SYLLABUS

For

M.Tech. PROGRAMME

In

DESIGN ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING
UNIVERSITY OF KASHMIR
SRINAGAR

NOVEMBER – 2021

(Applicable to Batch 2021 & Onwards)

Department of Mechanical Engineering,
Institute of Technology, University of Kashmir,
Zakura Campus, Srinagar

COURSE STRUCTURE, M.Tech, DESIGN ENGINEERING

PCC	Professional Core Course
PEC	Professional Elective Course
HSM	Humanities and Social Sciences including Management
OEC	Open Elective Course
HSM	Humanities and Social Sciences including Management
AU	Audit Course
DSV	Dissertation, Seminar and Professional Viva

ISE	Internal Semester Evaluation **(50 Marks)**	
	MSE	Mid Semester Evaluation **(35 Marks)**
	IA	Internal Assessment **(Assignment + Quiz/ Viva Voce (10 Marks) + Attendence (5 Marks)**
ESA	End Semester Evaluation	

SEMESTER- 1 (One)						**Examination Scheme (Distribution of Marks)**			
Course Code	**Course Name**	**L**	**T**	**P**	**Credits**	**ISE**		**ESA**	**Total**
						MSE	**IA**		
PCC_DE101	Finite Element Methods	2	1	2	4	35	15	50	100
PCC_DE102	Computational Fluid Dynamics	2	1	2	4	35	15	50	100
HSM_DE103	Design Thinking	2	0	0	2	35	15	50	100
PECA_DE104	Continuum Mechanics **(PEC1A_DE104)**/ Tribology in Design **(PEC2B_DE104)**/ Advanced Manufacturing Technology **(PEC3C_DE104)**	2	1	0 / 2	3 / 4	35	15	50	100
PECB_DE105	Principles of Solar Thermal Engineering **(PEC1B_DE105)**/ Cryogenics (**PEC2B_DE105)**	2	1	0	3	35	15	50	100
		10	**4**	**4 / 6**	**16 / 17**	**(Max/ Min)**			**500**
	Total Hours	**18 / 20**							

SEMESTER- 2 (Two)						**Examination Scheme (Distribution of Marks)**			
Course Code	**Course Name**	**L**	**T**	**P**	**Credits**	**ISE**		**ESA**	**Total**
						MSE	**IA**		
PCC_DE201	Introduction to Theory of Plates and Shells	2	1	2	**4**	35	15	50	100
PCC_DE202	Conduction and Radiation	2	1	2	**4**	35	15	50	100
HSM_DE203	Project Management	2	0	0	**2**	35	15	50	100
PECC_DE204	Computer Aided Engineering Design **(PEC1C_DE204)/** Fracture Mechanics **(PEC2C_DE204)/** Convective Heat Transfer **(PEC3C_DE204)**	2	1	2/ 0	**4 / 3**	35	15	50	100
OEC_DE205	Computational Methods in Engineering **(OEC1_DE205)/** Cost Management of Engineering Projects **(OEC2_DE205)/** Artificial intelligence and Machine Learning **(OEC3_DE205)/** Swaym (Moocs) (**OEC4_DE205**)	2	1	2/ 0	**4 / 3**	35	15	50	100
		10	**4**	**8/ 4**	**18 / 16**	**(Max/ Min)**			**500**
	Total Hours	**22 / 18**							

SEMESTER- 3 (Three)						Examination Scheme (Distribution of Marks)			
Course Code	Course Name	L	T	P	Credits	ISE		ESE	Total
						MSE	IA		
PECD_DE301	Mechanics of Composite Materials **(PEC1D_DE301)**/ Dynamics of Compressible Flow **(PEC2D_DE301)**/ Mechanical Vibrations of Continuous Systems (**PEC3D_DE301)**	2	1	2	4	35	15	50	100
DSV_DE302	Seminar	0	0	6	3	35	15	50	100
DSV_DE303	Professional Viva	0	0	0	3	50		50	100
AU_DE304	Experimental Methods/ Research Mathdology	2	1	-	-	-		-	-
DSV_DE305	Dissertation Phase-I	-		16	8	100		100	200
		4	**2**	**24**	**18**				**500**
	Total Hours	**30**							

SEMESTER- 4 (Four)						Examination Scheme (Distribution of Marks)		
Course Code	Course Name	L	T	P	Credits	ISE	ESE	Total
DSV_DE401	Dissertation Phase-II	-	-	30	15	200	200	400

Total Credits (Max/ Min)	67 / 66

Professional Elective-A					
Course Code		L	T	P	Credits
PEC1A_DE104	Continuum Mechanics	2	1	0	3
PEC2A_DE104	Tribology in Design	2	1	2	4
PEC3A_DE104	Advanced Manufacturing Technology	2	1	2	4

Professional Elective-B					
Course Code		L	T	P	Credits
PEC1B_DE105	Principles of Solar Thermal Engineering	2	1	0	3
PEC2B_DE105	Cryogenics	2	1	0	3

