting modifier - Suffix - Kata - sa and me - Particles - Made ni and dake - te form of verb and iru/imasu - noun - Uchi - Eba form of verbs - Kanji practice.</p>	
<b>4 .</b>	<b>9</b>
<p>Potential sentences - group 1 verbs - group 2 verbs irregular verbs - Nouns - Tsumori and Hazu - Adverbs: Moo and Made - Form of address: moshomoshi - Expression - Ee - verbs: Naru and suru - Particles - De and ka - kanji practice.</p>	
<b>5 .</b>	<b>9</b>
<p>Comparative sentences - no hoo ga and yori - Negative comparative sentences - Negative request - Adverbs of extent - Konna ni, sonna ni and anna ni - Te form of transitive verb and - arul - Passive sentence - neutral passive sentence - technical vocabulary related to Engineering and Technology - Preparation of technical reports.</p>	
<b>6 . TUTORIALS</b>	<b>15</b>

**Total No of periods: 60**

*Text Books:*

1. *OOTSUBO ET AL - " A Course in Modern Japanese ", Vol.II, The University of Nagoya Press, Japan, 1983.*
2. *SHIYO SUZUKI and IKUO KAWASE - Nihongo Shoho text book with audio tapes, The Japan Foundation, Tokyo, Japan, 1981.*
3. *YAN - SAN Serial - Video tapes, Japan.*

<b>1 .</b>	<b>9</b>
Alphabets - Pronunciation - Masculine and Feminine Genders only - Numbers - Indefinite and definite articles - plurals - Verbs to be and to have.	
<b>2 .</b>	<b>9</b>
Present tense - Affirmative, interrogative and negative sentences - Adjectives - Adverbs - Prepositions - Possessive Pronoun - Personnel Pronoun - Indirect Object.	
<b>3 .</b>	<b>9</b>
Group I verbs - Conjugations - Present, Past compound, Simple past and future tenses - Singular & Plural - Masculine and Feminine - adjectives and adverbs.	
<b>4 .</b>	<b>9</b>
Group II Verbs - Conjugations- Present, Past compound, simple past and future tenses - Singular and Plural - Masculine and Feminine - adjectives and adverbs.	
<b>5 .</b>	<b>9</b>
Pronomial verbs - Present, Past compound, Simple past and future tenses - Singular and Plural - Masculine and Feminine - adjectives - adverbs - Dialogue - Glossary.	
<b>6 . TUTORIAL</b>	<b>15</b>

**Total No of periods: 60**

*Text Books:*

1. MAUGER. G - *Course de Langue et de - Civilization Francaises*, HACHETTE -PARIS, 1986.
2. DOMINIQUE BERGER and REGINE MIRIEUX, *Cadences, Method de Francais Didier*, Paris, 1994.

*References:*

1. DENIS GIRARD, *French to English, English to French Dictionary*, Cassell - Mac Millan, 1981.

**HS040 Technical French II****3 1 0 100****1 . 9**

Group III Verbs - Conjugations - Adjectives - Adverbs - sentences - present - past compound - Simple past - future.

**2 . 9**

Comparative, superlative sentences - recent past - immediate future - grammatical analysis.

**3 . 9**

Translation from English to French - Translation from French to English - Texts from Physics and Chemistry.

**4 . 9**

Translation from English to French - Translation from French to English - Texts from Basic Engineering.

**5 . 9**

Report writing and translation from English to French - Translation from French to English - Letter Writing - Dialogue - Glossary.

**6 . TUTORIALS 15****Total No of periods: 60**

*Text Books:*

1. MAUGER, G - *Cours de Langue et de - Civilization Francaises*, HACHETTE - PARIS, 1986.
2. DOMINIQUE BERGER and REGINE MIRIEUX, *Cadences Methods de Francais*, Didier, Paris, 1994.

*References:*

1. CENTRE D'ETUDES FRANCAISES, " *Functional French for Scientists and Technologists* ", Jawaharlal Nehru University, New Delhi, 1986.
2. J.O.KETTRIDGE " *Dictionary of Technical terms and phrases Vol 1 & 2* ", The Gresham Press, Surrey, Great Britain, 1980.

**1 . LISTENING 7**

Listening comprehension-listening for specific information-note-taking-use of charts and diagrams.

**2 . SPEAKING 7**

Defining-describing objects-describing uses/functions-comparing-offering suggestions-analysing problems and providing solutions-expressing opinions (agreement/disagreement) predicting-expressing possibility/certainty-framing questions-providing answers-pronunciation practice (word stress).

**3 . READING 12**

Skimming-scanning-detailed reading-predicting content-interpreting charts and tables-identifying stylistic features in texts - evaluating texts-understanding discourse coherence-guessing meaning from the context- note - making / transferring information.

**4 . WRITING 12**

Sentence definition-static description-comparison and contrast-classification of information-recommendations-highlighting problems and providing solutions-formal and informal letter writing-using flow-charts/diagrams-paragraph writing-editing.

**5 . FOCUS ON LANGUAGE 7**

Word formation with prefixes and suffixes-discourse markers and their functions-degrees of comparison-expressions relating to recommendations and comparisons-active and passive voice-antonyms-tense forms-gerunds-conditional sentences-modal verbs of probability and improbability-acronyms and abbreviations - compound nouns and adjectives-spelling-punctuation.

**6 . PRACTICE IN LANGUAGE LAB 15**

Pronunciation practice - word stress - sentence stress - Listening comprehension - discussion - interpretation of visuals.

**Total No of periods: 60**

*Text Books:*

1. "*English for Engineers and Technologists* ", Volume I. Authors : *Humanities and Social Science Department, Anna University, Published by Orient Longman Ltd., 1990.*

*References:*

1. *Narayanaswami, V.R. Strengthen Your Writing, Orient Longman Ltd., Chennai 1996 (Revised Edition)*
2. *Pickett and Laster, Technical English, Writing, Reading and Speaking, New York Harper and Row Publications.*
3. *Swan, Michael, Basic English Usage, Oxford University Press, 1984.*

**1 . LISTENING 7**

Listening comprehension - listening for specific information - note-taking and using non-verbal devices.

**2 . SPEAKING 7**

Describing processes-stating purpose-offering opinions, suggestions and recommendations-summarizing-reporting-free discussion of chosen topics-pronunciation practice (word stress, consonant clusters-homonyms)

**3 . READING 12**

Skimming-scanning-note -making-understanding the organisation of texts discourse cohesion-predicting and evaluating content-evaluating style-inferring meaning-study reading-interpreting tables, flow-charts.

**4 . WRITING 12**

Extended definition-process description-cause and effect analysis-stating choice and justifying it -safety instructions-check list-letter of application-data sheet/resume.

**5 . FOCUS ON LANGUAGE 7**

Word formation-synonyms-prepositions-adverbs-passive voice-sequence words/discourse markers-connective adverbs-numerical expressions-expansion of abbreviations-rules for writing SI units-language of instructions, check-lists, causes and effects, purpose and means-indefinite adjectives of number and quantity-spelling and punctuation.

**6 . PRACTICE IN LANGUAGE LABORATORY**

Pronunciation practice - listening comprehension - discussion - interpreting and reporting from visual inputs.

