| FACULTY OF ENGINEERING & TECHNOLOGY  |         |  |         |              | G       | GANPAT       | Γ UN      | VERSITY             |            |           |              |          |  |  |
|--|---------|--|---------|--------------|---------|--------------|-----------|---------------------|------------|-----------|--------------|----------|--|--|
| Programme  |         |  | FA      | <u>CULT</u>  | Y OI    | F ENGIN      | NEER      | ING & TEC           | CHNO       | LOGY      | •            |          |  |  |
| Effective from Academic Year   2025-2026   Effective for the batch Admitted in July 2025   Course Code   SEE2IRS   Course Name   Restructured Power Systems   Feating scheme   F |         |  |         |              |         |              |           |                     |            |           |              |          |  |  |
| Course Code   SEE2 PE1   Course Name   Restructured Power Systems   Examination scheme (Marks)   | Semes   | ter  |         | II           |         |              |           | Version             | ·          |           |              |          |  |  |
| Teaching scheme   Teaching scheme   Teaching scheme   Total  | Effecti | ve from Ac   | ademi   | c Year       | 2       | 2025-2026    |           | Effective for th    |            |           |              |          |  |  |
| Cere week    Lecture(DT)   Practical(Lab.)   Total     CE   SEE   Total  | Course  | Code   |         | 3EE21PE      | 1 (     | Course Nam   | ie        | Restructured P      | ower Syst  | ems       |              |          |  |  |
| Cere week    Lecture(DT)   Practical(Lab.)   Total     CE   SEE   Total  |         |  |         |              |         |              |           | Ex                  | amination  | scheme    | (Marks)      |          |  |  |
| Credit   | (Per    | r week)  |         |              |         | tical(Lab.)  | Total     |                     |            |           |              |          |  |  |
| Credit   |         | <u> </u>   |         | ` '          |         |              |           | -                   |            |           |              |          |  |  |
| Hours  | Credit  |  |         |              |         |              | 4         | Theory              | 40         | 60        | 100          |          |  |  |
| Course Outcomes On successful completion of the subject, students should be able to: OO1 Understand deregulation and market models in restructured power systems. Apply optimal power flow and pricing concepts in electricity markets. Apply optimal power flow and pricing concepts in electricity markets. Apply optimal power flow and pricing concepts in electricity markets.  Apply optimal power flow and pricing concepts in electricity markets.  Apply optimal power flow and pricing concepts in electricity markets.  CO4 Evaluate ancillary services and global trends in power market restructuring.  Theory syllabus  Unit Content Hrs  Peregulation: Fundamentals of restructured system, Current situation around the world, Benefits from a competitive electricity market, Role of the independent system operator, Operational planning activities of ISO.  Philosophy of Market Model: Market equilibrium, Load elasticity, Perfectly competitive market, Comparison of market models, Social welfare maximization, Pillars of market design, Standard market design.  Optimal Power Flow: Role of OPF in VIU and restructured markets., Locational marginal cost, LMP for ACOPF, LMP for DCOPF, Basic Issues of the Restructured Power system: Optimal bidding, Risk assessment, Hedging, Tracing of power, Transmission planning, Transmission pricing, Transmission pricing model in India, Availability based tariff, Congestion management, Ancillary Service Management Ancillary service Management Ancillary service Management Ancillary service for restructuring, Classification of ancillary services, Ancillary services for restructuring, Developments in India, Distributed generation in the restructured market, IT applications in restructured markets.  Practicals, assignments, and tutorials are based on the above syllabus.  Text Books  Mohammad Shahidehpour, Muwaffaq Alomoush, "Restructured electrical power systems: operation, tradir and volatility," Marcel Dekker.  K. Bhattacharya, MiTT Bollen, and J.C Doolder, "Operation of Restructured Power Systems," Kluw Ac | Hours   |  | 3       | 0            | 2       | 0            | 5         |                     | 30         | 20        | 50           |          |  |  |