Professional Elective-C					
Course Code		L	T	P	Credits
PEC1C_DE204	Computer Aided Engineering Design	2	1	2	4
PEC2C_DE204	Fracture Mechanics	2	1	0	3
PEC3C_DE204	Convective Heat Transfer	2	1	0	3

Professional Elective-D					
Course Code		L	T	P	Credits
PEC1D_DE301	Mechanics of Composite Materials	2	1	2	4
PEC2D_DE301	Dynamics of Compressible Flow	2	1	2	4
PEC3D_DE301	Mechanical Vibrations of Continuous Systems	2	1	2	4

Open Elective					
Course Code		**L**	**T**	**P**	**Credits**
Courses from Department of Mechanical Engineering					
SEMESTER- 2 (Two)					
OEC1_DE205	Computational Methods in Engineering	2	1	2	4
OEC2_DE205	Cost Management of Engineering Projects	2	1	0	3
OEC3_DE205	Artificial intellengce and Machine Learning	2	1	2	4
OEC4_DE205	Swaym (Moocs)	-	-	-	3
Courses from Department of Electrical Engineering					
SEMESTER- 3 (Three)					
OEC1_PSC302	Python Data Analysis	2	1	0	3
OEC2_PSC303	Waste to Energy	2	1	0	3
OEC3_PSC304	Composite Material	2	1	0	3
OEC4_PSC305	Cost Management and Engineering Projects	2	1	0	3
Courses from Department of Electronics and Communication Engineering					
SEMESTER- 3 (Three)					
OECMECE311	Embedded Design and Prototyping	2	1	0	3
OECMECE311L	Embedded Design and Prototyping Lab	0	0	2	1
OECMECE312	Mechatronics	2	1	0	3
OECMECE312L	Mechatronics Lab	0	0	2	1
OECMECE313	Block chain and cryptocurrency	2	1	0	3
OECMECE313L	Block chain and cryptocurrency Lab	0	0	2	1
OECMECE314	Coding Techniques	2	1	0	3
OECMECE314L	Coding Techniques Lab	0	0	2	1

Course Code	**PCC_DE101**				
Course Category	**Professional Core Course**				
Course Title	**Finite Element Methods**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester - 1 (one)**
	2	**1**	**2**	**4**	

Strong and weak forms of governing differential equations, and their equivalence, weighted residual and variational approaches, Ritz method, discretization of weak form and boundary conditions. convergence, bar and beam elements, truss and frame problems, isoparametric formulation, plane strain, plane stress and axi-symmetric problems, formulation of dynamics problems, laboratory work on solid mechanics problems, use of commercial code (student version) for specific problems on beams and trusses.

Text Books Recommended

1. J. N. Reddy, *An introduction to the finite element method*, vol. 1221. McGraw-Hill New York, 2010.

References

1. R. D. Cook and others, *Concepts and applications of finite element analysis*. John wiley \& sons, 2007.
2. L. J. Segerlind and H. Saunders, “Applied finite element analysis,” 1987.

Course Code	**PCC_DE102**				
Course Category	**Professional Core Course**				
Course Title	**Computational Fluid Dynamics**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester - 1 (one)**
	2	**1**	**2**	**4**	

Introduction to *CFD*, computational approach to fluid dynamics and its comparison with experimental and analytical methods, basics of pde- elliptic, parabolic and hyperbolic equations, review of Navier-Stokes equation and simplified forms, solution methodology- *FDM* and *FVM* with special emphasis on *FVM*, stability, convergence and accuracy, finite volume method- domain discretization, types of mesh and quality of mesh, *SIMPLE*, pressure velocity coupling, checkerboard pressure field and staggered grid approach, practical aspects of computational modeling of flow domains, grid generation, types of mesh and selection criteria, mesh quality, key parameters and their importance, solution of *N-S* equations for incompressible flows.

Text Books Recommended

1. Patankar S.V. (1980) Numerical Heat Transfer and Fluid Flow, Hemisphere, Washington D.C., USA.
2. Ferziger J.H. & Peric M. (1999) Computational Methods for Fluid Dynamics, Springer, Berlin, Germany.

References

1. D. John and J. R. Anderson, “Computational fluid dynamics: the basics with applications,” *P. Perback, Int. ed., Publ.*, pp. 4–30, 1995.
2. H. K. Versteeg and W. Malalasekera, *An introduction to computational fluid dynamics: the finite volume method*. Pearson education, 2007.

Course Code	**HSM_DE103**				
Course Category	**Humanities and Social Sciences including Management**				
Course Title	**Design Thinking**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester - 1 (one)**
	2	**0**	**0**	**2**	

Definition, nature and scope of service science engineering management and design thinking, interdisciplinary and multidisciplinary characteristics of *SSMED*, T-shaped professional human resource development in Service Science, role of technology as operant resource, nature scope and significance of emerging, service ecosystems, service (Eco) systems perspective on value creation, nature, scope and characteristics of networks, Govinrajan's strategic concept of reverse engineering from emerging economies, Roger Martin conceptual framework of integrative Thinking.Design thinking evolution (Herbert Simon−Roger Martin), concepts, principles and practice, different schools of thought in design thinking, levels of design thinking, design thinking in management and its relevance to service and information economy. Strategic role of design thinking in strategy development and execution, applications in different organisational settings of the design thinking.
Note: Practical work, Case Studies & other assignments will be provided by the concerned faculty in the class.