**7 . TUTORIAL 15**

**Total No of periods: 60**

*Text Books:*

1. *" English for Engineers and Technologists ", Volume II, AUTHORS :Humanities and Social Science Department, Anna University, Published by Orient Longman Ltd.,1990.*

*References:*

1. *Swales, John.M. and Christine B Feak, "Academic Writing for graduates students", The University of Michigan Press, USA, 1994.*
2. *Goddard, Ken - " Informative Writing - Your Practical Guide to Effective Communication ", Cassell Publication U.K. 1998.*
3. *Cutts, Martin " The Plain English guide-How to write clearly and Communicate Better ", Oxford University Press, New Delhi, 1995.*

**1 . UNIT I 22**

ORAL COMMUNICATION - Practical use of language in simulated real - life situations through role playing - social skills - interaction with employers, peers and subordinates - Group dynamics - Listening techniques - Phonological aspects of language use - pronunciation, stress and intonation.

Introducing oneself and others, narrating events - Making telephonic conversation - Making requests, Asking questions, Making recommendations using modal verbs, Expressing causal relations with suitable discourse markers, Giving instructions using imperatives, Expressing purposes and functions, obligation and preferences, Accepting offers and Counselling, Interpreting advertisements, Describing processes using sequential expressions. (Lecture:8, Practicals 14)

**2 . UNIT II 12**

Presenting one's ideas at meetings and conferences, Making extempore talks, Public speaking, Body language, Strategic competence, Use of audio - visual aids and multimedia presentations. (Lecture : 6, Practical 6)

**3 . UNIT III 8**

Technical Writing - the structure of organised writing - paragraph writing, coherence, cohesion (use of Discourse Markers) and punctuation, Use of titles, nonverbal devices - Layout - Revision strategies - Reading techniques.

Letter Writing: - Personal/Informal letters: Letters to family members and friends Business / Formal letters: Letters thanking the recipients, announcing functions, extending invitations, congratulating associates on important occasions, letters of application (Resumes), apology and complaint, letters to the editor. (Lecture:8, Practical : 0)

**4 . UNIT IV 8**

Report Writing: - persuasive, explanatory, argumentative and informative, Writing agenda, minutes, memos, project proposals and checklists.

(Lecture : 8, Practical 0)

**5 . UNIT V 10**

Grammar - study of grammatical items in contexts. Nouns, pronouns, adjectives, comparative adjectives, adverbs, gerund, prepositions, voice, tenses, 'if clauses, direct and indirect speech (reporting verbs), concord Vocabulary - Synonyms, antonyms, homonyms, homophones, hyponyms, affixes, reference words, phrasal verbs and prepositional phrases. (Lecture:10, Practical : 0)

**Total No of periods: 60**

*Text Books:*

1. *Doff, Adrian and Jones, Christopher, Language in Use: Classroom Book (Intermediate level). Cambridge: CUP. 1994 (2 audio cassettes).*
2. *Dr.V.Chellammal, Learning to Communicate - a resource book for Engineers and Technologists. Coimbatore: Kamakhya Publications 2002 (1 audio cassette)*

*References:*

1. *Sung, Abraham. 330 more Model Letters for all occasions Malaysia-Minerva Publications. 2002.*
2. *Bentley, T.J. Report Writing in Business: The Effective Communication of Information. New Delhi: Viva Books Pvt.Ltd., 2001*
3. *Vivanilam, J.V. More Effective Communication: A Manual for Professionals. New Delhi: Response Books. 2000*
4. *Michael, V.P.Communication and Research for Management. Mumbai: Himalaya Publishing House 2001.*
5. *Nauheim, Ferd. How to Write Business Letters. New Delhi; Crest Publishing House 2000.*
6. *Mohan, Krishna, Meera Banerji. Developing Communication Skills. New Delhi: Macmillan 1991.*
7. *Denny, Richard. Communicate to Win. New Delhi: Kogan Page 2002.*

**1 . REFRIGERATION CYCLES & REFRIGERANTS: 9**

Vapour Compression Refrigeration Cycle-Simple saturated vapour compression Refrigeration cycle. Thermodynamic analysis of the above. Refrigerant Classification, Designation, Alternate Refrigerants, Global Warming Potential & Ozone Depleting Potential aspects.

**2 . SYSTEM COMPONENTS: 9**

Refrigerant Compressors - Reciprocating Open & Hermetic type, Screw Compressors and Scroll Compressors - Construction and Operation characteristics. Evaporators - DX coil, Flooded type Chillers Expansion devices - Automatic Expansion Valves, Capillary Tube & Thermostatic Expansion Valves. Condensing Units and Cooling Towers.

**3 . CYCLING CONTROLS AND SYSTEM BALANCING: 9**

Pressure and Temperature controls. Range and Differential settings. Selection and balancing of system components - Graphical method.

**4 . PSYCHROMETRY: 9**

Moist air behaviour, Psychrometric chart, Different Psychrometric process analysis.

**5 . AIR CONDITIONING: 9**

Summer and Winter Airconditioning, Cooling Load Calculations, Air Distribution Patterns, Dynamic and Frictional Losses in Air Ducts, Equal Friction Method, Fan Characteristics in Duct Systems.

**Total No of periods: 45**

*Text Book:*

1. *W.F.Stocker and J.W.Jones, " Refrigeration & Air Conditioning " McGraw Hill Book Company, 1985.*

*References:*

1. *R.J.Dossat, " Principles of Refrigeration ", John Wiley and Sons Inc., 1989.*
2. *Manohar Prasad, " Refrigeration and Air Conditioning ", Wiley Eastern Ltd., 1995.*

- 1 . CONSTRUCTION DETAILS AND HEAT TRANSFER 9**  
Types, Shell and Tube Heat Exchangers, Regenerators and Recuperators, Industrial applications. Temperature distribution and its implications, LMTD, Effectiveness.
- 2 . FLOW DISTRIBUTION AND STRESS ANALYSIS 9**  
Effect of Turbulence, Friction factor, Pressure loss, Channel divergence. Thermal Stress in tubes, Types of failures.
- 3 . DESIGN ASPECTS 9**  
Heat Transfer and pressure loss, Flow Configuration, Effect of Baffles, effect of Deviations from ideality, Design of Typical liquid, Gas-Gas-Liquid Heat Exchangers, Plate Heat Exchangers.
- 4 . CONDENSORS AND EVAPORATORS DESIGN 9**  
Design of Surface and Evaporative Condensers, Design of Shell and Tube, Plate type evaporators.
- 5 . COOLING TOWERS 9**  
Packings, Spray design, Selection of pumps, Fans and Pipes, Testing and Maintenance, Experimental Methods.

**Total No of periods: 45**

*Text Book:*

1. *D.Q.Kern, " Process Heat Transfer ", Tata McGraw Hill, Edition, New Delhi, 1997.*

*References:*

1. *Arthur P.Frass, " Heat Exchanger Design ", Second Edition, John Wiley & Sons, New York, 1996.*
2. *T.Taborek, G.F.Hewitt and N.Afgan " Heat Exchangers ", Theory and Praticce, McGraw Hill Book Co., 1980.*
3. *Walker, " Industrial Heat Exchangers " - A Basic Guide, McGraw Hill Book Co., 1980.*
4. *Nicholas Cheremisioff, " Cooling Tower ", Ann Arber Science pub., 1981.*
5. *Holger Martin, " Heat Exchangers ", Hemisphere Publishing Corporation, London, 1992.*

- 1 . CONSTRUCTION DETAILS AND HEAT TRANSFER: 9**  
Introduction to Cryogenic Systems Low Temperature properties of Engineering Materials. Cryogenic fluids and their properties. Applications in space, Food Processing, super Conductivity, Electrical Power, Biologymedicine, Electronics and Cutting Tool Industry.
- 2 . LIQUEFACTION AND LOW TEMPERATURE REFRIGERATION: 9**  
Liquefaction systems ideal system, Joule Thomson expansion, Adiabatic expansion, Linde Hampson A Cycle, Claude & Cascaded System, Magnetic Cooling, Stirling Cycle Cryo Coolers.
- 3 . SEPARATION AND PURIFICATION SYSTEMS: 9**  
General characteristics of mixtures-composition diagrams. Gas separation-principles of rectification-flash calculations - Rectification column analysis, Flash calculations.
- 4 . INSULATION AND VACUUM TECHNOLOGY: 9**  
Thermal insulation and their performance at cryogenic temperatures, Super Insulations, Vacuum insulation, Powder insulation, Cryopumping Applications.
- 5 . STORAGE AND INSTRUMENTATION 9**  
Cryogenic Storage vessels and Transportation, Transfer devices. Pressure flow-level and temperature measurements.