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| On successful completion of the subject, students should be able to:  Understand deregulation and market models in restructured power systems.  Analyze bidding, risk, transmission, and congestion in deregulated systems.  Oa Analyze bidding, risk, transmission, and congestion in deregulated systems.  Co4 Evaluate ancillary services and global trends in power market restructuring.  Theory syllabus  Unit Content Hrs  Deregulation: Fundamentals of restructured system, Current situation around the world, Benefits from a competitive electricity market, Role of the independent system operator, Operational planning activities of ISO.  Philosophy of Market Model: Market equilibrium, Load elasticity, Perfectly competitive market, Comparison of market models, Social welfare maximization, Pillars of market design, Standard market design.  Optimal Power Flow: Role of OPF in VIU and restructured markets., Locational marginal cost, LMP for ACOPF, LMP for DCOPF, Basic Issues of the Restructured Power system: Optimal bidding, Risk assessment, Hedging, Tracing of power, Transmission planning, Transmission pricing, Transmission pricing model in India, Availability based tariff, Congestion management, Classification of congestion management.  Ancillary Service Management Ancillary services for restructuring, Classification of ancillary services, Ancillary services management in various countries, Reactive power management in deregulated electricity markets.  Global Restructured Power Systems: Global experience with electricity reforms in different countries, PJM, Towards standard market Design, Recent trends in restructuring, Developments in India, Distributed generation in the restructured market, IT applications in restructured markets.  Practical content  Practical content  Roberside Analysis and tutorials are based on the above syllabus.  Ext Books  1. Mohammad Shahidehpour, Muwaffaq Alomoush, "Restructured electricial power systems: operation, tradir and volatility." Marcel Dekker.  2. K. Bhattacharya, MHT Bollen, and J.C Doo | -       | 1  |         |              |         |              |           |                     |            |           |              |          |  |  |
| CO2  | Cours   | e Outcome  | S       |              |         |              |           |                     |            |           |              |          |  |  |
| CO2  |         |  |         | on of the su | biect.  | students sho | ould be a | ible to:            |            |           |              |          |  |  |
| Analyze bidding, risk, transmission, and congestion in deregulated systems.   Theory syllabus  |         | A V  |         |              |         |              |           |                     |            |           |              |          |  |  |
| Analyze bidding, risk, transmission, and congestion in deregulated systems.   Theory syllabus  | CO2     | Apply optimal power flow and pricing concepts in electricity markets.  |         |              |         |              |           |                     |            |           |              |          |  |  |
| Unit   Content   Hrs   |         |  |         |              |         |              |           |                     |            |           |              |          |  |  |
| Unit Deregulation: Fundamentals of restructured system, Current situation around the world, Benefits from a competitive electricity market, Role of the independent system operator, Operational planning activities of ISO.  Philosophy of Market Model: Market equilibrium, Load elasticity, Perfectly competitive market, Comparison of market models, Social welfare maximization, Pillars of market design, Standard market design.  Optimal Power Flow: Role of OPF in VIU and restructured markets., Locational marginal cost, LMP for ACOPF, LMP for DCOPF,  Basic Issues of the Restructured Power system: Optimal bidding, Risk assessment, Hedging, Tracing of power, Transmission planning, Transmission pricing, Transmission pricing model in India, Availability based tariff, Congestion management, Classification of congestion management.  Ancillary Service Management Ancillary services for restructuring, Classification of ancillary services, Ancillary services management in various countries, Reactive power management in deregulated electricity markets.  Global Restructured Power Systems: Global Restructured Power Systems: Global experience with electricity reforms in different countries, PJM, Towards standard market Design, Recent trends in restructuring, Developments in India, Distributed generation in the restructured market, IT applications in restructured markets.  Practicals, assignments, and tutorials are based on the above syllabus.  