Text Books Recommended

1. Brown, Tim. "Design thinking." *Harvard business review* 86.6 (2008): 84.

References

1. Spohrer, Jim, and Stephen K. Kwan. "Service science, management, engineering, and design (SSMED): An emerging discipline-outline & references." *International Journal of Information Systems in the Service Sector (IJISSS)* 1.3 (2009): 1-31.
2. Kupp, Martin, Jamie Anderson, and JörgReckhenrich. "Why design thinking in business needs a rethink." *MIT sloan management review* 59.1 (2017): 42
3. Martin, R. The Design of Business: Why Design Thinking is the Next Competitive Advantage. Harvard Business School Press, Boston, MA.
4. Martin, R., &Euchner, J. Design Thinking. Research Technology Management.
5. Riel, Jennifer, and Roger L. Martin. *Creating great choices: A leader's guide to integrative thinking*. Harvard Business Press, 2017.

Course Code	**PEC1A_DE104**				
Course Category	**Professional Elective-I Courses**				
Course Title	**Continuum Mechanics**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester - 1 (one)**
	2	**1**	**0**	**3**	

Introduction to tensors, vectors and second order tensors, Tensor operation, properties of tensors, invariants, eigenvalues and eigenvectors of second order tensors, tensor fields, differentiation of tensors, divergence, Stokes and localization theorems, kinematics of deformation, Continuum hypothesis; Deformation mapping; Material (Lagrangian) and Spatial (Eulerian) field descriptions, length, area and volume elements in deformed configuration, material and spatial time derivatives, velocity and acceleration, linearized kinematics, balance laws, conservation of mass, balance of linear and angular momentum, cauchy stress tensor, state of stress, spatial and material forms of balance laws, concept of first and second Piola-Kirchoff stress tensors, conservation of energy, material frame-indifference, objective stress and stress-rates, material symmetry, constitutive relations for hyperelastic solids, generalized Hooke's law.

Text Books Recommended

1. D. S. Chandrasekharaiah and L. Debnath, *Continuum mechanics*. Elsevier, 2014.

References

1. L. E. Malvern, *Introduction to the Mechanics of a Continuous Medium*, no. Monograph. 1969.
2. C. S. Jog, *Continuum Mechanics: Volume 1: Foundations and Applications of Mechanics*. Cambridge University Press, 2015.

Course Code	**PEC2A_DE104**				
Course Category	**Professional Elective Courses**				
Course Title	**Tribology in Design**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester - 1 (one)**
	2	**1**	**2**	**4**	

Friction, theories of friction, friction control, surface texture and measurement, genesis of friction, instabilities and stick-slip motion, wear, types of wear, theories of wear, wear prevention, tribological properties of bearing materials and lubricants, lubrication, Reynolds's equation and its limitations, idealized bearings, infinitely long plane pivoted and fixed show sliders, infinitely long and infinitely short (narrow) journal bearings, lightly loaded infinitely long journal bearing (Petroff's solution), finite bearings, design of hydrodynamic journal bearings. hydrostatic, squeeze film circular and rectangular flat plates, variable and alternating loads, piston pin lubrication, application to journal bearings, elasto-hydrodynamic lubrication – pressure viscosity term in Reynolds's equation, Hertz' theory, Ertel-Grubin equation, lubrication of spheres, gear teeth and rolling element bearings, air lubricated bearings, tilting pad bearings, solution of lubrication models associated with vertical and horizontal hydrodynamic bearings and development of numerical codes using *FORTRAN* and *MATLAB* language.

Text Books Recommended

1. A. Cameron, "Basic Lubrication Theory.," *Ellis Horwood Ltd.,* p. 256, 1981.

References

1. S. Wen and P. Huang, *Principles of tribology*. John Wiley \& Sons, 2012.
2. D. D. Fuller, "Theory and practice of lubrication for engineers(Book)," *New York, Wiley-Interscience, 1984, 697 p*, 1984.
3. B. C. Majumdar, *Introduction to tribology of bearings*. AH Wheeler \& Company, 1986.
4. P. Huang, *Numerical calculation of elastohydrodynamic lubrication: methods and programs*. John Wiley \& Sons, 2015.
5. B. J. Hamrock, S. R. Schmid, and B. O. Jacobson, *Fundamentals of fluid film lubrication*. CRC press, 2004.