**Total No of periods: 45**

*Text Book:*

1. *Klaus D.Timmerhaus and Thomas M.Flynn, " Cryogenic Process Engineering " Plenum Press, New York, 1989.*

*References:*

1. *Randal F.Barron, " Cryogenic Systems ", McGraw Hill, 1986.*
2. *R.B.Scott, " Cryogenic engineering ", Van Nostrand Company Inc., 1985.*
3. *J.H.Bell, " Cryogenic Engineering ", Prentice Hall Inc., 1963.*

**1 . PRINCIPLE OF SOLAR RADIATION 9**

Solar Radiation - Empirical Equations - Solar Chart - Measurements of Solar Radiation and Sunshine - Solar Radiation Data.

**2 . SOLAR THERMAL ENERGY CONVERSION 9**

Solar Thermal Collectors - Flat Plate and Concentrating Collectors - Solar Heating and Cooling Techniques - Solar Desalination - Solar Pond - Industrial Process Heat - Solar Thermal Power Plant - Solar Thermal Energy Storage.

**3 . SOLAR PHOTO VOLTAICS 9**

Introduction - Fundamentals of photo Voltaic Conversion - Solar Cells - PV Systems - PV Applications.

**4 . WIND ENERGY 9**

Wind Data and Energy Estimation - Wind Energy Conversion Systems - Wind Energy Collectors and its Performance - Wind Energy Storage - Applications of Wind Energy - Safety and Environmental Aspects.

**5 . ECONOMIC ANALYSIS 9**

Introduction - Net present value concept - Life cycle cost method - Cost benefit comparison method - Payback method.

**Total No of periods: 45**

*Text Books:*

1. *W.S.P. Suknofme, " Solar Energy Principle of Thermal Collection and Storage ", (1997), Tata Mc Graw Hill Publishing Company Ltd., New Delhi.*
2. *G.D.Rai, " Non Conventional Energy Sources ", (1999), Khanna Publishers, New Delhi.*

*References:*

1. *H.P.Garg and J.Prakash, " Solar Energy, Fundamentals and Applications " (1997), Tata McGraw Hill Publishing Company Ltd., New Delhi.*
2. *B.S.Magal, " Solar Power Engineering " (1993), Tata McGraw Hill Publishing Company Ltd., New Delhi.*
3. *J.R.Howell, R.B.Bannerot and G.C.Vtiet, " Solar Thermal Systems ", (1982), Tata Mc Graw Hill Publishing Company Ltd., New Delhi.*
4. *J.A.Duffie and W.A.Beckman, " Solar Engineering of Thermal Process " (1991), John Wiley, New York.*
5. *Golding E.W. " The Generation of Electricity by Wind Power ", (1976), E and F N Spon Ltd., London.*
6. *Le Gourieres D., " Wind Power Plant, Theory and Design ", (1982), Pergamon Press, France.*

**1 . ENERGY AND ENVIRONMENT 9**

Introduction - Fossil fuels reserves-World energy consumption - Green house effect, Global warming- Renewable energy sources - Environmental aspects utilization - Energy prizes - Energy policies.

**2 . ENERGY CONSERVATION 9**

Energy conservation schemes - Industrial energy use - Energy surveying and auditing - Energy index - Energy cost - Cost index - Energy conservation in engineering and process industry, in thermal systems, in buildings and non-conventional energy resources schemes.

**3 . ENERGY TECHNOLOGIES 9**

Fuels and consumption - Boilers - Furnaces - Waste heat recovery systems - Heat pumps and refrigerators - Storage systems - Insulated pipe work systems - heat exchangers.

**4 . ENERGY MANAGEMENT 9**

Energy management principles - energy resource management - Energy management information systems - Instrumentation and measurement - Computerized energy management.

**5 . ECONOMICS AND FINANCE 9**

Costing techniques - Cost optimization - Optimal target investment schedule - Financial appraisal and profitability-Project management.

**Total No of periods: 45**

*Text Book:*

*1. W.R. Murphy and G.Mc KAY " Energy Management " Butterworths, London.*

*References:*

- 1. O.Callaghn. P.W. " Design and Management for Energy Conservation ", (1981) Pergamon Press, Oxford.*
- 2. David Merick, Richard Marshal, " Energy, present and future options, Vol. I and II ", (1981) John Wiley and Sons.*
- 3. Chaigier N.A. " Energy Consumption and Environment ", (1981), McGraw-Hill.*
- 4. Ikken P.A. Swart R.J and Zwerves.S, " Climate and Energy ", (1989).*
- 5. Ray D.A. " Industrial Energy Conservation ", (1980) Pergamaon Press.*

<b>1 . NUCLEAR PHYSICS</b>	<b>9</b>
Nuclear model of the atom - Equivalence of mass and energy - Binding - Radio activity - Half life - Neutron interactions - Cross sections.	
<b>2 . NUCLEAR REACTIONS AND REACTOR MATERIALS</b>	<b>9</b>
Mechanism of nuclear fission and fusion - Radio activity - Chain reactions - Critical mass and composition - Nuclear fuel cycles and its characteristics - Uranium production and purification - Zirconium, thorium, beryllium.	
<b>3 . REPROCESSING</b>	<b>9</b>
Nuclear fuel cycles - spent fuel characteristics - Role of solvent extraction in reprocessing - Solvent extraction equipment.	
<b>4 . NUCLEAR REACTIONS</b>	<b>9</b>
Reactors - Types of fast breeding reactors - Design and construction of fast breeding reactors - heat transfer techniques in nuclear reactors - reactor shielding.	
<b>5 . SAFETY, DISPOSAL AND PROLIFERATION</b>	<b>9</b>
Nuclear plant safety- Safety systems - Changes and consequences of an accident - Criteria for safety - Nuclear waste - Type of waste and its disposal - Radiation hazards and their prevention - Weapons proliferation.	
<b>Total No of periods:</b>	<b>45</b>

*Text Book:*

1. *Thomas J.Cannoly, " Fundamentals of Nuclear Engineering ", John Wiley (1978).*

*References:*

1. *Collier J.G., and G.F.Hewitt, " Introduction to Nuclear Power ", (1987), Hemisphere Publishing, New York.*
2. *Lamarsh U.R. " Introduction to Nuclear Engineering Second Edition ", (1983), Addison Wesley M.A.*
3. *Lipschutz R.D. " Radioactive Waste - Politics, Technology and Risk ", (1980), Ballingor, Cambridge. M.A.*

**1 . INTRODUCTION 9**

Environmental aspects - Impact of environment - Environmental quality - Role of environmental engineer.

**2 . AIR POLLUTANTS 9**

Air quantity - Definition, Characteristics and prospective - Types of our air pollutants - effect of air pollution on men and environment - Formation of air pollutants from combustion of fossil fuels and parameters controlling the formation.

**3 . WATER POLLUTANTS 9**

Water pollution from tanneries and other industries - Engineered systems for waste water treatment and disposal - Control systems and instrumentation for pollution control.