Text Books  1. Mohammad Shahidehpour, Muwaffaq Alomoush, "Restructured electrical power systems: operation, tradir and volatility," Marcel Dekker.  2. K. Bhattacharya, MHT Bollen, and J.C Doolder, "Operation of Restructured Power Systems," Kluw Academic Publishers, USA.  Reference Books  1. Lorrin Philipson, H. Lee Willis, "Understanding electric utilities and de-regulation," Marcel Dekker Pub.  2. Steven Stoft, "Power system economics: designing markets for electricity," John Wiley and Sons.  3. Sally Hunt, "Making Competition Work in Electricity," John Wiley Inc.                              |         |  |         |              |         |              |           |                     |            |           |              |          |  |  |
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| Academic Publishers, USA.  Reference Books  1. Lorrin Philipson, H. Lee Willis, "Understanding electric utilities and de-regulation," Marcel Dekker Pub.  2. Steven Stoft, "Power system economics: designing markets for electricity," John Wiley and Sons.  3. Sally Hunt, "Making Competition Work in Electricity," John Wiley Inc.   |         | Mohammad Shahidehpour, Muwaffaq Alomoush, "Restructured electrical power systems: operation, tr  |         |              |         |              |           |                     |            |           |              | , tradin |  |  |
| <ol> <li>Lorrin Philipson, H. Lee Willis, "Understanding electric utilities and de-regulation," Marcel Dekker Pub.</li> <li>Steven Stoft, "Power system economics: designing markets for electricity," John Wiley and Sons.</li> <li>Sally Hunt, "Making Competition Work in Electricity," John Wiley Inc.</li> </ol>  | 2.      |  | -       |              |         | , and J.C l  | Doolder,  | "Operation of       | Restructu  | red Pow   | er Systems," | Kluw     |  |  |
| <ol> <li>Steven Stoft, "Power system economics: designing markets for electricity," John Wiley and Sons.</li> <li>Sally Hunt, "Making Competition Work in Electricity," John Wiley Inc.</li> </ol>   | Refere  | ence Books   |         |              |         |              |           |                     |            |           |              |          |  |  |
| 3. Sally Hunt, "Making Competition Work in Electricity," John Wiley Inc.   | 1.      | Lorrin Philipson, H. Lee Willis, "Understanding electric utilities and de-regulation," Marcel Dekker Pub.  |         |              |         |              |           |                     |            |           |              |          |  |  |
| 3. Sally Hunt, "Making Competition Work in Electricity," John Wiley Inc.   | 2.      | Steven St  | oft, "P | ower syste   | m eco   | nomics: des  | igning n  | narkets for electri | city," Joh | n Wiley a | and Sons.    |          |  |  |
|  |         |  |         | -            |         |              |           |                     | -          |           |              |          |  |  |
|  |         |  |         |              |         |              |           |                     |            | Sons, UK  |              |          |  |  |

| 5.        | Edward Kahn "Electric Utility Planning and Regulation," American Council for Energy-Efficient Economy |  |  |  |  |  |  |  |  |
|-----------|---|--|--|--|--|--|--|--|--|
| 6.        | Fred I Denny and David E. Dismukes, "Power System Operations and Electricity Markets," CRC Press.     |  |  |  |  |  |  |  |  |
| 7.        | Central Electricity Regulatory Commission, Regulations and Orders - www.cercind.org                   |  |  |  |  |  |  |  |  |
| 8.        | Electricity Act 2003 and National Policies – www.powermin.nic.in.                                     |  |  |  |  |  |  |  |  |
| ICT/MOOCs |   |  |  |  |  |  |  |  |  |
| 1.        | https://nptel.ac.in/courses/108/101/108101005/  |  |  |  |  |  |  |  |  |

|     | Mapping of CO with PO and PSO: |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----|--------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
|     | PO1                            | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | P09 | PO10 | PO11 | P012 | PSO1 | PSO2 | PSO3 |
| CO1 | 2                              | 2   | 1   | 2   | 1   | 2   | 2   | 1   | 1   | 1    | 1    | 3    | 2    | 1    | 2    |
| CO2 | 3                              | 3   | 2   | 2   | 2   | 2   | 1   | 0   | 2   | 1    | 2    | 2    | 1    | 1    | 1    |
| CO3 | 2                              | 3   | 2   | 3   | 1   | 2   | 1   | 0   | 1   | 1    | 1    | 2    | 2    | 1    | 2    |
| CO4 | 3                              | 2   | 2   | 2   | 2   | 1   | 1   | 0   | 1   | 1    | 1    | 2    | 2    | 1    | 1    |