Course Code	**PEC3A_DE104**				
Course Category	**Professional Elective Course**				
Course Title	**Advanced Manufacturing Technology**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester - 1 (one)**
	2	**1**	**2**	**4**	

Micro-manufacturing and fabrication of microelectronic devices, introduction to *MEMS* and *NEMS*, clean rooms, semiconductors and silicon, crystal growth and wafer preparation, film deposition, oxidation, lithography, etching, diffusion and ion Implantation, metallization and testing, wire bonding and packaging, Micro-machining of MEMS devices, LIGA process, fabrication of microfluidic devices, additive manufacturing- basic principles of generative manufacturing, features and classification, stereolithography, selective laser sintering, selective powder binding, fused deposition modelling, laminated object manufacturing, solid ground curing, direct metal deposition, bio-printing, design and fabrication of scaffolds, atomic layer deposition, topology optimization, introduction to bio-materials and fabrication of medical devices, industry 4.0 and industrial internet of things- industry 4.0 basics, Industrial internet of things, contemporary sensing, and digital manufacturing, digital twins, industrial plant –the future architecture, machine learning and data sciences in industries, material characterization and design considerations, optical microscopy, micro hardness, *SEM* and *XRD* analysis of cast and welded structures.

Text Books Recommended

1. J. P. Davim, *Modern machining technology: A practical guide*. Elsevier, 2011.
2. C. K. Chua and K. F. Leong, *3D Printing and additive manufacturing: Principles and applications (with companion media pack)-of rapid prototyping*. World Scientific Publishing Company, 2014.

References

1. A. S. M. I. H. Committee, *ASM handbook*, vol. 7. ASM International, 1998
2. Gosh, A and Malik, A., Manufacturing Science, EWP
3. Gibsan, I., Rosen, D.W., and Stucker, B., Additive Manufacturing, Springer London, 2010
4. Kalpakjian, S and Schmid, S (2001), "Manufacturing Engineering and Technology", 4th edition, London: Pearson
5. Misra, S., Roy, C and Mukherjee A., Introduction to Industrial IOT and Industry 4.o, CRC Press Francis

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Course Code	**PEC1B_DE105**				
Course Category	**Professional Elective Course**				
Course Title	**Principles of Solar Thermal Engineering**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester - 1 (one)**
	2	**1**	**0**	**3**	

Introduction: Solar radiation and measurement, solar angles, day length, angle of incidence on tilted surface; sun-path diagrams; shadow determination, extra-terrestrial characteristic, measurement & estimation on horizontal and tilted surfaces, flat plate collectors: thermal analysis; heat capacity effect, testing methods; evacuated tubular collectors, air flat plate collectors, thermal analysis, thermal drying. selective surfaces: ideal coating characteristics; types and applications; anti-reflective coating, concentrating collector designs: classification, design and performance parameters, tracking systems, compound parabolic concentrators, parabolic trough concentrators, concentrators with point focus; heliostats; comparison of various designs: central receiver systems, parabolic trough systems, solar power plant, solar furnaces, solar Heating & cooling system, Liquid based solar heating system, natural, forced and gravity flow, mathematical modelling, Solar operated refrigeration systems, solar desiccant cooling; Performances of solar collectors, modelling of solar thermal system components.

and simulation; Design and sizing of solar heating systems: f–chart method and utilizability methods of solar thermal system evaluation.

Text Books Recommended

1. S. P. Sukhatme and J. K. Nayak, *Solar energy*. McGraw-Hill Education, 2017.

References

1. J. A. Duffie and W. A. Beckman, *Solar engineering of thermal processes*. Wiley New York, 1980.
2. D. Y. Goswami, F. Kreith, and J. F. Kreider, "Passive methods for heating, cooling, and daylighting," *Princ. Sol. Eng.*, pp. 297–336, 2000.

Course Code	**PEC2B-DE105**				
Category	**Professional Elective Courses**				
Course Title	**Cryogenics**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester - 1 (one)**
	2	**1**	**0**	**3**	

Cryogenics and its applications, properties of cryogenic fluids, properties of materials at cryogenic temperature, gas-liquefaction and refrigeration systems, gas separation, cryocoolers, cryogenic Insulations, vacuum technology, instrumentation in cryogenics, liquid storage and transfer systems, cryostat design, dilution refrigerator and adiabatic demagnetization.

Text Books Recommended

1. K. D. Timmerhaus and T. M. Flynn, *Cryogenic process engineering*. Springer Science \& Business Media, 2013.

References

1. R. B. Scott, *Cryogenic engineering*. Books on Demand, 1959.
2. R. F. Barron and G. F. Nellis, *Cryogenic heat transfer*. CRC press, 2017.
3. R. W. Vance, "Cryogenic technology," *Am. J. Phys.*, vol. 32, no. 8, p. 651, 1964.

Course Code	**PCC_DE201**				
Course Category	**Professional Core Course**				
Course Title	**Introduction to the Theory of Plates and Shells**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester - 2 (Two)**
	2	**1**	**2**	**4**	

Introduction to plate theory and background, Navier's method for rectangular plate, levy's method for rectangular plate, axi-symmetrical bending of circular plate, approximate methods for bending of plate, buckling of thin plate, approximate methods for buckling of thin plate, introduction to shell structures and shell geometry, membrane theory for surface of revolution, membrane theory of pressure vessels, membrane analysis for cylindrical shell roof, general theory of cylindrical shell.