**4 . SOLID WASTE 9**

Definition, characteristics - Types and sources of solid waste - Solid waste management - generation, collection, storage and processing techniques - Solid waste disposal.

**5 . INDUSTRIAL POLLUTION 9**

Methods and equipment's for industrial waste treatment - Pollution thermal power plants and nuclear power plants - Sources and control methods - Emission from SI and CI engines - Evaporative emission control - Exhaust treatment devices - Noise pollution and their control.

**Total No of periods: 45**

*Text Book:*

1. *Howard S. Peavy, Donald R. Rowe, and George Tchobanoglous, " Environmental Engineering ", (1985), Mc Graw Hill, New Delhi.*

*References:*

1. *A.C.Stern, H.C.Wonter, R.W. Boubce and W.P.Lowry " Fundamental of Air Pollution ", (1973), Academic Press.*
2. *Ikken P.A. Swart R.J. and Zwerves. S, " Climate and Energy ", (1989). Mc Graw Hill, New Delhi.*
3. *Metcalf and Eddy Inc, " Waste Water Engineering Treatment and Disposal Second Edition ", (1979), Mc Graw Hill, New York.*
4. *Wark, Kenneth and Cecil F.Warner, " Air Pollution: its Origin and Control ", (1976), Dun Dunnellers, New York.*
5. *Tchobanoglous.G, H.Theisan and R.Elaisen, " Solid Water: Engineering Principles and Management Issues ", (1977), Mc Graw Hill, New York.*

**ME041 Waste Heat Recovery and Co-generation**

**3 0 0 100**

**1 . INTRODUCTION: 9**

Source and utilization of waste heat, thermodynamic analysis - Second law and waste heat, Recovery of waste heat engines and other power plants -Heat pump for waste heat recovery.

**2 . DESIGN OF WASTE HEAT RECOVERY SYSTEMS: 9**

Design of waste heat recovery system - Heat exchanger - Theory and design. Organic fluid systems - Analysis and design.

**3 . COGENERATION PRINCIPLES: 9**

Cogeneration principles and thermodynamics power cycle analysis, combined for power generation and process heat.

**4 . APPLICATIONS OF COGENERATION: 9**

Applications in sugar mills rice mills, textile factories, and other process and engineering industries.

**5 . COST ANALYSIS OF COGENERATION SYSTEMS: 9**

Financial considerations, operating and maintenance cost, investment costs of waste heat recovery and cogeneration system, environmental and air quality consideration.

**Total No of periods: 45**

*Text Books:*

1. Charles H. Butler, "Cogeneration ", (1984), Mc Graw Hill Book Co.
2. Goldstick R., et.al., " Principles of Waste Heat Recovery ", (1986), The Fairment Press, Inc., Georgia.

*References:*

1. Kiang Y.H., " Waste Utilization Technology ", (1981), Maecel Dekker Inc.
2. David Hu and Gerald Hrd, " Waste recycling for Energy Conservation ", (1981), John Wiley and Sons, New York.
3. Sydney Reiter, " Industrial and Commercial Heat Recovery Systems ", (1985), Van Nostrand Reinhold.
4. Spiewak Scott A, " Cogeneration and Small Power Production Manual ", (1987), The Fairment Press.
5. Nelson E, Hay, " Guide to Natural Gas Cogeneration ", (1980), The Fairment Press Inc.

**1 . PRINCIPLES 9**

Energy transfer between fluid and rotor, classification of fluid machinery, dimensionless parameters, specific speed, applications, stage velocity triangles, work and efficiency for compressors and turbines.

**2 . CENTRIFUGAL FANS AND BLOWERS 9**

Types, stage and design parameters, flow analysis in impeller blades, volute and diffusers, losses, characteristics curves and selection, fan drives and fan noise.

**3 . CENTRIFUGAL COMPRESSOR 9**

Construction details, types, impeller flow losses, slip factor, diffuser analysis, losses and performance curves.

**4 . AXIAL FLOW COMPRESSOR 9**

Stage velocity triangles, enthalpy-entropy diagrams, stage losses and efficiency, workdone factor, simple stage design problems and performance characteristics.

**5 . AXIAL AND RADIAL FLOW TURBINES 9**

Stage velocity diagrams, reaction stages, losses and coefficients blade design principles, testing and performance characteristics.

**Total No of periods: 45**

*Text Book:*

1. Yahya, S.H., " *Turbines, Compressor and Fans* ", Tata Mc Graw Hill Publishing Company, 1996.

*References:*

1. Bruneck, Fans, Pergamom Press, 1973.
2. Earl Logan, Jr., " *Hand book of Turbomachinery* ", Marcel Dekker Inc., 1992.
3. Dixon, S.I., " *Fluid Mechanics and Thermodynamics of Turbomachinery* ", Pergamom Press, 1990.
4. Shepherd, D.G., " *Principles of Turbomachinery* ", Macmillan, 1969.
5. Stepanff, A.J., " *Blowers and Pumps* ", John Wiley and Sons Inc., 1965.
6. Ganesan .V., " *Gas Turbines* ", Tata Mcgraw Hill Pub. Co., New Delhi, 1999.

**1 . SPARK IGNITION ENGINES 9**

Spark ignition Engine mixture requirements - Feedback Control Carburettors -Fuel - Injection systems - Monopoint and Multipoint injection - Stages of combustion - Normal and Abnormal combustion-Factors affecting knock - Combustion Chambers - Introduction to Thermodynamic analysis S.I. Engine combustion

**2 . COMPRESSION IGNITION ENGINES 9**

States of combustion in C.I. Engine - Direct and indirect injection systems - Combustion chambers - Fuel spray behaviour - spray structure, spray penetration and evaporation - Air motion - Turbocharging - Introduction to Thermodynamic Analysis of C.I. Engine combustion.

**3 . POLLUTANT FORMATION CONTROL 9**

Pollutant - Sources and types - formation of NO<sub>x</sub> - Hydro-carbon Emission Mechanism - Carbon Monoxide Formation - Particulate emissions - Methods of controlling Emissions- Catalytic converters and Particulate Traps -Methods of measurements and Driving cycles.

**4 . ALTERNATIVE FUELS 9**

Alcohol, Hydrogen, Natural Gas and Liquefied Petroleum Gas - Properties, Suitability, Engine Modifications, Merits and Demerits as fuels.

**5 . RECENT TRENDS 9**

Lean Burn Engines - Stratified charge Engines - Gasoline Direct Injection Engine - Homogeneous charge compression Ignition - Plasma Ignition - Measurement techniques.

**Total No of periods: 45**

*Text Book:*

1. *John B. Heywood, " Internal Combustion Engine Fundamentals ", McGraw Hill, 1988.*

*References:*

1. *R.B.Mathur and R.P.Sharmal, " Internal Combustion Engines ".*
2. *Rowland S.Benson and N.D.Whitehouse, " Internal combustion Engines ", Vol.I and II, Pergamon Press, 1983.*
3. *Duffy Smith, " Auto fuel Systems ", The Good Heart Willox Company, Inc., 1987.*

**1 . INTRODUCTION: 9**

Introduction to sand casting - Conventional mould and Core making - Need for special casting process - applications.

**2 . SHELL MOULDING: 9**

Process - Machines - Pattern - Sand, resin and other materials - Process parameters characteristics of shell mould castings - 'D' Process - Applications.

**3 . INVESTMENT CASTING: 9**

Process - Pattern and mould materials - Block mould and ceramic shell mould - Mercast and shaw process - Application.

