



R25 Regulation

Subject code: F431PC1

TKR COLLEGE OF ENGINEERING AND TECHNOLOGY
(Autonomous, Accredited by NAAC with 'A+' Grade)

M.Tech I Semester Regular Examinations, March 2026

POWER CONVERTERS ANALYSIS
(PE)

Maximum Marks: 60

Date:02.03.2026

Duration: 3 hours

- Note: 1. This question paper contains two parts A and B.
2. Part A is compulsory which carries 10 marks. Answer all questions in Part A.
3. Part B consists of 5 Units. Answer any one full question from each unit.
4. Each question carries 10 marks and may have a, b, c, d as sub questions.

Part-A

| All the following questions carry equal marks (10X1M=10Marks) | | Marks | CO | BTL |
|---|---|-------|----|-----|
| 1.a | What is an IGBT? Mention any two advantages. | 1M | 1 | L1 |
| b | Compare Power MOSFET and IGBT with respect to switching speed. | 1M | 1 | L2 |
| c | Define firing angle (α) in controlled converters. | 1M | 2 | L1 |
| d | Write the input power factor and harmonic factor in converters. | 1M | 2 | L2 |
| e | What is Sinusoidal PWM (SPWM)? | 1M | 3 | L1 |
| f | Define modulation index in PWM inverters. | 1M | 3 | L1 |
| g | What is Space Vector Modulation (SVM)? | 1M | 4 | L1 |
| h | Why is sinusoidal PWM preferred over multiple PWM for harmonic reduction? | 1M | 4 | L2 |
| i | What is the principle and features of multilevel inverters? | 1M | 5 | L2 |
| j | How is the DC-link capacitor voltage balancing in multilevel inverters? | 1M | 5 | L2 |

Part-B

| Answer All the following questions. (5X10M=50Marks) | | Marks | CO | BTL |
|---|---|-------|----|-----|
| 2 | a) Explain the structure, operation and equivalent circuit of IGBT with neat diagrams. | 5M | 1 | L2 |
| | b) Explain MTO and ETO devices with neat diagrams. Discuss their advantages and limitations. | | | L2 |
| OR | | | | |
| 3 | a) Explain the structure, equivalent circuit and switching characteristics of Power MOSFET. | 5M | 1 | L2 |
| | b) Compare IGBT and Power MOSFET with respect to switching characteristics, losses, ratings and applications. | | | L2 |
| 4 | a) Explain the operation of a single-phase half-controlled converter with R-L load for continuous current conduction. | 5M | 2 | L3 |

| | | | | |
|----|--|----|---|----|
| | b) A single phase fully rectifier is used to supply power to load having impedance of 200 ohms and 150 mH, from 230V, 50Hz, ac supply at a firing angle of 90 degrees. Calculate i) Average values of output voltage and current and ii) RMS values of output voltage and current. | 5M | | L3 |
| | OR | | | |
| 5 | a) Analyze a three-phase fully controlled converter with continuous load current. Derive expressions for average output voltage and harmonic content. b) A three phase half wave thyristor controlled converter delivers power to a delta connected load of 20Ω. Compute the power delivered to load for an AC input voltage of 230V at the firing angle (i) 60° and (ii) 90° | 5M | 2 | L4 |
| | | 5M | | L3 |
| 6 | a) A single-phase full-bridge inverter fed from a 600 V DC source operates in square-wave mode and supplies an R–L load (R = 12 Ω, L = 40 mH) at 50 Hz. Determine: (i) Fundamental RMS output voltage, (ii) Fundamental load current, (iii) Load power factor b) Compare Single PWM and Multiple PWM techniques with suitable waveforms. | 5M | 3 | L3 |
| | | 5M | | L4 |
| | OR | | | |
| 7 | a) Describe staircase, stepped and trapezoidal modulation techniques. Mention their advantages and applications. b) A single-phase bridge inverter delivers power to a series R–L load with R = 8 Ω, L = 25 mH. The inverter output voltage is 230 V RMS at 50 Hz. Determine the instantaneous current expression and RMS current. | 5M | 3 | L3 |
| | | 5M | | L4 |
| 8 | a) Explain the working of a three-phase inverter operating in 180° conduction mode. b) A three-phase full-bridge inverter operates in 180° conduction mode with a DC input voltage of 600 V and feeds a balanced star-connected R-L load (R = 10 Ω, L = 20 mH) at 50 Hz. Determine: (i) RMS phase voltage and line voltage (ii) RMS phase current and line current (iii) Active power delivered to the load (iv) Fundamental component of phase current | 5M | 4 | L3 |
| | | 5M | | L4 |
| | OR | | | |
| 9 | a) Explain the operation of a three-phase inverter in 120° conduction mode. b) A three-phase inverter uses space vector modulation (SVM) with a DC link voltage of 700 V and a modulation index of 0.9. Determine: (i) Maximum RMS line-to-line output voltage (ii) Phase current RMS for a star-connected 10 Ω load (iii) Output power delivered | 5M | 4 | L3 |
| | | 5M | | L3 |
| 10 | a) Describe the operation and features of Diode-clamped and Flying capacitor multilevel inverters with comparison. b) Explain the multilevel inverter concept and classify multilevel inverters. | 5M | 5 | L4 |
| | | 5M | | L2 |
| | OR | | | |
| 11 | a) Describe Cascaded Multilevel Inverter and explain its applications in adjustable speed drives. b) Explain Flying Capacitor Multilevel Inverter with capacitor voltage balancing. | 5M | 5 | L3 |
| | | 5M | | L4 |