Text Books Recommended

1. S. Timoshenko and S. Woinowsky-Krieger, “Theory of plates and shells,” 1959.

Reference

2. J. N. Reddy, Theory and analysis of elastic plates and shells. CRC press, 2006.

Course Code	**PCC_DE202**				
Course Category	**Professional Core Course**				
Course Title	**Conduction and Radiation**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester - 2 (Two)**
	2	**1**	**2**	**4**	

Conduction- Fourier’s law of heat conduction, initial and boundary conditions, steady and unsteady heat conduction problems and their solutions in cartesian, cylindrical and spherical coordinates, separation of variables method, method of superposition, bessel’s equation and bessel functions, semi-infinite media, laplace transform, approximate analytical solution, conduction with phase change- integral method, solidification and melting - numerical methods, radiation- laws of radiation, intensity of radiation, irradiation, radiosity, radiative properties of surfaces, radiation exchange between surfaces, view factor, radiation exchange in a black enclosure, radiative heat transfer in participating media (gas radiation), radiative transfer equation.

Text Books Recommended

1. D W Hahn, and M N Ozisik, Heat Conduction, John Wiley & Sons, 3rd Edition, 2012.
2. M F Modest, Radiative Heat Transfer, Academic Press, 3rd Edition, 2013.

References

3. Analysis of heat and mass transfer by Eckert and Drake, McGraw-Hill
4. F P Incropera, D P Dewitt, T L Bergman, and A S Lavine, Incropera’s Principles of Heat and Mass Transfer, Wiley, 2018
5. V S Arpaci, Conduction Heat Transfer, Addison-Wesley, Reading, MA, 1966.
6. J R Howell, M P Menguc, and R Siegel, Thermal Radiation Heat Transfer, CRC Press, 6th Edition, 2015.

Course Code	**HSM_DE203**				
Course category	**Humanities and Social Sciences including Management**				
Course Title	**Project Management**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester - 2 (Two)**
	2	**0**	**0**	**2**	

Project, project management, programmes and portfolios, project life cycle (*PLC*), project life cycle phases, characteristics of *PLC*, *PLC* approaches, conceptualize phase, need analysis, business case, project charter, stakeholder management, project management plan, scope management, work breakdown structure, time management, network schedule, precedence diagram, critical path method (*CPM*), Gantt charts, *PERT*, resource histogram, cost management, estimation technique, cost baseline, estimation budget, quality management, quality assurance, planning and control, quality tools, interface, organizational structure, roles and responsibility, risk and opportunity management, risk identification, assessment response control and tools, communication and information management, barriers to communication, managing information, procurement and contract management, procurement guidelines and steps, contract administration, earned value management system, schedule variance, cost variance, change management, configuration management, problem solving, team performance, leadership, motivation and conflict management, health, safety, environment, corporate social responsibility (*CSR*), integrate, deliver and closeout.

Text Books Recommended

1. H Kerzner, Project Management: A Systems Approach to Planning, Scheduling, and Controlling, 13th Edition, 2022

References

1. A Shtub, Project Management: Processes, Methodologies, and Economics, Pearson, 3rd Edition, 2017.

Course Code	**PEC1C_DE204**				
Category	**Professional Elective Courses**				
Course Title	**Computer Aided Engineering Design**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester - 2 (Two)**
	2	**1**	**2**	**4**	

Computer graphics fundamentals- transformations, projections; parametric curves, differential geometry of curves, hermite (*PC*), bezier and *B*-spline curves, parametric surfaces, differential geometry of surfaces, differential geometry of ruled and developable surfaces, Ferguson, coon's, Bezier and B-spline surface patches, sweep and cylindrical surfaces, composite surface, representation of solids: cellular decomposition models, B-rep and *CSR* models, parametric instancing and sweep, *CG*, mass & geometrical properties, data transfer, *CAD* for *FEA*, design optimization and *CAM*, recent trends, reverse engineering and rapid manufacturing.

Text Books Recommended

1. I. Zeid, *CAD/CAM theory and practice*. McGraw-Hill Higher Education, 1991.

References

1. J. Brown, *Computer Aided Engineering and Design*. New Age International Private Limited.
2. D. F. Rogers, "Mathematical elements for computer graphics," *McGraw Hill, USA*, 1990.
3. K. Lee, *Principles of CAD/CAM/CAE Systems*. 1999.

4. D. L. Ryan, "Computer-Aided Graphics and Design," *Comput. Graph. Des.*, Dec. 2018.
5. M. E. Mortenson and M. E. Mortenson, "Mathematics for computer graphics applications," p. 354, 1999.
6. M. E. Mortenson, *Geometric modeling*. Industrial Press, 2006.
7. P. N. Rao, "CAD/CAM.," p. 785, 2010, Accessed: Nov. 08, 2021.

Course Code	**PEC2C_DE204**				
Course Category	**Professional Elective Courses**				
Course Title	**Fracture Mechanics**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester - 2 (Two)**
	2	**1**	**0**	**3**	

Fracture- an overview, theoretical cohesive strength, defect population in solids, stress concentration factor, notch strengthening, elements of fracture mechanics, Grifiths crack theory, stress analysis of crack, energy and stress field approaches, plane strain and plane stress fracture toughness testing, crack opening displacement, elastoplastic analysis, J-integral, ductile-brittle transition, impact energy fracture toughness correlation, microstructural aspects of fracture toughness, environmental assisted cracking, cyclic stress and strain fatigue, fatigue crack propagation, analysis of engineering failures.