**4 . CENTRIFUGAL AND DIECASTING: 9**

Types of Cetrifugal processes - calculation of rotating speed of the mould - Equipment - Application.

**5 . CONTINOUS CASTING CO2 SAND PROCESS AND FULL MOULD PROCESSES 9**

Reciprocating continous mould process - Direct chill process - Use of steel, aluminium, brass material in continuous casting.

CO2 mould / core hardening process - principles Full mould process - APPLICATIONS.

Other special process like squeeze casting and electro slag casting processes.

**Total No of periods: 45**

*Text Book:*

1. " *Foundry technology* ", P.L.Jain, 1992.

*Reference:*

1. " *Engineering Metallurgy* ", Vol.II, R.A. Higgins, 1994.

**1 . INTRODUCTION 9**

Definition of a Robot - Basic Concepts - Robot configurations - Types of Robot drives - Basic robot motions - Point to point control - Continuous path control.

**2 . COMPONENTS AND OPERATIONS 9**

Basic control system concepts - control system analysis - robot actuation and feedback, Manipulators - direct and inverse kinematics, Coordinate transformation - Brief Robot dynamics. Types of Robot and effectors - Grippers - Tools as end effectors - Robot/End - effort interface.

**3 . SENSING AND MACHINE VISION 9**

Range sensing - Proximity sensing - Touch sensing - Force and Torque sensing. Introduction to Machine vision - Sensing and digitizing - Image processing and analysis.

**4 . ROBOT PROGRAMMING 9**

Methods - languages - Capabilities and limitation - Artificial intelligence - Knowledge representation - Search techniques - AI and Robotics.

**5 . INDUSTRIAL APPLICATIONS 9**

Application of robots in machining - Welding - Assembly - Material handling - Loading and unloading - CIM - Hostile and remote environments.

**Total No of periods: 45**

*Text Book:*

1. *K.S. Fu., R.C.Gonzalez, C.S.G.Lee, " Robotics Control sensing ", Vision and Intelligence, McGraw Hill International Edition, 1987.*

*References:*

1. *Mikell P. Groover, mitchell Weiss, " Industrial robotics, technology, Programming and Applications ", McGraw Hill International Editions, 1986.*
2. *Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, " Robotic engineering - An Integrated Approach ", Prentice Hall Inc, Englewoods Cliffs, NJ, USA, 1989.*

**1 . INTRODUCTION - VARIATIONAL FORMULATION 8**

General field problems in Engineering - Modelling - Discrete and Continuous models - Characteristics - Difficulties involved in solution - The relevance and place of finite element method - Historical comments - Basic concept of FEM. Boundary and initial value problems - Gradient and divergence theorems - Functionals - Variational calculus - Variational formulation of VBPS. The method of weighted residuals - The Ritz method.

**2 . FINITE ELEMENT ANALYSIS OF ONE DIMENSIONAL PROBLEMS 8**

One dimensional second order equations - discretisation of domain into elements - Generalised coordinates approach - derivation of elements equations - assembly of element equations - imposition of boundary conditions - solution of equations - Cholesky method - Post processing - Extension of the method to fourth order equations and their solutions - time dependant problems and their solutions - example from heat transfer, fluid flow and solid mechanics.

**3 . FINITE ELEMENT ANALYSIS OF TWO DIMENSIONAL PROBLEMS 8**

Second order equations involving a scalar-valued function - model equation - Variational formulation - Finite element formulation through generalised coordinates approach - Triangular elements and quadrilateral elements - convergence criteria for chosen models - Interpolation functions - Elements matrices and vectors - Assembly of element matrices - boundary conditions - solution techniques.

**4 . ISOPARAMETRIC ELEMENTS AND FORMULATION 7**

Natural coordinates in 1,2 and 3 dimensions - use of area coordinates for triangular elements in - 2 dimensional problems - Isoparametric elements in 1,2 and 3 dimensions - Lagrangean and serendipity elements - Formulation of element equations in one and two dimensions - Numerical integration.

**5 . APPLICATIONS TO FIELD PROBLEMS IN TWO DIMENSIONS 7**

Equations of elasticity- plane elasticity problems - axisymmetric problems in elasticity - Bending of elastic plates - Time dependent problems in elasticity - Heat - transfer in two dimensions - incompressible fluid flow.

**6 . INTRODUCTION TO ADVANCED TOPICS (NOT FOR EXAMINATION PURPOSES.) 7**

Three dimensional problems - Mixed formulation - use of software packages.

**Total No of periods: 45**

*Text Book:*

1. *J.N.Reddy, " An Introduction to Finite Element Method ", McGraw Hill, Intl. Student Edition, 1985.*

*References:*

1. *Rienkiewics, " The finite element method, Basic formulation and linear problems ", Vol.1, 4/e, McGraw Hill, Book Co.*
2. *S.S.Rao, " The Finite Element Method in Engineering ", Pergaman Press, 1989.*
3. *C.S.Desai and J.F.Abel, " Introduction to the Finite Element Method ", Affiliated East west Press, 1972.*

**1 . STRESS 9**

Stress at a point - Stress equations of Equilibrium - Laws of stress transformation - Principal stresses - Maximum Shear stress - Dimensional state of stress.

**2 . STRAIN MEASUREMENT 9**

Strain - its relation to experimental determination - properties of strain Gauge systems - Electrical resistance strain gauges - strain gauge circuits - recording instruments - analysis of strain gauge data.

**3 . MOIRE METHODS 9**

Mechanism of formation of Moire fringe - geometrical approach to Moire fringe analysis - displacement field approach to Moire fringe analysis - out of plane measurements experimental procedure.

**4 . PHOTOELASTICITY METHODS 9**

Temporary double refraction - stress optic law - effects of stressed model in a plane polariscope fringe multiplication - isochromatic fringe patterns - isoclinic fringe pattern compensation techniques - calibration methods - separation methods - scaling model to phototype stresses - materials.

**5 . BIREFRIGENT COATINGS 9**

Coating stresses and strains - sensitivity - materials and applications - effect of thickness - stress separation.

**Total No of periods: 45**

*Text Book:*

*1. Dove Adams, Experimental Stress Analysis, McGraw Hill, 1992.*

*References:*

- 1. James Dalley, W.F.Riley, " Experimental mechanics ", int. Student Edition  
McGraw Hill, Kogakusha Ltd., 1992.*
- 2. Perry and Lissiener, " Strain Gauge Primer ", McGraw Hill, 1965.*
- 3. Durelli, Photomechanics Prentice Hall, 1972.*

**1 . INTRODUCTION 9**

Relevance of and need for vibrational analysis - Mathematical modelling of vibrating systems - Discrete and continuous systems - review of single-degree of freedom systems - free and forced vibrations, Various damping models.

**2 . TWO DEGREE-OF-FREEDOM SYSTEMS 9**

General solution to free vibration problem - damped free vibration - Forced vibration of undamped system - dynamic vibration absorbers - Technical applications.

**3 . MULTI DEGREE-OF-FREEDOM SYSTEMS 9**

Free and forced vibrations of multi-degree of freedom systems in longitudinal torsional and lateral modes - Matrix methods of solution-normal modes - Orthogonality principle-Energy methods, Introduction to vibrations of plates.

**4 . CONTINUOUS SYSTEMS 9**

Torsional vibrations - Longitudinal vibration of rods - transverse vibrations of beams - Governing equations of motion - Natural frequencies and normal modes - Energy methods, Introduction to vibration of plates.

**5 . VIBRATION MEASUREMENT 9**

Vibration monitoring - data acquisition - Vibration Parameter Selection-Vibration sensors-Accelerometers- Performance characteristics-Sensor location-Signal preamplification-Types of preamplifiers-Instrumentation-Tape recorders-Real time analysis-Digital Fourier transforms-FFT Analysis- Signature analysis and preventive maintenance: Vibration meters-vibration signatures-standards-vibration testing equipment-in-site balancing of rotors.

**Total No of periods: 45**

*Text Book:*

1. *J.S.Rao and K.Gupta, " Introductory Course on Theory and practice of Mechanical Vibrations ", Wiley Eastern Ltd., 1991.*

*References:*

1. *P.Srinivasan, " Mechanical Vibration Analysis ", Tata-Mc Graw Hill, New Delhi, 1982.*
2. *G.K.Grover, " Mechanical Vibrations ", New Chand and Bros., Roorkey, 1989.*
3. *Seto, " Mechanical Vibrations ", Schaum Series, McGraw Hill Book Co.,*
4. *J.P.Den Hartog, " Mechanical Vibrations ", (4th Edition) McGraw Hill, New York, 1985.*
5. *L.Meirovitch, " Elements of vibration Analysis ", (2nd Edition) McGraw Hill, New York, 1985.*

**1 . SURFACES AND FRICTION 9**

Topography of Engineering surfaces- Contact between surfaces - Sources of sliding Friction - Adhesion  
Ploughing- 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 9**

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.

**3 . LUBRICANTS AND LUBRICATION TYPES 9**

Types and properties of Lubricants - Testing methods - Hydrodynamic Lubrication - Elasto hydrodynamic lubrication- Boundary Lubrication - Solid Lubrication Hydrostatic Lubrication.

**4 . FILM LUBRICATION THEORY 9**

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 Co-efficient of friction - The Somerfield diagram.

**5 . SURFACE ENGINEERING AND MATERIALS FOR BEARINGS 9**

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.

**Total No of periods: 45**

*Text Book:*

1. *I.M. Hutchings, Tribology, " Friction and Wear of Engineering Material ", Edward Arnold, London, 1992.*

*References:*

1. *T.A. Stolarski, " Tribology in Machine Design ", Industrial Press Inc., 1990.*
2. *E.P.Bowden and Tabor.D., " Friction and Lubrication ", Heinemann Educational Books Ltd., 1974.*
3. *A.Cameron, " Basic Lubrication theory ", Longman, U.K., 1981.*
4. *M.J.Neale (Editor), " Tribology Handbook ", Newnes. Butter worth, Heinemann, U.K., 1975.*

**1 . DFMN APPROACH AND PROCESS 9**

Methodologies and tools, design axioms, design for assembly and evaluation, minimum part assessment taquchi method, robustness assessment, manufacturing process rules, designer's tool kit, Computer Aided group process rules, designer's tool kit, Computer Aided group Technology, failure mode effective analysis, Value Analysis. Design for minimum number of parts, development of modular design, minimising part variations, design of parts to be multi-functional, multi-use, ease of fabrication, Poka Yoka principles.

**2 . GEOMETRIC ANALYSIS 9**

Process capability, feature tolerance, geometric tolerance, surface finish, review of relationship between attainable tolerance grades and difference machining processes. Analysis of tapers, screw threads, applying probability to tolerances.

**3 . FORM DESIGN OF CASTINGS AND WELDMENTS 9**

Redesign of castings based on parting line considerations, minimising core requirements, redesigning cast members using weldments, use of welding symbols.

**4 . MECHANICAL ASSEMBLY 9**

Selective assembly, deciding the number of groups, control of axial play, examples, grouped datum systems - different types, geometric analysis and applications-design features to facilitate automated assembly.

**5 . TRUE POSITION THEORY 9**

Virtual size concept, floating and fixed fasteners, projected tolerance zone, assembly with gasket, zero true position tolerance, functional gauges, paper layout gauging, examples. Operation sequence for typical shaft type of components. Preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples.

**Total No of periods: 45**

*Text Books:*

1. *Harry Peck, "Designing for Manufacture ", Pitman Publications, 1983.*
2. *Matousek, "Engineering Design, - A Systematic Approach" - Blackie & Son Ltd., London, 1974.*

*References:*

1. *Sports M.F., " Dimensioning and Tolarence for Quantity Production ", Prentice Hall Inc., 1983.*
2. *Oliver R. Wade, " Tolarence Control in Design and Manufacturing ", Industrial Press Inc. New York Publications, 1967*
3. *James G. Bralla, " Hand Book of Product Design for Manufacturing ", McGraw Hill Publications, 1983.*
4. *Trucks H.E., " Design for Economic Production ", Society of Manufacturing Engineers, michigan, 2nd edition, 1987.*

**1 . INTRODUCTION 9**

Methods for determining stresses - Terminology and Ligament Efficiency - Applications.

**2 . STRESSES IN PRESSURE VESSELS 9**

Introduction - Stresses in a circular ring, cylinder - Membrane stress Analysis of Vessel Shell components - Cylindrical shells, spherical shells, torispherical heads, conical heads - Thermal stresses - Discontinuity stresses in pressure vessels.

**3 . DESIGN OF VESSELS 9**

Design of tall cylindrical self supporting process columns - supports for short vertical vessels - stress concentration - at a variable thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of reinforcement - pressure vessel design.

**4 . BUCKLING AND FRACTURE ANALYSIS IN VESSELS 9**

Buckling phenomenon - Elastic Buckling of circular ring and cylinders under external pressure - collapse of thick walled cylinders or tubes under external pressure - effect of supports on Elastic Buckling of cylinders - Buckling under combined External pressure and axial loading - Control and significance of Fracture Mechanics in Vessels - FEM application.

**5 . PIPING 9**

Introduction - Flow diagram - Piping layout and piping stress Analysis.

**Total No of periods: 45**

*Text Book:*

1. *John F. Harvey, " Theory and Design of Pressure Vessels ", CBS Publishers and Distributors, 1987.*

*References:*

1. *Henry H. Bedner, " Pressure Vessels, Design Hand Book ", CBS Publishers and Distributors, 1987.*
2. *Stanley, M. Wales, " Chemical Process Equipment, Selection and Design. Buterworths series in Chemical Engineering ", 1988.*

**1 . INTRODUCTION 9**

Limitations of conventional materials - definition of composite materials - types and characteristics - applications.

**2 . MATERIALS 9**

Fibbers - Materials - Fibber reinforced plastics - thermoset polymers - Coupling agents, fillers and additives - Metal Matrix and Ceramic composites.

**3 . MANUFACTURING 9**

Fundamentals - bag moulding - compression moulding pultrusion-filament winding - other manufacturing process - quality inspection and non-destructive testing.

**4 . MECHANICS AND PERFORMANCE 9**

Introduction to micro-mechanics-unidirectional lamina - laminates - interlaminar stresses - static mechanical properties - fatigue properties - impact properties - enviromental effects - fracture mechanics and toughening mechanisms, damage prediction, failure modes.

**5 . DESIGN 9**

Failure predictions - design considerations - joint design - codes - design examples. Optimization of laminated composites - Application of FEM for design and analysis of laminated composites.

**Total No of periods: 45**

*Text Books:*

1. *Ronald Gibson, " Principles of Composite Material Mechanics ", Tata McGraw Hill, 1994.*
2. *Micael hyer, " Stress Analysis of Fiber - Reinforced Composite Materials ", Tata McGraw Hill, 1998.*

*References:*

1. *P.K.Mallicak, " Fiber-reinforced composites ", Monal Deklar Inc., New York, 1988.*
2. *B.D. Agarwal and L.J.Broutman, " Analysis and Performance of Fiber Composites ", John Wiley and Sons, New York, 1980.*
3. *F.L.Matthews & R.D.Rawlings, " Composite Materials, Engineering and Sciences ", Chapman & hall, London, 1994.*

**1 . INTRODUCTION 5**

Crack in a structure - Griffiths Criterion cleavage fracture Ductile fracture fatigue cracking service failure analysis.