Text Books Recommended

Ted.L. Anderson, "Fracture Mechanics: Fundamentals and Applications," *CRC Press*, 2017.

References

K. P. Prashant Kumar, *Elements of Fracture Mechanics*. Tata McGraw Hills, 2009.

Course Code	**PEC3C_DE204**				
Course Category	**Professional Core Course**				
Course Title	**Convective Heat Transfer**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester - 2 (Two)**
	2	**1**	**2**	**4**	

Conservation equations, boundary layers, free convection, forced convection, heat transfer in laminar and turbulent, internal as well as external flows, mixed convection, combined convection and radiation, boiling and condensation, molecular diffusion in fluids, mass transfer coefficient, simultaneous heat and mass transfer, applications.

Text Books Recommended

1. P. H. Oosthuizen and D. Naylor, *An introduction to convective heat transfer analysis*. McGraw-Hill Science, Engineering & Mathematics, 1999.

References

1. W. M. Kays, *Convective heat and mass transfer*. Tata McGraw-Hill Education, 2011.

2. H. Schlichting and J. Kestin, *Boundary layer theory*, vol. 121. Springer, 1961.

Course Code	**OEC1_DE205**				
Category	**Open Elective Courses**				
Course Title	**Computational Methods in Engineering**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester - 2 (Two)**
	2	**1**	**2**	**4**	

Formulation and solution of linear system of equations, Gauss elimination, *LU, QR* decomposition, iteration methods (Gauss-Seidal), convergence of iteration methods, singular value decomposition and the sensitivity of rank to small perturbation, Newton's divided difference, interpolation polynomials, Lagrange interpolation polynomials non-linear regression, multiple linear regression, general linear least squares, vector spaces, basis vectors, orthogonal/ unitary transform, Fourier transform, Laplace transform, local and global minima, line searches, steepest descent method, conjugate gradient method, quasi Newton method, penalty function, graphs and matrices, simple graph, cyclic graph, complete graph, properties of the Laplacian matrix and relation with graph connectivity non-negative matrices. applications of graph theory to engineering problems.

Text Books Recommended

1. Steven C. Chapra and Raymond P. Canale "Numerical Methods for Engineers", , McGraw Hill

References

1. Hines and Montrogmery, John"Probability and Statistics in Engineering and Management Studies",
2. R. B. Bapat "Graphs and Matrices", , TRIM Series, Hindustan Book Agency, 2011.

Course Code	**OEC2_DE205**				
Course Category	**Open Elective Course**				
Course Title	**Cost Management of Engineering Projects**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester - 2 (Two)**
	2	**1**	**0**	**3**	

Introduction and overview of the strategic cost management process cost concepts in decision-making, relevant cost, differential cost, incremental cost and opportunity cost, objectives of a costing system, inventory valuation, creation of a database for operational control, provision of data for decision-making, project, meaning, different types, why to manage, cost overruns centres, various stages of project execution, conception to commissioning, project execution as a conglomeration of technical and nontechnical activities, detailed engineering activities, pre project execution main clearances and documents project team: role of each member, importance project site, data required with significance. project contracts, types and contents, project execution, project cost control, bar charts and network diagram, cost behavior and profit planning marginal costing, distinction between marginal costing and absorption costing, break-even analysis, cost-volume-profit analysis, various decision-making problems, standard costing and variance analysis, pricing strategies, Pareto analysis, target costing, life cycle costing, cost of the service sector, just-in-time approach, material requirement planning, enterprise resource planning, total quality management and theory of constraints, activity-based cost management, benchmarking; balanced scorecard and value-chain analysis. budgetary control, flexible budgets, performance budgets, zero-based budgets, measurement of divisional profitability pricing decisions including transfer pricing, quantitative techniques for cost management.

Text Books Recommended

R. S Kaplan Anthony A. Alkinson, Management & Cost Accounting, Pearson, 3rd Ed.

References

C. T. Horngren , G Foster, S. M. Datar, M. V. Rajan, C. M. Ittner, Cost Accounting A Managerial Emphasis Prentice Hall, 13th Ed.

N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill/ 4th Ed.

Course Code	**OEC3_DE205**				
Course Category	**Open Elective Courses**				
Course Title	**Artificial intelligence and Machine Learning**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester - 2 (Two)**
	2	**1**	**2**	**4**	

Introduction to artificial intelligence (*AI*) and machine learning (*ML*), overview of Python & introduction to Python packages NumPy, pandas, matplotlib, Seaborn, Scikit-Learn, real world *AI*, odds and probability, the Bayes rule, introduction to Naïve Bayes classification, supervised and unsupervised machine learning, reinforcement learning, Introduction to pre-processing techniques, model overfitting and underfitting, intuitive understanding of the Naïve Bayes classification, Implementation of Naïve Bayes Classification using Python- Scikit-Learn, intuitive understanding of the linear regression, visualizing linear regression, machine learning applications of linear regression, Implementation of nearest neighbor classifier using Python- Scikit-Learn, intuitive understanding of the logistic regression as classifier, Implementation of Logistic regression using Python— Scikit-Learn, intuitive understanding of the nearest neighbor classifier, Implementation of Nearest Neighbor classifier using Python-Scikit-Learn, elements of a neural network, perceptron, simple neural network classifier, implementation using Python-Scikit-Learn, brief introduction to deep learning, support vector machine (*SVM*), mathematical formulation of *SVM*, Implementation of *SVM* for classification and regression using Scikit-Learn.