**2 . ELASTIC CRACK 8**

Elastic Crack tip stress field - Solution to Crack problems Effect of finite size stress intensity factor - Special cases - Irwin plastic zone correction- Actual shape of plastic zone - Plane stress - Plane strain.

**3 . ENERGY PRINCIPLE 8**

Energy release rate - Criterion for crack growth - Crack resistance curve - Principles of crack arrest - Crack arrest in Practice.

**4 . FATIGUE CRACK GROWTH 8**

Fatigue crack growth test, stress intensity factor, factors affecting stress intensity factor - variable amplitude service loading, retardation model.

**5 . ELASTIC PLASTIC FRACTURE MECHANICS 8**

Elastic plastic fracture concept - crack tip opening displacement - J using FEM.

**6 . APPLICATION OF FRACTURE MECHANICS 8**

Fracture design - selection of materials - fatigue crack growth rate curve - stress intensity factor range - use of crack growth law.

**Total No of periods: 45**

*Text Book:*

1. *John M. Barson and Stanley T. Rolfe Fracture and Fatigue Control in Structure* ", Prentice Hall, Inc, USA, 1987.

*References:*

1. *David Broek - " Elementary engineering Fracture Mechanics Sifhoff "* , Noordhoff Internal Publishers, 1978.
2. *" Jean Lemaitre and Jean Louis Chaboche Mechanics of Solid Materials "* , Cambridge University Press, Cambridge, 1987.

**ME054 Unconventional Machining Processes****3 0 0 100****1 . INTRODUCTION 8**

The need of the process-classification - Energies employed in the processes- EDM,EC,USM,LBM,PAM,AJM,WJM etc.

**2 . ELECTRICAL DISCHARGE MACHINING 8**

Process, operating principles-Breakdown mechanism-Dielectric fluid-Electrode material-Tool wear - Power generator circuits- Process parameters - Metal removal rate - wire out EDM - Applications - Recent Developments in EDM.

**3 . ELECTRO CHEMICAL MACHINING 8**

Process-principles-Equipment-Analysis of metal removal-tool material-Insulation-Process parameters-ECH,ECG etc. - Applications.

**4 . ELECTRON BEAM, LASER BEAM AND PLASMA ARC MACHINING 7**

EBM Process, Principle-gun construction - Types of gun - Vacuum and non-vacuum technique-Applications. LBM Process, principles, pumping processes, emission types-beam control-applications.

**5 . ULTRASONIC MACHINING 7**

Process-working principles-types of transducers-concentrators-nodal point clamping-feed mechanism-metal removal rate-Process parameters-Applications.

**6 . ABRASIVE JET AND WATER JET MEASURING 7**

AJM Processes-Principle-Equipment-Metal removal rate process parameters-Applications. WJM Process-Principle-Equipment-Applications.

**Total No of periods: 45**

*Text Book:*

1. " *Non Conventional Machining* ", P.K.Mishra, *The Institution of Engineers (India) Text Books: Series*, 1997.

*Reference:*

1. *A Text Books: of Production Engineering*, P.C.Sharma, 1995.

**1 . COMBUSTION OF FUELS 9**

Combustion equations, Theoretical air, excess air, air fuel ratio, equivalence ratio, exhaust gas composition, Air-fuel ratio from exhaust gas composition, heating value of fuels.

**2 . THERMODYNAMICS OF COMBUSTION 9**

Thermo-chemistry, First law analysis of reacting systems, Adiabatic combustion temperature, Second law analysis of reacting systems, criterion for chemical equilibrium, Equilibrium constant for gaseous mixtures, Evaluation of equilibrium composition, chemical availability.

**3 . KINETICS OF COMBUSTION 9**

Rates of reaction, Reaction order and molecularity complex reactions, chain reactions, Arrhenius rate equation, Collection theory, activated complex theory, Explosive and general oxidative characteristics of fueled.

**4 . FLAMES 9**

Laminar and Turbulent flames, Premixed and Diffusion flames, Burning velocity and its determination, Factors affecting burning velocity, Quenching, Flammability and Ignition, Flame stabilization in open burners.

**5 . ENGINE COMBUSTION 9**

Combustion in SI and CI engines, stages of combustion in SI and CI engines, Normal combustion and Abnormal combustion, Emissions from premixed combustion, Emission from Nonpremixed combustion, Control of emissions

**Total No of periods: 45**

*Text Book:*

*1. Stephen R.Turns, " An Introduction to Combustion ", McGraw Hill Book Company, 1996.*

*References:*

- 1. Irwin Glassman, " Combustion ", Third Edition, Academic Press, 1996.*
- 2. S.P. Sharma and Chandramohan, " Fuels and Combustion ", Tata McGraw Hill Book Co., 1984.*
- 3. Samir Sarkar, " Fuels and Combustion ", Orient Longman, 1984.*
- 4. K.K.Kuo, " Principles of Combustion ", John Wiley & Sons, 1984.*
- 5. J.B. Heywood, " Internal Combustion Engine Fundamentals ", Mc Graw Hill Book Co., 1988.*

**ME056 Entrepreneurship Development**

**3 0 0 100**

**1 . ENTREPRENEURSHIP 9**

Entrepreneur - Traits of Entrepreneurs - Types of Entrepreneurs - Intrepeneur Diffenernce between Entrepreneur and Intrapreneur - Entrepreneurship in Economic Growth, Factors affecting Entrepreneurial Growth.

**2 . MOTIVATION 9**

Major motives influencing Entrepreneur- Achivement Motivation Training, Self Rating, Business game, Thematic Apperception Test - Stress Management. Entrepreneurship Development Programs - Need, objectives.

**3 . BUSINESS 9**

Small Enterprises-definition, Classification - Characteristics, ownership structure-Project Formulation - Steps involved in setting up a Business - Identifying, Selecting a good business opportunity Market survey and Research, Techno economic Feasibility Assessment - Preliminary Project Report-Project Appraisal-Sources of information-Classification of needs and Agencies.

**4 . FINANCING & ACCOUNTING 9**

Need-Sources of Finance, Term Loans, Capital structure, Financial Institutions, Management of working capital, Costing Break Even Analysis, Network analysis Techniques of PERT/CPM - Taxation - Income Tax, Excise Duty - Sales Tax.

**5 . SUPPORT TO ENTREPRENEURS 9**

Institutional Support to Entrepreneurs-Sickness in small Business - Concept, Magnitude, Causes and Consequences, Corrective measures - Government Policy for small Scale Enterprise - Growth strategies in small Industry - Expansion, Diversification, Joint venture, Merger, sub-contracting.

**Total No of periods: 45**

*Text Book:*

1. S.S. Khanka, *Entrepreneurial Development*, S.Chand & Co. Ltd, Ram Nagar , New Delhi, 1999.

*Reference:*

1. EDII - " Faculty & External experts - A Hand Book for new Entrepreneurs. publishers :  
*Entrepreneurship Development "*, Institute of India, Ahmedabad, 1986.

**1 . INTRODUCTION 8**

Introduction to technology Management - Environment of Business - Technological changes - Productivity Management - Cultural Impact on Management & Technology - Japanese Management Practices.