Text Books Recommended

1. Andreas C. Muller & Sarah Guido O'Reilly, Introduction to Machine Learning with Python

References

1. Aurélien Géron O'Reilly, Hands on Machine Learning with Scikit-Learn and TensorFlow
2. Sanders, Finn, Python Machine Learning for Beginners: Handbook for Machine Learning, Deep Learning and Neural networks Using Python, Scikit-Learn and Tensor Flow

Course Code	**PEC1D_DE301**				
Course Category	**Professional Elective Courses**				
Course Title	**Mechanics of Composite Materials**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester - 3 (Three)**
	2	**1**	**2**	**4**	

Introduction to composite materials, constituents application, general characteristics, characteristics of fibers and matrices, lamina constitutive equations, lamina assumptions, macroscopic viewpoint, generalized Hooke's law, reduction to homogeneous orthotropic lamina, isotropic limit case, orthotropic stiffness matrix (Q_{ij}), typical Commercial material properties, rule of mixtures, generally orthotropic lamina –transformation matrix, transformed stiffness. definition of stress and moment resultants, strain displacement relations, laminate constitutive equations, balanced laminates, symmetric laminates, angle ply laminates, cross ply laminates, laminate structural moduli, evaluation of lamina properties from laminate tests, quasi-isotropic laminates, determination of lamina stresses within laminates, maximum stress and strain criteria, *Von-Misses* Yield criterion for Isotropic materials, meneralized Hill's criterion for anisotropic materials, Tsai-Hill's failure criterion for composites, tensor polynomial (Tsai-Wu) failure criterion, prediction of laminate failure, equilibrium equations of motion, energy formulations, static bending analysis, buckling analysis.

Text Books Recommended

1. R. M. Jones, *Mechanics of composite materials*, Second. CRC Press.

References

1. O. Ishai, Isaac M. Daniel, *Engineering Mechanics of Composite Materials*, Second. Oxford University Press
2. B. D. Agarwal, L. J. Broutman, and K. Chandrashekhara, *Analysis and performance of fiber composites*. John Wiley, 2006.
3. M. W. Hyer, "Stress Analysis of Fiber-Reinforced Composite Materials," 2009.

Course Code	**PEC2D_DE301**				
Course Category	**Professional Elective Courses**				
Course Title	**Dynamics of Compressible Flow**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester - 3 (Three)**
	2	**1**	**2**	**4**	

Introduction and review of basic thermodynamics, normal shocks, oblique shocks, expansion waves, area- mach relationship, unsteady shock waves, wave propagation, method of characteristics, application of the method of characteristics, design of a minimum length nozzle, flow through a diverging channel flow over a wavy wall, formulation using perturbation theory, subsonic flow and supersonic flow over a wavy wall, supersonic flow past a 3*d* cone.

Text Books Recommended

1. J. D. Anderson, "Modern compressible flow : with historical perspective," p. 760, 2003.

References

1. A. H. Shapiro, "The dynamics and thermodynamics of compressible fluid flow *(Volume 1)*," 1953.
2. A. H. Shapiro, *The Dynamics and Thermodynamics of Compressible Fluid Flow (Volume 2)*. Wiley, NY.
3. A. R. Liepmann, Hans Wolfgang, *Elements of Gasdynamics*.
4. M. A. Saad, *Compressible fluid flow*. Prentice Hall, 1993.

Course Code	**PEC3D_DE301**				
Course Category	**Professional Elective Courses**				
Course Title	**Mechanical Vibrations of Continuous Systems**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester - 3 (Three)**
	2	**1**	**2**	**4**	

Longitudinal vibration of bars, equation of motion, free vibration solution and natural frequencies, solution using separation of variables, orthogonality of eigenfunctions, free vibration response due to initial excitation, forced vibration, response of a bar subjected to longitudinal support motion, transverse vibration of beams, equation of motion, Euler–Bernoulli, free vibration equations, beam simply supported with different support conditions, orthogonality of normal modes, free vibration response due to initial conditions, forced vibration, response of beams under moving loads, transverse vibration of beams subjected to axial force, beam on an elastic foundation, beam on an elastic foundation, raleigh and Timoshenko's theory, transverse vibration of plates, classical plate theory, equilibrium approach, variational approach, free vibration of rectangular plates, solution for a simply supported plate, solution for plates with other boundary conditions, forced vibration of rectangular plates, free and forced vibration of circular plates, effects of rotary inertia and shear deformation, plate on an elastic foundation, transverse vibration of plates subjected to in-plane loads.

Text Books Recommended

1. S. S. Rao, *Mechanical Vibrations of Materials*, Fith. Pearson, Prentice Hall, 2011.

References

1. Singiresu S. Rao, *Vibration of Continuous Systems*. John Wiley & Sons, 2019.

Course Code	**DSV_DE302**				
Course Category	**Dissertation, Seminar and Professional Viva**				
Course Title	**Seminar**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester - 3 (Three)**
	0	**0**	**6**	**3**	
Pre requisites					

Course Objectives:

The seminar curriculum pedagogy is designed to focus on approaches for planning, creating, and transmitting technical information within a variety of technical situations found in the global employment and professional marketspace. The seminar curriculum will adhere to the domains of workplace professional/ technical writing, successful and effective presentation design in the emerging technical scenario.

Course Plan:

Each student shall identify a topic of current relevance mechanical engineering branch, get approval of faculty concerned, collect sufficient literature on the topic, study it thoroughly, prepare a presentation and report and will be later on assessed before an expert committee constituted by the concerned department on the basis of:

1. Quality of content presented
2. Proper planning for presentation.

3. Effectiveness of presentation.
4. Report writing based on the Literature, fundamentals of the topic,and state of art application

The objectives and learning outcomes of the seminar are:

- To Ensure that students are made ***aware*** about the basic and core communication frameworks, tools, frameworks and typologies,
- To ensure that students are able to ***enhance*** their personal, professional communication skills through seminar mode teaching-learning pedagogy,
- To ***understand*** the individual and team/group level communication styles through experiential understanding, learning and application of emerging communication techniques
- To ***develop*** problem solving and analytical skills in global-cross cultural business communication and awareness of challenges required for successful communication within and outside multinational organizations
- To ***enhance*** the communication skills across variety of formal and informal networks,
- To ***understand*** the ethical approach for roles and responsibilities as business communicators through case discussions of technical/business dilemmas and problems
- To ensure ***application*** of the modern data analysis and visualisation software's for enhanced presentation/communication modules so that to incorporate the professional use of technology in communications.

Course Code	**DSV_DE303**				
Course Category	**Dissertation, Seminar and Professional Viva**				
Course Title	**Professional Viva**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester - 3 (Three)**
	0	**0**	**0**	**3**	

Course Plan:

Each student will have to appear at a viva voce examination in front of a board of examiners composed of faculty members from all the specializations on all subjects completed during the course of his/her Postgraduate study. Viva-voce is intended to assess the student's understanding of the subjects he/ she studied during the M.Tech. course of study.

Comprehensive Viva-Voce enables a successful student to ***demonstrate*** knowledge in the program domain, ***present*** his views cogently and precisely, ***exhibit*** professional etiquette suitable for career progression

Course Code	**DSV_DE305**				
Category	**Dissertation, Seminar and Professional Viva**				
Course Title	**Dissertation Phase-I**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester- 3 (Three)**
	0	**0**	**16**	**8**	
Pre requisites	-				

Course Plan:

The dissertation work will start in semester 3 (Three) and should preferably be a problem with research potential and should involve scientific research, design, generation/ collection and analysis of data, determining solution and must preferably bring out the individual contribution. The examination shall consist of the preparation of a report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The candidate has to be in regular contact with his supervisor and the topic of dissertation must be mutually decided by the supervisor and student. The work has to be later on presented/ assessed before an expert committee constituted by the concerned Head / Coordinator of the department and **Project and Training Incharge (PTI),** on the basis of:

- Quality of content presented.
- Proper planning for presentation.
- Effectiveness of presentation.
- Dissertation writing based on the start of art, fundamentals of the topic and its viability (A dissertation is documentation of a research of a student- a record of the original research done by the student during his M. Tech. program and provides information on the student's research work to future researchers).

Course Code	**DSV_DE401**				
Category	**Dissertation, Seminar and Professional Viva**				
Course Title	**Dissertation Phase-II**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester- 4 (Four)**
	0	**0**	**30**	**15**	
Pre requisites	-				

Course Plan:

It is a continuation of dissertation work started in semester 3 (Three). The dissertation should be presented in standard format as provided by the department. The candidate has to prepare a detailed dissertation report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study. The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a guide, co-guide etc. as decided by the Head and PG coordinator. The candidate has to be in regular contact with his guide. The work has to be later on presented/ assessed before an expert committee constituted by the concerned Head / Coordinator of the department and **Project and Training Incharge (PTI),** on the basis of:

- Quality of content presented.
- Proper planning for presentation.
- Effectiveness of presentation.
- Dissertation writing based on the start of art, fundamentals of the topic and its viability

Guidelines for awarding Marks in End of the Semester		
Evaluated by	**Evaluation percentage**	**Max. Marks Evaluation Criteria / Parameter**
Supervisor(s)	10.0	Punctuality during work
	10.0	Work Progress over all
	30.0	Quality of the work throughout
	10.0	Analytical / programming / experimental Skills
	10.0	Report preparation in a standard format/ template
External Examiner	20.0	Presentation
	50.0	Quality of work
	30.0	Innovations, society applicable and future scope.
	20.0	Viva-voce