**2 . MANAGING WORLD ECONOMIC CHANGE 8**

Concepts for Managing change - The global environment - Domestic sources of multi national behaviour- Multi national strategies - Economic cycles and Direct Investment.

**3 . ENTREPRENEURSHIP, CREATIVITY & ORGANISATION 7**

Managing creativity - A perspective on Entrepreneurship creating Effective work groups-understanding self and other people at work -Stress Strain Management - time Management -Strategic management-Innovation Management.

**4 . INFORMATION TECHNOLOGY IN BUSINESS 7**

Technical foundation - Building information systems - Management organisational support system-Managing Information Systems.

**5 . MATERIALS MANAGEMENT 8**

Micro and Macro Level - Systems Approach-materials-Planing-ABC Analysis -SQC-Incoming material control-Kaizan and 5's - International Buying and Import purchasing practice and procedures-Just in time. Maintenance measurement.

**6 . PORTFOLIO MANAGEMENT 7**

Introduction to securities-Risk and return-Economic analysis-Industry analysis-Technical analysis-Portfolio selection-Managing portfolio and performance measurement.

**Total No of periods: 45**

*Text Books:*

1. *Kenneth C.Lauden, " MIS Organisation & Technology ", Prentice hall, 1995.*
2. *James A Senn, " Information Technology in Business ", Prentice hall, 1995.*
3. *Joseph M. Putti, " Management - A Functional Approach ", McGraw-Hill, 1997.*

*References:*

1. *Ronald J.Jordan, " Security analysis and Portfolio Management ", Prentice Hall, 1995.*
2. *Irvin M.Robin, " Organisational Behaviour - An Experimental Approach ", prentice Hall, 1995.*
3. *A.K.Datta, " Materials Management ", Prentice Hall, 1998.*

<b>1 . BASICS</b>	<b>9</b>
Definition, Marketing Process, Dynamics, Needs, Wants & Demands, Marketing Concepts, Environment, mix, types, philosophies, Selling Vs. Marketing, organisation, Industrial Vs. Consumer Marketing, Consumer goods, Industrial goods, Product hierarchy.	
<b>2 . BUYING BEHAVIOUR &amp; MARKET SEGMENTATION</b>	<b>9</b>
Cultural, Demographic factors, Motives, types, Buying decisions, segmentation factors, Demographic, Psychographic & Geographic Segmentation, Process, Patterns.	
<b>3 . PRODUCT PRICING &amp; MARKETING RESEARCH</b>	<b>9</b>
Objectives, pricing, Decisions and Pricing methods, Pricing Management. Introduction, Uses, process of Marketing Research.	
<b>4 . MARKETING PLANNING &amp; STRATEGY FORMULATION</b>	<b>9</b>
Components of a marketing plan, strategy formulations and the marketing process, implementation, Portfolio analysis, BCG, GEC grids.	
<b>5 . ADVERTISING, SALES PROMOTION &amp; DISTRIBUTION</b>	<b>9</b>
Characteristics, Impact, goals, types, Sales promotion-Point of Purchase, Unique Selling proposition. Characteristics, Wholesaling, Retailing, channel design, logistics, Modern Trends in retailing.	
<b>Total No of periods:</b>	<b>45</b>

*Text Book:*

1. *Govindarajan.M. 'Modern Marketing Management', Narosa Publishing House, New Delhi, 1999.*

*References:*

1. *Philip Kotler, " Marketing Management: Analysis, Planning, Implementation and Control ", 1998.*
2. *Green Paul.E. and Donald Tull, " Research for Marketing Decisions ", 1975.*
3. *Ramaswamy.V.S. and S.Namakumari, " Marketing Environment: Planning, Implementation and Control the Indian Context ", 1990*
4. *Jean Plerre Jannet Hubert D Hennessey Global Marketing Strategies.*

**1 . INTRODUCTION 9**

Data-Information-Knowledge-Concepts of Database Design and Architecture-Commercial and Engineering Database.

**2 . COMPUTER HARDWARE AND SOFTWARE 9**

Mother Board-Memory Devices-Bus-Ports and Peripherals-i/o Devices-PC and Work stations- Foundations of Operating System and its level of Abstraction-Compilers-Interrupt Services-Applications Software - Elements of Visual Programming - Concepts, Components and formats of Multimedia-Principles of Virtual Reality.

**3 . SOFTWARE ENGINEERING AND QUALITY CONTROL 9**

Introduction-Principles and Requirements-Planning-Cost Estimation-Design Concepts-Modularisation-Notation-Implementation-Verification-Manintenance-Software quality management, ISO and CMM.

**4 . NETWORKS AND COMMUNICATION 9**

Introduction to Computer Networks-Layered Architecture-Data Communication Concepts - Transmission Media and Topologies-Internetworking Issues-Internet-TCP/IP Protocols and WWW.

**5 . APPLICATION OF INFORMATION TECHNOLOGY IN MECHANICAL ENGINEERING 9**

IT applications in Design, Materials, Manufacturing, Automation, Controls, Energy and Industrial Management.

**Total No of periods: 45**

*References:*

1. *Wing Toy benjamin Zee, " Computer hardware/software aritecture ", Prentice Hall of India,1992.*
2. *Caralo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, " Fundamentals of software engineering ", Prentice Hall of India, 1998.*
3. *Andrew S. Tanenbaum, " Computer Networks ", Prentice Hall of India, 1996.*

**1 . GOVERNING DIFFERENTIAL EQUATIONS 9**

Conservation of chemical species -The energy equation - Momentum equation -Time -Averaged equations for Turbulent flow - Turbulence -Kinetic -Energy Equations -The General Differential Equation -Nature of Co-ordinates-Independent variables-Choice of Co-ordinates-One way and Two-way Co-ordinates.

**2 . DISCRETIZATION METHODS 9**

Nature of numerical methods - Methods of Deriving the Discretization Equations - Taylor Series formulation - variational formulation-Method of weighted residuals -Control volume -Formulation.

**3 . HEAT CONDUCTION, CONVECTION AND DIFFUSION 9**

Steady one-dimensional conduction - two and three dimensional conduction -Steady one-dimensional convection and Diffusion - Discretization equations for two dimensional convection and diffusion.

**4 . CALCULATION OF FLOW FIELD 9**

Representation of the pressure - Gradient term and continuity equation - Staggered grid - Momentum equations - Pressure and velocity corrections - Pressure - Correction equation. Introduction to Finite Element method - Solution of Steady heat conduction by FEM - incompressible flow -Simulation by FEM.

**5 . TURBULENCE MODELS -ALGEBRAIC MODELS 9**

One equation Model - Two equation models - High and Low Reynolds number models - Reynolds stress models - Prediction of fluid flow and Heat Transfer using Standard codes.

**Total No of periods: 45**

*Text Book :*

1. *Muralidhar, K and Sundarajan .T., " Computational Fluid Flow and Heat Transfer ", Narosa Publishing House, New Delhi, 1995.*

*References:*

1. *Ghoshdastidar, P.S., " Computer Simulation of flow and heat transfer ", Tata McGraw Hill Publishing Company Ltd., 1998.*
2. *Fletcher, C.A.J, " Computational Techniques for Fluid Dynamics "1" Fundamental and General Techniques, Springer-Verlag, 1987.*
3. *Fletcher, C.A.J., " Computational Techniques for Fluid Dynamics " 2" Specific Techniques Different Flow Categories, Springer-Verlag, 1987.*
4. *Bose, T.K., " Numerical Fluid Dynamics ", Narosa publishing House, 1997.*
5. *Muralidhar, K and Biswas " Advanced Engineering Fluid Mechanics ", Narosa Publishing House, New Delhi, 1996.*